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Teaching Wave Concepts Using Self-Made Wave Machine and Computer Simulator

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Abstract. This study aimed to investigate the effectiveness of utilizing a self-made wave machine and a computer simulator in teaching basic concepts of waves to Grade 7 students. Drawing on Schwab's Inquiry-based Learning Theory, the research explored how these hands-on and technology-based approaches impact student performance and interest in science education. The researcher used descriptive-correlational and comparative designs. A total of 109 students utilized the self-made wave machine, and 110 students used the computer simulator. These approaches were randomly assigned to the two groups of students. The findings revealed that the students' performances after using the self-made wave machine and computer simulator were both at the "outstanding" level. The data also indicated no significant difference in the students' performances after using the self-made wave machine and computer simulator. Furthermore, students' interest in using the self-made wave machine and computer simulator was generally "high." Lastly, no significant relationship was found between students' interest in activities using self-made wave machine and computer simulator and their performance. These findings suggest that hands-on and digital methods can effectively support science learning, providing educators with versatile tools to engage students. Incorporating self-made apparatus and simulators in science education may enhance student engagement and understanding without significantly altering performance outcomes.

Keywords: Computer simulator; Educational technology; Science education; Self-made wave machine; Wave phenomena.

1.0 Introduction

The COVID-19 pandemic has seriously disrupted education systems worldwide, making learning losses worse. This is especially true in science education, where students are already struggling with engagement and performance. Educational institutions and policymakers have noted a marked decline in student interest in science careers, an alarming trend given the critical role science education plays in economic and technological advancement (Toma & Greca, 2022). As countries strive to recover and rebuild, there is a pressing need to reinvigorate science education to nurture the next generation of scientists and innovators.

In the Philippines, educational challenges are especially severe. The country's learners consistently score below international averages in major assessments, such as the Programme for International Student Assessment (PISA) and the Trends in International Mathematics and Science Study (TIMSS). These assessments reveal significant gaps in scientific knowledge and skills among Filipino students, which, in turn, highlight systemic issues in the educational framework (Andy, 2022; Hadi & Novaliyosi, 2019). Contributing factors include inadequate educational resources, such as insufficient laboratory equipment, a lack of engaging instructional materials, and the need for improved teacher training (Soriano & Vargas, 2021; David et al., 2019). Addressing these deficiencies

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is essential for improving students' academic outcomes, fostering technological innovation, and preparing a skilled workforce to support the country's economic growth. Integrating interactive, hands-on materials and technology-based simulations into science education directly addresses these challenges, providing students with more engaging and effective learning experiences. As Pineda (2023) emphasizes, enhancing science education through improved curricula and teaching strategies can lead to better academic outcomes and greater employability in science-related fields. These advancements prepare students to contribute to the global knowledge economy and support the Philippines' long-term competitiveness.

While numerous studies have explored the use of localized apparatus and interactive simulators to enhance science learning, there remains a scarcity of research focused explicitly on innovative teaching aids for learning wave phenomena. Existing literature predominantly concentrates on other scientific concepts, such as electricity and motion, with less attention given to the pedagogical approaches in wave science (Duya, 2021; Dionson, 2021; Gainsan, 2021; Acabal, 2022). Thus, this study was pursued to fill this gap by developing and assessing the effectiveness of a self-made wave machine and a computer simulator. This dual approach aims to enhance the understanding of wave concepts, often abstract and challenging for learners, thereby addressing a critical need in science education.

This study sought to ignite learners' interest in science and encourage scientific careers by evaluating the effectiveness of a self-made wave machine and a computer simulator in teaching basic wave concepts. By combining hands-on learning with digital simulators, the research aims to enhance learners' understanding of wave phenomena and improve science education outcomes. Success could serve as a model for similar interventions, benefiting the Philippines and other regions facing similar challenges.

2.0 Methodology

2.1 Research Design

This study used descriptive-correlational and comparative designs. This inquiry is descriptive because it describes the students' performance after utilizing the localized apparatus and computer simulator. It also describes the students' interest in using the two methods of instruction. Furthermore, it is correlational because the students' interest in using the methods was correlated with their assessment results. Moreover, it is comparative since the students' performance utilizing the two methods was compared.

2.2 Research Locale

The study was conducted at Manjuyod National High School, located in Barangay Sundo-an, Manjuyod, Negros Oriental, where one of the researchers works as a science teacher. To minimize potential bias, the researcher adhered to established ethical guidelines, maintained neutrality in the study's procedures, and ensured that external experts objectively reviewed the results.

2.3 Research Participants

The study's respondents were the 219 Grade 7 students of Manjuyod National High School enrolled during the school year 2023-2024. They were divided into two groups based on their prior grades in science to ensure both groups had a similar level of knowledge. To validate that there were no significant differences in their prior grades, a t-test for independent samples was conducted. The results confirmed that the two groups did not differ significantly in their science knowledge.

2.4 Research Instrument

The study employed an activity guide designed by the researchers, which combined a self-made wave machine and computer simulator to help students grasp basic wave concepts. The self-made wave machine and the computer simulators were chosen based on insights from related studies and educational tools. The self-made wave machine, crafted using locally available materials, provided hands-on experience for students. At the same time, the interactive computer simulators, sourced from PhET Colorado, illustrated the behavior and properties of waves.

The researcher developed an assessment questionnaire to assess the students' understanding, which three General Science experts validated. Additionally, a questionnaire measuring students' interest in using both the wave

machine and the computer simulator was adapted from Piñero et al. (2023). All questionnaires underwent content validation to ensure alignment with the study's objectives. A pilot test was conducted with a group of students not included in the final sample to evaluate the reliability of the items using Cronbach's alpha, yielding the following results: 0.701 for the computer simulator and 0.712 for the self-made wave machine, indicating that the items in evaluating students' interest were reliable.

2.5 Data Gathering Procedure

With the approval of the Dean of the Foundation University-Graduate School, the researcher submitted a formal request to the Schools Division Superintendent of Negros Oriental, along with a refined version of the questionnaire. Once the request was approved, a copy was sent to the principal of Manjuyod National High School to seek access to the subject teachers and class advisers. With all necessary permissions granted, the researcher briefed the students on the study's objectives and significance before proceeding with the activities and administering test questionnaires. The study was conducted over two days to teach basic wave concepts. On the first day, the researcher presented the fundamental concepts of waves to four different sections at various times.

The students were divided into two groups per section on the second day. The researcher then provided instructions on the procedures for using the localized wave machine and the computer wave simulator. Students followed the activity guide to manipulate the tools, perform the tasks, and answer the questions. The activity lasted one hour, after which the students were administered an assessment questionnaire. An additional questionnaire was distributed to measure the students' interest in the two approaches. Once all the questionnaires were completed, the researcher collected the results, which were tallied, analyzed, and interpreted for further evaluation.

2.6 Ethical Considerations

The study was conducted according to ethical standards. Ethical approval was obtained from the Foundation University Research Office's Ethical Committee. The application of the right to self-determination, secrecy, and anonymity and the study's advantages and disadvantages were closely scrutinized.

3.0 Results and Discussion

3.1 Difference in the Performance of the Students Using the Self-Made Wave Machine and Computer Simulator

Table 1 shows that both groups of students who utilized the self-made wave machine and computer simulator achieved an "outstanding" level of performance, with mean scores of 92.73% and 92.57%, respectively. These ratings are not significantly different ($p = 0.737 > \alpha = 0.05$) and suggest that students could grasp the concepts of waves effectively using the self-made wave machine and computer simulator. The students acquired the skills and knowledge and could utilize them in other performance tasks involving waves (DepEd Order No. 73, s. 2012). The standard deviations for both groups (3.58 and 3.90) indicate that the students' scores are slightly dispersed.

Table 1. Difference in the performance of the students using the self-made wave machine and computer simulator

Group	Performance	D	SD	t-value	p-value	Decision	Remark
Self-Made Wave Machine (n=109)	92.73 (Outstanding)	0.16	3.58	0.336	0.737	Accept H_{o1}	Not significant
Computer Simulator (n=110)	92.57 (Outstanding)		3.90				

The students' ratings further indicate that both instructional tools—the self-made wave machine and the computer simulator—are equally effective in promoting student achievement. The effectiveness of computer simulators and self-made apparatus in science education is well-documented, with research confirming their ability to enhance student understanding and engagement. Studies by Langbeheim and Levy (2019) reveal that simulators foster scientific inquiry, while Patron and Despojo (2020) highlight the benefits of self-made apparatus in addressing educational challenges and promoting active engagement, leading to improved student comprehension.

The lack of a significant difference in performance aligns with the findings of Benong et al. (2024) and Acabal et al. (2022), who reported no significant difference in the post-test performances of students who used localized apparatus and interactive computer simulators, such as PHET (Physics Education Technology). A study by

Langbeheim and Levy (2019) also demonstrates the effectiveness of both computer simulators and self-made apparatus in enhancing student understanding and engagement in science education. The above findings suggest that educators can choose either tool based on availability, cost, and classroom preferences without compromising the instructional quality.

3.2 Level of Interest of the Two Groups of Students in Activities Using the Self-Made Wave Machine and the Computer Simulator

Table 2 shows the level of interest among the two groups of students using the self-made wave machine and computer simulator. Generally, the results indicate that the group using the self-made wave machine has a composite mean of 4.05, while the computer simulator group has a composite mean of 3.93. These figures mean that both groups exhibit a "high" interest in learning about waves through these instructional tools. This finding highlights that the self-made wave machine and computer simulator are engaging tools that effectively capture students' attention. This is crucial for enhancing understanding and retention of scientific concepts.

Table 2. Level of interest of the two groups of students in activities using the self-made wave machine and the computer simulator

	Indicators	Self-Made Wave Machine (n=109)			Computer Simulator (n=110)		
		$w\bar{x}$	**VD**	**EoI**	**$w\bar{x}$**	**VD**	**EoI**
1	The activities led me to the realization that learning science concepts goes beyond memorization of formulas.	4.22	SA	VH	4.27	SA	VH
2	The self-made wave machine/computer simulator helped me grasp the basic wave concepts effectively.	4.21	SA	VH	4.01	A	H
3	The use of a self-made wave machine/ computer simulator in the discussion of concepts of wave is interesting.	4.19	A	H	4.04	A	H
4	Using a self-made wave machine/ computer simulator makes me visualize basic concepts of abstract wave.	4.05	A	H	3.89	A	H
5	The use of the self-made wave machine/ computer simulator is what I want to learn other concepts in science.	4.05	A	H	3.81	A	H
6	The basic concepts of waves are very fascinating to me because of the use of a self-made wave machine/computer simulator.	4.01	A	H	3.97	A	H
7	The use of a self-made wave machine/ computer simulator makes me excited about the discoveries I am about to make, especially in the lesson on the fundamentals of waves.	4.01	A	H	3.82	A	H
8	Utilizing a self-made wave machine/ computer simulator sparks my interest in the fundamentals of science.	3.91	A	H	3.87	A	H
9	Interacting with the self-made wave machine/ computer simulator captured my focus, leading me to pay attention to the teacher.	3.91	A	H	3.80	A	H
10	The activity motivated me to utilize my object – manipulation skills.	3.91	A	H	3.83	A	H
Composite		**4.05**	**A**	**H**	**3.93**	**A**	**H**

Specifically, the data indicate that both groups claimed that the activities led them to realize that learning Science concepts goes beyond memorizing formulas ($w\bar{x}$ of 4.22 and 4.27). Additionally, the data show that both groups demonstrate a "high" level of interest because the activities allowed students to visualize abstract wave concepts, grasp other scientific principles, and maintain focus while using the self-made wave machine and computer simulator ($w\bar{x}$ ranges from 3.41 to 4.20). This display of student enthusiasm suggests that students are generally engaged and motivated when using these tools, which can positively influence their learning outcomes.

These results align with the studies by Acabal et al. (2022), Benong et al. (2024), and Piñero et al. (2023), which also found that students exhibit a "high" or "very high" level of interest when using localized apparatus and interactive simulators for learning science and mathematics concepts. Students reported that they found both instructional tools engaging and enjoyable and that these tools significantly improved their skills and conceptual understanding.

3.3 Relationship Between the Level of Students' Interest in Activities Using Self-Made Wave Machines and their Performance

Table 3 presents the relationship between students' interest in activities using the self-made wave machine and their performance. The Spearman Rank Order Correlation analysis shows a p-value of 0.826, indicating that there

is no significant relationship between the level of students' interest in using the self-made wave machine and their performance.

Table 3. Relationship between the level of students' interest in activities using self-made wave machines and their performance

Variables	r_s	p-value	Decision	Remark
Level of Interest in Activities Using Self-Made Wave Machines and Their Performance	0.021	0.826	Accept H_{o2}	Not significant

The results suggest that variations in students' interests are not associated with changes in their performance. This lack of correlation may be due to students' relatively uniform levels of interest. The raw data shows that student's responses to the indicators are closely aligned, with nearly all reporting a high-interest level. Additionally, the findings suggest that cognitive ability and prior knowledge may play a more significant role in understanding wave concepts than interest alone. Students with a stronger foundation in physics likely face fewer barriers when engaging with the wave machine, leading to relatively uniform performance outcomes. The current findings are consistent with previous studies, such as those by Piñero et al. (2023) and Acabal et al. (2022), which found no significant relationship between students' interest and performance. These results connote that other factors may contribute to students' performance beyond their level of interest.

3.4 Relationship Between Students' Interest in Activities Using Computer Simulator and Their Performance

Table 4 shows that there is no significant relationship between students' interest in activities using the computer simulator and their performance ($p = 0.675 > \alpha = 0.05$).

Table 4. Relationship between the level of students' interest in activities using computer simulator and their performance

Variables	r_s	p-value	Decision	Remark
Level of Interest in Activities Using Simulator and Their Performance	0.041	0.675	Fail to reject H_o	Not significant

This result indicates that changes in interest do not directly influence performance, suggesting that interest alone is insufficient for mastering concepts. Other variables, such as prior knowledge, cognitive skills, motivation, and external support, may play a more significant role in learning. These findings highlight that interest is only one component of the learning process. While the computer simulator can generate engagement, it must be paired with effective teaching strategies and a supportive learning environment to enhance outcomes. This conclusion aligns with Langbeheim and Levy (2019), who suggest that developing interest in technology-based tools does not necessarily lead to improved performance.

4.0 Conclusions

Wave concepts are often abstract and can be challenging for students to grasp through traditional lecture methods alone. However, educational tools such as wave machines and simulators provide a more tangible approach. By allowing students to see and manipulate wave properties dynamically, these tools offer interactive and visual experiences that make abstract concepts more concrete and understandable. The hands-on engagement with wave properties, including amplitude, frequency, and wavelength, not only aids in visualization but also deepens comprehension. Furthermore, this interactive learning typically results in higher engagement levels, linked to improved learning outcomes and a deeper understanding of the material. By making science more accessible and enjoyable, these tools improve immediate learning outcomes and inspire sustained interest and confidence in pursuing further studies and careers in scientific fields. This positive impact can contribute to the development of future scientists and innovators equipped to address complex problems.

5.0 Contributions of Authors

The authors confirm their equal contribution to all aspects of this research. Mrs. Kleizi and Mr. Piñero conceptualized the research problem, while Dr. Futalan carried out the necessary protocols for conducting the study and handled the statistical analysis. All authors collaborated in discussing the findings, and they reviewed and approved the final version of this paper.

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7.0 Conflict of Interests

All authors declared that they have no conflicts of interest as far as this study is concerned.

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Open Educational Resources in Science Education: Effects on Teacher Practices and Students' Academic Performance

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Abstract. This study investigates the effects of open educational resource (OER) utilization, specifically revision, remix, and redistribution, on students' academic performance in science for the school year 2023-2024. Using a descriptive-quantitative research design, data were collected from teacher respondents through a survey questionnaire. The results showed that teachers predominantly utilized OER for revision, with moderate engagement in remix and redistribution activities. Students' academic performance, measured by their general weighted average in science for the first quarter, was satisfactory, with a mean score of 83.73. The findings indicated that using OER for revision significantly enhanced students' academic performance while remixing and redistribution did not significantly impact student outcomes. Furthermore, no significant differences were found in the extent of OER utilization among teachers based on sex, educational attainment, years of teaching experience, or relevant training. These results highlight the need for targeted professional development programs that emphasize the effective use of OER in revising, remixing, and redistributing educational materials. Schools can foster more innovative and personalized student learning experiences by improving teachers' capacity to utilize OER fully. The study recommends that educational institutions ensure the availability and accessibility of high-quality OER, alongside ongoing support and training for teachers, to optimize their potential to improve student achievement. Ultimately, the findings suggest that strategic integration of OER into instructional practices can lead to enhanced educational outcomes and greater collaboration among educators.

Keywords: Open Educational Resources (OER); Revision; Remix; Redistribution; Science education.

1.0 Introduction

Open Educational Resources (OERs) represent a transformative paradigm in education, promoting an interactive and collaborative learning environment that enhances teaching and learning experiences. Designed with flexible and adaptable features, OERs empower learners to engage deeply with content while fostering opportunities for active knowledge dissemination and community-driven educational advancements. The emergence of OERs in the 1970s responded to growing concerns about the affordability of educational materials, marking a pivotal shift toward accessibility in education. The United Nations Educational, Scientific and Cultural Organization (UNESCO) formally coined the term "Open Educational Resources" in 2002, laying the foundation for what has evolved into Open Education Practices (OEPs). Despite the recognized benefits of OERs, challenges such as discoverability and accessibility persist, as emphasized by Roncevic (2022).

The integration of OERs, coupled with technological advancements, has positively influenced student motivation and academic performance. Empirical evidence indicates that students enrolled in courses incorporating OERs and technology consistently outperform peers who rely solely on traditional learning resources. This underscores

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the critical role OERs can play in enhancing educational outcomes and enriching the academic experience. However, while several educational institutions in the Philippines, including the University of the Philippines Open University, have pioneered using OERs from 2015 to 2017, their adoption remains limited in many regions. Discoverability remains a substantial obstacle, hindering the widespread use and integration of OERs nationwide. Nevertheless, OERs hold immense potential to foster creativity, facilitate collaboration, and bridge the educational divide by providing accessible, adaptable, and high-quality learning resources that can be continuously updated to align with the evolving needs of the academic community.

Motivated by the growing global and national interest in OERs, this study investigates their application and potential impact within Science education—a field that demands rigorous knowledge acquisition and the cultivation of critical thinking skills. Science education benefits from dynamic and interactive learning experiences, which OERs are uniquely positioned to provide. By leveraging the adaptability of OERs, educators can create enriched learning environments that support deeper conceptual understanding and mastery of scientific principles. This research explores how the use of OERs in teaching Science subjects in high schools influences student academic performance. Focusing on selected high schools within the Division of Zamboanga City, this study will examine the implementation and broader utilization of OERs and evaluate their impact on student learning outcomes in Science. Through this analysis, the research seeks to contribute valuable insights into how OERs can be effectively harnessed to advance Science education in the Philippines.

2.0 Methodology

2.1 Research Design

The study used a descriptive-quantitative research design to examine how the "revise, remix, and redistribute" aspects of Open Educational Resources (OERs) impact student academic performance. This approach helps to systematically measure and describe the phenomenon, collecting numerical data for statistical analysis. The design effectively identifies patterns and trends while gathering qualitative insights through open-ended questions. The research aims to understand how OERs can improve student outcomes, especially in the post-pandemic context. It examines the relationship between OER utilization (independent variable) and student academic performance (dependent variable) to inform future instructional strategies. This study is particularly relevant for Zamboanga City schools, helping to develop effective educational practices to meet community needs.

2.2 Research Locale

The study was conducted in Zamboanga City, focusing on selected public schools during the 2023-2024 school year. It aimed to examine the profiles of teacher respondents, including their sex, educational attainment, years of teaching experience, relevant training, and their students' academic performance. Specifically, the study analyzed the teachers' utilization of Open Educational Resources (OER) based on David Wiley's 5R framework, focusing only on revising, remixing, and redistributing. The selected schools included School A, located 16.9 kilometers west of the city center, with 1,735 students and 74 teachers; School B, situated on R.T. Lim Boulevard, with 5,776 students and 216 teachers; School C, 5.1 kilometers from the city center, with 6,759 students and 256 teachers; School D, 5.9 kilometers from the city proper, enrolling 3,108 students and employing 104 teachers; School E, located 47 kilometers from the city center on the East Coast, with 1,556 students and 66 teachers; and School F, 23 kilometers from the city, serving 1,980 students and 87 teachers. A School Principal IV or II manages each school. This diverse sample of schools provides a comprehensive view of how OER utilization impacts student academic performance across different educational settings in the city.

2.3 Research Participants

The total population of teacher-respondents in the six selected schools in Zamboanga City for this study is 215. Based on a 5% margin of error and a 95% confidence interval, a minimum sample size of 137 teachers was determined. The teachers were randomly selected from the target population across the six schools. These teachers were chosen regardless of their sex, age, educational attainment, years of teaching experience, or any other demographic factors. The selection process aimed to ensure a diverse representation of teachers regarding their professional background and their utilization of Open Educational Resources (OERs).

2.4 Research Instrument

The research utilized a researcher-developed survey questionnaire structured into three sections. Part I collected demographic information about the teacher-respondents, including their sex, educational attainment, years of teaching experience, and relevant training. Part II focused on the teachers' utilization of Open Educational Resources (OERs), specifically examining how they "revise," "remix," and "redistribute" educational materials. This section used a four-point Likert scale, ranging from "Not at all" to "To a great extent," to measure the extent of engagement with each of these OER practices. Part III gathered data on student academic performance, primarily on grades, to assess the relationship between the teachers' OER practices and the student's academic outcomes. By linking the teachers' revision, remixing, and redistribution of OERs to students' academic performance, the survey aimed to explore the potential impact of these OER practices on student success and achievement in the classroom.

2.5 Data Gathering Procedure

The data-gathering procedure involved recruiting teacher respondents who were available and willing to participate in the study. The selection of participants was facilitated through a combination of random selection and established connections within the school community. To ensure a representative sample, the researcher contacted potential respondents using various methods, including social media postings, email invitations, and face-to-face visits. Upon confirming the respondents' participation, the researcher distributed the questionnaires during their free time to avoid disrupting their teaching schedules. Before completing the questionnaires, clear and straightforward instructions were provided to the respondents to ensure they understood the purpose and structure of the survey. The researcher was available to address any questions or concerns on the spot, ensuring that participants felt comfortable and confident in providing accurate responses. Each respondent was informed of the study's purpose and allowed to provide informed consent before participating. The survey was administered face-to-face to foster a more personal and interactive environment, allowing for better clarification of instructions and ensuring data accuracy.

2.6 Ethical Considerations

This research adhered strictly to ethical guidelines to safeguard the rights and well-being of all participants. Participation was entirely voluntary, with respondents free to withdraw from the study at any point without any consequence or penalty. The researcher took all necessary measures to prevent physical, social, or emotional harm, prioritizing the comfort and safety of the participants throughout the research process. Ethical approval for this study was obtained from the Institutional Ethics Committee of Zamboanga Peninsula Polytechnic State University. Confidentiality and anonymity were rigorously maintained, with all collected data securely stored and accessible only to authorized personnel. The dignity and respect of the teacher respondents were upheld, and the research was conducted with the utmost integrity and transparency. Additionally, findings were reported honestly, with stringent measures to avoid plagiarism and research misconduct. The study was carried out in strict compliance with ethical standards to ensure the results' reliability, validity, and accuracy.

3.0 Results and Discussion

3.1 Utilization of Open Educational Resources

In terms of Revision

Table 1 shows how teacher respondents use open educational resources (OER) in terms of revision. The highest mean score of 3.37 was for the statement, "adjusting the level of difficulty from the downloaded science reading materials to match the learning styles of my students," with a description of "strongly agree" and interpreted as "highly utilized." This means teachers are modifying the difficulty of science materials to fit students' learning styles better, which can improve engagement and outcomes.

Research by Al-Harthi (2020) and Kaur et al. (2019) supports this, showing that OER use boosts student engagement and performance. The lowest mean score of 3.05 was for the statement, "altering downloaded templates into science daily lesson plans," with a description of "agree" and interpreted as "moderately utilized." While teachers are modifying templates for lesson planning, this indicates they are still becoming more comfortable using technology for planning, which could enhance lesson effectiveness and student engagement.

Studies by the NCES and AERA show that students using technology are more engaged and perform better, suggesting that teachers' use of technology in lesson planning can positively impact student success.

Table 1. Utilization of open educational resources in terms of revision

Indicator	Mean	Verbal Description	Interpretation
1. Modifying resources such as the capsulized self-learning empowerment toolkit to align with my teaching better.	3.36	Strongly Agree	Highly Utilized
2. Adapting science investigatory projects to reflect my students' current research and best practices.	3.20	Agree	Moderately Utilized
3. I will adjust the difficulty level of the downloaded science reading materials to match my student's learning styles.	3.37	Strongly Agree	Highly Utilized
4. Altering downloaded templates into science daily lesson plans.	3.05	Agree	Moderately Utilized
5. Translate the content of science articles, journals, or news into another language to meet the needs of my students.	3.18	Agree	Moderately Utilized
Overall Mean	**3.23**	**Agree**	**Moderately Utilized**

In terms of Remix

Table 2 shows the extent of open educational resource (OER) utilization among teacher respondents regarding remixing. The highest mean score of 3.45 was for the statement, "reproducing worksheets from various sources," with a description of "strongly agree" and interpreted as "highly utilized." This indicates that teachers often remix worksheets from different sources, showing greater awareness of the benefits of OER. They are actively using these resources to create engaging and effective learning materials, highlighting the growing role of OER in education. Khan et al. (2020) also found that teachers increasingly use OER to remix worksheets, supporting this trend. The lowest mean score of 3.07 was for the statement, "remixing background music for my class presentations," with a description of "agree" and interpreted as "moderately utilized."

Table 2. Utilization of open educational resources in terms of remix

Indicator	Mean	Verbal Description	Interpretation
1. Reproducing worksheets from various sources.	3.45	Strongly Agree	Highly Utilized
2. Remixing background music for my class presentations.	3.07	Agree	Moderately Utilized
3. Downloading and remixing the content of science lessons from websites.	3.21	Agree	Moderately Utilized
4. Modifying downloaded powerpoint presentations for my science classes.	3.29	Strongly Agree	Highly Utilized
5. Remixing the illustrated scientific concepts into infographics.	3.15	Agree	Moderately Utilized
Overall Mean	**3.24**	**Agree**	**Moderately Utilized**

This suggests that some teachers remix background music for presentations, but it is not as widely practiced. Teachers could consider incorporating background music remixing into their teaching strategies to engage students and improve the learning experience. Research from Yap and Tan (2020) and Smith (2019) supports this, showing that remixing music can enhance student engagement and create a more interactive learning environment. These findings suggest that remixing background music can be an effective tool for improving student engagement and learning.

In terms of Redistribute

Table 3 shows how teachers use open educational resources (OER) for redistribution. The highest mean score of 3.32 was for "sharing links of science learning platforms with other educators," indicating that teachers often share these resources with their peers.

Table 3. Utilization of open educational resources in terms of redistribution

Indicator	Mean	Verbal Description	Interpretation
1. Sharing links to science learning platforms with other educators.	3.32	Strongly Agree	Highly Utilized
2. Making original science resources available to the public.	2.97	Agree	Moderately Utilized
3. Using open licenses that allow the easy sharing of resources.	3.09	Agree	Moderately Utilized
4. Providing attribution and credit to the creators of science learning materials	3.24	Agree	Moderately Utilized
5. I administer copies of science reading materials to my students so they can replicate them or keep them for themselves.	3.29	Strongly Agree	Highly Utilized
Overall Mean	**3.24**	**Agree**	**Moderately Utilized**

This promotes collaboration among educators and helps provide equal access to educational resources for students. Al-Harthi (2020) supports this, noting that teachers actively share OER, leading to better teaching practices. The lowest mean score of 2.97 was for "making original science resources available to the public," showing that while some teachers share their resources with the public, it is less common. This practice can encourage more people to engage in scientific activities like experiments or citizen science projects. Research from the National Science Foundation (NSF) and the American Association for the Advancement of Science (AAAS) supports this, showing that making science resources available increases public interest and understanding of science.

Table 4 summarizes teachers' use of open educational resources (OER) in terms of revision, remixing, and redistributing. Teachers were found to moderately utilize OER for these purposes, meaning they are somewhat adjusting and sharing resources but not extensively. This suggests that teachers primarily use OER for personal teaching and learning rather than for creating or remixing new content. This could be due to limited knowledge or skills in effectively using OER for content creation and remixing. Al-Harthi (2020) also notes the need for training to help teachers maximize OER in these areas, supporting more innovative and collaborative use of resources.

Table 4. Summary of the extent of utilization of open educational resources

Indicators	Mean	Interpretation
Revise	3.23	Moderately Utilized
Remix	3.24	Moderately Utilized
Redistribute	3.24	Moderately Utilized
Over-All Mean	3.23	Moderately Utilized

3.2 Academic Performance of the Students

Table 5 shows the students' Science performance for the 1st quarter of School Year 2022-2023, with an average score of 83.73, rated as "Satisfactory." This indicates that students perform well in science, suggesting that the school's curriculum and learning environment effectively support their success. Research by Smith (2021) and Jones (2020) supports the idea that a supportive environment and effective teaching strategies lead to better academic outcomes. Thus, the students' satisfactory performance reflects positively on the school's efforts in science education.

Table 5. Academic performance of the students in science

Indicator	Mean	Verbal Description
General Weighted Average Grade	83.73	Satisfactory

3.3 Impact of Using Open Educational Resources

Table 6 explores the impact of using open educational resources (OER) specifically for revising, remixing, and redistributing students' academic performance in science. The results show that only "revise" ($B = -0.411$, $t = -2.514$, $p < 0.013$) has a significant favorable influence on academic performance, indicating that students benefit when teachers use OER to modify materials to suit their needs. However, "remix" ($B = 0.222$) and "redistribute" ($B = 0.008$) do not show any significant effect on academic performance. These findings suggest that teachers can maximize the academic benefits of OER by focusing on revision, while remixing and redistributing materials may not impact student outcomes in science as effectively.

Table 6. Multiple regression analysis with academic performance as outcome variable

Predictor	Beta Coefficients	R2	F	t-value	p-value	Interpretation
Revise	-0.411			-2.514	0.013	Significant
Remix	0.222	0.060	1.319	1.354	0.179	Not Significant
Redistribute	0.008			0.073	0.942	Not Significant

3.4 Difference in OER Usage

In terms of Sex

Table 7 presents the comparison of OER usage between male and female teachers, showing no significant difference in mean scores (male: $M = 17$, $SD = 0.41822$; female: $M = 93$, $SD = 0.39547$; $t(108) = 1.070$, $p = 0.287$). This result suggests that male and female teachers utilize open educational resources equally, indicating no gender-based disparity in OER usage. As a result, the null hypothesis, stating no significant difference in OER usage by

gender, is accepted. This implies that both genders have similar access to and utilization of OER, making gender-neutral policies appropriate for promoting OER use. This finding aligns with studies by Kaur et al. (2020) and Al-Hazza et al. (2019), which found no significant gender difference in OER usage among teachers.

Table 7. T-test results on the teachers' extent of utilization of oer according to sex

Sex	N	Mean	SD	T	df	p-value	Interpretation
Male	17	3.33	0.418	1.070	108	0.287	Not Significant
Female	93	3.22	0.395				

In terms of Educational Attainment

Table 8 shows the mean OER utilization scores based on teachers' educational attainment. Teachers with a bachelor's degree had a mean score of 3.19 (SD = 0.39), master's units scored 3.24 (SD = 0.42), master's degree holders scored 3.25 (SD = 0.34), those with doctorate units scored 3.84 (SD = 0.17), and doctorate holders scored 3.02 (SD = 0.11). There was no significant difference in OER utilization across these groups ($F(4, 105) = 1.556$, $p = .192$). Thus, the null hypothesis—stating no significant difference in OER utilization based on educational attainment—is accepted. This suggests that teachers utilize OER similarly, regardless of their educational level, providing equal access to resources for teachers and students alike. Studies by Al-Harthi (2020) and Al-Harthi et al. (2019) support these findings, indicating that educational attainment does not significantly impact teachers' use of OER.

Table 8. ANOVA results on the teachers' extent of utilization of oer according to educational attainment

Educational Attainment	N	Mean	SD	F	df	p-value	Interpretation
Bachelor's Degree	27	3.192	0.392				
Masters with units earned	63	3.243	0.418				
Master's Degree	14	3.245	0.335	1.556	4105	0.192	Not Significant
Doctorate with units earned	2	3.840	0.169				
Doctorate	4	3.020	0.105				

In terms of Teaching Experience

Table 9 shows that teachers' utilization of open educational resources (OER) varies based on years of teaching experience. Teachers with five or fewer years scored highest ($M = 3.41$, $SD = 0.37$), while those over 31 years had the lowest mean score ($M = 2.98$, $SD = 0.41$). A significant difference was found in OER utilization among groups based on teaching experience ($F(3, 103) = 4.015$, $p = .001$). Thus, the null hypothesis is rejected—that no significant difference exists in OER utilization by years of teaching experience. These findings suggest that teachers with fewer years of experience may be more open to using new resources, while those with more extended experience may be more resistant. Studies by Smith (2020) and Jones (2021) support this, indicating that less-experienced teachers tend to embrace OER and other new technologies more readily. This insight can guide educators when introducing new resources, as newer teachers may be more receptive to change.

Table 9. ANOVA results on the teachers' extent of utilization of oer according to the number of years in teaching

Educational Attainment	N	Mean	SD	F	df	p-value	Interpretation
5 and below	19	3.412	0.366				
6-10	32	3.260	0.357				
11-15	15	3.477	0.432				
16-20	12	3.203	0.299	4.015	3103	0.001	Significant
21-25	10	3.028	0.382				
26-30	6	3.000	0.203				
31 and above	16	2.982	0.414				

In terms of Training Attended

Table 10 shows that teachers' utilization of open educational resources (OER) does not significantly vary based on the number of relevant training sessions attended. Mean scores across training groups (ranging from 5 or fewer sessions to 31 or more) showed slight variation, with no significant difference in OER utilization ($F(6, 103) = 0.411$, $p = 0.870$). This supports the null hypothesis that training quantity does not significantly impact OER use among teachers, suggesting that teachers can effectively utilize OER regardless of training level. This underscores the importance of providing teachers with support and guidance, as studies by Al-Harthi and Warschauer (2018) and

Kukulska-Hulme and Shield (2008) found that access to professional development and technical support enhances teachers' ability to utilize OER effectively.

Table 10. ANOVA results on the teachers' extent of utilization of oer according to the number of relevant training

Relevant Training	N	Mean	SD	F	df	p-value	Interpretation
5 and below	36	3.288	0.4136				
6-10	30	3.214	0.3549				
11-15	21	3.171	0.4400				
16-20	8	3.360	0.3615	0.411	6103	0.870	Not Significant
21-25	4	3.160	0.5685				
26-30	2	3.180	0.2545				
31 and above	9	3.160	0.4331				

4.0 Conclusion

This study emphasizes revising, remixing, and redistributing Open Educational Resources (OER) to enhance teaching effectiveness. While teachers primarily use OER to retain resources, revising, remixing, and redistributing are utilized to a lesser extent. The findings suggest that teachers are not fully leveraging the potential of OER to modify, adapt, and share resources in ways that could foster more personalized, collaborative, and dynamic learning environments. By revising OER to meet specific teaching needs, remixing resources for diverse educational contexts, and redistributing these resources for broader access, educators can enhance both the quality of teaching and student learning experience. Therefore, it is crucial for educational institutions to encourage and support teachers in embracing these practices, ensuring that OER is not only retained but also effectively revised, remixed, and redistributed to maximize their impact on education. Future research could investigate strategies for training and supporting teachers in these OER practices and explore the long-term educational outcomes of comprehensive OER integration. Additionally, studies could examine the impact of OER usage on student engagement and learning outcomes across various disciplines and educational settings, providing a more holistic understanding of the benefits and challenges associated with OER adoption.

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The authors indicate equal contribution to each section. The authors reviewed and approved the final work.

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7.0 Conflict of Interests

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The Effect of *Colocasia esculenta* L. Schott (Taro) Leaf Extract in the Clotting Time and Evaluation of Electrolytes as a Potential Clot Activator

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Abstract. Clot activators are substances added to blood collection tubes to initiate the coagulation cascade, separating blood into serum. Blood chemistry uses serum separator tubes (SST) as they promote rapid clotting and allow serum separation from cellular components through centrifugation. Taro (Colocasia esculenta L.) Schott is a tropical crop widely produced for its edible corms. Researchers used leaves as they remain underutilized, they contain alkaloids, terpenoids, saponins, flavonoids, and phenols, essential to mimic a clot activator and how it influences blood integrity. This study tests different concentrations (12.5, 25, 50, and 100%) of leaf extract to determine its effect on blood. The pre-test also recorded the clotting time and physical observation, whereas (gold top, 12.5%, 25%, 50%, 100%, and red top) had a time of 14:04, 10:45, 11:58, 12:09, 14:29, and 21:33 minutes, respectively. Researchers observed that the clotting time is slower as the concentration increases, and samples that did not hemolyze were used on eight healthy individuals. In each case, they collected 10 mL of blood and placed 2 mL in each respective vacutainer. All 40 specimens were sent to the laboratory for electrolyte testing, specifically for sodium, potassium, and chloride levels. After releasing the results, one-way ANOVA and Tukey's HSD Post-hoc Test were performed, setting the alpha value to 0.05 to determine significant differences between groups. The ANOVA result showed that 50% concentration had the most significant effect compared to 12.5% and 25% in (sodium, potassium, and chloride) with p-values of 6.71E-05, 6.14E-08, and 4.36E-05, respectively. Comparing all setups obtained p-values of 1.95E-13, 1.90E-15, and 1.19E-11, respectively, indicating significant differences among the groups. The findings suggest that taro leaf extract affected clotting time, blood sample integrity, and electrolyte values, with increasing concentrations leading to a more significant effect, showing the potential to act as a clot activator.

Keywords: Clot activator; Taro leaf extract; Clotting time; Sodium; Potassium; Chloride.

1.0 Introduction

Clot activators are substances added to blood collection tubes that initiate the coagulation cascade, causing blood to clot and separate into serum. (Lima-Oliveira et al., 2020). Clinical laboratories widely use serum tubes with clot activators for various diagnostic tests because they promote rapid clotting, which allows for serum separation from cellular components through centrifugation. Serum-separating tubes (SSTs) are test tubes used in clinical chemistry tests requiring blood serum. These test tubes contain micronized silica particles, which aid in the coagulation process of blood before centrifugation, and a gel at the bottom of the tube, which separates the cell

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components from the scrum (Jo et al., 2021). Clot activators act as catalysts to promote blood clotting, and serum gel separators act as a barrier that enables the diffusion and separation of blood clot contaminants and other cellular components.

Taro (*Colocasia esculenta*) leaves have garnered attention for their potential application as a clot activator in medicine. Mba and Agu (2021) investigated a more practical application of the presence of bioactive compounds in taro leaves that are anti-cancer, anti-inflammatory, and antioxidant. They also contain carbohydrates with properties such as antihyperglycemic and antihyperlipidemic. In comparison, Nwaogwugwu et al. (2020) explored taro leaf's hematological changes and antidiabetic activities in diabetic rats. The study's results proved that taro leaf extract boosts the body weight of the rats, which may help with potential weight loss following complicated diabetes. It also demonstrated that the leaf extract improved diabetic control and management in rats.

Another study by Sjamsudin et al. (2021) shows their therapeutic potential in promoting the healing process of wounds contaminated with *Staphylococcus aureus*, where it has been shown to stimulate hematopoietic cells and enhance healing, which significantly affects wound repair and regeneration. Furthermore, the efficacy of taro leaf extract and its potential as a natural clot activator in clinical applications offer further research to utilizing plant-based alternatives for therapeutic applications. Clot activators in blood collection tubes ensure accurate electrolyte panel values. It has shown that clot activators, such as silica particles, can significantly impact the stability of electrolytes in serum, including (sodium, potassium, and chloride). The delay in specimen processing can occur due to various factors and can lead to changes in these electrolyte values, potentially affecting patient diagnosis and treatment (Fauziah et al., 2021).

This research focuses on the potential clot activator properties of Taro (*Colocasia esculenta* L.) Schott leaf extract. Its effects on blood clotting time, physical observations, and electrolyte panel values (sodium, potassium, and chloride) were observed. This study assessed the phytochemical analysis of taro leaves, whereas alkaloids, terpenoids, flavonoids, phenols, and saponins were suspected to influence blood clotting. The researchers examined only the extract's four concentrations (12.5, 25, 50, and 100%). A pre-test was conducted *in vitro to determine which concentrations would be viable to maintain* blood integrity. The blood samples mixed with the extract were compared to those from a commercially available clot activator, serum separator tube (SST), and negative control, red top (no additive). This study only focused on creating an alternative natural clot activator compared to existing ones. Furthermore, the study's findings can help understand the mechanisms behind blood clotting activity, which can contribute more to the knowledge of the clinical application of plant-derived compounds. Further research can help strengthen the effects of plant-derived clot activators and their processes of influencing blood, linking conventional treatments to evidence-based therapy.

2.0 Methodology

2.1 Research Design

The quantitative research design involved a systematic approach to investigating and addressing a specific problem. The method used numerical data and statistical analysis to test theories and generate findings. Furthermore, it enabled the researchers to establish cause-and-effect relationships and make informed conclusions regarding the impact of the manipulated variables. Statistical analyses, like One-way ANOVA and Tukey's HSD hoc test, were used to evaluate the significance of observed differences. The researchers used experimental quantitative data to gather information about the present condition. The scientific method involves modifying one or more variables to observe their effects on another variable, such as experimental research. It is quantitative and provides verifiable, numerical facts. In line with the quantitative and experimental research design, the researchers implemented a two-group design, with the experimental group, taro leaf extract, compared with the positive (serum separator tube) and negative control (no additive). At the end of the study, the objective was to provide an in-depth understanding of the clot-activating properties of taro leaf extract when mixed with the blood samples.

2.2 Research Locale

Researchers conducted the study at the National University-Manila, a private university at 551 F. Jhocson St, Sampaloc, Manila, 1008 Metro Manila.

2.3 Research Participants
Four male and female first-year Medical Technologist Students were willing to get their blood extracted. The researchers collected their samples on the 6th floor of the main building inside the laboratory under the supervision of a registered medical technologist (RMT).

2.4 Research Instrument
This study used laboratory equipment, including a centrifuge, to isolate the serum of the vacutainers obtained from the eight blood collections of the volunteers. The Cornley AFT-800 Electrolyte Analyzer processed the serum samples of the subjects.

2.5 Data Gathering Procedure
Materials
Two kilograms of taro leaves were obtained from Aurora Subdivision, Angono Rizal. All medical supplies were purchased, including vacutainers: gold top (serum separator tube) and red top (no additive), ten cc/mL syringe, tourniquet, alcohol swabs, cotton, micropore, surgical gloves, and 95% ethanol from Bambang, Manila.

Ethanolic Extract of Taro Leaves
Before extraction, a sample was sent on-site for authentication to the Institute of Biology, University of the Philippines, Diliman. Subsequently, taro leaves were washed with distilled water, air-dried for two days, weighed, and ground the resulting weight of the powder. Fifty grams of the powdered sample was taken in a thimble and submerged with 250 mL of 95% ethanol in the Soxhlet apparatus. It took 6 hours to complete. The extract was filtered by Whatman filter paper no. 1 and refrigerated (Deutsch, 2021).

Phytochemical Analysis of Taro Leaf Extract
Standard procedures qualitatively determined the phytochemicals presented in a study by Al-Kaf et al. (2019). Alkaloids: Dragendorff's test. For the Salkowski test for terpenoids. In the Foam test for saponins. For detecting flavonoids using the Shinoda test. In the $FeCl_3$ test for phenols.

Pre-testing of Different Concentrations
A pre-test was conducted to determine which concentration (12.5, 25, 50, and 100%) affects blood clotting. One random healthy subject willing to have their blood extracted was selected. A syringe method was performed: each vacutainer contained 12.5%, 25%, 50%, and 100% of the extract, respectively. A gold top was used as a positive control, and a red top was used as a negative control. The clotting time of all tubes collected was observed, recorded, and centrifuged. After evaluation, the concentrations (12.5, 25, and 50%) are used.

Blood Extraction on 4 Males and Females
Healthy individuals were identified to get their blood extracted. Unitek College (2022) standard procedures were used during blood extraction, where a Registered Medical Technologist (RMT) was supervised while performing venipuncture using the syringe method. 10 mL of blood was extracted, placing 2 mL into each of the five vacutainers: a gold top (positive control), red tops with the experimental setup (taro leaves extract) at concentrations of 12.5, 25, and 50%, and a red top (negative control), respectively.

In-vitro Blood Chemistry of Taro Leaf Extract, Gold, and Red Top
Forty specimens were obtained and transported to St. Ignatius De Loyola Health Care Services at #253 Shoe Avenue, Sto. Nino, Marikina City. A Registered Medical Technologist (RMT) processed all specimens using a Cornley AFT-800 Electrolyte Analyzer. The vacutainers are placed inside the machine and fed to aspirate the serum and analyze the content of the electrolytes (sodium, potassium, and chloride) of each sample.

***Recording Data of the Electrolyte Panel (Sodium, Potassium, and Chloride*)**
Before carrying out these results, it was crucial to double-check their accuracy. All data were collected inside the clinic laboratory, and statistics were used to find significant differences between the experimental, positive, and negative control groups.

Statistical Analysis and Interpretation of Results
A statistician analyzed and interpreted the collected data, calculating whether there were significant differences between the experimental (taro leaves extract), positive control (serum separator tube), and negative control (no additive) groups. A one-way analysis of variance (ANOVA) and Tukey's HSD Post-hoc Test were used.

2.6 Ethical Considerations
Consent of the participants
The consent form was handed out to 1st Year Medical Technology students at National University-Manila and those who volunteered to have their blood extracted, and their information was kept confidential with no risks of harming the student.

Risks
The study involved sampling four male and female volunteers for blood extraction, which was performed by the researchers, with a registered medical technologist throughout the procedure.

Proper waste disposal
The materials used in the study, such as needles, vacutainers containing blood, and ethanol from taro leaves extraction, were considered hazardous wastes. Therefore, the researchers adequately disposed of the said materials in an orderly, preventing contamination, exposure, and contact with people.

3.0 Results and Discussion
The phytochemical analysis result of the taro leaf extract is found in Table 1. The Alkaloids test showed an orange precipitate. Zubair et al. (2023) reported that alkaloids extracted from taro leaves can enhance platelet aggregation, a crucial step in clotting. The Terpenoids test resulted in a reddish-brown coloration at the interface. A study by Masyita et al. (2022) demonstrated that terpenoids isolated from taro leaves can accelerate the coagulation cascade. This acceleration is achieved by enhancing the activity of coagulation factors, leading to quicker fibrin formation and clot stabilization. The Saponins test produced persistent foam for over ten minutes.

Table 1. Phytochemical analysis of taro leaf extract

Bioactive Compound	Method Used	Result
Alkaloids	Dragendorff's test	+
Terpenoids	Salkowski test	+
Saponins	Foam test	+
Flavonoids	Shinoda test	+
Phenols	$FeCl_3$ test	+

Research by Juang and Liang (2020) highlighted the ability of saponins from taro leaves to promote clot formation. These saponins facilitate the aggregation of red blood cells and platelets, contributing to the rapid formation of a clot. The Flavonoids test showed an orange coloration. Ferdaus et al. (2023) identified that flavonoids such as quercetin and kaempferol enhance platelet function and promote the release of clotting factors. The phenols test showed a blue-green coloration. Christou et al. (2023) reported that phenolic acids in taro leaves can reduce oxidative stress at the injury site, thus preserving the function of clotting factors and platelets.

Results of the different set-ups (Gold Top, 12.5%, 25%, 50%, 100%, and Red Top) are presented in Table 2, where the pre-testing of blood in their clotting time and physical observation were taken. It is shown that among the four concentrations, as it goes lower, so does the time needed for blood to clot. However, the 100% concentration was not viable in further testing for the electrolyte panel because the sample was hemolyzed, per standard laboratory procedure.

Table 2. Physical observation and clotting time of set-ups

Set-up	Observation	Clotting Time (minutes)
Gold Top (SST)	Clear and Not Hemolyzed	14:04
Red Top (12.5%)	Clear and Not Hemolyzed	10:45
Red Top (25%)	Clear and Not Hemolyzed	11:58
Red Top (50%)	Clear and Not Hemolyzed	12:09
Red Top (100%)	Reddish and Hemolyzed	14:29
Red Top (No additive)	Clear and Not Hemolyzed	21:33

Azman et al. (2019) explained that when red blood cells undergo hemolysis, they release intracellular contents into the serum or plasma. This can lead to falsely elevated levels of certain electrolytes, particularly potassium, while diluting others like sodium.

The effect of the taro leaf extract on the blood clot with different set-ups in the electrolyte sodium is presented in Table 3. The values are expressed in millimole per liter (mmol/L). The extract has increased sodium levels, as the concentration, potentially impacting sodium regulation within the samples. Yuen et al. (2021) used measuring sodium concentrations. Their findings showed a dose-dependent relationship, with sodium levels showing distinct patterns across different concentrations.

Table 3. Comparison of electrolyte: Sodium levels on experimental, positive, and negative control

Positive Control	12.5%	25%	50%	Negative Control
138.7	124.8	130.0	132.6	137.4
140.6	127.0	129.2	133.0	139.4
139.2	130.6	135.2	135.8	137.8
135.9	125.3	129.0	131.0	136.6
136.2	126.2	123.5	133.7	139.5
137.7	127.0	130.0	133.2	136.2
135.1	126.4	128.0	132.4	135.3
137.2	125.2	128.2	131.8	138.3

Table 4 shows that when subjected to one-way ANOVA, the analysis between the F value's experimental, positive, and negative values was 45.78. By using an alpha of 0.05, the F0.05 was 4,35 = 2.64. Since the test statistic is much larger than the critical value and the *p-value* for 2.64 is 1.95×10^{-13}, the test statistic is significant at that level. Therefore, there is a significant difference in the sodium electrolyte activity.

Table 4. ANOVA analysis of sodium levels between set-ups

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	781.04	4	195.26	45.78	1.95E-13	2.64
Within Groups	149.27	35	4.2648			
Total	930.31	39				

Furthermore, Table 5 presents a post-hoc test, or Tukey's Honestly Significant Difference (HSD) test, was performed. A significant difference between the sodium levels of positive control compared to 12.5%, 25%, and 50% concentration resulted in a p-value = 0.001. There is a significant difference between 12.5%, 25%, and 50% compared to the negative control resulting in a p-value = 0.001. When compared between concentrations, there is no significant difference between 12.5% and 25%, with a p-value = 0.086. There is a significant difference between 12.5% and 50% concentrations with a p-value = 0.001. Additionally, there is a significant difference between 25% and 50% concentrations with a p-value = 0.009. Abubakar and Sule (2010) reported that higher doses of the extract led to significant increases in serum potassium levels and notable decreases in serum sodium levels, indicating a complex interaction where the concentration of plant extract influences sodium balance in the body.

Table 5. Tukey's HSD Post-hoc test analysis of sodium levels between set-ups

Pairwise comparison	Tukey HSD Q statistic	Tukey HSD p-value	Tukey HSD interference
Positive control vs 12.5%	15.06	0.001005	p<0.05
Positive control vs 25%	11.54	0.001005	p<0.05
Positive control vs 50%	6.344	0.001005	p<0.05
Positive control vs Negative control	0.017	0.899995	insignificant
12.5% vs Negative control	15.04	0.001005	p<0.05
25% vs Negative control	11.52	0.001005	p<0.05
50% vs Negative control	6.327	0.001005	p<0.05

The effect of the taro leaf extract on the blood clot with different set-ups in the electrolyte potassium is presented in Table 6. The values are expressed in millimole per liter (mmol/L). The results align with the study of Zubair et al. (2023), which shows its significant role in regulating potassium levels due to its high mineral content. The study highlights taro leaves with high potassium content as crucial for various physiological functions. This supports the observed dose-dependent increase in potassium levels when different concentrations were applied. It suggests that taro's substantial potassium content can effectively modulate potassium levels, reinforcing its potential applications in dietary and medicinal contexts for maintaining electrolyte balance and proper cellular function.

Table 6. Comparison of electrolyte: Potassium levels on experimental, positive, and negative control

Positive Control	12.5%	25%	50%	Negative Control
3.92	4.41	5.42	6.75	3.70
3.94	4.98	5.51	6.82	3.82
4.01	4.50	5.29	6.35	4.01
4.19	4.54	5.45	6.45	4.33
3.49	4.37	6.28	6.04	3.61
3.69	4.25	5.01	6.06	3.70
4.06	4.48	5.42	6.23	4.19
4.47	5.59	5.97	7.10	4.74

Table 7 shows that when subjected to one-way ANOVA, the analysis between the experimental, positive, and negative values of the F value was 62.47. By using an alpha of 0.05, the F0.05 was 4,35 = 2.64. Since the test statistic is much larger than the critical value and the p-value for 2.64 is 1.90×10^{-15}, the test statistic is significant at that level. Therefore, there is a significant difference in the potassium electrolyte activity.

Table 7. ANOVA analysis of Potassium levels between set-ups

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	36.87	4	9.217	62.47	1.90E-15	2.641
Within Groups	5.164	35	0.147			
Total	42.03	39				

Furthermore, Table 8 presents a post-hoc test, or Tukey's Honestly Significant Difference (HSD) test, which was performed. A significant difference between the sodium levels of positive control when compared to 12.5%, 25%, and 50% concentration resulted in a p-value = 0.001. There is a significant difference between 12.5%, 25%, and 50% when compared to the negative control resulting in a p-value = 0.001. When compared between concentrations 12.5%, 25%, and 50%, there is a significant difference between the potassium levels with a p-value = 0.001. Koukoui et al. (2022) examined various plant extracts, noting that higher concentrations of certain extracts, mainly from *Heliotropium indicum* and *Ipomoea fistulosa*, significantly increased serum potassium levels in rats. Their research emphasizes these plants' potassium-rich nature and potential therapeutic effects, which correlates with the study by Ferdaus et al. (2023), where taro leaves are a highly nutritious crop rich in carbohydrates, dietary fiber, and essential minerals such as potassium, magnesium, and calcium.

Table 8. Tukey's HSD Post-hoc test analysis of Potassium levels between set-ups

Pairwise comparison	Tukey HSD Q statistic	Tukey HSD p-value	Tukey HSD interference
Positive control vs 12.5%	4.924	0.011106	p<0.05
Positive control vs 25%	11.57	0.001005	p<0.05
Positive control vs 50%	18.43	0.001005	p<0.05
Positive control vs Negative control	0.303	0.899995	insignificant
12.5% vs Negative control	4.620	0.019315	p<0.05
25% vs Negative control	11.27	0.001005	p<0.05
50% vs Negative control	18.13	0.001005	p<0.05

The effect of the taro leaf extract on the blood clot with different set-ups in the electrolyte chloride is presented in Table 9. The values are expressed in millimole per liter (mmol/L). In support of the recorded results of the research study, Christou et al. (2023) conducted an ultrasound-assisted extraction of the chemicals and antioxidants found in taro leaf extracts. Taro, in general, is widely known as a practical resource of proteins, potassium, calcium, phosphorus, iron, and polyphenolic compounds. In addition, chloride is one of the most abundant components in taro.

Table 9. Comparison of electrolyte: Chloride levels on experimental, positive, and negative control

Positive Control	12.5%	25%	50%	Negative Control
100.1	92.6	90.6	95.7	100.0
104.0	87.7	90.0	95.9	96.9
102.1	91.6	96.7	96.5	101.0
101.6	89.8	93.4	96.5	98.5
108.5	90.7	90.7	99.0	104.1
104.2	92.8	95.5	98.1	106.2
102.3	94.9	93.4	97.0	99.2
101.0	89.9	92.6	96.3	98.4

Table 10 shows, when subjected to One-way ANOVA, the analysis between the experimental, positive, and negative of the F value of 34.23 and by using an alpha of 0.05, the $F_{0.05;4,35} = 2.64$. Since the test statistic is much larger than the critical value and the *p-value* for 2.64 is 1.19×10^{-11}, the test statistic is significant at that level. Therefore, there is a significant difference in the activity of electrolytes in chloride.

Table 10. ANOVA Analysis of Chloride Levels Between Set-ups

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	786.8925	4	196.7231	34.23015	1.19E-11	2.641465
Within Groups	201.1475	35	5.747071			
Total	988.04	39				

Furthermore, Table 11 presents a post-hoc test, or Tukey's Honestly Significant Difference (HSD), performed. A significant difference between the sodium levels of positive control compared to 12.5%, 25%, and 50% concentration resulted in a p-value = 0.001. There is a significant difference between 12.5% and 25% compared to the negative control, resulting in a p-value = 0.001. In comparison, there is a significant difference between 50% and negative control with a p-value = 0.033. When compared between concentrations, there is no significant difference between 12.5% and 25% with a p-value = 0.26. There is a significant difference between 12.5% and 50% with a p-value = 0.001. Additionally, there is a significant difference between 25% and 50% with a p-value = 0.002. In correlation to sodium levels presented in Table 3 and chloride levels in Table 9, Osonuga et al. (2023) study examined the effects of *Phyllanthus amarus* leaf extract on serum electrolyte levels, including chloride. Their results indicate that while there was a non-significant difference in serum sodium and potassium levels, there were slight increases in chloride levels with higher doses of the extract. It suggests that plant extracts can influence the bloodstream's electrolyte balance, including chloride levels. The results of sodium levels using the different concentrations of taro leaf extracts are lower than the positive and negative control.

Table 11. Tukey's HSD post-hoc test analysis of Chloride levels between set-ups

Pairwise comparison	Tukey HSD Q statistic	Tukey HSD p-value	Tukey HSD interference
Positive control vs 12.5%	13.83	0.001005	p<0.05
Positive control vs 25%	11.93	0.001005	p<0.05
Positive control vs 50%	7.197	0.001005	p<0.05
Positive control vs Negative control	2.875	0.271804	insignificant
12.5% vs Negative control	10.95	0.001005	p<0.05
25% vs Negative control	9.055	0.001005	p<0.05
50% vs Negative control	4.321	0.032629	p<0.05

4.0 Conclusion

The following conclusions were drawn based on the researchers' findings concerning the effect of taro leaf extract on the blood samples. Researchers observed that using taro leaf extract affected blood and clotting time. Compared to the serum separator tube (SST) and red top (no additive), the three concentrations (12.5, 25, and 50%) displayed a faster time of clotting. It also separated the blood components without causing hemolysis of the red blood cells and obtained serum. They established that the 100% was not part of the electrolyte panel testing procedure because it underwent hemolysis after centrifugation during the pre-testing phase. The three concentrations (12.5, 25, and 50%) affected the blood chemistry, mainly the electrolyte panel (sodium, potassium, and chloride). The researcher noted that as the concentration increased, so did the values of the electrolyte panel. The data analysis shows that the different concentrations of taro leaf extract had a significant effect in evaluating the blood chemistry of the electrolyte panel (sodium, potassium, and chloride). The researchers conclude that there are significant differences in comparing the experimental set-up (taro leaf extract), positive control (serum separator tube), and negative control (no additive) in the activity of the electrolyte panel (sodium, potassium, and chloride).

5.0 Contributions of Authors

All authors gave equal contributions, reviewed, and approved for the final work.

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7.0 Conflict of Interests

The authors declare no conflict of interest in publishing the paper.

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Future-Proofing the BSE Science Curriculum: Stakeholder Perspectives on Integrating AI and Emerging Technologies at Pangasinan State University

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Abstract. The rapid advancement of technology, particularly in artificial intelligence (AI) and emerging innovations, has reshaped the education landscape, necessitating the modernization of academic programs to meet future demands. This study assesses the readiness of the Bachelor of Science in Education (BSE) Science curriculum at Pangasinan State University for integrating AI and emerging technologies. Qualitative data were collected from students, faculty, the college dean, the program chairperson, and the director for curriculum to identify gaps and recommend curriculum enhancements. Key findings reveal significant curriculum limitations, including outdated content and insufficient focus on technology, hinder students' preparedness for careers in a digital world. Participants emphasized the need for practical learning experiences, such as hands-on projects and real-world applications, to bridge the gap between theoretical knowledge and practice. Faculty development in AI and digital tools was highlighted as critical for teaching effectiveness. Participants recommended incorporating AI, machine learning, and data science fundamentals to future-proof the curriculum and address institutional constraints like limited resources and infrastructure challenges. The study recommends a comprehensive curriculum overhaul that integrates advanced technologies enhances digital literacy and emphasizes professional development for faculty to align with global educational trends. These changes are essential to prepare future science educators for the dynamic demands of modern education and the evolving workforce.

Keywords: Artificial Intelligence; Career readiness; Digital literacy; Faculty development; Technological integration.

1.0 Introduction

The rapid advancement of artificial intelligence (AI) and emerging technologies presents a significant challenge for educational institutions: ensuring their curricula remain relevant in preparing students for a technology-driven world. This challenge is particularly pressing in science education, as technological advancements are reshaping both teaching methodologies and the skills required in the workforce. Despite these trends, many academic programs, particularly in developing countries, face outdated curricula, limited technological access, and a lack of alignment with global standards. These concerns necessitate an urgent re-evaluation of existing curricula to address these gaps and foster student technological readiness (John et al., 2023).

The National Higher Education Research Agenda in the Philippines underscores the need for curriculum responsiveness to labor market demands (Commission on Higher Education Memorandum Order No. 46, s. 2012).

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However, studies indicate that Filipino graduates often lack digital and AI-related skills, hindering their employability in an increasingly competitive global workforce (Alvarez & Cammayo, 2023). The Bachelor of Science in Education (BSE) Science program at Pangasinan State University reflects this broader concern, facing the challenge of preparing educators with AI competencies and other technological proficiencies needed for the 21st-century classroom.

Theoretical frameworks such as Roehrig et al.'s (2022) model for STEM curriculum innovation emphasize the integration of advanced technologies to enhance student engagement and learning outcomes. Furthermore, Lameras and Arnab (2022) propose that empowering educators with AI-focused training strengthens their ability to deliver technology-integrated instruction, thus aligning educational practices with global standards. Locally, Pangasinan State University has acknowledged the importance of engaging stakeholders—students, faculty, and administrators—in assessing curriculum needs (Tolentino et al., 2020), fostering an inclusive approach to addressing these challenges.

Despite these efforts, the BSE Science curriculum still lacks adequate focus on AI and practical applications, limiting students' preparedness for the demands of modern education (Mubofu & Mambo, 2023). This study investigates whether curriculum enhancements are necessary to effectively integrate AI and other emerging technologies, thus addressing these gaps and aligning the program with the global movement toward future-ready education. By examining stakeholder perspectives, this study seeks to contribute to developing a responsive, innovative curriculum capable of meeting the instructional needs of a digitally adept generation.

2.0 Methodology

2.1 Research Design

The study employed a qualitative research design to explore the perspectives of key stakeholders regarding the need for curriculum enhancement in the Bachelor of Science in Education (BSE) Science program at Pangasinan State University. Data collection involved semi-structured interviews with three faculty members, the college dean, the program chairperson, and the curriculum director, as well as a survey questionnaire for six student participants. While the number of student participants was limited, this approach aligns with the principles of qualitative research, which emphasize depth and richness of data over sample size. Including multiple stakeholders provided a comprehensive understanding of the curriculum's relevance in advancements in artificial intelligence and emerging technologies. This methodology ensured that the study captured a range of perspectives, allowing for the identification of specific challenges and actionable recommendations to improve the curriculum and better prepare graduates for future educational demands.

2.2 Research Locale

The study was conducted at Pangasinan State University (PSU) Binmaley Campus, one of PSU's nine campuses, known for its designation as a Center of Excellence in Fisheries, highlighting its dedication to quality education and research. Located in Binmaley, a coastal town in Pangasinan, the campus fosters an educational environment that combines academic rigor with practical, hands-on learning experiences, especially in fisheries and aquatic sciences. While the campus primarily serves aspiring professionals in fisheries, it also offers diverse programs such as a Bachelor of Science in Criminology, Environmental Science, and Secondary Education, majoring in Science. This dynamic academic setting, enriched by modern facilities and a strong focus on research and community involvement, provides a relevant backdrop for exploring the need to future-proof the BSE Science curriculum by integrating AI and emerging technologies. This setting ensures that findings are grounded in a campus context that values academic excellence and practical application, offering valuable insights for advancing science education amidst technological advancements.

2.3 Research Participants

The research participants in this study consisted of 12 individuals selected to provide a comprehensive view of the BSE Science curriculum at Pangasinan State University's Binmaley Campus. The researchers employed purposive sampling to ensure that participants possessed relevant experiences and roles for assessing the curriculum. This technique was employed because it allowed for the intentional selection of participants who could provide rich, detailed insights into the study's objectives. The participants included six students currently enrolled in the BSE Science program, three faculty members who teach science courses, the college dean, the

program chairperson, and the director for curriculum. The inclusion criteria for participants required direct involvement in or experience with the BSE Science curriculum. Students were selected based on their enrollment in the program and willingness to share their experiences. Faculty members were chosen for their teaching experience in science courses, while administrative personnel were included for their roles in curriculum planning and implementation. Participants who lacked direct involvement with the BSE Science program or declined to participate were excluded. Participants retained the right to withdraw at any study stage without repercussions.

Table 1. Participants of the study

Pseudonym	Role	Relevant Details
P1–P6	Students	Current BSE Science students, varying year levels
P7–P9	Faculty Members	Science educators with relevant teaching and research experience
P10	College Dean	Head of the College
P11	Program Chairperson	Responsible for teaching supervision
P12	Director for Curriculum	Aligns curriculum with industry trends

2.4 Research Instrument

The study employed multiple data collection methods, utilizing a survey questionnaire for the six student participants to gather detailed insights into their experiences and perceptions of the BSE Science curriculum. For the faculty members, the college dean, the program chairperson, and the curriculum director, in-depth interviews were conducted to capture their professional insights on the curriculum's current structure and the potential need for integrating AI and emerging technologies. This combination of survey and interview methods provided a comprehensive understanding of the curriculum's effectiveness from multiple perspectives.

2.5 Data Gathering Procedure

The data-gathering procedure for this study will begin with securing the necessary permissions from Pangasinan State University's administration and relevant departments. Once approval is granted, the researchers will distribute survey questionnaires to the six student participants, ensuring that each participant is informed of the study's purpose and their right to confidentiality. The questionnaire will be structured, allowing students to provide quantitative responses and open-ended feedback on the BSE Science curriculum. Following the student surveys, in-depth interviews will be scheduled with the three science faculty members, the college dean, the program chairperson, and the curriculum director. Each interview will be semi-structured, allowing for flexibility in exploring participants' insights into curriculum relevance, technological integration, and areas needing enhancement. All interviews will be audio-recorded, with participants' consent, to ensure accuracy during data analysis. After data collection, responses from the questionnaires and interviews will be carefully reviewed and coded to identify common themes, supporting the study's aim of assessing curriculum adaptability in the face of emerging technologies.

2.6 Ethical Considerations

Ethical considerations were carefully observed throughout the study to ensure the protection and dignity of all participants. Informed consent was obtained from each participant before data collection, ensuring they fully understood the purpose, procedures, and rights within the study. Participants were assured of the confidentiality and anonymity of their responses, with all data securely stored and personal identifiers removed during transcription and analysis. Participation was voluntary, and participants were informed they could withdraw from the study without any consequences. Additionally, the study adhered to all institutional and legal guidelines concerning research with human subjects, ensuring that ethical standards were maintained at every stage of the research process.

3.0 Results and Discussion

3.1 BSE Science Curriculum's Readiness for Technological Advancements

The effectiveness of the BSE Science curriculum was evaluated by gathering insights from key stakeholders, including students, faculty, and administrators. Their perspectives provided a holistic view of how well the current curriculum prepares students for the demands of a technology-driven world, particularly in integrating AI and related advancements.

Table 1. BSE Science curriculum's readiness for technological advancements

Participants	Themes	Sub-theme/s
P1, P2, P3, P5, P7, P8	Curriculum Gaps	Lack of tech focus, Outdated Content
P2, P6, P9, P10, P12	Curriculum Enhancement	Future Career Skills, Future-Proofing
P4, P6, P8	Curriculum Gaps	Hands-on Learning, Future-Oriented Content
P7, P8, P10, P11, P12	Implementation Challenges	Resource Needs, Faculty Training
P9, P10, P11, P12	Relevance of AI	Career Relevance, Job Market Readiness

Curriculum Gaps (Lack of Tech Focus, Outdated Content)

Participants consistently identified gaps in the curriculum, particularly in its lack of focus on technology and outdated content. P1 remarked,

"The curriculum does not include much about AI or modern science tools, and I feel unprepared for future careers in technology-driven fields." P1

"Some topics are outdated, and current advancements like AI are not mentioned." P3

"The curriculum meets the basics but does not align with technological progress, leaving students underprepared." P7

These insights indicate a disconnect between the curriculum and technological advancements, underscoring the urgent need for modernization. According to Mubofu and Mambo (2023), addressing curriculum gaps is critical for aligning with global industry demands. The findings also align with Roehrig et al. (2022), who highlight the importance of continuously updating STEM curricula to reflect technological progress. This gap suggests that the curriculum is not adequately preparing graduates for the demands of AI-driven science education, a concern that must be addressed to remain competitive.

Curriculum Enhancement (Future Career Skills, Future-Proofing)

The need for curriculum enhancement was a recurring theme, as participants emphasized the importance of equipping students with skills that align with a technology-driven job market.

"We need more exposure to AI and data science – skills that are essential for future careers." P6

"The curriculum needs to integrate AI and modern technologies to future-proof our graduates for industry demands." P10

This aligns with Alvarez and Cammayo's (2023) findings, which emphasize that incorporating AI-related content enhances employability by providing relevant skills for the workforce. Furthermore, John Melchor et al. (2023) highlight that integrating AI fosters adaptability, allowing graduates to navigate the evolving technological landscape. By focusing on future-proofing the curriculum, these enhancements can prepare students for lifelong learning and career readiness, addressing the growing need for a workforce skilled in emerging technologies. These findings directly address the research objective of identifying gaps and opportunities for enhancing the BSE Science curriculum to prepare graduates for technology-driven careers. The identified themes provide actionable insights into areas requiring immediate attention, such as modernizing content and integrating AI and related technologies.

3.2 Challenges in Technology Integration within the BSE Science Curriculum

Understanding the challenges faced in integrating modern technologies into the BSE Science curriculum sheds light on the barriers hindering its effectiveness. Insights from stakeholders helped uncover limitations in resources, training, and curriculum structure that affect technology adoption.

Table 2. Identified challenges in technology integration within the BSE Science curriculum

Participants	Themes	Sub-theme/s
P1, P3, P4, P5, P7, P9	Curriculum Limitations	Limited Access to Technology, Outdated Resources
P2, P4, P6, P10, P11	Need for Practical Applications	Lack of Hands-on Activities, Insufficient Real-World Relevance
P3, P5, P8, P11, P12	Training and Skill Gaps	Limited Faculty Skills in Technology, Need for Faculty Development
P6, P9, P10, P12	Student Preparedness	Insufficient Exposure to AI, Lack of Technological Skills
P7, P8, P11	Institutional Constraints	Resource Limitations, Infrastructure Challenges

Curriculum Limitations (Limited Access to Technology, Outdated Resources)
Participants highlighted significant curriculum limitations, citing restricted access to modern technology and reliance on outdated resources.

"We do not have access to advanced tools or updated learning materials that align with current technological trends." P1

"Students often lack exposure to technology that is standard in today's educational and professional environments." P7

These insights reflect broader challenges educational institutions face, where outdated resources hinder the integration of global competencies (Alvero, 2023). Mubofu and Mambo (2023) emphasize that investment in technological resources is critical for aligning curricula with modern educational demands, addressing a key barrier to technological adoption in the BSE Science curriculum.

Need for Practical Applications (Lack of Hands-on Activities, Insufficient Real-World Relevance)
Participants stressed the lack of practical applications in the curriculum, which limits students' ability to bridge theoretical knowledge with real-world experiences.

"We need more hands-on activities that show us how science concepts apply in real life." P2

"Practical projects are vital for preparing students to handle real-world scenarios." P10

Wu and Yang (2022) support this observation, emphasizing that hands-on learning enhances understanding and retention of complex concepts. Roehrig et al. (2022) advocate for curriculum designs incorporating real-world relevance, making learning more effective and applicable.

Training and Skill Gaps (Limited Faculty Skills in Technology, Need for Faculty Development)
Participants identified faculty development as a critical issue, noting gaps in technological proficiency among educators.

"Some teachers are not trained in using advanced tools, which limits their ability to teach modern technologies." P3

"Faculty need continuous training to stay updated with advancements like AI." P8

Lameras and Arnab (2022) highlight the importance of empowering educators through professional development to enhance their capacity for integrating emerging technologies. Such training enables teachers to deliver high-quality education and better prepare students for future technological demands (Virgolesi et al., 2020).

Student Preparedness (Insufficient Exposure to AI, Lack of Technological Skills)
Participants expressed concerns about students' lack of readiness for technology-driven careers.

"Many students have limited exposure to AI and other technologies, which puts them at a disadvantage." P9

"Technological skills are critical, but the current curriculum does not provide enough opportunities to develop them." P12

This aligns with findings by John Melchor et al. (2023), who emphasize the importance of technological proficiency for career success. Alvarez and Cammayo (2023) also note that exposing students to relevant technologies throughout their education enhances their readiness for an evolving job market.

Institutional Constraints (Resource Limitations, Infrastructure Challenges)
Participants also pointed to institutional constraints, such as insufficient resources and infrastructure, as major barriers to technology integration.

"The lack of infrastructure, like computer labs, limits what we can teach and learn." P7

"Our institution struggles with resource allocation, which affects the implementation of new technologies." P11

These challenges are echoed by Miranda and Cruz (2023), who note that resource limitations in institutions significantly impact the quality of education. Addressing these structural barriers is critical to creating a supportive environment for technology-enhanced learning. These findings address the objective of identifying challenges in integrating modern technologies into the BSE Science curriculum. The key themes—curriculum limitations, lack of practical applications, faculty skill gaps, student unpreparedness, and institutional constraints—highlight specific barriers and provide insights into areas requiring targeted interventions to improve the curriculum's effectiveness.

3.3 Perceptions of AI and Emerging Technologies in Science Education Careers

Identifying areas for improvement within the BSE Science curriculum is crucial to ensure its relevance in a rapidly advancing technological landscape. Stakeholders' responses highlighted key gaps and opportunities for curriculum enhancement that can better align the program with global education standards.

Table 3. Perceptions of AI and emerging technologies in science education careers

Participants	Themes	Sub-theme/s
P1, P2, P3, P5, P7	Perceived Career Relevance	Enhancing Teaching Methods, Improving Student Engagement
P4, P6, P9, P10, P12	Curriculum Support Deficiencies	Insufficient Skill Development, Lack of AI Content
P3, P8, P10, P11, P12	Need for Skill Alignment	Career-Ready Skills, Technological Proficiency
P6, P8, P9, P11	Professional Growth Opportunities	AI Training Workshops, Continuous Learning Needs
P7, P10, P12	Future Educational Impact	Preparing for Digital Classrooms, Building Adaptability

Perceived Career Relevance (Enhancing Teaching Methods, Improving Student Engagement)

Participants highlighted the relevance of AI and emerging technologies in improving teaching methods and increasing student engagement.

"AI can make lessons more interactive, which keeps students interested and helps them understand better." P1

"It would be great if the curriculum taught us how to use these tools to make our teaching more effective." P5

These insights align with John Melchor et al. (2023), who emphasize AI's potential to enrich instructional strategies and foster dynamic, engaging learning environments. This recognition underscores the transformative impact of AI on traditional science education, highlighting its role in creating interactive, technology-enhanced experiences.

Curriculum Support Deficiencies (Insufficient Skill Development, Lack of AI Content)

Participants expressed concerns about the curriculum's deficiencies, particularly its failure to develop essential skills and include AI-related content.

"We are not learning enough about technologies that are shaping the future of science education." P6

"The lack of AI content in the curriculum makes it difficult for students to gain relevant skills for their future careers." P10

This aligns with Lameras and Arnab's (2022) findings, which stress the importance of integrating AI to support skill development and meet the demands of a technology-driven workforce. Addressing these deficiencies is crucial to equipping students with the tools and knowledge needed for the evolving job market.

Need for Skill Alignment (Career-Ready Skills, Technological Proficiency)

Participants emphasized aligning the curriculum with industry requirements to ensure students develop career-ready skills and technological proficiency.

"The curriculum should include specific skills that align with what employers are looking for, especially in science and technology." P11

"We need to learn practical skills to make us competitive in a tech-focused job market." P8

This supports the findings of Alvarez and Cammayo (2023), who note that aligning academic learning with industry needs enhances employability and ensures graduates possess relevant career competencies.

Professional Growth Opportunities (AI Training Workshops, Continuous Learning Needs)
Participants highlighted the need for professional development opportunities to ensure educators are prepared to teach emerging technologies.

"Workshops and continuous training on AI would help teachers stay updated and improve their teaching methods." P9

"It is important for teachers to keep learning to teach new technologies effectively." P6

Virgolesi et al. (2020) emphasize that continuous learning initiatives are essential for adapting to technological advancements, benefiting educators and students by enhancing instructional quality.

Future Educational Impact (Preparing for Digital Classrooms, Building Adaptability)
Participants recognized the impact of AI and technology on the future of education, particularly in preparing for digital classrooms and fostering adaptability.

"Teachers need to be ready for digital classrooms where technology plays a key role in teaching and learning." P12

"Adaptability is essential for educators to thrive in rapidly changing educational settings." P7

These findings align with Wu and Yang (2022), who stress the importance of preparing educators to manage technology-enhanced learning environments. Incorporating adaptability and AI into the curriculum ensures that future educators are equipped to meet the challenges of increasingly digitalized classrooms. These findings address evaluating the curriculum's capacity to prepare students for careers in science education, focusing on technological proficiency and future educational practices. The themes highlight the importance of aligning the curriculum with industry demands, fostering skill development, and equipping students and educators for a technology-driven future.

3.4 Recommendations for Enhancing the BSE Science Curriculum
Based on the findings, actionable recommendations were developed to address the identified gaps and challenges. These recommendations focus on integrating AI, modern technologies, and skill-based approaches to equip students for careers in science education while addressing the evolving demands of the 21st century.

Table 4. Participant recommendations for enhancing the BSE science curriculum

Participants	Themes	Sub-theme/s
P1, P2, P3, P4, P5	Recommended Curriculum Additions	AI and Machine Learning, Data Science Fundamentals
P4, P6, P7, P8, P12	Need for Practical Learning	Hands-on Technology Projects, Real-World Application
P3, P5, P9, P10, P11	Enhancing Digital Literacy	Digital Tools Proficiency, Computational Thinking
P6, P8, P11	Faculty Development Needs	Training on Emerging Technologies, Continuous Professional Development
P7, P10, P12	Career-Driven Skills	Classroom Technology Management, Preparing for Technological Advancements

Recommended Curriculum Additions (AI and Machine Learning, Data Science Fundamentals)
Participants suggested incorporating AI, machine learning, and data science fundamentals into the curriculum to enhance technological competencies.

"Adding AI and data science would make the curriculum more relevant to modern needs." P1

"These skills are essential for scientific research and practical applications today." P5

This aligns with the findings of Roehrig et al. (2022), who advocate for including cutting-edge technological content to meet evolving industry standards. John Melchor et al. (2023) further highlight the importance of such

additions in fostering a forward-thinking curriculum that equips students for future challenges in science education.

Need for Practical Learning (Hands-on Technology Projects, Real-World Application)
Participants emphasized integrating hands-on technology projects and real-world applications into the curriculum.

"Projects that let us use technology practically would help us understand its real-world relevance." P4

"Students learn better when they can apply concepts to real-life situations." P8

Wu and Yang (2022) confirm that experiential learning enhances engagement and knowledge retention, while Mubofu and Mambo (2023) stress the need to bridge the gap between theory and practice. Incorporating practical learning ensures that students can use technology meaningfully in science.

Enhancing Digital Literacy (Digital Tools Proficiency, Computational Thinking)
Participants highlighted the need to enhance digital literacy through proficiency in digital tools and computational thinking.

"Digital literacy is foundational, and the curriculum should teach us how to use technology effectively." P10

"Skills like computational thinking are crucial for solving modern problems." P9

Alvarez and Cammayo (2023) and Lameras and Arnab (2022) both emphasize the critical role of digital literacy in equipping students for academic and professional success. Strengthening these competencies can ensure that students are prepared for technology-driven environments in science education and beyond.

Faculty Development Needs (Training on Emerging Technologies, Continuous Professional Development)
Faculty development emerged as a priority, with participants calling for training on emerging technologies and opportunities for continuous professional growth.

"Teachers need training to stay updated and effectively teach new technologies." P6

"Continuous development for faculty is vital to ensure the curriculum keeps pace with technological advancements." P11

This aligns with Virgolesi et al. (2020), who emphasize that investing in faculty development enhances teaching quality and curriculum delivery. Miranda and Cruz (2023) also underscore the importance of faculty preparedness in managing advanced technological content.

Career-Driven Skills (Classroom Technology Management, Preparing for Technological Advancements)
Participants suggested emphasizing career-driven skills such as classroom technology management and preparing for technological advancements.

"Future teachers must know how to use and manage technology in the classroom effectively." P7

"The curriculum should prepare students for advancements that will shape the teaching profession." P12

Tolentino et al. (2020) emphasize that equipping educators with these skills ensures they are adaptable and capable of meeting the demands of a tech-driven educational landscape. Alvero (2023) reinforces the need for such skills to foster a workforce ready to respond to modern challenges. These findings address the objective of identifying actionable recommendations for enhancing the BSE Science curriculum. The themes highlight specific areas of improvement, such as integrating advanced technologies, emphasizing practical learning, enhancing digital literacy, and prioritizing faculty development. These recommendations aim to equip graduates with the skills and knowledge necessary to thrive in a technology-driven educational environment.

4.0 Conclusion

The findings of this study revealed critical areas in need of attention within the BSE Science curriculum at Pangasinan State University, particularly concerning its readiness for technological advancements. Significant gaps, such as limited focus on AI and outdated content, hinder the curriculum's ability to prepare students for careers in a rapidly evolving, technology-driven environment. These deficiencies highlight the pressing need to modernize the curriculum by incorporating relevant technological advancements and aligning it with global standards and industry demands.

In addition to curriculum gaps, stakeholders identified challenges restricting the effective integration of modern technologies into the program. Limited access to technology, outdated resources, insufficient hands-on applications, and faculty skills and infrastructure gaps emerged as significant barriers. These findings underscore the necessity for targeted interventions, including resource investment, infrastructure upgrades, and continuous professional development for educators, to create a more supportive learning environment. Furthermore, the study emphasized the need to equip students with career-ready skills and technological proficiency, which is currently lacking in the curriculum. Participants highlighted the importance of aligning academic learning with industry requirements by integrating digital literacy, computational thinking, and AI-related competencies. Such efforts are essential to enhance graduates' employability and ensure relevance in a competitive, technology-driven workforce. To address these gaps and challenges, actionable recommendations have been proposed to future-proof the curriculum. These include integrating advanced technologies such as AI and data science fundamentals, enhancing hands-on learning opportunities, and prioritizing faculty training on emerging technologies. By focusing on career-driven skills like classroom technology management and adaptability, the curriculum can better prepare graduates to navigate the dynamic demands of modern science education. These enhancements will collectively ensure that the BSE Science curriculum evolves into a forward-looking program that meets local and global education standards.

5.0 Contributions of Authors

This study was a collaborative effort among the three authors, who each played a distinct and vital role in ensuring its success. Mr. Sicuan led the study's conceptualization, overseeing the research design and the development of objectives to align with the study's aims. Ms. Ermino managed data gathering and coding, organized participant responses, and systematically analyzed data to extract meaningful insights. Ms. Junio took primary responsibility for writing, editing, and synthesizing the findings into a coherent narrative. The authors engaged in thorough discussions at every stage, from initial planning to final reporting, demonstrating a shared commitment to the study's integrity and quality. This collective approach highlights the authors' combined expertise and dedication to advancing the BSE Science curriculum through meaningful research.

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7.0 Conflict of Interests

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Competencies of Librarians: Inputs Towards a Proposed CPD Plan

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Abstract. Continuous Professional Development (CPD) ensures that professionals can be updated with the new trends and practices in their profession. Continuous learning in the workplace is essential for a professional's development and ensuring quality delivery. This study examined the competency levels of librarians at State Universities and Colleges (SUC) in Region 3, Philippines, about the National Competency-Based Standards for Filipino Librarians (NCBS-FL) and the Philippine Qualification Frameworks for Librarians (PQF-L). The research employed a mixed methods design. A total of forty-four (44) librarians from SUC Main Campuses took part in a study using a research instrument that was adapted from the work of Lanzuela (2018) and Fernandez and Buenrostro (2015). The profiles of the participants were described using frequency and percentage. For the analysis of their self-evaluation on the NCBS-FL, PQF-L, and the impact of the CPD in developing essential competencies, means and standard deviations were calculated, along with ANOVA and T-Tests for inferential analysis. The results indicated that the participants had a Proficient Level of competency in both the Personal and Professional Competencies areas, according to the NCBS-FL assessment. The participants have a Proficient Level in the Desired Minimum Professional Competencies domain but are at the Developing Level in the Advanced Professional Competencies domain. The findings show that CPD programs help participants achieve basic professional skills and develop more advanced skills. The participants faced several challenges in achieving professional growth through the CPD program. These included budget constraints, lack of support from administrators, and insufficient staffing.

Keywords: Challenges; Competencies; Continuous professional development; National competency-based standards for Filipino librarians; Philippine qualification frameworks for librarians.

1.0 Introduction

The National Qualifications Framework (NQF) serves as a mechanism for categorizing the various levels of qualifications within a country, establishing a standardized approach. To achieve each level of qualification, individuals must meet specified minimum requirements concerning learning outcomes. These qualifications are foundational for international competencies and are crucial in promoting lifelong learning (Cedefop & European Training Foundation, 2017). The NQF organizes qualifications within a hierarchical structure, with each level reflecting distinct complexities of skills and competencies. The qualifications outlined in the framework represent the essential knowledge, skills, and competencies recognized in the international marketplace.

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The Philippine Qualifications Framework (PQF) was established by the National Coordinating Committee for the PQF, led by the Department of Education (DepEd). The committee includes members from the Technical Education and Skills Development Authority (TESDA), the Commission on Higher Education (CHED), the Department of Labor and Employment (DOLE), and the Professional Regulation Commission (PRC). The framework was created following Executive Order Number 83 Series of 2012, known as the Institutionalization of the Philippine Qualifications Framework, signed by President Benigno Simeon C. Aquino III on October 1, 2012. The PQF consists of eight levels of Qualification Descriptors and is further categorized into three domains: knowledge, skills and values application, and degree of independence (Granda, 2015). This government initiative is designed to define the educational requirements and establish quality standards for achieving improved and credible outcomes. Additionally, it serves as a national framework that ensures individuals' development, recognition, and qualification based on standards that can be attained through various methods by any learner or professional within a given country.

As outlined on its official website, the Philippine Qualifications Framework (PQF) has been established with the following objectives: 1) To implement national standards and levels regarding educational outcomes; 2) To facilitate the development and maintenance of pathways and equivalencies that enable access to qualifications and assist individuals in transitioning smoothly between various education and training sectors, as well as between these sectors and the labor market; and 3) To align the PQF with international qualifications frameworks to enhance the national and international mobility of workers by increasing the recognition and comparability of Philippine qualifications (TESDA, 2012, p.4). The Philippine Qualifications Framework (PQF) is a quality-assured national system that ensures product quality is achieved according to globally established standards, facilitated by professionals through various means. The PQF has effectively restructured the education system to develop the skills and competencies necessary for thriving in the Fourth Industrial Revolution. By adopting the PQF, which features a globally recognized set of qualifications and standards, Filipinos have become more employable and competent, knowing that their qualifications are relevant and aligned with the current demands of society.

Additionally, the PQF seeks to establish a national standard for education by aligning Philippine qualifications with those recognized internationally. To ensure full international recognition, the PQF facilitates the seamless movement of Filipinos across various education sectors and workforce categories. In pursuit of the objectives set forth by the Philippine Qualifications Framework (PQF), various government agencies, including DOLE, DepEd, CHED, PRC, and TESDA, have collaborated to establish the National Coordinating Council (NCC). This council is tasked with the approval and implementation of Republic Act No. 10968, titled "An Act Institutionalizing the Philippine Qualifications Framework (PQF), Establishing the PQF-National Coordinating Council (NCC), and Appropriating Funds Therefor," commonly referred to as the "Philippine Qualifications Framework Act" (Philippine Qualifications Framework, 2019). President Rodrigo Duterte signed this legislation into law on January 16, 2018.

Establishing a qualifications framework required educational institutions, both public and private, to align their expected outcomes with the competencies demanded in the global market. This initiative aimed at enhancing professional development and ensuring the provision of quality and advanced services. Consequently, State Universities and Colleges (SUCs) aligned their outputs to meet these standards. SUCs are public Higher Education Institutions (HEIs) created by the government and governed by independent Boards of Trustees or officials. State Universities and Colleges (SUCs) have been established in response to Republic Act No. 10931, commonly known as the "Universal Access to Quality Tertiary Education Act." This legislation underscores the State's obligation to implement measures that ensure accessible education for all Filipinos. Key objectives of SUCs include prioritizing academically capable but underprivileged students and ensuring the effective use of government funds allocated for education (Law Phil, 2016). All Higher Education Institutions (HEIs), both public and private, in the Philippines are regulated by the Commission on Higher Education (CHED) under Republic Act No. 7722, also referred to as the "Higher Education Act of 1994" (Commission on Higher Education, 2001). SUCs, governed by CHED, must adhere to the standards established by the commission, one of which mandates the provision of a functional academic library that supports the institution's curricular offerings (Gako & Las Piñas, 2015). This requirement is facilitated by Republic Act No. 9246, commonly referred to as “The Philippine Librarianship Act of 2003” (Professional Regulatory Commission, 2004). Through this legislation, the Philippine government

recognizes the crucial role that librarians play in enhancing the intellectual development of every Filipino, thereby integrating library services into the framework of national development.

In this context, state universities and colleges (SUCs) as higher education institutions (HEIs) funded by the government often encounter challenges related to financing. Aduda (2018) noted that the availability of funds is a crucial factor in delivering quality education within public educational institutions. To ensure HEIs can effectively contribute to economic and social growth in an increasingly globalized world, policymakers must revise funding policies and explore innovative strategies to enhance and generate more financial resources. In the Philippines, SUCs are granted the authority to manage and control their internal income streams as outlined in CHED Memo No. 20 (Higher Education Modernization Act of 1997) and the Public Higher Education Reform Framework, aimed at addressing the shortfall in national government subsidies (Manasan & Revilla, 2015).

From a student's perspective, the library and education are fundamentally intertwined. They coexist to further each other's purpose. Libraries have significantly contributed to educational efforts by providing access to teaching materials and information resources. Education represents the knowledge acquired, while the library serves as a repository. Education shapes individuals, fostering a discerning mindset that cultivates better citizenship, while libraries promote self-education, leading to an enhanced outlook on life. Thus, libraries hold a crucial position in education and research by supplying society with essential information (Shukla et al., 2013). Unfortunately, many SUCs often face funding challenges, with most allocations directed toward operational costs, leaving library development a low priority. Professional development poses a significant challenge for many librarians, as some must cover the costs of their professional growth. In contrast, others may choose not to pursue further education due to the financial burden. Although numerous studies have examined the competency levels of librarians concerning global competitiveness within private institutions, there is a lack of research in public higher education institutions (HEIs). While most private HEIs allocate an annual budget for staff professional development, this funding is often absent in many public HEIs.

In light of the established competencies and skills for librarians in alignment with the Philippine Qualifications Framework (PQF), the Professional Regulation Commission (PRC) has taken significant steps to ensure that all professionals in the country engage in continuing education. This initiative aims to keep them updated with the evolving demands of the workplace by requiring Continuing Professional Development (CPD) credit units to renew professional licenses. Given this context, the researcher, who is also a librarian, has contemplated the challenges faced by librarians in State Universities and Colleges (SUCs) that operate under significant budget constraints. Consequently, this research focuses on assessing librarians' competency levels in SUCs based on the PQF for Librarians (PQF-L) and the National Competency-Based Standards for Filipino Librarians (NCBS-FL). The findings from this study will ultimately inform the development of a Continuing Professional Development Plan.

2.0 Methodology

2.1 Research Design

The researcher employed a mixed-methods research design. Almeida et al. (2016) highlight that this approach combines quantitative and qualitative techniques. Utilizing this integration allows for a more comprehensive understanding of the research problem than relying on a single method. Specifically, the researcher adopted a sequential explanatory design, beginning with a quantitative study followed by a qualitative phase. This explanatory design was also instrumental in clarifying the study's purpose during the qualitative segment, aiming to elucidate the earlier quantitative results (Poth, 2018). Furthermore, the quantitative phase used the descriptive method to assess the respondents' profiles and gauge the SUC librarians' self-assessments of the NCBS-FL and PQF-L standards.

Conversely, the phenomenological method, employing in-depth interviews, was utilized for the qualitative component to gather participants' insights regarding the challenges they faced with CPD program requirements and PQF-L standards as avenues for professional growth. Neubauer et al. (2019) emphasize that phenomenology is a qualitative research approach that explores individuals' lived experiences. This "participant-oriented" method allows participants to express themselves and share their experiences in their own words without any alteration

(Alase, 2017). As a result, the data obtained from both the quantitative and qualitative components were compared, integrated, and synthesized to generate a comprehensive interpretation.

2.2 Research Participants

According to the reports compiled by CHEDRO III, a total of fifty-two (52) State University and College (SUC) librarians with permanent librarian positions were identified. However, only forty-four (44) agreed to participate in the study. For the quantitative aspect of the research, the entire population was included, as total population sampling is a purposive technique utilized due to the small number of individuals possessing specific attributes (McCarthy & Ahmed, 2021). Additionally, nine (9) librarians consented to be interviewed were selected for the qualitative portion using purposive sampling.

2.3 Research Instrument

A researcher-developed survey questionnaire, adapted from the instruments utilized by Fernandez and Buenrostro (2015) and Lanzuela (2018), was employed to gather data on the personal and professional competencies of librarians about the Philippine Qualifications Framework for Librarians (PQF-L) and the National Competency-Based Standards for Filipino Librarians (NCBS-FL). Specific competencies and skills were derived from the authoritative documents of the PQF-L and NCBS-FL standards to ensure content validity. Additionally, some elements were modeled after the tools Fernandez and Buenrostro (2015) and Lanzuela (2018) used. The survey instrument underwent face or judgmental validity testing through expert validation. Furthermore, the researcher developed an interview guide to collect qualitative data to complement and reinforce the quantitative findings from the survey questionnaire. This interview guide also underwent expert validation to ensure content validity.

2.4 Data Gathering Procedure

The necessary permissions to conduct the study were obtained in a letter addressed to the heads of the identified state universities and college libraries. This letter was acknowledged by the paper adviser and approved by the Holy Angel University Institutional Review Board (HAU-IRB Protocol No.: 2021-030-NRDABU-SUCLIBRARIANS). The invitation letters sent to the participants outlined the objectives and rationale of the study. Due to COVID-19 restrictions, these invitations were distributed electronically via email, Facebook Messenger, or both.

For the quantitative component of the study, participants completed survey questionnaires that required approximately 15 minutes of their time. These questionnaires were administered using the Google Form platform. In contrast, the qualitative component involved in-depth interviews lasting around 30 minutes, conducted through Zoom and Google Meet. Participants were asked for their availability and permission to record their video and/or audio. The transcriptions of the interviews were subsequently shared with the participants to ensure the accuracy of the transcriptions and interpretations. Participants provided signature specimens to confirm their agreement with the transcriptions. Lastly, respondents received instructions on contacting the researcher should they require clarification regarding the instrument used or the study.

2.5 Data Analysis

In the quantitative section of the study, frequency and percentage were utilized to characterize the distribution of respondents based on their profile variables, which include age, sex, highest educational attainment, registration status, years of service as a librarian, nature of work, in-service training attended, and CPD Credit units earned. Additionally, means and standard deviations were calculated to assess the participants' self-evaluated competencies concerning the National Competency-Based Standards for Filipino Librarians (NCBS-FL) and the Philippine Qualifications Framework for Librarians (PQF-L). The means were described in terms of level of competence based on the following scale:

Table 1. Level of competencies scale

Scale	Mean Ranges	Description
4	3.25 – 4.00	Advanced level
3	2.50 – 3.24	Proficient level
2	1.75 – 2.49	Developing level
1	1.00 – 1.74	Learning level

In the qualitative segment of the study, the interview responses were transcribed for analysis. A content analysis approach was employed to interpret the data, which involved categorizing verbal information and engaging in an iterative process of coding and classifying this information to form distinct categories. The transcripts of the interviews, along with accompanying field notes, were analyzed and coded into themes and sub-themes through content analysis to understand better the insights shared by the respondents as a collective group (Kuckartz & Rädiker, 2023).

2.6 Ethical Considerations

The principles of ethical conduct must be upheld as a fundamental rule when conducting a research study involving human interactions. The researcher tried to adhere to ethical standards from the conceptualization of the study to the reporting of the findings. Appropriate language was utilized in the research instruments, and proper citations were provided for the works of other authors referenced in the study. Additionally, the researcher maintained impartiality throughout the research process and sought approval from the HAU Institutional Review Board (IRB) before the study's implementation.

Participation in the study was entirely voluntary, with participants given the autonomy to choose whether to engage in the quantitative component via Google Forms. Furthermore, the ten respondents selected for the 30-minute in-depth interviews conducted through Google Meet and Zoom were informed of their right to withdraw at any time should they feel uncomfortable sharing their experiences, particularly regarding the recorded nature of the interviews. They were reminded to deactivate the recorder at any moment during the discussion and withdraw from the study without any reservations. Moreover, no financial incentives were offered for participation, as the study was conducted solely for educational purposes.

Participants greatly benefited from the study as they established a clear self-assessment of their professional status about the national competencies required for librarianship, which is essential for achieving global competitiveness and professional competence. Before the survey, informed consent was obtained, allowing participants to decide whether to participate. They also had the option to receive the study results via email following publication. Access to all collected data was restricted solely to the researcher. The information gathered from the study was coded to safeguard participant identity, and any potential risks associated with disclosing personal information were excluded from the final paper and oral presentation. The data collected from the online survey and recorded interviews were securely stored on a protected server. All such data will be permanently deleted one year after the study's publication. Additionally, participants have the right to refuse the use of their collected data if the principal investigator intends to use it for future research.

3.0 Results and Discussion

3.1 Profile of State Universities and Colleges Librarians

According to the findings from the study on the profiles of SUC librarians in Region III, the youngest participants are 22 to 32. At the same time, the oldest belong to the age group of 55 and above, as illustrated in Table 2. Regarding the demographic variable of sex, the results align with Blackburn (2015), who characterized librarianship as "women's work," noting a significant predominance of female participants over their male counterparts.

Table 2. Frequency and percentage distribution of respondents in terms of age and sex

			Male	Female	Total
Age	22 – 32	Frequency	3	12	15
		Percentage (%)	6.8%	27.3%	34.1%
	33 – 43	Frequency	2	17	19
		Percentage (%)	4.5%	38.6%	43.2%
	44 – 54	Frequency	0	7	7
		Percentage (%)	0.0%	15.9%	15.9%
	55 above	Frequency	0	3	3
		Percentage (%)	0.0%	6.8%	6.8%

Table 3 presents respondents' frequency and percentage distribution based on their highest educational attainment and registration status. Regarding educational qualifications, most participants hold a Master's Degree, a requirement for academic librarians. Moreover, higher education institution (HEI) libraries must be

overseen by licensed librarians possessing master's degrees in Library and Information Science or a related field (CHED, 2017). Despite this requirement, the proportion of master's degree holders among academic librarians in Region 03 State Universities and Colleges (SUCs) remains below expectations. The research further reveals that most librarians are registered and have renewed their licenses, while only a few are pending renewal. This indicates a strong awareness among librarians of the significance of maintaining a registered license in their professional practice.

Table 3. Frequency and percentage distribution of respondents in terms of highest educational attainment and registration status

		Frequency (f)	Percentage (%)
Highest educational attainment	Bachelor's Degree	17	38.6%
	Masterate Degree	26	59.1%
	Doctorate Degree	1	2.3%
Registration Status	Registered	35	79.5%
	For Renewal	9	20.5%

It is important to note that the participants are seasoned librarians, as indicated by their years of service in both the public and private sectors, as shown in Table 4. Nearly half of the participants have over ten years of experience, with some having dedicated more than thirty years to the field. As a fellow librarian, the researcher recognizes this level of commitment as a hallmark of the profession, particularly given the shortage of librarians, a situation exacerbated by the limited number of colleges and universities offering Library & Information Science (LIS) courses (Adel, 2020). The participants also have diverse roles within their organizations, with some serving as Directors or Department Heads, Assistant Directors or Assistant Department Heads, and many occupying positions as Section Heads. At the same time, a portion of the support staff is in their workplaces.

Table 4. Frequency and percentage distribution of respondents in terms of years in service and nature of work as a librarian

		Frequency (f)	Percentage (%)
Years in service as a librarian	1 – 5 years	12	27.3%
	6 – 10 years	12	27.3%
	11 – 15 years	8	18.2%
	16 – 20 years	6	13.6%
	21 – 25 years	3	6.8%
	26 – 30 years	0	0
	31 above	3	6.8%
Nature of work as a librarian	Director/Department Head	10	22.7%
	Asst. Director/ Asst. Department Head	1	2.3%
	Section Head	25	56.8%
	Support Staff	8	18.2%

Training and seminars are essential to professional growth and benefit employees and their organizations. The researcher aligns with Tampon (2023), who emphasized the numerous advantages of participating in professional seminars, conferences, and training. Benefits such as skill enhancement through expert guidance, opportunities for networking within and beyond the profession, acquiring and developing soft and hard skills, and developing self-esteem are notable outcomes of engaging in these activities. However, the study's findings did not entirely support this notion. As indicated in Table 5, most respondents attended only 1 to 5 trainings or seminars over three years. Alarmingly, some individuals did not participate in a single seminar during this period, while very few attended more than ten trainings.

Table 5. Frequency and percentage distribution of respondents in terms of training attended in LIS and CPD credit units earned

		Frequency (f)	Percentage (%)
Training attended in Library and Information Science	None	4	9.1%
	1 – 5 trainings	26	59.1%
	6 – 10 trainings	10	22.7%
	11 – 15 trainings	1	2.3%
	16 above trainings	3	6.8%
CPD credit units earned	0	4	9.1%
	1 -10	18	40.9%
	11 – 20	11	25.0%
	21 -30	6	13.6%
	31 above	5	11.4%

Most librarians from State Universities and Colleges (SUCs) attend at least one seminar each year. This suggests that ongoing professional development through regular and sustained participation in library and information science-related seminars and training has not yet become a well-established aspect of SUC librarians' professional lives.

As indicated by the participants and illustrated in Table 6, the primary reason for their non-attendance at seminars and training sessions is the inconvenience and inability to attend due to heavy workloads in the office. This concern was reiterated during the interviews, where participants noted that they occasionally have to forgo Continuing Professional Development (CPD) programs because of work demands related to accreditation. Additionally, some expressed that there is often no staff available to oversee the library in their absence at these seminars. The workload tends to be overwhelming, leading to a shortage of librarians and support staff.

Table 6. Frequency and percentage distribution of respondents in terms of reasons for non-attendance at a seminar/training

Reasons	Frequency (f)	Percentage (%)	Rank
Cost is high	18	40.9%	3
Lack of sponsorship	10	22.7%	4
Lack of interest	0	0	Not a reason
Lack of awareness	6	13.6%	5
Inconvenience to attend due to workload in the office	23	52.3%	1
Others	19	43.2%	2

Lourdes David further emphasized this issue in her interview, highlighting that the country has approximately 9,000 registered librarians. However, only a small number actively practice in the field, while many others have sought employment overseas (Adel, 2020). Interestingly, the researcher discovered that "lack of interest" was not cited as a reason for non-attendance, which contrasts with the findings of Idiegbeyan-Ose et al. (2014), who identified "lack of interest" as a key factor in attendance issues at seminars, training sessions, and conferences. This highlights that librarians readily seize opportunities to participate in Continuing Professional Development (CPD) programs. One of the primary motivations for attending seminars is to obtain CPD units alongside the goal of enhancing professional skills. This was confirmed during interviews, where participants acknowledged that attending seminars serves as an opportunity to improve their competencies and stay updated with the latest trends in Library and Information Science. Additionally, it was noted that participation in CPD programs is mandatory, as it is required to renew professional licenses. According to the law, all registered and licensed professionals must earn the requisite number of CPD units to renew their professional identification cards. For librarians, 15 CPD units are needed for license renewal (PRC, 2020). Overall, the CPD programs available for librarians are commendable, particularly since most are registered.

3.2 Level of Self-Assessed Competencies: Domains of the National Competency-Based Standards for Filipino Librarians

Numerous professionals have employed competency evaluation to monitor their career progression and define their goals and objectives. A self-evaluation allows employees to objectively assess their strengths and identify areas for improvement related to their job performance. This process is instrumental in goal setting, competency development, and charting an employee's career path. As illustrated in Table 7, SUC librarians rated their competencies concerning the NCBS-FL as proficient. Among the seven domains of personal competencies, Ethics and Values achieved the highest mean score of 3.27 (SD = 0.499), reflecting the high regard SUC librarians hold for the librarian's Code of Ethics in their professional practice. Conversely, Leadership received the lowest mean score of 2.89 (SD = 0.493) among the personal competency domains. The researcher views this finding as an understatement, as many SUC libraries are understaffed, resulting in many librarians fulfilling a one-man-librarian role. As noted by the Philippine Librarians Association, Inc. (2016), assuming the role of a librarian inherently involves exercising leadership.

Furthermore, the participants assessed their professional competencies across all four domains and rated them as Proficient. In Managing Information Resources, cataloging received the highest mean score of 3.23 (SD = 0.424), whereas E-Resources Management had the lowest mean score of 2.93 (SD = 0.398). These findings align with the research conducted by Fernandez and Buenrostro (2015) in their paper titled "Competencies of Professional Librarians in Northern Luzon, Philippines: Basis for Building Capacities and Continuing Professional Development."

Table 7. Means and qualitative descriptions of the respondents' self-assessment in terms of NCBS-FL domains

Domains	Subdomains	Mean	SD	Qualitative Description
Personal Competencies	Communication	2.95	0.526	Proficient Level
	Customer Service	3.14	0.462	Proficient Level
	Leadership	2.89	0.493	Proficient Level
	Lifelong Learning & Personal Growth	3.02	0.549	Proficient Level
	Ethics and Values	3.27	0.499	Proficient Level
	Interpersonal Competencies	3.14	0.462	Proficient Level
	Cultural Competencies	2.98	0.403	Proficient Level
	Total/Overall	**3.06**	**0.339**	**Proficient Level**
Managing Information Resources	Selection and Acquisition	3.07	0.501	Proficient Level
	Cataloging	3.23	0.424	Proficient Level
	Collection Management	3.14	0.510	Proficient Level
	E-Resources Management	2.93	0.398	Proficient Level
	Total/Overall	**3.09**	**0.374**	**Proficient Level**
Managing Information Services	Access Services	3.14	0.347	Proficient Level
	Reader's Advisory Services	3.11	0.443	Proficient Level
	Reference and Information Services	3.16	0.428	Proficient Level
	Information Literacy Services	3.07	0.398	Proficient Level
	Public/ Outreach Services	2.77	0.565	Proficient Level
	Total/Overall	**3.05**	**0.332**	**Proficient Level**
Managing Information Tools and Technology (Core Areas)	E-Mail	3.20	0.462	Proficient Level
	Hardware	2.80	0.462	Proficient Level
	Internet	3.09	0.520	Proficient Level
	Operating System	2.64	0.574	Proficient Level
	Software Applications	2.70	0.632	Proficient Level
	Web Tools	2.66	0.526	Proficient Level
	Applications of Information and Technologies	2.70	0.509	Proficient Level
	Total/Overall	**2.83**	**0.408**	**Proficient Level**
Managing Information Organization	Strategic Planning/ Policy Formulation	2.77	0.476	Proficient Level
	Financial Management	2.80	0.509	Proficient Level
	Project Management/ Research	2.61	0.579	Proficient Level
	Personnel Management	2.86	0.594	Proficient Level
	Public Relations	2.98	0.549	Proficient Level
	Collaboration	2.86	0.554	Proficient Level
	Facilities Management	3.00	0.482	Proficient Level
	Total/Overall	**2.84**	**0.438**	**Proficient Level**

Regarding Managing Information Services, Reference and Information Services achieved the highest mean score of 3.16 (SD = 0.428), reflecting the participants' recognition of the essential aspects of reference services in delivering quality support. This outcome likely stems from the participants' engagement in Continuing Professional Development (CPD) programs focused on customer service—a topic noted as relevant to their training. Conversely, Public/Outreach Service recorded the lowest mean of 2.77 (SD = 0.565). This suggests an area needing improvement, as this subdomain is critical for enhancing library services to meet the literacy needs of target clients, achievable through effective outreach programs.

Regarding managing information tools and technology, e-mail displayed the highest mean of 3.20 (SD = 0.462), followed by the Internet, which had a mean of 3.09 (SD = 0.520). These results indicate that participants are proficient in utilizing the primary functions of e-mail applications and the Internet. In contrast, Web Tools received the lowest mean of 2.66 (SD = 0.526), suggesting that while participants are familiar with common social networking platforms, they do not utilize them to the same extent as E-Mail and the Internet.

In the area of Managing Information Organization, Facilities Management achieved the highest mean of 3.00 (SD = 0.482), demonstrating that participants can design plans and strategies for the optimal use of library facilities and equipment. It is also noteworthy that respondents are aware of their deficiencies in technological advancement and actively seek to address this gap by participating in CPD programs to enhance their ICT competencies.

Furthermore, the researcher asserts that the curriculum has influenced the self-assessed competencies of participants, specifically at the Proficient Level, according to the NCBS-FL. Some interviewees highlighted that the Bachelor of Library & Information Science curriculum is extensive and designed to encompass all the essential

skills required for librarians to be effective and competent. Nevertheless, a significant challenge arises from the necessity to develop numerous skills within the limited time allocated in the curriculum. As a result, librarians often seek Continuing Professional Development (CPD) activities or programs to enhance the skills meant to be nurtured during their undergraduate education. This is particularly relevant regarding technological advancements, which are increasingly shaping the future direction of library services.

3.3 Level of Self-Assessed Competence Along the Philippine Qualifications Framework for Librarians

The PQF-L serves as a national standard for quality assurance among Filipino librarians, designed to assess the knowledge and skills acquired through various avenues. According to Vea (2018), one of the key benefits of the PQF is its promotion of lifelong learning, enabling professionals to enhance their qualifications to meet the evolving demands of organizations. Additionally, it offers a common framework for standards, qualifications, and levels that benefit employers. Participation in Continuing Professional Development (CPD) programs is essential for librarians striving to attain the qualifications outlined for their profession. In this study, participants evaluated their minimum professional competencies and advanced professional competencies about the PQF-L guidelines, specifically for those who have completed a Baccalaureate Degree (Level 6), Master's Degree (Level 7), or Doctorate (Level 8). Interview participants collectively affirmed that pursuing postgraduate studies would equip them with the knowledge necessary to address the current information needs of their communities. As illustrated in Table 8, participants indicated that their desired minimum professional competencies are set at the Proficient Level, with an overall mean score of 2.96 (SD = 0.395). Among the various subdomains, Cataloging and Classification emerged as the most prominent, boasting a mean score of 3.27 (SD = 0.544). In contrast, Information Technology, particularly Operating Systems, recorded the lowest mean score of 2.66 (SD = 0.608).

Table 8. Means of respondents' self-assessment in terms of the desired minimum professional competencies on the PQF-L

Desired Minimum Professional Competencies	Mean	SD	Qualitative Description
Selection and Acquisition of multi-media sources of information	3.02	0.590	Proficient Level
Cataloging and Classification	3.27	0.544	Proficient Level
Indexing and Abstracting	3.02	0.664	Proficient Level
Reference, Bibliography, and Information Services	3.16	0.526	Proficient Level
Organization, Management and development., and Maintenance of multi-media-based library or information service, Laws, Trends, and Practices affecting the profession	3.07	0.501	Proficient Level
Information Technology (Total)	2.87	0.446	Proficient Level
a. E-mail	3.18	0.446	Proficient Level
b. Hardware	2.80	0.553	Proficient Level
c. Internet	3.11	0.538	Proficient Level
d. Operating Systems	2.66	0.608	Proficient Level
e. Software Applications	2.77	0.605	Proficient Level
f. Web Tools	2.77	0.522	Proficient Level
g. Applications of Information and Technologies	2.82	0.495	Proficient Level
Total/Overall	**2.96**	**0.395**	**Proficient Level**

The researcher concurs with the finding that Cataloging and Classification stand out, as this subject is incorporated into the BLIS program's old and new curricula. Conversely, Information Technology has only been included in the new curriculum, leaving students from the old curriculum without exposure to this important area. As one participant noted in her interview, her college experiences did not encompass courses on library automation or OPAC. However, she recognized the evolution of library services through technological advancements and acknowledged the necessity of acquiring these skills to remain effective in the contemporary landscape of library services.

In contrast, advanced professional competencies were identified as being at the Developing Level, with an overall mean score of 2.33 (SD = 0.612), as illustrated in Table 9. Among the subdomains of advanced professional competencies, Lifelong Learning achieved the highest mean score of 2.89 (SD = 0.618). Conversely, Specialized Librarianship practice recorded the lowest mean of 2.01 (SD = 0.718), primarily due to the participants' affiliations with academic libraries. Most participants had completed their master's degrees, and one even held a doctorate, showcasing their commitment to professional growth and lifelong learning. Nevertheless, the perceived level of advanced professional competencies remains at the Developing Level, particularly in the realm of specialized librarianship practice.

Table 9. Means of respondents' self-assessment in terms of the desired minimum professional competencies on the PQF-L

Advanced Professional Competencies Domain	Mean	SD	Qualitative Description
Self-directed research	2.59	0.757	Proficient Level
Lifelong learning	2.89	0.618	Proficient Level
Leadership practice in ASEAN countries	2.27	0.788	Proficient Level
Leadership and working with teams in the domains of professional competencies	2.61	0.754	Proficient Level
Specialized librarianship practice: Total	2.01	0.718	Developing Level
a. law librarianship	2.00	0.889	Developing Level
b. medical and allied sciences librarianship	1.93	0.828	Developing Level
c. theological librarianship	1.75	0.751	Developing Level
d. information technology	2.25	0.839	Developing Level
e. archives	2.11	0.841	Developing Level
Total/Overall	**2.33**	**0.612**	**Developing Level**

Since most participants hailed from state universities and colleges (SUCs), they lack proficiency in specialized librarianship, law librarianship, medical and allied sciences librarianship, theological librarianship, information technology, and archives. This perceived low competency in specialized librarianship was further corroborated by respondents' feedback indicating that they attended seminars relevant to their current roles for practical purposes. Their primary motivation for attending these seminars is to enhance their ability to meet clients' information needs; they believe that seminars not aligned with their current job would misuse resources, as the knowledge gained would not be applicable in their present positions. Additionally, obtaining approval to attend seminars unrelated to their institution's library services is seldom feasible. The researcher observed that librarians were somewhat cautious in evaluating their competencies, even though many had completed advanced degrees at Level 8 or above. The researcher strongly contends that, given their educational qualifications, these participants could justifiably assess their competencies at an Advanced Level.

3.4 Contribution of Continuing Professional Development (CPD) to the Development of Competencies Along the PQF-L

Continuing Professional Development (CPD) is essential as it ensures the ongoing pursuit of structured, pragmatic, and relevant learning activities after obtaining a baccalaureate degree. It allows individuals to prioritize specific skills and knowledge to achieve proficiency. Furthermore, it enables professionals to regularly assess key areas of development and take appropriate actions to address any deficiencies (CPD News Team, 2016). The researcher echoed this perspective during interviews, during which participants identified CPD programs as vital tools for updating the competencies required to keep pace with the latest advancements in information services. While participants recognized the importance of continuous learning in their professions, they sometimes felt compelled to engage in CPD solely to meet the requisite number of credit units needed for license renewal. The study's findings revealed varying impacts of CPD activities on the participants' desired and advanced professional competencies. As illustrated in Table 10, participants indicated that CPD activities significantly enhanced their desired professional competencies, leading to a self-assessment of their abilities at the Proficient Level across all competency domains, with an overall mean score of 2.86 (SD = 0.500).

Table 10. Means of CPD's Contribution to Librarians' Desired Minimum Professional Competencies on the PQF-L

CPD Contribution - Desired Minimum Professional Competencies	Mean	SD	Qualitative Description
Selection and Acquisition of multi-media sources of information	2.93	0.625	Proficient Level
Cataloging and Classification	3.16	0.526	Proficient Level
Indexing and Abstracting	2.82	0.691	Proficient Level
Reference, Bibliography, and Information Services	3.09	0.520	Proficient Level
Organization, Management and development., and Maintenance of multi-media-based library or information service, Laws, Trends, and Practices affecting the profession	3.07	0.545	Proficient Level
Information Technology (Total)	2.74	0.557	Proficient Level
a. E-mail	3.00	0.528	Proficient Level
b. Hardware	2.70	0.632	Proficient Level
c. Internet	2.84	0.568	Proficient Level
d. Operating Systems	2.66	0.745	Proficient Level
e. Software Applications	2.68	0.674	Proficient Level
f. Web Tools	2.64	0.685	Proficient Level
g. Applications of Information and Technologies	2.68	0.674	Proficient Level
Total/Overall	**2.86**	0.500	**Proficient Level**

The contrary perspective can be observed in the advanced professional competencies, where participants viewed the CPD activities as beneficial for developing their skills and knowledge. This is evidenced by their descriptions in Table 11, reflecting an overall mean score of 2.38 (SD = 0.717) at the Developing Level. Only three domains within the advanced professional competencies—namely, Self-directed Research (Mean = 2.61; SD = 0.722), Lifelong Learning (Mean = 2.89; SD = 0.689), and Leadership and Working with Teams in the Domains of Professional Competencies (Mean = 2.59; SD = 0.757)—demonstrated enhancement as a result of attending CPD activities. The contribution of CPD to improving competencies in "Leadership Practice in ASEAN Countries" and "Specialized Librarianship Practice" was characterized at a Developing Level. Factors contributing to this perspective, as noted by the participants, include the limited number of librarians practicing in other countries and the participants' preference for CPD activities focused on developing the specific skills relevant to their current roles and positions.

Table 11. Means of CPD's Contribution to Librarians' Advanced Professional Competencies on the PQF-L

CPD Contribution - Advanced Professional Competencies Domain	Mean	SD	Qualitative Description
Self-directed research	2.61	0.722	Proficient Level
Lifelong learning	2.89	0.689	Proficient Level
Leadership practice in ASEAN countries	2.45	0.820	Developing Level
Leadership and working with teams in the domains of professional competencies	2.59	0.757	Proficient Level
Specialized librarianship practice:			
a. law librarianship	2.11	0.945	Developing Level
b. medical and allied sciences librarianship	2.09	0.910	Developing Level
c. theological librarianship	2.02	0.927	Developing Level
d. information technology	2.39	0.895	Developing Level
e. archives	2.23	0.886	Developing Level
Total/Overall	**2.38**	**0.717**	**Proficient Level**

The researcher observed a sense of apprehension among the interview participants, who felt that Continuing Professional Development (CPD) programs do not effectively enhance their competencies. This perception stems from the belief that many CPD programs do not align with the participants' existing levels of knowledge. Similarly, the study conducted by Moonasar and Underwood (2018) echoed these sentiments. Their respondents recognized the importance of CPD and acknowledged the impact of ICT on library resources and services; however, many expressed skepticism regarding the ability of the CPD programs to fulfill their intended purpose. These findings suggest that even though most participants have completed their master's degrees and have attended various CPD activities, they still do not feel that their skills and knowledge are at an Advanced Level.

3.5 Insights and Challenges of Librarian-participants in the Continuing Professional Development (CPD) Program and the Philippine Qualifications Framework

The findings from the qualitative phase of this study were based on the responses of nine (9) librarians from State Universities and Colleges (SUCs) who agreed to participate in the interview portion of the research. These participants are referenced as Participant 1 through Participant 9. To better understand their experiences, guide questions were formulated to address the research question: "What insights and challenges do librarian-participants face regarding CPD and PQF-L as pathways for professional growth?" Table 12 presents the guide questions, the themes derived from the participants' responses, and their contributions.

The Professional Regulation Commission (PRC) oversees the implementation of the Continuing Professional Development (CPD) program aimed at enhancing the professional growth of Filipino professionals to ensure their global competitiveness. To facilitate this professional advancement, the PRC has mandated the accumulation of CPD credit units as a requirement for renewing professional licenses. Although the PRC's intention behind these requirements is reasonable, professionals have faced significant challenges during implementation. Librarians in state universities and colleges (SUCs) are no exception, encountering difficulties in obtaining the necessary CPD credit units for their license renewals. The PRC has established measures to assess the skills and competencies acquired by professionals, but various obstacles persist. Among the primary challenges reported by participants are an understaffed library, limited budgetary resources, work demands, and a lack of administrative support, all of which hinder their ability to attend CPD programs.

Table 12. Insights and challenges librarians have concerning the CPD and PQF-L as means of professional growth

Guide Questions	Themes	Responses
What can you say about CPD and why do you think it is important in the view of the Professional Regulation Commission (PRC)?	1. improved skills	• Good because it improves the skills of librarians making them proficient in delivering library services.
	2. continuous learning	• CPD helps professionals achieve continuous learning since learning does not stop after graduating from college and obtaining a license. • CPD can be coined into an acronym CAN I (Constant And Never-Ending Improvement) for quality and standards of professional services.
	3. CPD as a business	• "Objective is good, but if you look at the manner of implementation, it has become a business for some entities from time to time.
Why do you think CPD is important in the view of the PRC?	1. assurance of professional growth	• CPD is mandated to ensure that licensed professionals continue to uphold the highest professional standards by way of aligning qualifications with ASEAN standards.
	2. attainment of global competitiveness	• CPDs are the PRC's means of meeting the demands of the global market and preparing Filipino professionals for global competition.
How relevant is CPD in your profession?	1. updating of competencies	• CPD is relevant in their profession as librarians. • "CPD is important for us to be updated with the new trends to better serve the clients". • "CPD is relevant to improve and update our skills. What we have learned after graduation is not enough. I have been in the service for 18 years and I need training, especially in information technology". • "CDP is relevant since it will ensure that librarians will be aware of the new trends in the practice of the profession".
	2. mandated license renewal requirement	• CPD is necessary because it is needed in renewing the license and at the same time it is already a law. • They do not have any choice but to abide by it. • "CPD is just a requirement in renewing the license".
How do you feel about the required CPD point system in renewing your professional license?	1. attainability	• Participants displayed satisfaction with the required CPD units, especially since the requirement was lowered from the original 45 points to just 15 points in the meantime. • Does not have any problem with the CPD point requirement but took note that such a case may not be true for everyone "It's not the willingness of the librarian to attend the professional development activities especially it is needed for the renewal of licenses, the problem boils down to funding support from the administration".
	2. mandated requirements	• CPD points as obligatory and they were left with no option but to abide by it. • Disappointed with this requirement because she is the one paying whenever she attends a CPD program because it is necessary for the renewal of her license. • Reiterated that attending the CPD program does not guarantee new learning for the attendees • "When it is required, you need to abide, required, obligated because you are obliged, it is a requirement"
What course of action have they taken related to the CPD point system?	1. prioritized	• Prioritize which CPD activity to attend. • Plan what CPD programs to take to maximize her allotted budget • chooses CPD activities that are not that expensive but offer higher CPD points since she is the one who pays • makes sure to attend seminars related to the current job assigned to him
	2. pursuit of post-graduate studies	• has completed their master's degree in MLIS programs in pursuit of professional growth • obtained a PhD degree as a means of professional growth
	3. compliance with accreditation requirements	• "I tell my VPAA that I have to attend seminars, and since these are basic requirements for the accreditation of the different programs of the school, they are obligated now. However, in the past, they did not send me due to lack of budget, but now, they are obliged to send me to seminars because of accreditation requirements"
	4. attendance at in-service seminars/webinars	• attended supervisory seminars/training given by the Civil Service Commission and training related to becoming an accreditor provided by AACUP
How do they find the CPD programs being offered about their work?	1. relevance to work	• participants have perceived the CPD programs as beneficial since CPD programs improve the skills of librarians which may translate to better library services • "I find them useful since I am just new in the profession, so most of the seminars that I have attended were useful" • CPD programs are useful especially when he attends CPD activities that are related to his assigned tasks in the library • because of the CPD program, she has developed more confidence because of the learning she has gained from the program
	2. mismatch with work	• some CPD activities as non-fulfilling • sometimes no new knowledge can be learned from the CPD program • The webinars being offered did not provide gainful insights for application for the job. • Observed that CPD programs are not aligned to the level of knowledge and experiences of the target audience which is why the acquisition of new learnings never happened. "They should program their topics and analyze the target audience because target audiences are not the same, and they may have different needs. If you are already a seasoned professional, why would they still teach you the basics? What I am trying to say is that they should provide training commensurate to the level of knowledge and experience of their target participants"
Who paid for the CPD program?	1. school funds	• participants' affiliations pay for the expenses related to CPD programs attended by their librarians • Most SUCs have allotted funds for professional development, allowing the professionals to grow and develop professionally
	2. personal funds	• participants intimated that they used their funds to attend the CPD program for their professional development because their institution's allotted budget was insufficient
was a time that they missed a CPD program that they liked to attend and why they missed it.	1. understaffed library	• missed the National Congress because no one would man the library for she is the only librarian in her school and she could not entrust the library operations to her non-librarian staff due to possible losses of equipment or unavoidable circumstances which might happen while she was away since the majority of PLAI National Congress Trainings are held in far places and takes more than one day to complete. • Feared losing library materials which could be charged against her name because of accountability in public offices.
	2. limited budget	• the school did not prioritize the library and it has no allotted funds to pay for staff training and seminars. • Uses personal funds to attend seminars/training
	3. demands of work	• workload, especially in times of accreditation, as the primary reason for missing a training/workshop • "During the Librarian Congress in 2019, in the exigencies of the work, the schedule of our program accreditation was during the time of National Conference" • even if there is available budget for the CPD program, they were not allowed to attend the CPD program if it coincided with the schedule of accreditation
	4. unsupportive administration	• lack of support from the administration as the reason for missing a CPD activity

These challenges are not unique to the Philippines. A study conducted by Bernadine (2019) in Gauteng Province revealed similar issues faced by respondents regarding CPD as a vehicle for professional growth, including inadequate administrative support, budget constraints, and a lack of motivation among employees. The study conducted by Guo (2014) echoes similar sentiments, revealing that financial constraints and a lack of motivation from administrators are primary deterrents for professionals seeking involvement in Continuing Professional Development (CPD) programs. The researcher commendably acknowledges the resilience demonstrated by participants, who, despite facing challenges in their professional growth, continue to persevere and actively seek ways to enhance both their personal and professional development. They strive to explore various opportunities to ensure that their skills and competencies align with the demands of their profession. Some participants utilize their funds, while others actively search for free CPD programs to acquire the necessary skills for delivering improved library services.

Additionally, the participants recognize the vital role of the Professional Regulation Commission (PRC) and CPD in meeting the qualifications required of librarians in the global market. However, they have also expressed concerns regarding issues such as the extension of validity for unused CPD credit units, additional criteria for professional growth—such as speakerships, serving as professors in Bachelor of Library and Information Science (BLIS) programs, or acting as accreditors for those programs—and the regulation of seminar fees, particularly for librarians who lack the financial resources in their library budgets to support their professional growth and development.

3.6 Proposed CPD Plan for SUC Librarians

The researcher, motivated by a desire to create a meaningful impact for her colleagues in the librarianship profession, developed a proposed Continuing Professional Development (CPD) plan grounded in the self-assessment results of participants regarding their competencies as librarians. The primary objective of this CPD plan is to assist information professionals in achieving the highest level of competency (advanced level) within their practice. The plan is structured based on the National Competency-Based Standards for Filipino Librarians (NCBS-FL) to fulfill the Philippine Qualifications Framework for Librarians (PQF-L). For the CPD plan to be effective, librarians must thoroughly self-assess their current skills and competencies about the NCBS-FL and PQF-L. It is recommended that librarians identify their specific career goals and determine strategies to achieve these goals following their self-evaluation. Furthermore, it is essential to consider a timeframe for career development to objectively measure progress (Martinelli, 2017).

The proposed Continuing Professional Development (CPD) plan is structured to address two key competency areas for librarians: personal and professional competencies. The personal competencies targeted in this plan include Communication, Customer Service, Leadership, Lifelong Learning and Professional Growth, Ethics and Values, Interpersonal Skills, and Cultural Competencies. Conversely, the professional competencies focus on Managing Information Resources, Managing Information Services, Managing Information Tools and Technology, and Managing Information Organization (Philippine Librarians Association, Inc., 2016).

For each target skill, specific objectives are outlined, along with the individuals responsible for implementing them. The plan also includes suggested methods, strategies, and activities that guide enhancing each targeted area and achieving the stated objectives. Additionally, a timeline for completing these activities and the associated budget requirements are specified. Funding may be sourced from the library's budget or through personal contributions. Librarians, as providers of information, must recognize that continuing education is essential for delivering high-quality library services, particularly with the increasing adoption of diverse technologies to support the community and foster independent library use among readers. Oinam and Thoidingjam (2019) noted that "Librarians should serve as a guiding force or educators to help readers develop into lifelong learners. They should emphasize the importance of lifelong learning for the growth and welfare of the community. Lifelong learning involves acquiring constantly evolving information in today's world and utilizing that knowledge through effective information literacy skills.".

Rodriguez (2021) articulated that CPD "is a personal responsibility of professionals to maintain current knowledge and skills, enabling them to deliver high-quality service that safeguards the public and meets the expectations of clients, as well as the standards of their profession." The researcher emphasizes that a CPD plan is essential for

librarians to effectively navigate today's information-rich environment, regardless of whether it is sponsored. This notion is echoed in the NCBS-FL (Philippine Librarians Association, Inc., 2016), which asserts that "regardless of their position, employment status, or career aspirations, lifelong learning, and continuous improvement are integral to the enhancement of a librarian's professional life and personal growth." By overcoming challenges and participating in CPD programs, librarians cultivate vital learning skills essential for effective information delivery.

Table 13. Proposed CPD Plan

Target Area	Objectives	Persons Responsible/ Implementers	Activities	Time Frame	Budget	
					Amount	Source
Personal Competencies						
Communication	Develop the ability to communicate clearly and effectively in the workplace.	Library Administrators, Human Resource Management Officer, Librarians	Attendance to seminar/ workshop relevant to improving communication skills such topics on Public Speaking, Self Confidence Training, Communication Skills Training (Verbal and Non-Verbal)	Once a year	P 3,000	Library Budget or Personal Funds
Customer Service	Understand and meet library client's information needs. Create a positive patron's experience.	Library Administrators, Human Resource Management Officer, Librarians	Participate in seminars/ workshop purposeful in refining relationships with the community specifically with library clients. E.g., Client Relationship Management, Customer Service in the Public Sector, Managing Customer Feedback Mentoring. Role-Playing.	Once a year	P 3,000	Library Budget or Personal Funds
Leadership	Establish leadership skills necessary to achieve quality library services. Prepare librarians to take part in managerial roles in the future.	Library Administrators, Human Resource Management Officer, Librarians	Engage in leadership training and Workshops on topics about Handling workload effectively, Striking a balance between work and personal life, Leadership style and behavior Leads to conflicting and challenging situation	Once a year	P 3,000	Library Budget or Personal Funds
Lifelong Learning & Professional Growth	Understand the importance of lifelong learning and continuing education for librarians as part of the educational system. Identify available resources related to continuing education and establish a personal professional development plan.	Library Administrators, Human Resource Management Officer, Librarians	Scout for free webinars, online tutorials, or scholarships. Example: Use of new technology (Smart devices, new applications, new software, etc.) Enroll in a graduate school program or self-interest course online or face-to-face.	2 years for the graduate school program	P25,000/semester	Library Budget or Personal funds
Ethics and Values	Recognize the importance of ethics and values in the practice of the profession.	Library Administrators, Human Resource Management Officer, Librarians	Attendance to seminar/ workshop concerning professional ethics, especially the topic of the Code of Ethics for Philippine Librarians.	Twice every 3 years	P3,000	Library Budget or Personal funds
Interpersonal Competencies	Establish good working relationships with library users, community, and colleagues.	Library Administrators, Human Resource Management Officer, Librarians	Engage in workshops on teamwork and group-problem solving such as topics on Build Meaningful Relationships, Positive Body Language and Attitude	Once a year	P3,000	Library Budget or Personal funds
Cultural Competencies	Develop awareness towards cultural heritage.	Library Administrators, Human Resource Management Officer, Librarians	Research about local histories	Once a year	P1,000	Library Budget or Personal funds
Professional Competencies						
Managing Information Resources	Guarantee relevant and adequate library resources	Library Administrators, Human Resource Management Officer, Librarians	Conduct in-house training on Managing Information Resources, explore available online tutorials on Managing Information Resources, and attend seminars/ training on Managing information resources. Topics focusing on Selection and Acquisition, Cataloging,	Once a year	P3,000	Library Budget or Personal funds

			Collection Management, E-Resources Management, and Preservation.			
Managing Information Services	Upgrade library services to meet the information needs of the community.	Library Administrators, Human Resource Management Officer, Librarians	Evaluate the status of the existing library services based on current trends in library services and attend seminars/ workshop on trends in librarianship, in particular topics on Access Services, Reader's Advisory, Reference/ Information, Patron Training, Information Literacy, Public Service/Outreach. Children's Services	Once a year	P3,000	Library Budget or Personal funds
Managing Information Tools & Technology	Develop competencies in technology imperative for effective delivery of library services.	Library Administrators, Human Resource Management Officer, Librarians	Participate in hands-on training/ workshops on ICT (Core Email, Core Hardware, Core Internet, Core Operating System, Core Software Applications, Core Web Tools, Core Applications of Information Tools and Technologies	Once a year	P4,000	Library Budget or Personal funds
Managing Information Organization	Design a scheme for effective management of the library.	Library Administrators, Human Resource Management Officer, Librarians	Collaborate with other libraries, coordinate with administration, attendance to Management seminars/ trainings on topics about Strategic Planning, Financial Management, Research, Personnel Management, Public Relations, Networking, and Facilities Management.	Once a year	P3,000	Library Budget or Personal funds

4.0 Conclusion

Most SUC librarians in Region 3 are primarily female, aged 22 to 43. They possess a Master of Library and Information Science degree, the preferred qualification for academic libraries. These librarians are registered professionals who have been in the field for 1 to 10 years and hold Section Head positions. Most have participated in 1 to 5 training sessions and have earned at least 1 – 10 CPD credit units over the past three years. They self-assess their competencies in personal and professional domains, and they are proficient, according to the National Competency-Based Standards for Filipino Librarians (NCBS-FL).

The professional ethics upheld by librarians are held in high regard. Regarding Personal Competencies, librarians scored highest in Managing Information Resources, particularly in the subdomain of Cataloging. Conversely, their lowest score was in Managing Information Tools and Technology, specifically in the subdomain of Operating Systems. SUC librarians perceive themselves as having achieved a Proficient Level of competence concerning the Desired Minimum Professional Competencies outlined in the Philippine Qualifications Framework for Librarians (PQF-L), with Cataloging and Classification being their strongest areas of expertise. They are at the Developing Level for Advanced Professional Competencies, with Specialized Librarianship Practice identified as their weakest area.

Through Continuing Professional Development (CPD) activities, SUC librarians have advanced to a Proficient Level in the competencies defined by the PQF-L. The most significant impact of CPD activities has been in Cataloging and Classification, while the least impact has been observed in the Information Technology domain. Moreover, CPD programs have contributed the least to developing Advanced Professional Competencies in the PQF-L, especially within Specialized Librarianship Practice. SUC librarians acknowledge the importance of CPD programs in enhancing their competencies and recognize the role of the Philippine Qualifications Framework for Librarians in promoting the global competitiveness of Filipino librarians. However, they face challenges in attending seminars and training required to fulfill the CPD credit units necessary for renewing their professional licenses. Among the challenges cited are budget constraints, understaffing in libraries, and lack of support from administrators. A proposed continuing professional development plan for SUC librarians, based on the National

Competency-Based Standards for Filipino Librarians (NCBS-FL), aims to help them achieve the highest level of competency (advanced level). This plan focuses on improving competencies that have been identified as lower and in need of enhancement.

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Development and Evaluation of Marungko-Based Reading Intervention Material for Kindergarten Learners

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Abstract. With the call of the Department of Education, schools are encouraged to explore relevant strategies to achieve the desirable literacy performance outcomes, especially in reading in the foundational key stage of learning. To improve the beginning reading performance of Kindergarten learners, this study explored the development, validation, and utilization of a researcher-developed reading intervention material employing the principles of the Marungko approach. Participants of this study were 32 Kindergarten learners from a private school and three Kindergarten teacher-validators in the Schools Division Office of Nueva Vizcaya. Ethical research guidelines set by the division office and the participating school were strictly followed in the study. The participants were informed of the study's objectives, associated benefits and risks, management of vulnerability issues, and their rights before their consent to participate was requested. The descriptive-comparative research design was employed where the pre-test and post-test reading performances and the validity indices of the developed intervention material were described, and a statistical comparison of both performances was made to assess the potential of the designed intervention material. The results revealed that the developed reading intervention material met the minimum standards set by the Department of Education and was valid for utilization. Also, increases in the performance levels of the Kindergarten learners across reading subskills were noted after the intervention. The reading performance of Kindergarten learners in the pre-intervention phase considering letters Mm, Ss, and Aa significantly improved after the two-week intervention using the developed Marungko-based intervention material. These findings emphasize the significance of employing developmentally appropriate practices in developing intervention materials toward improving foundational literacy. Further, the study highlights the necessity of evaluating the learning intervention materials to ensure compliance with the Department of Education's standards before utilization.

Keywords: Intervention material; Kindergarten education; Marungko approach; Reading.

1.0 Introduction

Aligned with the United Nations Organization's Sustainable Development Goal on quality education, functional literacy serves as the cornerstone for achieving meaningful and flexible lifelong learning through relevant educational opportunities (Chapman et al., 2020; Confraria et al., 2024; Dodd et al., 2020; Ghosh & Chakravarty, 2024; Fallah Shayan et al., 2022; Foley, 2021; Sorooshian, 2024; United Nations Department of Economic and Social Affairs, 2021).

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Reading skills, as a component of functional literacy, should be enhanced. These are essential skills that learners should master with full appreciation beginning in the early years of education (Lasdya et al., 2022). Formal development of reading skills is one of the compelling goals of educational institutions to produce learners who are effective readers. Reading together with writing is one of the foundations of literacy. Moreover, effective reading is about understanding what is read, applying the information read, and synthesizing what is read for functional living. Hence, learning to read in the early grades is one of the key learning outcomes of primary education (Purwanto, 2021a, 2021b; Saquing, 2015; Yang, 2022).

However, this vision of effective reading is challenged if early-grade readers have not acquired the essential reading skills. This may tremendously impact their academic performance at succeeding levels. In the Programme for International Student Assessment (PISA), the 2022 results revealed that the Philippines scored less than the OECD average in mathematics, reading, and science. Focusing on the reading performance, 24% of Filipino learners attained Level 2 or higher. Learners within this level can identify the main idea of a text, determine information, and reflect on the purpose and form of texts when explicitly told. Also, almost no students scored at Level 5 or higher in reading who are supposed to be learners who can comprehend texts more than moderate length, deal with abstract concepts, and distinguish between fact and opinion based on implicit cues about the content or source of information (OECD, 2023).

Further, one of the national programs to gauge the learners' outcomes in the Philippine basic education system is the conduct of the Early Language, Literacy, and Numeracy Assessment (ELLNA) for the primary learners. Based on the report forwarded to the Schools Division Office of Nueva Vizcaya (2024), the learners' performance in 2022 ELLNA, particularly in English, Filipino, Mother Tongue, and Mathematics, is within the 'average mastery' level. However, reading and comprehension remained the lowest learning domain in English, Filipino, and Mother Tongue.

To address the issues related to literacy enhancement in basic education, the Department of Education calls on the innovation of relevant contextualized strategies to help learners improve their literacy performance within a positive school climate in the early years of formal education. More than literacy performance, the department aims explicitly to improve reading, math, and socio-emotional skills in the early grades through developmentally appropriate practices (National Educators Academy of the Philippines, 2024; RTI International, 2021).

One contextualized approach considered in developing reading skills in the primary grades in the country is the use of Marungko-based reading. The reading approach is found to be an effective tool in enhancing foundational reading skills, especially in identifying letter names, identifying letter sounds, identifying initial sounds, reading familiar words, and reading oral passages (Alauya & Basmayor, 2023; Balgua et al., 2022; Boltron & Ramos, 2021; Canaveral et al., 2023; Santos & De Vera, 2020). This reading approach is conducted with the developmentally appropriate instructional strategies and materials necessary to promote learners' literacy in the foundational learning stages (Abayan et al., 2021; Qasmi et al., 2022; Silinskas et al., 2020; Sucena, 2023; Tariman, 2022).

Given these challenges, there is a clear gap in the literature on how literacy can be enhanced at the Kindergarten education level, which serves as the primary educational level, especially in the local context of the Schools Division Office of Nueva Vizcaya. Responding to the Department of Education's call, the division encourages schools to explore relevant strategies to achieve desirable literacy performance outcomes, especially in reading. While existing studies emphasize the wide acceptance of the Marungko reading approach as a potential reading intervention to raise literacy performance among learners, the local studies usually considered non-Kindergarten learners. The reviewed studies considered Grade I to Grade III learners who underwent contextualized reading intervention using the approach.

To address these gaps, the present study explores the development and validation of the researcher-developed reading intervention material employing the principles of the Marungko approach to improve the beginning reading skills of kindergarten learners in the Schools Division Office of Nueva Vizcaya. Also, this study aims to determine and compare the beginning reading performance of kindergarten learners before and after using the validated researcher-developed reading intervention material to establish the intervention material's effectiveness.

2.0 Methodology

2.1 Research Design

This study employed a descriptive-comparative research design. In this study, the reading performance levels of the Kindergarten learners in producing letter sounds, identifying letter names, reading familiar words, and reading phrases/sentences are described before and after the conduct of the intervention activities using the designed intervention material. Descriptive statistics is employed to determine the acceptability of the designed intervention material as evaluated by the learning area experts. Statistical comparison between the pre-and post-intervention performance is also done to assess the potential of the designed intervention material.

2.2 Research Participants

The study's participants included 32 Kindergarten learners from a private school in Solano, Nueva Vizcaya. They have their respective informed assent through their parents or legal guardians to participate in the study. The learners underwent a two-week reading intervention using the developed intervention material. Also, the study involved three early childhood education teachers who were purposely selected and have expressed their consent to compose the group of evaluators to evaluate the developed intervention material for the Kindergarten learners based on the Department of Education's standards. The teacher-participants are from Solano District and have handled learners in Key Stage 1 for at least seven years.

2.3 Research Instrument

The study utilized a three-part researcher-made test to evaluate the Kindergarten learners' performance levels in producing letter sounds, identifying letter names, reading familiar words, and reading phrases/sentences. The first part of the researcher-made test considers six letter cards composed of the uppercase and lowercase format of the first three letters introduced in the Marungko reading approach for beginning reading. Each card bears one letter in either uppercase or lowercase format, which will be shown to the learners so they can produce the sounds and names. The second part of the test uses a set of ten flash cards. In each card is a Tagalog word formed from a combination of the letters Mm, Ss, and Aa, like "masa, ama, and mas," which are relevant to the daily context of the learners. The third part of the test uses five phrase cards. In each card is a phrase from the combination of the words initially shown in the second part of the test, such as "*sasama sa ama.*"

The researcher-made test underwent content validation and was subsequently tested for reliability using Cronbach's alpha. In its content validation, three teachers with at least five years of experience handling Kindergarten learners initially evaluated the test instrument before its pilot testing. The pilot test involving 34 Kindergarten learners yielded a Cronbach's alpha of .829 for letter identification and sound production, .885 for word reading, and .877 for phrase/sentence reading. In addition to the researcher-made test, the evaluation form introduced by the Department of Education – Learning Resources Management and Development Section (LRMDS) for teacher-developed print instructional material was adopted to establish the validity of the researcher-developed reading intervention material. This four-part evaluation tool looks into the material's content, format, presentation, organization, and accuracy, which is rated using a four-point Likert scale.

2.5 Data Gathering and Analysis Procedure

In the reading performance assessment of the Kindergarten learners, the learners were assessed individually using the three-part researcher-made test to evaluate the Kindergarten learners' performance levels in producing letter sounds, identifying letter names, reading familiar words, and reading phrases/sentences before and after the two-week group intervention. Mean score, mean percent score and qualitative descriptions were used to provide a comprehensive view of the performance levels and evaluation of the intervention material. In interpreting the performance levels of the Kindergarten learners across the competencies being assessed, the following qualitative descriptions from DepEd Order No. 31 s. 2012 were adopted. Specifically, the qualitative descriptions are beginning (74% and below), developing (75-79%), approaching proficiency (80-84%), proficient (85-89%), and advanced (90% and above).

The existing Department of Education guidelines in evaluating learning resource materials were used to validate the researcher-made reading intervention material. Three local experts in Kindergarten education evaluated the reading intervention material. The following qualitative descriptions for the acceptability of the material are adopted from the Guidelines and Processes for LRMDS Assessment and Evaluation (DepEd, 2009), which include

very satisfactory (3.50-4.0), satisfactory (2.50-3.49), poor (1.5-2.49), and not satisfactory (1.0-1.49). In each component, the material is evaluated as either passed or failed. For the resource material to pass in each component, it must score 21-28 in content, 54-72 in format, 15-20 in presentation and organization, and 24 in accuracy of information. The Kindergarten learners' performance levels across the competencies before and after using the researcher-made reading intervention material were statistically compared using the t-test for dependent samples to determine if a significant difference exists.

2.6 Ethical Considerations

The procedures in this study adhered to ethical research guidelines set by the Department of Education-Schools Division Office of Nueva Vizcaya and the participating school. After obtaining clearance to conduct the study from the school administration, informed assent was obtained from the Kindergarten learners through their parents or legal guardians. Consent from the parents or legal guardians was also secured. Likewise, consent from the three local validators of the reading intervention material was secured before they participated in the study. To protect their privacy and confidentiality, all collected data were meticulously anonymized, with no personally identifiable information disclosed in the research findings. Their responses were utilized within the bounds of the study. Participants were also explicitly informed of the voluntary nature of their participation and their unconditional right to withdraw from participating without facing any consequences at any phase of the study.

3.0 Results and Discussion

3.1 Pre-Intervention Performance of the Kindergarten Learners

Before the intervention, the Kindergarten learners' performance levels in producing letter sounds, identifying letter names, reading familiar words, and reading phrases/sentences were assessed, focusing on the letters Mm, Ss, and Aa. Table 1 shows the pre-intervention learners' performance levels in the identified competencies.

Table 1. Pre-intervention performance of the kindergarten learners

Competencies	Mean	Qualitative Description
Producing letter sounds	50.52	Beginning
Identifying letter names	50.52	Beginning
Reading familiar words	53.13	Beginning
Reading phrases/sentences	27.08	Beginning

It can be gleaned from the table that the performance of the Kindergarten learners before the administration of intervention across the competencies is within the beginning level. The learners in this stage struggle and have not yet acquired the foundational knowledge or skills to aid understanding. Among the four competencies assessed, the Kindergarten learners exhibited the lowest performance in reading phrases/sentences with a mean percent score of 27.08% while the highest performance in reading familiar words with a mean percent score of 53.13%. The learners have equal performance levels in producing letter sounds and identifying letter names, with a mean percent score of 50.52%.

The pre-intervention reading performances of the Kindergarten learners across the competencies considered are within the same level observed in the 2022 Early Language, Literacy, and Numeracy Assessment performance of the Schools Dıvision Office of Nueva Vizcaya. Among the learning domains of English, Fılipino and Mother Tongue, the Key Stage 1 learners performed least in grammar and in reading with comprehension (Schools Division Office of Nueva Vizcaya, 2024). This outcome is similar to the 2022 Program for International Student Assessment result. The Philippines scored less than the Organisation for Economic Co-operation and Development (OECD) average in reading, mathematics, and science. Among the three fields, Filipino learners had the lowest performance in reading, with a mean score of 347 (OECD, 2023). With these outcomes, the need to explore contextualized developmentally appropriate interventions is emphasized from the national to the classroom levels. These instructional strategies are necessary to promote foundational literacy at the earliest stage of education (Abayan et al., 2021; Qasmi et al., 2022; Silinskas et al., 2020; Sucena, 2023; Tariman, 2022).

3.2 Evaluation of the Researcher-Developed Intervention Material

In developing the reading intervention material, the principles of the Marungko approach to improving reading skills were considered, focusing on producing letter sounds, identifying letter names, reading familiar words, and reading phrases/sentences using the letters Mm, Ss, and Aa. Furthermore, the resource material considered

principles of fostering a positive school climate to improve literacy performance through developmentally appropriate practices. Three learning area experts evaluated the researcher-developed reading intervention material using the DepEd's guidelines and processes for LRMDS assessment and evaluation of print materials. Table 2 details the consolidated evaluation results of the researcher-developed print intervention material.

Table 2. Consolidated evaluation results of the researcher-developed intervention material

Factors	Mean	Description
A. Content		
1. Content is suitable to the student's level of development.	4	Very Satisfactory
2. Material contributes to the achievement of specific objectives of the subject area and grade/year level for which it is intended.	4	Very Satisfactory
3. Material provides for developing higher cognitive skills such as critical thinking, creativity, learning by doing, inquiry, problem-solving, etc.	4	Very Satisfactory
4. Material is free of ideological, cultural, religious, racial, and gender biases and prejudices.	4	Very Satisfactory
5. Material enhances the development of desirable values and traits such as pride in being Filipino, honesty and trustworthiness, scientific attitude and reasoning, etc.	4	Very Satisfactory
6. Material arouses the interest of the target reader.	4	Very Satisfactory
7. Adequate warning/cautionary notes are provided in topics and activities related to safety and health.	4	Very Satisfactory
Total	***28***	***Passed***
B. Format		
1. Prints		
1.1 The size of the letters is appropriate for the intended user.	3	Satisfactory
1.2 Spaces between letters and words facilitate reading.	3.66	Very Satisfactory
1.3 Font is easy to read.	4	Very Satisfactory
1.4 Printing is of good quality (i.e., no broken letters even density, correct alignment, properly placed screen registration).	4	Very Satisfactory
2. Illustrations		
2.1 Simple and easily recognizable	3.66	Very Satisfactory
2.2 Clarify and supplement the text	4	Very Satisfactory
2.3 Properly labeled or captioned (if applicable)	4	Very Satisfactory
2.4 Use realistic/appropriate colors	4	Very Satisfactory
2.5 Attractive and appealing	4	Very Satisfactory
2.6 Culturally relevant	3.66	Very Satisfactory
3. Design and Layout		
3.1 Attractive and pleasing to look at	4	Very Satisfactory
3.2 Simple (i.e., does not distract the attention of the reader)	4	Very Satisfactory
3.3 Adequate illustration of the text	4	Very Satisfactory
3.4 Harmonious blending of elements (e.g., Illustrations and text)	4	Very Satisfactory
4. Paper and Binding		
4.1 The paper used contributes to easy reading.	4	Very Satisfactory
4.2 Its durable binding can withstand frequent use.	3.66	Very Satisfactory
5. Size and Weight of Resource		
5.1 Easy to handle	3.66	Very Satisfactory
5.2 Relatively light	3.66	Very Satisfactory
Total	***69***	***Passed***
C. Presentation and Organization		
1. The presentation is engaging, interesting, and understandable.	4	Very Satisfactory
2. There is a logical and smooth flow of ideas.	4	Very Satisfactory
3. Vocabulary level is adapted to the target reader's likely experience and level of understanding.	4	Very Satisfactory
4. The length of sentences is suited to the comprehension level of the target reader.	4	Very Satisfactory
5. Sentences and paragraph structures are varied, and interesting to the target reader.	4	Very Satisfactory
Total	***20***	***Passed***
D. Accuracy of Information		
1. There are no conceptual errors.	4	Very Satisfactory
2. There are no factual errors.	4	Very Satisfactory
3. There are no grammatical errors.	4	Very Satisfactory
4. There are no computational errors.	4	Very Satisfactory
5. There is no obsolete information.	4	Very Satisfactory
6. There are no typographical and other minor errors (e.g., inappropriate or unclear illustrations, missing labels, wrong captions, etc.).	4	Very Satisfactory
Total	***24***	***Passed***

It can be gleaned from the table above that the teacher-developed reading intervention material has passed the minimum considerations in the four major factors for learning material to be utilized in instruction, which includes the content, the presentation and organization, accuracy, and format. Each subcomponent in the first three identified major factors (i.e., content, presentation and organization, accuracy) is identified to be meeting the standards (very satisfactory). Although the print instructional material generally 'passed' along format, one of its subcomponents was identified to have been 'satisfactorily' met. One of the format's components, namely the font sizes, has to be adjusted based on existing standards to provide a better experience for the target audience. The readability of the information may be significantly enhanced, which can, in turn, lead to an increase in user engagement.

The Guidelines and Processes for LRMDS Assessment and Evaluation Manual (DepEd, 2009) states that any material before utilization must pass the requirements or standards in the four components, specifically on content, format, presentation and organization, and accuracy of information. For the resource material to pass the standards, it must score at least 21 points out of a maximum of 28 points in content, at least 54 points out of 72 points in format, and at least 15 out of 20 points. Moreover, the resource material must have a perfect score of 24 points in accuracy of information to pass. Should there be any component where the resource material does not meet the minimum standards, the resource material will undergo revision before utilization.

3.3 Post-Intervention Performance of the Kindergarten Learners

After the intervention using the researcher-designed reading intervention material, the learners' performance levels across the competencies were assessed. Table 3 shows the post-intervention performance of the Kindergarten learners in the identified competencies.

Table 3. Post-intervention performance of the kindergarten learners

Competencies	Mean	Qualitative Description
Producing letter sounds	73.96	Beginning
Identifying letter names	72.92	Beginning
Reading familiar words	81.77	Approaching Proficiency
Reading phrases/sentences	57.56	Beginning

The table above reveals an increase in the performance of Kindergarten learners across the competencies after administering intervention. Among the performance levels of the Kindergarten learners, their performance in reading familiar words elevated to approaching proficiency level with a mean percent score of 81.77%. The learners at this level have developed the basic knowledge and skills with foundational understanding. With this performance level, the learners still need guidance from the teacher and assistance from their peers to apply their knowledge and skills in authentic performance tasks.

Though increases in performance scores are noted, the learners are still within the beginning level in terms of producing letter sounds (mean percent score=73.96%), identifying letter names (mean percent score=72.92%), and reading phrases/sentences (mean percent score=57.56%). The utilization of developmentally appropriate intervention resource material using the Marungko approach is effective in developing reading skills among Kindergarten learners. The increase in the performance results share with the findings in the studies of Alauya & Basmayor (2023), Balgua et al. (2022), Boltron & Ramos (2021), Canaveral et al. (2023), and Santos & De Vera (2020).

3.4 Comparison of the Pre- and Post-Intervention Performances of the Kindergarten Learners

The Kindergarten learners' performance levels across the competencies before and after using the researcher-made reading intervention material were statistically compared to determine if a significant difference exists. The results of the statistical comparison are shown in Table 4.

Table 4. Comparison of the pre- and post-intervention kindergarten learners' performances

	Mean Difference (Pre-Post)	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
				Lower	*Upper*			
Producing letter sounds	-1.41	0.797	0.140	-1.693	-1.118	-9.97	31	.000
Identifying letter names	-1.34	0.700	0.123	-1.596	-1.091	-10.8	31	.000
Reading familiar words	-1.72	1.113	0.196	-2.120	-1.317	-8.72	31	.000
Reading phrases/sentences	-1.47	0.621	0.109	-1.692	-1.244	-13.3	31	.000

Based on the previous table, the Kindergarten learners' performance levels are within the 'beginning' level, specifically in producing letter sounds, identifying letter names, and reading phrases and sentences. Meanwhile, the learners achieved approaching proficiency level in reading familiar words. Although the Kindergarten learners are within these levels, the table above shows the existence of statistically significant differences in the performance levels of the Kindergarten learners across competencies before and after the intervention phase. Specifically, the p-value<0.001 at a 0.05 level of significance highlights the significance of the gain scores that the learners had when their pre-intervention performance was compared with their post-intervention performance.

For the gain scores, the highest increase is observed in the learners' performance on reading familiar words, with a mean gain score of 1.72, while the least is on identifying letter names, with a mean gain score of 1.34. This is followed by the learners' performance on reading phrases/sentences (1.72) and producing letter sounds (1.41).

Using the researcher-made intervention material focusing on letters Mm, Ss, and Aa allowed the learners to develop the necessary reading skills appropriate to their grade level, from producing letter sounds to reading phrases and sentences. With the consideration of developmentally appropriate practices, the Marungko approach can be maximized to help the early grade learners to develop foundational literacy, which is a cornerstone of academic success in higher grade levels (Alauya & Basmayor, 2023; Balgua et al., 2022; Boltron & Ramos, 2021; Canaveral et al., 2023; Santos & De Vera, 2020). As one of the essential skills of functional literacy, reading is a sequential process that should start within the early years of education and should be mastered with full appreciation (Abbas, 2019; Agustina, 2016; Bektas & Horzum, 2012; Mutiani, 2021).

4.0 Conclusion

The reading performance of the Kindergarten learners in the first phase considering letters Mm, Ss, and Aa improved using the Marungko approach-based researcher-made intervention material after the two-week intervention. The pre-test performance of the learners in producing letter sounds, identifying letter names, reading familiar words, and reading phrases/sentences significantly improved after using the designed intervention material based on the post-test results. These findings emphasize the significance of employing developmentally appropriate practices in developing intervention materials toward improving foundational literacy. Further, the study highlights the necessity of evaluating the learning intervention materials to ensure compliance with the Department of Education's standards before utilization.

5.0 Contributions of Authors

The author confirms sole responsibility for the study conception and design, data gathering, and manuscript preparation. For the data analysis and interpretation of results, the author worked with a local expert in statistical analysis to ensure the appropriateness of the data analysis procedures.

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7.0 Conflict of Interests

To prevent any conflicts of interest, the researcher established certain protocols beforehand. The researcher collected data and analyzed the data impartially by remaining neutral and having no direct affiliations with the participating learners, and local validators.

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Sequential Learning Activity: Effect on the Performance of Grade 5 Pupils in Dividing Fractions

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Abstract. This study aimed to determine the effectiveness of Sequential Learning Activity as an intervention material to improve the performance of Grade 5 pupils in dividing fractions at Lias Elementary School for the School Year 2022-2023. The study utilized a quasi-experimental design, specifically the one-group pretest-posttest involving 27 pupils whose scores are categorized as "Does Not Meet Expectation" based on the result of the Diagnostic Test given. The pupil-respondents were exposed to the intervention material (Sequential Learning Activities) that offered lessons and activities ranging from the most basic, which serve as the prerequisite skill, progressing to more complex concepts leading to mastery of division of fractions. The study revealed that there was a significant improvement in the pupils' scores in dividing fractions after they were exposed to the intervention, as manifested in the associated p-value of .000, which is less than alpha .05, and in the increase of pretest and posttest mean scores of 2.74 and 7.33, respectively. In light of the findings, the researchers recommended that the use of Sequential Learning Activities developed as an intervention material can help pupils understand the step-by-step process of how to divide fractions effectively. The findings suggested specific implications that can affect learners' division skills. From the gathered related studies, it has been suggested that the agreeable attitude of the pupils when it comes to using the intervention material (SLA) in developing division skills may influence their performance in Dividing Fractions. As a result, they become more focused on division activities. Furthermore, the use of sequential learning as a strategy not only in teaching Mathematics but in other learning areas as well is highly recommended as it ensures that the prerequisite skill and fundamental knowledge will be fully acquired before moving forward to other lessons with increasing complexity to achieve mastery of the knowledge and skills taught.

Keywords: Division; Fractions; Intervention materials; Sequential learning.

1.0 Introduction

Pupils learn in a sequential process. Learning the fundamentals is essential to develop a higher proficiency level. Pupils should be capable of solving more manageable tasks and problems before presenting the difficult ones. Thus, some preliminary skills should be learned before learning complex ones (Chen et al., 2015). Moreover, failure to acquire basic skills in any field of knowledge may pose significant challenges, affecting learners' success in class and future endeavors.

This is also the underlying notion of the spiral progression approach to learning, which begins with the basic facts of knowledge and progresses upward until a rich breadth of knowledge and abilities is attained. The spiral

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progression approach in the K-12 curriculum is derived from Bruner's model, wherein learners should repeatedly experience a diverse range of concepts or disciplines with increasing complexity to master the knowledge and skills taught.

More so, the 2018 Program for International Assessment (PISA) worldwide study proved that Filipino learners elicit worrying signs of an education crisis. In Math, Filipino students around 15 ranked second to the lowest among the 79 participating countries. Another international test, the 2019 Trends in International Mathematics and Science Study (TIMSS), revealed that Grade 4 Filipino learners obtained the lowest scores in Math and Science among 58 countries involved in the study. Therefore, it is urgent to address issues and gaps in the country's attainment of quality primary education, particularly in math, science, and reading.

The sudden leap from the two-year blended and modular distance learning to effective implementation of face-to-face instruction for the current school year has brought enormous challenges in the education sector. There is a need to address learning gaps to meet the required essential learning competencies and compensate for the backlog of years learners could not attend in-person classes as part of the Learning Recovery and Continuity Plan (LRCP) as stipulated in the DepEd Order No. 34, s. In 2022, schools will be highly encouraged to focus on learning intervention and remediation.

Therefore, teachers shall continue to provide interventions to the learners, especially the most vulnerable ones, in acquiescence with the DepEd Order No. 8, s. 2015. Interventions include instructional materials, learning materials, facilities, equipment, and teaching programs. Hence, teachers need to prepare materials that the learners can utilize to provide meaningful academic opportunities to them. In connection with the serious problems learners encounter in coping with mathematics topics, teachers need to use meaningful and appropriate instructional materials as shored up by the instructional theory.

In their early years, elementary pupils are expected to acquire confidence and a practical understanding of the four basic arithmetical operations- addition, subtraction, multiplication, and division. However, the arithmetical operation that appears to be the most difficult to learn is division, with children having difficulty with this arithmetical operation and, in some cases, having no understanding of it at all (Cawley et al., Ehlert et al., & Robinson et al.). The study mentioned above substantiated the results of the Diagnostic Test in Math given among Grade 5 pupils of Lias Elementary School, Marilao South District, for the school year 2022-2023, which revealed that 27 out of 222 learners got 74% and below of the required level of proficiency as mandated in the DepEd Order No. 31, s. 2012. Their level of proficiency is categorized as beginning, which means that the prerequisite skill and fundamental knowledge have not been acquired.

For this reason, this action research aimed to improve the performance of Grade 5 pupils in the division of fractions by using Sequential Learning Activities as learning intervention material. The material focused on the division of fractions, which is the identified least learned skill based on the Diagnostic Test in Mathematics result and is aligned with the Most Essential Learning Competencies required for Grade 5 pupils. It is designed to cater to pupils struggling to perform division skills by presenting a systematic and logical process of dividing numbers. It helped learners master this skill in a step-by-step manner. More so, it covered three levels- starting from the basic and progressing to a more difficult one.

The Sequential Learning Activities intervention material entailed a detailed guide on how to divide each given fraction, and the catch was, as the level moves forward, the activities progress from the easiest and simplest way to learn the skill until the learners can perform it independently. The process relied on rote memorization and mastery of this basic operation. Through this technique, learners found it easier to break division problems into more manageable steps. By doing those steps, they solved various problems and understood numbers more deeply. Therefore, it is a powerful procedure through which pen and paper division can be carried out.

The study of Chiu & Hong (2019) focused on a single classroom setting, limiting the generalizability of the findings. It did not account for long-term retention of the skills learned or variations in student demographics, which could affect outcomes. Students engaged in sequential teaching strategies exhibited improved understanding and problem-solving skills in fraction division.

Bottino and Chiappini (2020) suggested integrating digital tools in sequential learning to improve conceptual understanding and provide immediate feedback. Moreover, Huang & Wang 2021 believed that a structured, sequential learning model significantly enhanced students' proficiency in fraction operations, especially division. While numerous materials are available, the researchers believed that the learning intervention material that they developed would help improve the quality of Mathematics teaching so that no learner will be left behind, especially during this time when pupils experience the transition from two-year modular distance learning back to face-to-face instruction.

2.0 Methodology

2.1 Research Design

The study's primary objective was to evaluate the effectiveness of the intervention (Sequential Learning Activities) in improving the Grade V pupils' performance in dividing fractions. A one-group, pretest, and posttest quasi-experimental research design was used. Because this design is perfectly aligned with the study's objectives, the researchers chose to utilize it. Of the 222 Grade 5 pupils, 27 need intervention in developing their skills in dividing fractions. The researchers determined its effectiveness on how this (Sequential Learning Activities) may help the learners improve their poor skills in dividing fractions.

2.2 Research Locale

This study was conducted in Lias Elementary School, Marilao, Bulacan. It comprises 27 Grade 5 pupils who got 74% and below the required level of proficiency as mandated in the DepEd Order No. 31, s. 2012. This is based on the result of the diagnostic test given during the second week of September at Lias Elementary School, Marilao South District, Schools Division of Bulacan, for the S.Y. 2022- 2023. As the design and purpose of diagnostic tests are formative, these test results provide a glance at the baseline data on Learners' knowledge concerning the standard competencies based on competence standards as well as denoting learners' level of prior knowledge and mastery over relevant prerequisite/enabling competencies/skills taught in the immediately preceding grade level about competencies and skills from what they have been provided exposure covering through learning process during earlier grades.

As seen from the previous RDA data, as a result of analyzing the RDA data, there are significant areas of learning loss across subjects at the grade 6 level, which had been carried up since the prior grade based on what should have taken place in last year and this particularly is seen in mathematics for the learners at Bunducan Elementary School. This is something that has to be addressed immediately. It can even multiply the probability of a learner encountering learning horizons if overlooked. The respondents came from the five Grade Five sections: Earth, Mercury, Jupiter, Venus, and Mars. The sections from which the participants came are heterogeneously classified, establishing a diverse range of gender, race, economic status, numeracy, and literacy levels of the learners. The researchers recognized that the limitations of the study's conclusions cannot be used to extrapolate the findings of other studies, as outcomes may differ due to sample restrictions and adjustment of the study's target timeframe.

2.3 Research Participants

The study's respondents were 27 Grade 5 learners from the total population of 222 enrolled fifth graders, who got 74% and below the total number of items in the Diagnostic Test in Math administered among them. The said criteria are based on the required level of proficiency as mandated in the DepEd Order No. 31, s. 2012 wherein pupils' level of proficiency and equivalent numerical value were categorized as follows: beginning (74% and below), developing (75- 79%), approaching proficiency (80- 84%), proficient (85-89%), and advanced (90% and above). The sections from which the participants came are heterogeneously classified, establishing a diverse range of gender, race, economic status, numeracy, and literacy levels of the learners.

2.4 Research Instrument

In this action research, Sequential Learning Activities were used as intervention material to improve the performance of the Grade 5 pupils in dividing fractions for the school year 2022- 2023 to help the pupils cope with the learning gaps in their mathematical abilities and prepare them for more difficult mathematical concepts that they will encounter in the future were among the researchers' guiding principles for this study.

The intervention material offered lessons and activities ranging from the most basic, which are the prerequisite skills, progressing to more difficult concepts, leading to mastery. It is composed of five lessons as follows: (1) Parts of Division Sentence, (2) Kinds of Fractions, (3) Simplifying Fractions, (4) Getting the Reciprocal, and (5) Division of Fractions. The latter part is composed of several sub-topics highlighting the material, such as the division of fractions by whole numbers, the division of whole numbers by fractions, and the division of proper fractions. Each topic is supplemented with activities to apply the concepts learned and check to understand. However, before introducing pupils to the intervention material, the researchers sought help from other Math teachers to check the material.

Additionally, to quality assure and improve the material developed, it underwent evaluation both at the school and district level by the quality assurance team of the LRMDS using the evaluation form and field-testing tool used by the LRMDS of the Schools Division of Bulacan in validating different learning materials. This tool comprises 144 total points where evaluators scored the resource material using a 4-point Likert scale (4 – Very satisfactory, 3- Satisfactory, 2- poor, 1- Not satisfactory). Factors evaluated in the material include content, format, presentation and organization, and accuracy and up-to-date information.

After the approval, a designated place and time were set to facilitate the intervention using face-to-face instructional interaction, ensuring the safety of each learner. During the remediation process, the following process was observed: Each of the Grade 5 pupil-participants was given material that served as their guide during the instruction and answer sheets on which they wrote their answers for each activity. All parts of the intervention material were taught to the learners.

To assess the Grade 5 pupils' skills in dividing fractions, a pretest and posttest patterned after the Division-wide Unified First Quarterly Assessment Test was administered. The 10-item multiple choice test was where pupils were challenged to compute and solve the given numbers or questions focusing on the identified competency. There was no time limit in answering the given test since the researchers intended to measure their performance in dividing fractions correctly and not their ability to solve with speed. The following data was used to determine whether there is a significant effect on their performance. Furthermore, the researchers ensured that each respondent received and utilized the intervention material prepared to attain the desired outcomes. Also, all the pupils' outputs concerning the study were compiled in their portfolios.

2.5 Data Gathering Procedure

To ensure the safety of the learners, strict implementation of public health protocols due to the COVID-19 pandemic was strictly observed in adherence to the Department of Education, Regional Memorandum No. 228, s. 2020. Before submitting the research proposal to the Division Office for checking and approval, a letter of intent was submitted to the school and district office asking permission to conduct the study. The intervention material underwent school and district validation using the evaluation form and field-testing tool used by the LRMDS of the Schools Division of Bulacan to validate different learning materials. This tool comprises 144 total points, where evaluators scored the resource material using a 4-point Likert scale (4—Very satisfactory, 3—Satisfactory, 2—Poor, 1—Not satisfactory). Factors evaluated in the material include content, format, presentation and organization, accuracy, and up-to-date information.

After the Division Office approved the research proposal, the preparation and implementation of the study were pushed through, starting with the distribution of assent and consent forms for respondents to ask permission from their parents for their involvement in the study. When parents had already consented to the pupils being involved in the study, they were given an orientation to explain the intervention properly. Then, a pretest was given to evaluate the pupils' performance level in dividing fractions before the study. Meanwhile, after the intervention's implementation, a posttest was provided to determine if there were significant differences in pupils' pretest and posttest scores. Also, it served as the basis for determining if the proposed intervention significantly affected the pupils' performance in the division of fractions. A pretest and posttest were administered to assess the Grade 5 pupils' skills in dividing fractions. The 10-item multiple choice test was where pupils were challenged to compute and solve the given numbers or questions focusing on the identified competency. There was no time limit in answering the given test since the researchers intended to measure their performance in dividing fractions correctly and not their ability to solve with speed. The following data was used to determine whether there is a

significant effect on their performance. The researchers tabulated, organized, analyzed, and interpreted the data gathered. Following the Data Privacy Act of 2012, the researchers ensured that the standards set by the research ethics were followed. Thus, the data collected was kept confidential and used only for research purposes. Lastly, the conclusion and recommendations for the study's significant beneficiaries were disseminated based on the findings.

2.6 Ethical Considerations

The study followed the stated ethical standards on the adherence to research principles and responsibilities in different studies that involve teaching-related, non-teaching personnel, and learners as stated in the DepEd Order No. 16 s. 2017 entitled Research Management Guidelines, also known as Republic Act No. 10173, as "Data Privacy Act of 2012". Furthermore, the researchers were sensitive to the need to consider, respect, and safeguard the well-being of vulnerable participants, and the confidentiality of the information of the participants was followed, kept, and secured properly. The confidentiality of data and privacy of the participants during all the transactions, transmission, storage, and destruction of data will be handled considering the ethical standards in adherence to Regional Memorandum no. 228, s. 2020.

3.0 Results and Discussion

Table 1 shows the performance level of grade 5 pupils in dividing fractions before the intervention. It further reveals that the level of understanding of Grade 5 pupils in dividing fractions is very low, as evidenced by the number of pupils who failed (24) the pretest. This shows that the respondents have a wide learning gap in Mathematics since one of the four essential basic math operations, division, was not fully mastered.

Table 1. The performance level of before the intervention

Scores	Equivalence	Pretest
10	Excellent	0
8-9	Very Good	0
7	Good	0
6	Satisfactory	0
5	Passing	3
4 and below	Failed	24

This is incongruent with the study of Deringöl (2019); a lack of understanding of fractions ideas among the impacted students may be the primary cause of their low performance in fractions calculations. The study found that some phrases, such as equivalent, numerator, and quotient, were given colloquial meanings instead of technical ones. Some phrases were mistakenly thought to imply the same mathematical action, which may have confused them. Some terms were mistaken for their inverses in mathematics.

Table 2 presents the performance level of grade 5 pupils in dividing fractions after the intervention. The table shows that 24 learners passed the exam. Three of them obtained a perfect score. Thirteen respondents got a score of 8-9 (Very Good), three got 7 (Good), three scored 6 (Satisfactory), and two received a score of 5 (Passing). This demonstrates that the effort to conduct intervention may bridge pupils' learning gaps.

Table 2. Performance level after the intervention

Scores	Equivalence	Posttest
10	Excellent	3
8-9	Very Good	13
7	Good	3
6	Satisfactory	3
5	Passing	2
4 and below	Failed	3

However, three out of 27 respondents got a failing score (4 and below). To address this emerging problem, these three remaining respondents underwent one-on-one tutorial sessions to improve their skills. During the one-on-one tutorial session with the three respondents who failed to pass the given posttest, it was found that all had difficulties multiplying numbers, resulting in difficulties in dividing fractions. Because of this unforeseen event in the research process, the researchers decided to create an intervention material about the multiplication of numbers and the multiplication of fractions until these three respondents successfully passed and met the required

passing mark in the posttest. This is in line with the study of Ubah (2021), which reveals that when teaching fractions, teachers' understanding and capacity to draw links between representations and their flexibility in switching between different types of representations are critical to students' performance.

Table 3 presents the mean and standard deviation of the pretest and posttest scores of Grade 5 pupils. The pretest score's mean and standard deviation are 2.74 and 1.509, respectively, while the posttest score's mean and standard deviation are 7.3333 and 1.90142, respectively. This further implies that the respondents improved their division skills in fractions. The intervention material used also played a significant role in developing and improving the skills of the grade 5 respondents. After implementing the intervention material, the respondents' pretest and posttest scores were compared and analyzed using a t-test.

Table 3. Mean and standard deviation of post-test of the respondents

	Minimum	Maximum	Mean	Std. Deviation
Pretest	0	5	2.74	1.509
Posttest	3.00	10.00	7.33	1.901
Valid N (listwise)				

Recent studies have emphasized the significance of structured learning pathways in mathematics education. In the study of Rukundwa et al. (2021), teaching division—especially with fractions—sequentially increased student performance and comprehension by enabling them to build on their prior knowledge.

Table 4 shows the difference between the learners' pretest and posttest results after implementing the intervention material. It can be deduced from the table that at 0.05 significance level, the p-value is .000. This clearly shows that the results of the pretest and the posttest were significantly different in favor of the posttest, as manifested in the obtained mean and p-value. Furthermore, it was concluded that there was a significant improvement in the pupils' scores after exposure to the intervention. Moreover, the result implies that the intervention material (SLA) can significantly help increase the participants' interest in dealing with competency in Mathematics, particularly in dividing fractions.

Table 4. Test of difference between the pretest and post-test of the participants

	Mean	Std. Deviation	Alpha	P-Value	Statistical Inference
Pre-test	2.74	1.509	0.05	.000	Significant
Posttest	7.33	1.901			

In general, if properly structured and presented, the learners can understand even the most complex lesson if there is a sequential and logical progression from simple to complex ideas that will help them strengthen their skills (Johnston, 2012). This is also in consonance with a recent analysis by Barak and Keren (2020), where scaffolding improves students' understanding of difficult subjects like fraction division. They discovered that guided discovery strategies can greatly enhance student outcomes by giving students the support they need to solve problems.

4.0 Conclusion

Teachers must utilize the Sequential Learning Activities developed as intervention material in Mathematics to improve the pupils' division skills. These activities can help learners understand the step-by-step process of dividing fractions effectively and clearly. Sequential Learning is highly recommended as a strategy not only in teaching Mathematics but also in other learning areas. It ensures that the prerequisite skills and fundamental knowledge are fully acquired before moving forward to other lessons with increasing complexity to achieve mastery of the knowledge and skills taught.

Teachers must assess the level of the learners and consider their needs and interests in planning and developing learning intervention materials to guarantee their success and effectiveness. Likewise, teachers are encouraged to prepare and produce learning materials to cater to the needs of high-quality education and transform the pupils' learning deficiencies into great learning opportunities. Therefore, it was manifested that the pupils' skills in connection to the division of fractions had greatly improved using the locally produced intervention material—sequential Learning Activities. This method is found to be effective since preliminary skills and fundamentals are tackled first before moving forward to more complicated and challenging tasks and activities.

5.0 Contributions of Authors

The researchers have shared an equal distribution of tasks to develop this study. It was also reviewed by some experts in the fields, presented to a research festival, and approved by the research evaluation committee of the Schools Division of Bulacan.

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7.0 Conflict of Interests

The researchers declare no conflicts of interest about the publication of this paper.

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Assessing the Extent and Effectiveness of Inventory Management Practices of Auto Supply Businesses: A Workbook for Success

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Abstract. Inventory management is critical to running any business, especially in auto supply businesses, where maintaining an optimal stock level directly impacts profitability and customer satisfaction. Inventory management involves tracking, ordering, storing, and selling a company's stock. In the context of auto supply businesses, effective inventory management ensures that essential parts and products are available when needed while avoiding the high costs associated with excess inventory or stockouts. This study aimed to analyze the inventory management practices of auto supply businesses in Candelaria, Quezon, surveying nine (9) business owners/managers. While the sample size might seem small, it represents a significant portion of the local industry and provides valuable information for the research study. The study identified barriers such as "compliance-related expenses" like obtaining permits, licenses, and certifications from the local government units and "inventory fluctuations," which hindered effective inventory management. Moreover, the recommendation to adopt a "just-in-time" (JIT) inventory system is insightful, for it can help reduce costs by minimizing the amount of inventory held at any given time, lowering storage costs, and reducing the risk of overstocking. This approach ensures that businesses only order inventory as needed, improving cash flow and preventing excess inventory from becoming obsolete or taking up valuable space.

Keywords: Cost barriers; Ordering decisions; Minimizing inventory levels; Eliminating costs.

1.0 Introduction

The auto supply industry is experiencing a growing emphasis on specialization, with shops specifically catering to particular car brands and supplies. Traditionally, inventory management practices, such as spreadsheets, are labor-intensive, error-prone, and inefficient. These methods often lead to data inaccuracy, oversight, and internal shrinkage, significantly impacting business operations (Madamidola et al., 2024). In response to these trends, some auto supply businesses are adapting their inventory management practices to better align with their specialization needs. By adopting new inventory management techniques, these businesses can gain greater control over stock levels and streamline their ordering processes, ultimately enhancing efficiency and operational effectiveness.

Understanding the significance of physical location in inventory management is crucial for auto supply businesses. Smith and Johnson (2018) emphasized that the location of retail establishments greatly influences

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inventory turnover rates, demand forecasting accuracy, and transportation costs. Urban locations often have higher demand but may face challenges related to space constraints and traffic congestion (Rahman et al., 2021). Conversely, rural areas might offer lower operating costs but could struggle with lower customer traffic (Li & Liu, 2012). On the other hand, the longevity of an auto supply business can significantly impact its inventory management practices. Jeong et al. (2019) noted that established businesses often have refined inventory control systems, benefiting from historical sales data for more accurate demand forecasting. Conversely, newer businesses may face challenges such as inventory overstocking or stockouts due to limited historical data (Garcia & Nguyen, 2019).

Inventory management is the art and science of maintaining stock levels of a given group of items, incurring the least cost, and being consistent with other relevant targets and objectives set by management (Prempeh, 2015). It is an important part of making all the decisions in handling the inventory in an organization, such as activities to be carried out, policies of inventory management, and procedures in handling the inventory to ensure enough quantity of each item is always kept in the warehouse. (Chan et al., 2017). Effective inventory management practices (EIMP) are essential in the operation of any business. However, implementing such practices faces challenges, notably cost barriers, attitudes, and knowledge of owners/managers (Atnafu et al.; Ahmad & Zabri, 2018). Overcoming these hurdles is vital for sustaining growth and competitiveness in the market. Furthermore, the effectiveness of inventory management practices may directly impact customer satisfaction through ordering decisions, minimizing inventory levels, and eliminating costs (Ahmad et al., 2020; Andersson et al., 2015; Smith & Jones, 2018). While optimizing inventory ordering decisions and minimizing levels are essential for operational efficiency (Orobia et al., 2020), eliminating costs must be balanced to avoid stockouts and maintain customer service levels (Simchi-Levi et al., 2015).

Despite the prevailing trend, some auto supply businesses in smaller towns, like Candelaria and Quezon, rely on traditional inventory management methods. While these methods may still be functional, they may not be as effective in today's highly competitive market. Inefficient and ineffective inventory management can result in unnecessary costs, excessive inventory levels, and stock shortages, which can hurt auto supply businesses' profitability and day-to-day operations (Coyle et al., 2003). In today's highly competitive market, traditional inventory management methods have increasingly been deemed ineffective for addressing the dynamic demands of modern supply chains. Traditional inventory systems—largely based on manual tracking, static reorder levels, and batch processing—fail to meet contemporary businesses' demands for flexibility, responsiveness, and precision (Christopher, 2016). These methods were initially designed in a more stable, predictable market environment, with longer lead times and lower demand variability.

However, in today's fast-paced, globalized market, supply chains are becoming more complex, and customer expectations are more variable. As a result, organizations face issues such as stockouts, overstocking, and high holding costs, all of which contribute to inefficiencies and hinder overall operational performance. The core problem with traditional methods in today's market is that they rely on outdated assumptions and manual processes that cannot effectively adapt to rapidly changing conditions. This lack of flexibility in inventory control can lead to increased costs, such as unnecessary inventory carrying costs or lost sales due to stockouts (Slack et al., 2019). Additionally, traditional approaches fail to capitalize on data analytics and real-time decision-making, which is crucial for optimizing inventory levels and improving service levels in competitive markets. Therefore, to address this gap, the study addresses these challenges by proposing a systematic evaluation and refinement of current inventory management practices within the auto-supply industry. By assessing the extent of existing practices and their effectiveness, the researchers hope to provide a workbook that introduces a framework for assessing inventory effectiveness and offers practical guidelines for adapting to modern inventory demands. In particular, the workbook helps bridge the gap between theory and practice, ensuring businesses can adapt their inventory strategies to remain competitive.

Lastly, the assessment of the effectiveness of current inventory practices connects directly to the development of the workbook, as it provides the necessary insights into areas of improvement, allowing the tool to guide companies through optimizing their inventory strategies. By evaluating current practices, researchers can help businesses identify critical inefficiencies and adopt more responsive, data-driven solutions that align with the needs of the modern market through the workbook.

2.0 Methodology

2.1 Research Design

This study employed a descriptive-correlational research design to investigate the extent to which inventory management practices influence or affect their effectiveness in the auto supply industry.

2.2 Research Locale

The study was carried out in the Municipality of Candelaria, Quezon. The municipality is considered a first-class locale in Quezon Province. It is situated in the Calabarzon region on the island of Luzon and is a vital part of the province. It is home to various stores of auto supply-related businesses, with around the majority of its 25 barangays. However, the researchers have limited the study to selected municipal auto supply businesses whose operation solely provided auto-supply products/services.

2.3 Research Participants

The study's respondents comprised nine (9) auto supply businesses operating in the Municipality of Candelaria, Quezon business environment. Specifically, respondents are residing in the barangays of Malabanban Norte, Poblacion, Mangilag Norte, Malabanban Sur, and Mangilag Sur. They were selected using a random sampling method.

2.4 Research Instrument

The researcher-created instrument in this study was specifically designed to evaluate inventory management techniques and their efficacy in auto supply organizations. The design procedure included picking questions from credible sources focused on key variables indicated in the research framework, ensuring relevance and validity. The instrument is divided into three sections: the demographic profile, the extent of inventory management practices, and the effectiveness of inventory management practices. A pilot test was conducted to ensure the instrument's reliability. The validator performed the reliability analysis manually, allowing for a thorough inspection of each item to verify its accuracy and consistency with the study objectives. This hands-on approach enabled complete oversight, ensuring that survey questions were appropriate and reliable for the study's objectives.

The questionnaire includes several items for each indicator to assess inventory management techniques comprehensively. The "Extent of Inventory Management Practices" section has five indicators that examine cost barriers, owner/manager attitudes, and knowledge. Similarly, the "Effectiveness of Inventory Management Practices" section assesses ordering decisions, inventory level minimization, and cost management, each of which has five components. The questionnaire is presented clearly and concisely with English and Filipino translations to accommodate respondents' language preferences. The questionnaire respected participants' choice to participate voluntarily and ensured privacy and confidentiality of responses. This planned framework ensures that the survey items are closely related to the study objectives, resulting in a reputable inventory management assessment in auto supply businesses.

2.5 Data Gathering Procedure and Analysis

The essential data for this research study were gathered by following proper procedures and protocols. The researchers began the data-gathering process by sending letters to the Head Office of the Municipality of Candelaria, requesting permission to conduct the study. These letters included a formal request to obtain lists and details of the auto supply businesses in Candelaria, Quezon. Additionally, the researchers sought permits to conduct surveys of the respondents, specifying the dates for data collection. The survey questionnaires used to gather data were carefully designed, incorporating relevant questions that included the concept of the extent and effectiveness of inventory management practices. The target population for this study was the owners/managers of selected auto supply businesses in the Municipality of Candelaria. Before distributing the questionnaires, the researchers sought informed consent from each respondent. They explained the nature of the study and gave respondents the freedom to choose whether to participate or decline. Respondents were fully informed about the study, and ample time was given for them to complete the survey questionnaires. The research team also encouraged respondents to ask questions and seek clarification. The researchers collected data by administering the survey questionnaires to the selected respondents, ensuring adherence to ethical practices and respecting individual choices.

The data gathered were subjected to statistical treatment for analysis and interpretation. For the demographic profile of the respondents, weighted mean, percentage, and standard deviation were used. For the extent and effectiveness of inventory management, the researchers used linear regression analysis to determine the significant relationship between the extent and effectiveness of inventory management practices in auto supply businesses.

2.6 Ethical Considerations

The researchers prioritized participant welfare, ensuring their identities remained anonymous and their personal information was secured. They interpreted and presented the study findings appropriately to ensure accuracy. This study was conducted for their benefit, to uphold ethical standards, maintain research integrity, and prevent misconduct.

3.0 Results and Discussion

3.1 Profile of the Respondents

Table 1 shows the Summary of Demographic Profile of the Respondents.

Table 1. Summary table of the demographic profile of the respondents

Profile	Characteristics	Frequency	Percentage (%)
Physical Location	Malabanban Norte	3	33.3
	Poblacion	2	22.2
	Malabanban Sur	1	11.1
	Mangilag Norte	2	22.2
	Mangilag Sur	1	11.1
	Total	9	100.0
Years in Operation	Less than 1 year	0	0.0
	1 – 5 years	4	44.0
	6 – 10 years	2	22.0
	11 – 15 years	1	11.0
	16 – 20 years	0	0.0
	More than 20 years	2	22.0
	Total	9	**100.0**

The study revealed that most auto supply businesses are located near Barangay Malabanban Norte, a highly urbanized area in the municipality (33.3%). Most auto supply businesses in this area greatly influence inventory turnover rates, demand forecasting accuracy, transportation costs, and higher demand (Smith & Johnson, 2018). In terms of years in operation, most auto supply businesses are operated within 1-5 years (44%), suggesting a mix of established and newer ventures. Those operating at 6 to 10 years cover 22%. Meanwhile, only 11% of those operating within 11 to 15 years, reflecting a stable middle ground regarding operational longevity. However, a significant portion of 22% of the business population has been operational for over 20 years, indicating long-standing establishments within the industry. This suggests that the older the auto supply businesses are, adapting to current practices is needed to remain competitive in the evolving market (Garcia & Nguyen, 2019)

3.2 Extent of Inventory Management Practices

Cost Barriers

Compliance-related expenses and managing cost fluctuations got the highest mean of 3.33 and were described as "Great Extent." The lowest indicator was training employees on inventory management systems, with a mean of 2.78, which was described as "Great Extent" with an overall mean of 3.07 and described as "Great Extent." The findings revealed that auto supply businesses were at "Great Extent" in addressing cost barriers. Notably, they perceived managing compliance-related expenses and cost fluctuations as crucial factors imposing a substantial financial burden on the entity's operation. Conversely, "training for employees on inventory management systems", gained the lowest mean, though it still reflected many practices. It indicates that less financial burdens are covered by providing necessary skills training to equip employees with proper knowledge of inventory management systems.

Table 2. Summary table of the extent of inventory management practices in terms of cost barriers

Items	WM	SD	Interpretation
Financial constraints	3.00	1.00	Great Extent
Managing cost fluctuations	3.33	0.71	Great Extent
Budget limitations	2.89	0.60	Great Extent
Compliance-related expenses	3.33	0.71	Great Extent
Training employees on inventory management systems	2.78	0.97	Great Extent
Overall Mean	**3.07**	**0.50**	**Great Extent**

Owner/Manager's Attitude

Enthusiasm and commitment toward effective inventory control had the highest mean of 3.44 and were described as "Great Extent." Meanwhile, proactive anticipation of potential issues and opportunities in inventory management had the lowest mean of 3.22. It was described as "Great Extent" with an overall mean of 3.33 and described as "Great Extent". The study indicates that auto supply businesses value attitude to a "Great Extent." Specifically, they value "enthusiasm and commitment in providing effective inventory management control." On the other hand, they are less focused on being "proactive in anticipating future potential issues as well as dealing with possible opportunity."

Table 3. Summary table of the extent of inventory management practices in terms of owner/manager's attitude

Items	WM	SD	Interpretation
Supporting and promoting inventory management practices	3.33	1.00	Great Extent
Enthusiasm and commitment toward effective inventory control	3.44	0.53	Great Extent
Seeking ways to optimize inventory	3.33	0.71	Great Extent
Prioritizing inventory accuracy and continuous improvement	3.33	0.50	Great Extent
Proactive anticipation of potential issues and opportunities in inventory management	3.22	0.83	Great Extent
Overall Mean	**3.33**	**0.48**	**Great Extent**

Owner/Manager's Knowledge

Table 4 shows that adequate understanding of the product/service had the highest mean, 3.33, and was described as a "Great Extent." Conversely, familiarity with inventory control methods gains the lowest mean with 2.56, and is described as "Great Extent" with an overall mean of 2.91 and "Great Extent." The study revealed that auto supply businesses know about a "Great Extent." The result of the study indicates that the respondents prioritized having an "adequate understanding of the product/services or its features" to effectively address customer's inquiries about their product/service offerings. On the other hand, they are less knowledgeable about gaining "familiarity with inventory control methods," which might reflect the current industry's incompetency in providing effective inventory management systems due to unfamiliarity with inventory methods.

Table 4. Summary table of the extent of inventory management practices in terms of owner/manager's knowledge

Items	WM	SD	Interpretation
Good understanding of inventory management principles and techniques	3.11	0.93	Great Extent
Familiarity with inventory control methods	2.56	0.88	Great Extent
Adequate understanding of the product/service	3.33	1.12	Great Extent
Effective analysis of inventory data	2.89	0.78	Great Extent
The proactive approach of continuously monitoring trends	2.67	0.87	Great Extent
Overall Mean	**2.91**	**0.76**	**Great Extent**

3.3 Effectiveness of Inventory Management Practices

Ordering Decisions

Table 5 shows that Timely ordering decisions had the highest mean of 3.67 and were described as "Highly Effective." On the other hand, the lowest indicators considered demand forecasts and historical sales data. They minimized stockouts to prevent stockout situations, with a mean of 3.33 and described as "Effective" with an overall mean of 3.49 and described as "Effective." The results revealed that the respondents were "Effective" regarding management ordering decision-making. They perceived that "timely ordering decisions" are crucial to managing inventory turnover and reducing associated costs efficiently. In contrast, "considering demand forecast and minimizing stockouts to prevent overstock situations," though still significant in decision-making, has gained fewer highlights when considering management's ordering decisions.

Table 5. Summary table of the effectiveness of inventory management practices in terms of ordering decisions

Items	WM	SD	Interpretation
Timely ordering decisions	3.67	0.50	Highly Effective
Considering demand forecasts and historical sales data	3.33	0.50	Effective
Minimizing stockouts and preventing overstock situations	3.33	1.00	Effective
Monitoring inventory turnover and adjusting ordering frequency	3.56	0.53	Highly Effective
The Proactive approach of continuously monitoring trends	3.56	0.53	Highly Effective
Overall Mean	**3.49**	**0.38**	**Effective**

Minimizing Inventory Levels

Actively monitoring inventory turnover and prioritizing minimization stockouts while avoiding overstock situations both got the highest mean of 3.56 and were described as "Highly Effective." The lowest indicator was optimizing inventory management for high-value items, with a mean of 3.22, and described as "Effective" with an overall mean of 3.42 and described as "Effective". In the area of minimizing inventory levels, the study revealed that the respondents were "Effective" in conducting measures to minimize inventory levels. Specifically, the study indicates that auto supply businesses are "Highly Effective" in "monitoring inventory turnover and in minimizing stockouts for them to prevent overstock situations" which might have a substantial impact on their profitability. However, they are less focused on "optimizing inventory management in the area of valuing high-value items". This may reflect that they are more often into prioritizing high volume of low-value or slow-moving items.

Table 6. Summary table of the effectiveness of inventory management practices in terms of minimizing inventory levels

Items	WM	SD	Interpretation
Actively monitoring inventory turnover	3.56	0.53	Highly Effective
Using just-in-time (JIT) inventory management	3.33	0.87	Effective
Actively seeking ways to reduce lead times from suppliers	3.44	0.53	Effective
Prioritizing minimization stock outs while avoiding overstock situations	3.56	0.53	Highly Effective
Optimizing inventory management for high-value items	3.22	0.67	Effective
Overall Mean	**3.42**	**0.46**	**Effective**

Eliminating Costs

Table 7 shows that "negotiating with suppliers" had the highest mean of 3.56 and was described as "Highly Effective". Conversely, the lowest indicator was "identifying and eliminating obsolete inventory," with a mean of 3.11, and described as "Effective," with an overall mean of 3.33 and described as "Effective." The study highlights that the respondents were "Effective" in providing necessary actions to eliminate unnecessary costs associated with their day-to-day operations. Notably, respondents prioritized good "negotiation with suppliers" beforehand to easily eliminate costs even before an item arrived at their stores. By negotiating properly with suppliers, they can request favorable pricing terms, volume discounts, and even payment terms to reduce procurement costs. In contrast, the respondents are not too focused on "identifying possible obsolete inventory," which might be caused by their efficient procedures for eliminating necessary costs even before an inventory arrives at their stores.

Table 7. Summary table of the effectiveness of inventory management practices in terms of eliminating costs

Items	WM	SD	Interpretation
Identifying and eliminating obsolete inventory	3.11	0.60	Effective
Optimizing inventory processes to minimize waste	3.44	0.53	Effective
Actively tracking and managing carrying costs	3.22	0.44	Effective
Seeking ways to streamline processes and reduce non-value-added Negotiating	3.33	0.50	Effective
with suppliers	3.56	0.53	Highly Effective
Overall Mean	**3.33**	**0.33**	**Effective**

3.4 Relationship of Extent of Inventory Management

The study examined the predictive power of the extent of inventory management practices to its effectiveness. The researchers used linear regression to find an insignificant relationship between the variables used to assess the extent and effectiveness of inventory management practices under study (refer to Table 8). For the dependent variable of ordering decisions, the intercept ($\beta = 1.455$, SE = 1.562, $p = .404$) indicates a non-significant base level of effectiveness. Cost barriers ($\beta = .255$, SE = .253, $p = .371$) and owner's/manager's attitude ($\beta = .510$, SE = .319, $p = .185$) similarly did not show a statistically significant impact on effectiveness. The owner's/manager's knowledge ($\beta = -.170$, SE = .601, $p = .791$) was also non-significant, suggesting these factors alone do not substantially predict effectiveness in ordering decisions. The relatively lower p-value (0.185) suggests that the

owner/manager's attitude towards inventory management might influence the effectiveness of ordering decisions. An engaged and proactive manager likely ensures timely orders, considers demand forecasts, and evaluates suppliers effectively. This can minimize stockouts and prevent overstock situations.

Table 8. Linear regression for the relationship between variables to assess the extent and effectiveness of inventory management practices

Dependent Variables	Parameter	β	Std. Error	Sig.	Partial Eta Squared	Interpretation
Ordering Decisions	Intercept	1.445	1.562	0.404	0.178	Insignificant
	Cost Barriers	0.255	0.253	0.371	0.202	
	Owner/Manager's Attitude	0.510	0.319	0.185	0.390	
	Owner/Manager's Knowledge	-0.170	0.601	0.791	0.020	
Minimizing Inventory Levels	Intercept	-0.097	1.954	0.963	0.001	Insignificant
	Cost Barriers	0.302	0.317	0.395	0.185	
	Owner/Manager's Attitude	0.450	0.399	0.322	0.241	
	Owner/Manager's Knowledge	0.318	0.752	0.694	0.043	
Eliminating Costs	Intercept	0.920	0.861	0.345	0.222	Insignificant
	Cost Barriers	0.002	0.140	0.988	0.000	
	Owner/Manager's Attitude	-0.004	0.176	0.983	0.000	
	Owner/Manager's Knowledge	0.742	0.331	0.089	0.556	

When considering the dependent variable of minimizing inventory levels, the intercept was non-significant (β = -.097, SE = 1.954, p = .963). Cost barriers (β = .302, SE = .317, p = .395) and owner's/manager's attitude (β = .450, SE = .399, p = .322) also showed no significant effect. Owner's/manager's knowledge (β = .318, SE = .752, p = .694) did not significantly predict the effectiveness of minimizing inventory levels, indicating these variables were insufficient predictors within this context. This trend indicates that a positive attitude towards inventory management could potentially contribute to minimizing inventory levels. Managers who prioritize inventory accuracy, seek to optimize processes, and minimize waste might better manage inventory turnover, reduce lead times, and avoid excess stock, ultimately leading to more efficient inventory management.

The intercept (β = .920, SE = .861, p = .345) was insignificant regarding eliminating costs. Cost barriers (B = .002, SE = .140, p = .988) and owner's/manager's attitude (β = -.004, SE = .176, p = .983) also failed to show significant predictive power. Interestingly, the owner's/manager's knowledge approached significance (β = .742, SE = .331, p = .089) with a relatively high partial eta squared (.556), suggesting a potentially meaningful impact that warrants further exploration. The owner/manager's knowledge is significant in eliminating costs. It demonstrates a relatively high partial eta squared (.556), suggesting a meaningful impact on the effectiveness of inventory management practices in eliminating costs. This suggests that managers with a strong understanding of inventory management principles and techniques can identify and eliminate obsolete inventory, optimize processes to reduce waste and manage to carry costs effectively. They will likely streamline operations and negotiate better terms with suppliers, reducing procurement costs.

In summary, the findings suggest that while certain variables, such as the owner's/manager's knowledge in eliminating costs, show potential relevance, overall, the inventory management practices studied did not significantly predict effectiveness in achieving customer satisfaction within the sample. This may imply a need for more comprehensive models incorporating additional variables or broader strategic frameworks to understand better and enhance inventory management practices in the auto supply business sector. Catering to a larger population is also recommended.

3.5 Validation of Workbook Guide

This workbook guide has undergone content and research validation based on the results of the study. It aimed to provide various strategies essential to improve the current inventory management practices of the auto supply industry. Inventory management is crucial for any merchandising and service entity where accurate stock levels and timely procurement are significant to attain operational efficiency. Through a combination of industry data and other studies, it provides practical recommendations for an effective inventory management process. By following the guidelines outlined in this workbook, auto supply businesses can streamline their inventory processes, reduce wastage, and enhance their competitive advantage in the market. The goal is to enable these

businesses to achieve greater efficiency, profitability, and customer satisfaction through effective inventory management.

4.0 Conclusion

The study focuses on managing inventory in the auto supply industry, emphasizing methods to increase productivity and cut expenses. Even if many companies are implementing advanced inventory systems, certain areas still need to be improved to increase productivity and performance and improve customer satisfaction and inventory turnover. The study's primary output, a workbook, acts as a manual for efficient inventory procedures to meet these goals. This workbook provides auto supply companies with recommendations such as Just-In-Time (JIT) inventory, which helps keep stock levels low, cut storage costs, and respond quickly to demand changes. It also suggests adopting relevant inventory management technologies and negotiating better terms with suppliers. The workbook also suggests the ABC analysis for optimal cost control, which prioritizes high-demand items and encourages investment in staff training that guarantees accurate product understanding for customers. Future research could expand upon these findings by examining a larger sample of companies across diverse markets to identify additional factors contributing to successful inventory management.

5.0 Contributions of Authors

The research team leader, Angelo H. Barcelona, played a significant role in the overall structure and design of the research study and the paper on international publication. He worked on proofreading and provided necessary changes to the manuscript. He is responsible for communicating with the statistician, validators, and grammarians. He also assigned tasks to the research members and made sure everyone functioned. Alyce C. Gungon is one of the primary authors of the original draft of the paper, including the problem statement, literature reviews, and data gathering. She contributed to formulating the research instrument, data gathering and interpretations, and designing the research output. Mujahid S. Sultan Amanollah helped form the research topic and concept. He designed the conceptual framework, provided supporting theoretical frameworks and models, and made the problem statement of the research. He also contributed to the formation of the research instrument and provided key citations and revisions. Jessa Grace C. Laylo contributed parts to the review of related literature and parts of the methodology, provided Filipino translation of the survey questions, and assisted in the data gathering. Jeffrey M. Panganiban engaged by providing technical support and writing the manuscript's revisions.

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7.0 Conflict of Interests

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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Exploring the Impact of AI Tools on Student Learning Through Text Mining

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Abstract. This study addresses the research gap regarding the impact of AI tools on student learning, recognizing their increasing role in educational settings and the potential implications for learning outcomes. The objective was to evaluate students' perceptions and the effectiveness of AI tools in enhancing their learning experiences. A descriptive research design was employed, utilizing an online survey to collect data from 251 4th-year undergraduate students and applying text mining techniques for frequency and text mining analysis. Due to their significant presence in academic activities, the study focused on the five most commonly used AI tools - Quillbot, ChatGPT, Grammarly, Quizizz, and Brainly. Findings revealed predominantly positive sentiments (82.87%) regarding AI's role in improving writing, problem-solving, and information-processing skills, alongside concerns about over-dependence on AI and its impact on critical thinking. The results emphasize the importance of fostering a balanced use of AI tools and promoting AI literacy among students. Educators are encouraged to carefully incorporate these resources to improve instruction while fostering fundamental human abilities, guaranteeing the overall growth of their students.

Keywords: Artificial Intelligence; Educational technology; Sentiment analysis; Student learning; Text mining.

1.0 Introduction

Artificial intelligence (AI) is revolutionizing education, reshaping traditional teaching and learning paradigms with unprecedented speed. From AI-powered writing assistants to adaptive learning platforms, these technologies promise to enhance learning outcomes but also raise critical questions about their impact on students. This study explores these transformative processes, specifically looking at how AI applications affect students' learning. Despite growing adoption, research on AI's impact often overlooks student perceptions, a crucial lens for understanding how these tools integrate into real-world academic settings. Previous studies have highlighted the potential benefits of AI, such as personalized learning and improved efficiency (Ayanwale & Ndlovu, 2024; Greene, 2023; Gocen & Aydemir, 2021; Perez, 2023; Slimi, 2023; Team Capacity, 2021), as well as concerns like dependency and diminished critical thinking (Adlawan, 2024; Santiago et al., 2023). However, gaps remain in exploring how students, particularly those nearing the completion of their undergraduate programs, perceive and utilize AI tools in their academic journey. This study seeks to fill that gap by focusing on 4th year undergraduate

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students at Cavite State University-Silang Campus, a population well-positioned to provide insights due to their extensive exposure to AI tools throughout their studies.

The purpose of this research is to evaluate the perceptions and effectiveness of AI tools in supporting student learning. By analyzing the experiences of these students, this study aims to provide insights for educators and policymakers. The findings are particularly relevant in an era where educational practices are entwined with technology, necessitating a balanced approach that takes advantage of AI's benefits while addressing its potential drawbacks. This paper contributes to the field by highlighting both the opportunities and challenges of AI integration in education. It emphasizes the importance of thoughtful implementation strategies that promote AI literacy and foster essential human skills like critical thinking and problem-solving, ultimately ensuring that AI supports holistic student development.

2.0 Methodology

2.1 Research Design

This study employed a descriptive research design, which aims to systematically describe the usage patterns and perceived impacts of AI tools on student learning. Creswell and Creswell (2018) defines descriptive research design as a type of research that systematically collects and analyzes data to provide an accurate portrayal of characteristics, behaviors, or phenomena within a specific population or context. Using an online survey, data were collected from 251 4th-year undergraduate students to identify the most frequently used AI tools and their specific applications in academic activities. Text mining techniques, including frequency and sentiment analysis, were applied to the open-ended survey responses to further illustrate student perceptions and attitudes. These use natural language processing to draw insightful conclusions from unstructured text (Sandu et al., 2024).

2.2 Research Participants

The study focused on a population: 4th-year undergraduate students at Cavite State University-Silang Campus enrolled during the second semester of the 2023-2024 academic year. This choice was driven by the researchers' interest in understanding the experiences of students nearing the end of their undergraduate studies, who are likely to have had more exposure to AI tools in academic settings. A stratified random sampling technique was implemented to ensure representation from various academic disciplines. The student population was divided into strata based on their academic programs, and a proportional sampling approach was applied to determine the sample size for each stratum. Table 1 details the total population and adjusted sampling population for each course. This sampling strategy aimed to provide a balanced representation of students from different academic backgrounds, enhancing the generalizability of the findings.

Table 1. Population and sampling

Course (Stratum)	Population	Sample
Information Technology	135	40
Computer Science	72	22
Business Management	199	60
Hospitality Management	93	28
Tourism Management	83	25
Psychology	121	36
Early Childhood Education	24	7
Secondary Education	109	33
Total	**836**	**251**

2.3 Research Gathering Procedure

An online questionnaire was developed using Google Forms to collect data from the selected participants. The questionnaire comprised five key questions:

1. What are the AI tools that you usually use for learning?
2. How do you use AI tools in terms of learning?
3. What are the benefits of using AI applications for student learning?
4. What are the drawbacks of using AI applications for student learning?
5. How effective do AI tools support your learning process?

Questions 1 and 2 were designed to gather quantitative data on AI tool usage and application. The multiple-choice format allowed for efficient data collection and analysis. Questions 3, 4, and 5 were open-ended, prompting students to provide detailed, qualitative responses regarding their perceptions of AI's impact on learning. This approach aimed to capture student experiences. The survey was administered online through Google Forms, allowing for convenient and anonymous participation. Data collection took place between March 25 and May 17, 2024.

2.4. Text Mining Analysis

The collected survey responses, specifically the open-ended responses to Questions 3, 4, and 5, underwent a rigorous preprocessing stage to prepare the data for text mining analysis. This involved several steps: removal of irrelevant characters, removal of unnecessary spaces, lowercase conversion, stop word removal, and lemmatization. Word frequency analysis was applied to Questions 3 and 4, focusing on identifying the most frequently occurring words in student responses regarding AI tools' perceived benefits and drawbacks in learning. Word frequency counts provided insights into the dominant themes and concerns (Simatupang et al., 2024) expressed by students. The results were visualized using word clouds to enhance interpretation.

The sentiment analysis technique was employed to analyze the sentiment expressed in student responses to Question 5, which inquired about the perceived effectiveness of AI tools in supporting their learning process. Sentiment analysis aimed to classify student opinions into positive, negative, or neutral categories. A lexicon-based approach, considering valence shifters, was used to assign sentiment scores to each response (Dervenis, 2024). The results were visualized using a table, showing the overall sentiment distribution.

2.5 Ethical Considerations

Ethical considerations, including voluntary participation, confidentiality, and data privacy, were emphasized throughout the data collection process. The researchers ensured that participants were informed about the study's purpose, data usage, and their right to withdraw at any time.

3.0 Results and Discussion

3.1 Dominant AI Tools and Their Applications

Figure 1 shows the top five AI tools used by students. The study identified Quillbot as the most frequently used AI tool, selected by 187 out of 251 respondents, followed by ChatGPT, Grammarly, Quizizz, and Brainly. This trend aligns with findings by Marzuki et al. (2023), which highlighted the growing reliance on AI-powered writing assistance tools among students. Quillbot's paraphrasing and grammar correction features are particularly valued, supporting students in producing polished academic outputs. Similarly, the versatility of ChatGPT as a conversational AI tool has been noted in previous studies (Greene, 2023; Santiago et al., 2023), where its capacity to deliver individualized responses improves research and learning.

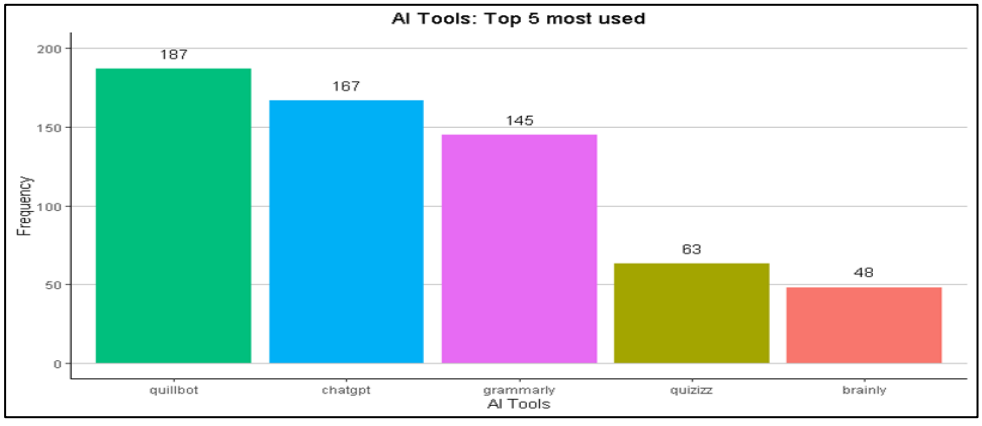


Figure 1. Bar plot of top 5 AI tools students use for learning

Figure 2 reveals that the most frequently selected purposes for using AI tools were "Writing and editing Assistance," followed by "Studying Assistance" and "Information Research Gathering." These findings highlight

AI's essential role in streamlining academic activities and increasing student engagement, as reported in similar studies (Ayanwale & Ndlovu, 2024; Gocen & Aydemir, 2020).

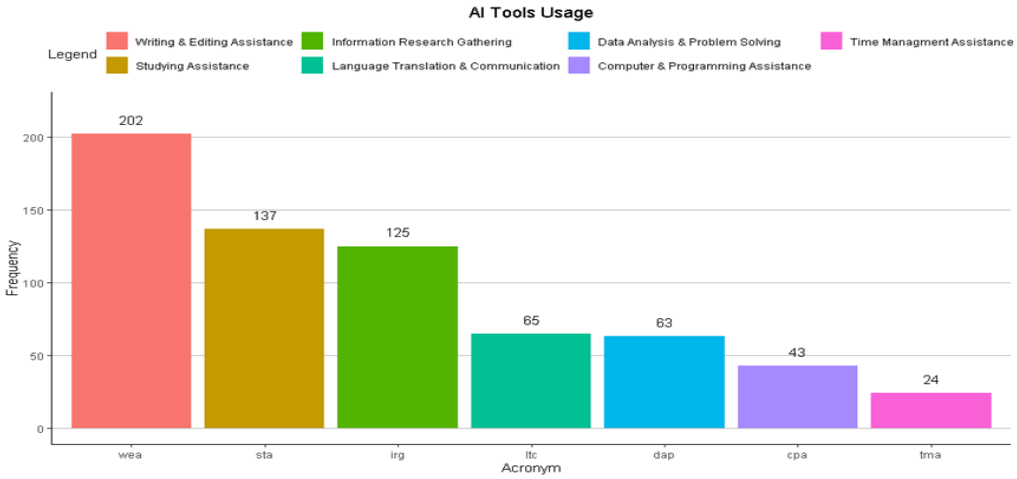


Figure 2. Bar plot showing the different ways students use AI tools for learning

3.2 Perceived Benefits: Efficiency, Accessibility, and Personalized Learning

The analysis of open-ended responses regarding the benefits of AI applications in student learning revealed several recurring themes. The word cloud in Figure 3 visually represents these benefits.

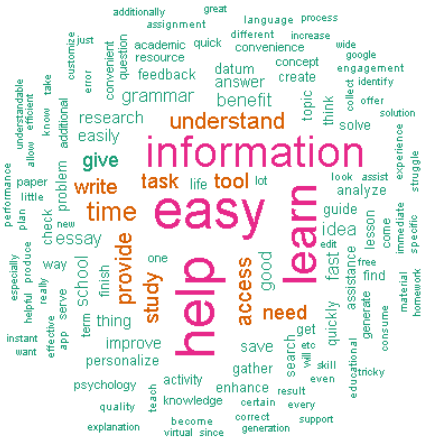
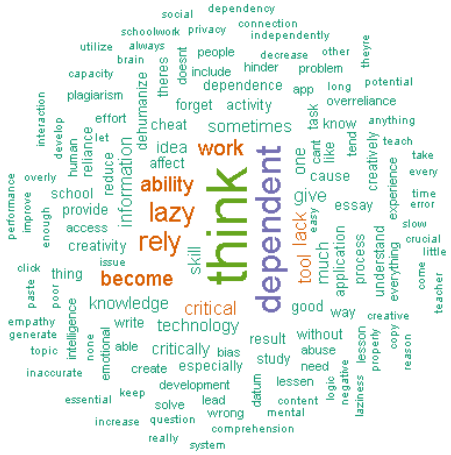


Figure 3. Word cloud visualization of AI applications' benefits to student learning

The word "easy" appeared most frequently (81 times), indicating that students appreciate the user-friendliness and efficiency of AI tools. This suggests that these tools effectively reduce the cognitive load associated with certain academic tasks, allowing students to focus on higher-order thinking and problem-solving. This is consistent with the findings of Ayanwale and Ndlovu (2024), who noted that the accessibility of AI fosters greater student engagement. Responses also emphasized the potential of AI to personalize the learning experience by providing customized feedback, adaptive learning pathways, and access to diverse resources. This suggests that students recognize the value of AI in catering to individual learning needs and promoting greater accessibility to educational content. The emphasis on personalized learning affirms Gocen and Aydemir's (2021) work, which emphasized AI's role in adaptive learning and feedback systems. These benefits indicate that AI applications are supplementary tools integral to modern educational practices.

3.3 Perceived Drawbacks: Concerns About Dependency and Critical Thinking

While students acknowledged the numerous benefits of AI applications, their responses also revealed concerns regarding potential drawbacks. The word cloud in Figure 4 visually represents these drawbacks.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4.0 Conclusion

The study confirms that AI is no longer a futuristic concept but a tangible reality for today's students. A significant majority of respondents (specifically, 187 out of 251) identified Quillbot as their primary AI tool, emphasizing the widespread adoption of AI writing assistance. ChatGPT's emergence as a versatile tool for various academic tasks, chosen by 167 respondents, further underscores this trend. These findings and the student's primary use of AI for writing and information gathering reveal how students approach academic tasks - a shift facilitated by AI's ability to streamline and enhance these processes.

While the efficiency and accessibility offered by AI tools are undeniable, student perceptions reveal a balanced perspective. While 82.87% expressed positive sentiment towards AI's effectiveness in learning, a significant portion also acknowledged potential drawbacks. Concerns regarding over-dependence and potential negative impacts on critical thinking highlight the need for a cautious and strategic approach to AI integration in education. The study's findings emphasize the importance of a pedagogical approach that balances AI's capabilities with developing essential human skills. It is crucial to leverage AI as a tool for empowerment, encouraging students to use it to enhance their learning while fostering critical thinking, problem-solving, and intellectual independence.

The key takeaway from this study is the need for a thoughtful and balanced approach to AI in education. This entails equipping students with the knowledge and skills to use AI tools effectively and ethically while fostering a learning environment that promotes critical thinking, creativity, and a deep understanding of the subject matter. By embracing this balanced perspective, educators can harness AI's transformative potential to create a more engaging, personalized, and effective learning experience for all students.

5.0 Contributions of Authors

Gwen Lei Irish P. Maala – drafting, editing, writing, data analysis, Laika Melanie D. Montoya – data analysis, encoding, writing, editing; Feliz Nicole L. Pampan – writing, editing, encoding; Erwin L. Cahapin – supervising, editing; Eleandro C. Anciro – supervising, editing; Beverly A. Malabag – supervising, editing

6.0 Funding

No funding was requested for this study.

7.0 Conflict of Interests

The authors declare no conflict of interest.

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Understanding Key Factors Affecting Online Purchasing Behavior in a Municipality in the Philippines

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Abstract. The study aimed to know the profile of the respondents and the key factors influencing the online purchasing behavior of consumers in the municipality of Bongabong. The researcher employed a descriptive-correlational survey method using a self-made questionnaire. Frequency percentage was used to determine the profile of the respondents in terms of age, gender, status, income or allowance, and frequency of online shopping. Weighted mean was utilized to determine the factors influencing online purchasing behavior, and the Chi-square test of Independence (also known as Pearson's chi-square test) to test the hypothesis of the study performance. The majority of the respondents were students and showed minimal income or allowance. At the same time, they strongly agreed that perceived usefulness, ease of use, and price influenced their online purchasing behavior. The result also indicates significant relationships between the profile of the respondents and the factors influencing online purchasing behavior.

Keywords: Ease of use; Price; Product variety; Trust; Usefulness.

1.0 Introduction

The prevalence of online buying is growing, which has an impact on customer shopping choices. Shopping in different online platforms is a rapidly growing industry because it offers customers more convenient, practical, and cost-effective ways to find a wider choice of goods than traditional retail. Due to the advent of various economic and societal circumstances, diverse consumers have switched from traditional shopping stores to online businesses. According to Li *et al*. (2020), and Frank & Peschel (2020), online-based economic growth affects shifts in consumer activities, lifestyles, and behaviors. Customers utilize the Internet to shop because they value cost savings, efficiency, and time. Additionally, they are not obliged to go to actual businesses and deal with vendors face-to-face. Customers are increasingly turning to e-commerce to buy groceries because it enables them to conduct their regular shopping through an online store and complete transactions immediately on the same platform. This trend is probably here to stay. With more people purchasing goods online, sales have reached all-time highs.

As a result, Xi et al. (2018), highlighted that the more time spent online, the more likely people are to purchase goods from online companies. Online search engines are essential for providing product connections, which promotes online purchasing. Qinghe et al. (2014), emphasized that other aspects, such as convenience, services, and pricing, may also impact people's judgments regarding the channels of purchase. Furthermore, Juniwati (2014), asserts that opinions regarding internet buying are significantly influenced by perceived utility, simplicity

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of use, and danger. Whereas perceived risk and attitude have a major impact on online purchasing, perceived utility and ease of use have little effect on the intention to shop online. While Azzam and Mahmoud (2014) assert that perceived ease of use, attitude, and perceived behavioral control are important antecedents in determining online customer behavior, there is no relevant association between trust and online buying behavior. Additionally, the development of COVID-19 was one of the global socioeconomic conditions that changed. In particular, this has affected the purchasing habits of consumers and resulted in various limitations and risks to the public's health and safety.

This is consistent with research by Enriquez (2020), which found that during the COVID-19 pandemic, customers boosted their online purchases of a wide range of products, from food to exercise equipment. Additionally, a survey found that 56% of respondents believed that more products were purchased online in Singapore during the COVID-19 pandemic, with online sales increasing to 151.2% year over year in June 2020 (Nurhayati-Wolff, 2020). Bucko et al. (2018) noted that, given the increasing rivalry among online retailers, monitoring the variables influencing prospective buyers as they proceed through the purchasing process is imperative. When businesses do not do this, they risk losing clients to rival businesses. An overview of how consumers see specific aspects of online buying is given in their study. The contribution is made by entrepreneurs (businesses) and organizations specializing in creating websites and online stores using the knowledge they have gained. Web agencies can use this information as guidance when creating new e-shops, while businesses can use it to optimize their existing stores. Agencies can also use the data to develop a customer sales plan. Additionally, according to Bucko et al. (2018), purchasing decisions are influenced by price, availability, scarcity, product information, conditions, and social media. Quality, timing, price insensitivity, loyalty, and information availability all substantially impact customer happiness, according to the findings of an empirical study on online buying. (Vasic et al., 2019; Kalyani and Reddy, 2017)

This literature supported the researcher's data and information on how consumers perceived online purchasing behavior. These written literature studies also fall similar to the current study based on the status of purchasing online during the COVID-19 pandemic. The preceding pieces of literature were somewhat related and strengthened the issues of the study in terms of the subject matters covered. The data were analyzed and interpreted to draw conclusions and recommendations. Generally, all the findings, observations, and concepts by the different authors, writers, and researchers provided the present researcher with some ideas and inputs in conducting the study. Moreover, it was the community's responsibility to respond to the various facets of development according to the Sustainable Development Goals 2030 of the United Nations, especially SDG 9, which was centered on industry, innovation, and infrastructure. According to the Our World in Data Team (2023), goal nine (9) prioritizes investing in cutting-edge technology, reducing carbon emissions, and expanding mobile broadband availability. By concentrating on analyzing customers' online purchases, the SDG can be accomplished by reducing carbon footprints and enabling the community to use internet broadband more frequently.

Also, the study is beneficial for retail establishments, particularly in the subject area, since it will provide a buyer's perspective on the factors influencing their decision-making in choosing one's product or services. Through the results undertaken, managers and operators will be able to enhance online visibility and other strategies to increase the market size and penetrate niche markets. Finally, no study has been done on the municipality's consumers' online buying habits. Therefore, the researcher recommended a study to determine the elements influencing customers' online buying behavior. In light of this, the study looked at the profile of the respondents and their characteristics, such as age, gender, income or allowance, status, and frequency of online shopping. Also, the different elements that affect their online buying decisions include perceived utility (PU), perceived ease of use (PEU), price, perceived trust, and product variety and guarantee. This study's findings will aid in understanding consumers in the Philippines and the online purchasing behaviors of customers in other Southeast Asian developing countries.

2.0 Methodology

2.1 Research Design

This study used a quantitative design. In addition, the research design of this study is descriptive-correlational.

2.2 Research Locale
The study was conducted in the Municipality of Bongabong, Oriental Mindoro, Philippines.

2.3 Research Participants
Respondents were the consumers who purchased online and lived in Bongabong. The respondents included consumers who have experienced one or more online purchases. Meanwhile, walk-in shoppers were excluded as respondents of the study. This study used a random- sampling technique to obtain an appropriate sample size from the population to infer the status of the study population. The sample size was calculated using Slovin's number. A total of four hundred (400) were the participants of the survey.

2.4. Research Instrument
The researcher developed a self-made questionnaire based on the problem statement of this study. The first part of the questionnaire was the demographic characteristics of the respondents, and the second part was the questions about the factors influencing the consumers' online purchasing behavior. The questionnaire was validated by the selected faculty members and the Dean of the Business Management program of one state university in the province. Moreover, the researchers employed a test-retest method to ensure the instrument's reliability, and this was done through a reliability test using the pilot study. The pre-test was carried out using 20 copies of the questionnaire administered to the online customers of the retail supermarkets in the province.

2.5 Data Gathering Procedure
The researcher sought approval to conduct the survey. Once approved, the participants were selected randomly, and their approval and consent were obtained before answering the questionnaire. The researcher used printed questionnaires and a Google Form link to the participants' messenger. The researcher briefly discussed the content of the questionnaire. These were retrieved face-to-face and online.

2.6 Ethical Considerations
For ethical considerations, the personal information of the respondents was kept confidential, and the data collected were solely used for research purposes.

3.0 Results and Discussion
3.1 Proflile of the Respondents
As shown in Table 1, of the overall population of 208 students, the majority (52 percent) were between 16 and 25. Next in line were those between the ages of 26 and 35 (a total of 116 students, or 29 percent). Fifty-eight, or 14.5 percent, were between 36 and 45, and the final 4.5 percent were older than 46. The result implies that the frequent customers who were ordering or buying online were younger generations compared to older individuals. This may be the technological advancements of the youth when it comes to using cellular phones and other gadgets.

Table 1. Frequency and percentage distribution of respondents in terms of age

Age	Frequency	Percentage (%)
16-25 years old	208	52%
26-35 years old	116	29%
36-45 years old	58	14.5%
46 years old and above	18	4.5%
Total	**400**	**100**

As reflected in Table 2, 242 out of 400 students, or 60.5 percent, were female, one hundred forty-two, or 35.5 percent, were male, and sixteen signified another gender for 4 percent of the total population. This implies that most of the respondents engaged in online shopping were female compared to the other gender. This is in line with the study of Assaker (2020), where perceived usefulness is the key factor for males and younger generations, while perceived ease of use holds greater significance for females and older travelers.

Table 2. Frequency and percentage distribution of respondents in terms of gender

Gender	Frequency	Percentage (%)
Female	242	60.5
Male	142	35.5
Others	16	4
Total	**400**	**100**

Table 3 presents the frequency and percentage distribution of the respondents' profiles in terms of their status. Two hundred sixty-two respondents were students, or 65.5 percent; one hundred twenty-one respondents, or 30.25 percent, claimed that they were employed, and 4.25 percent, or seventeen respondents, were unemployed. This implies that most respondents were students, and due to challenges in mobility during the crisis, their buying behavior also changed. As correlated to the study by Jilkova and Kralova (2021), consumer behavior was impacted by both the COVID-19 pandemic and the government-imposed restrictions. During the crisis, people of all generations were more inclined to purchase goods and services online. In general, there was a notable shift towards e-commerce, with an increase in the frequency of online shopping (Rios-Lama & Merino, 2021).

Table 3. Frequency and percentage distribution of respondents in terms of status

Status	Frequency	Percentage (%)
Student	262	65.5
Employed	121	30.25
Not Employed	17	4.25
Total	**400**	**100**

The respondents' income or allowance was displayed in the table. Table 4 indicates that 208 participants, or 52% of the 400 respondents, have incomes or allowances under 5,000.00. One hundred sixteen respondents, or 29% of those with incomes between 5,000 and 15,000, followed it. Additionally, fifty-eight, or 14.5 percent, had incomes between 16,000 and 25,000; thirteen, or 3.25 percent, had incomes between 26,000 and 35,000; and five out of 400, or 1.25 percent, had incomes or allowances of 36,000 or more. Given that most of the participants were students, as reflected in the results in Table 3, this statistic suggests that those who shopped online had little money or allowance. Moreover, in consonance with this, a study by Bucko et al. (2018) found that young students, most of whom have part-time jobs and limited income, prioritize factors such as product price, shipping costs, and discounts when making purchasing decisions. Given their restricted budgets, they believe consumers are not just looking for the cheapest option but the product that best meets their needs.

Table 4. Frequency and percentage distribution of respondents in terms of income or allowance

Income or Allowance	Frequency	Percentage (%)
Below 5,000	208	52
5000-15000	116	29
16000-25000	58	14.5
26000- 35000	13	3.25
36 000 and above	5	1.25
Total	**400**	**100**

As noted in Table 5, most respondents had performed online shopping more than once a week, with a total population of one hundred sixty or 40 percent. This was followed by the frequency of online shopping, more than once a month, of one hundred four participants, with 26 percent. Next, participants indicated their online shopping frequency once a week at one hundred or 25 percent, twenty-three, or 5.75 percent daily. Lastly, 3.25 percent of thirteen participants had online shopping once a month. This indicates that the frequency of online shopping in the province has somehow appeared to have subsequently changed. This brought challenges to the operators and managers of the selected retail establishments. This is associated with the study of Islam et al. (2021), where the shift in shopping behavior during the pandemic prompted many companies to reassess their business strategies and consider new situational factors influencing consumer purchasing decisions to retain existing customers and attract new ones.

Table 5. Frequency and percentage distribution of respondents in terms of frequency of online shopping

Frequency of Online Shopping	Frequency	Percentage
Every day	23	5.75
Once a week	100	25
More than once a week	160	40
Once a month	13	3.25
More than once a month	104	26
Total	**400**	**100**

3.2 Factors Influencing Online Purchasing Behavior

In terms of Perceived Usefulness

As reflected in Table 6, participants Strongly Agreed that perceived usefulness influenced their online purchasing behavior, with an overall weighted mean of 3.56. The health and safety of the consumers motivated by shifting from offline to online shopping has the highest composite mean of 3.87. This implies that the participants strongly agreed that health and safety are top priorities when purchasing online. This result was consistent with the study of Warganegara and Babolian-Hendijani (2022), where the COVID-19 situation was an unpredictable push factor for Indonesians to purchase groceries through online platforms in terms of the usefulness of purchasing groceries online; the respondents mentioned the convenience and time-saving aspects of these platforms. It is possible to conclude that online platforms must incorporate these aspects into their services and effectively express them in their marketing strategies.

Table 6. Factors influencing online purchasing behavior in terms of perceived usefulness

Items	Mean	Interpretation
1. Concerns about consumer safety and health are the main drivers of the shift from offline to online shopping.	3.87	Strongly Agreed
2. Online purchasing is more convenient and time-efficient than traditional retail.	3.52	Strongly Agreed
3. The delivery service encourages consumers to buy products online.	3.46	Agreed
4. The availability of services for returns, refunds, and feedback influences customers' purchasing decisions.	3.38	Agreed
Composite Mean	**3.56**	**Strongly Agreed**

In terms of Perceived Ease of Use

The participants Strongly Agreed that the perceived ease of use has influenced their online purchasing behavior, as shown in Table 7. It has an overall mean of 3.62, which is a verbal interpretation of Strongly Agreed. With a weighted mean of 3.72, the table shows that most participants strongly agreed that products and services are easier to find online than in physical stores. Additionally, it was demonstrated that there are fewer communication barriers when shopping online (3.59), that the payment method is more effective when shopping online (3.61), and that using technology and online platforms makes shopping easier than in traditional physical stores (3.56). All of these suggested a linguistic meaning of "strongly agreed." the perceived ease of use denotes perceptions concerning "the process leading to the outcome." As suggested by Nguyen-Viet et al. (2017), the benefits of perceived ease of use in e-commerce include ease of ordering at any time and from any location, perceived ease of information searching, and overall ease of use.

Table 7. Factors influencing online purchasing behavior in terms of perceived ease of use

Items	Mean	Interpretation
1. Unlike conventional businesses, products and services are easier to find online.	3.72	Strongly Agreed
2. Using technology and internet platforms facilitates buying more easily than traditional physical enterprises.	3.56	Strongly Agreed
3. The simplicity of use of online buying reduces the likelihood of communication hurdles.	3.59	Strongly Agreed
4. When shopping online, the payment method is more effective.	3.61	Strongly Agreed
Composite Mean	**3.62**	**Strongly Agreed**

In terms of Price

As shown in Table 8, the study findings show that price has a weighted mean of 3.55 with a verbal interpretation of Strongly Agreed. As the table illustrates, participants' online purchasing behavior was impacted by their financial skills, as seen by the highest mean score of 3.7 with a verbal interpretation of Strongly Agreed. It was followed by purchasing decisions influenced by price comparisons between brands and online retailers (3.58), and the degree to which online retailers' price promotions impact customers' purchasing decisions (3.53), both of which have a verbal meaning of "Strongly Agreed." However, with a weighted mean of 3.47, participants concurred that price information in online stores is a motivating element when making an online purchase. The findings of Nittala (2015) support this perspective, as the study involved 1,500 internet users from six major cities in India. The regression analysis results showed that perceived risk, price, and promotion have the most significant positive effect on consumers' purchasing decisions.

Table 8. Factors influencing online purchasing behavior in terms of price

Items	Mean	Interpretation
1. The degree to which internet retailers heavily advertise their prices affects the decisions of their customers.	3.53	Strongly Agreed
2. One of the driving forces behind online purchases is price information.	3.47	Agreed
3. Price comparisons between various brands and internet retailers influence purchasing decisions.	3.58	Strongly Agreed
4. Financial skills have an impact on online buying habits.	3.70	Strongly Agreed
Composite Mean	**3.55**	**Strongly Agreed**

In terms of Perceived Trust

As shown in Table 9, the factor that influenced the online purchasing behavior of the participants in terms of perceived trust obtained a complete mean of 3.37 with a verbal interpretation of Agreed. The result shows that the majority of the participants Strongly agreed that their previous experience in online shopping impacts future purchasing decisions. It has the highest composite mean of 3.81. According to Escobar-Rodríguez et al. (2017), and Sarkar et al. (2020), trust disposition is a person's inclination to trust or distrust. It is linked to personal characteristics influenced by their experiences, cultural background, or educational attainment.

Table 9. Factors influencing online purchasing behavior in terms of perceived trust

Items	Mean	Interpretation
1. Customers place a high value on the products' dependability and authenticity when they shop online.	3.74	Strongly Agreed
2. Internet sites protect the privacy and security of personal data.	3.43	Agreed
3. Previous online buying experiences impact future purchases.	3.81	Strongly Agreed
4. Online buying offers a more secure payment method than traditional retail establishments.	2.47	Disagree
Composite Mean	**3.37**	**Agreed**

Moreover, with a weighted mean of 3.74, the majority of them strongly agreed that the authenticity and dependability of the products displayed in online stores are significant aspects to consumers. With a weighted mean score of 3.43, participants concurred that online websites protect the privacy and security of personal information. On the other hand, it is interesting that participants disagreed that payment is more secure in online shopping compared to physical stores, with a low mean score of 2.47. This finding correlates with the study of Grégoire et al. (2017); while online payment methods are quick and efficient, they also save customers much time by avoiding having to wait in line at the bank to make a transaction or visit a particular store and spend much time searching for the desired product. However, there is a security risk associated with these methods, so customers are hesitant to use this new digital payment platform.

In terms of Product Variety and Guarantee

As reflected in Table 10, the product variety and guarantee acquired a total composite mean of 3.45, which implied that participants agreed that these two factors have influenced their online purchasing behavior. Online retailers with product characteristics that meet the demands and preferences of their customers and encourage them to make purchases online are the items with the highest weighted mean score of 3.67, which is vocally translated as strongly agreed. The participants verbally interpreted the following points as agreed upon: online shopping provides a wide range of products (3.23); online stores' product reviews guarantee product quality (3.45); and online stores enable comparisons of goods and services and their reviews with those of traditional stores (3.47).

Table 10. Factors influencing online purchasing behavior in terms of product variety and guarantee

Items	Mean	Interpretation
1. One benefit of shopping online is the large assortment of goods available.	3.23	Agreed
2. Product reviews in online merchants served as a guarantee of product quality.	3.45	Agreed
3. Online retailers encourage customers to purchase by providing product attributes that satisfy their needs and desires.	3.67	Strongly Agreed
4. Compared to traditional storefronts, online retailers offer a comparison of goods and services and customer reviews.	3.47	Agreed
Composite Mean	**3.45**	**Agreed**

Similarly, Liu et al. (2008) and Chen et al. (2012), discovered that delivery performance and product variety were significant factors influencing online purchasing satisfaction. This demonstrates that prompt delivery and giving customers a large selection of products are important strategic considerations for online management. Online merchants ought to offer a range of product delivery choices in addition to flexible order fulfillment (Vakulenko et al., 2019; Xiao et al., 2018).

3.3 Relationship Between the Profile and the Perceived Factors Influencing Online Purchasing Behavior

Table 11 presents the Pearson correlation that determines the significant relationship between the profile of the respondents and the perceived factors that influence online purchasing behavior. The results showed a significant relationship between the age profile and the perceived usefulness with a computed p-value of <0.001, and product variety and guarantee with a computed p-value of 0.005. This means that there was a direct link between the age of the respondents and the perceived influence of usefulness, product variety, and guarantee on their online purchasing behavior. On the other hand, ease of use, price, and trust (0.409, 0.78, 0.056) have shown no significant relationship between the age of the respondents and their online purchasing behavior.

Table 11. Correlation analysis between the profile of the respondents and the factors that influence online purchasing behavior

Variables		**χ2 value**	**p-value**	**Interpretation**
Age	Usefulness	52.75	<0.001	Significant
	Ease of Use	9.314	0.409	Not Significant
	Price	6.820	0.780	Not Significant
	Trust	12.27	0.056	Not Significant
	Product Variety and Guarantee	18.36	0.005	Significant
Gender	Usefulness	36.58	<0.001	Significant
	Ease of Use	40.93	<0.001	Significant
	Price	21.79	<0.001	Significant
	Trust	5.509	0.239	Not Significant
	Product Variety and Guarantee	89.35	<0.001	Significant
Status	Usefulness	35.75	<0.001	Significant
	Ease of Use	48.62	<0.001	Significant
	Price	30.45	<0.001	Significant
	Trust	2.579	0.631	Not Significant
	Product Variety and Guarantee	85.51	<0.001	Significant
Income or allowance	Usefulness	55.74	<0.001	Significant
	Ease of Use	49.17	<0.001	Significant
	Price	9.263	0.055	Not Significant
	Trust	13.34	0.101	Not Significant
	Product Variety and Guarantee	58.24	<0.001	Significant
Frequency of online shopping	Usefulness	43.67	<0.001	Significant
	Ease of Use	29.11	0.004	Significant
	Price	20.75	<0.001	Significant
	Trust	19.10	0.014	Significant
	Product Variety and Guarantee	21.73	0.005	Significant

Based on the results, it was shown that gender, as well as status, have a significant relationship with the factors that influenced the respondents' online purchasing behavior in terms of its usefulness, ease of use, price and product variety, and guarantee with a computed p-value of <0.001 respectively. This implied that based on the respondents' gender, the above-mentioned factors significantly influenced the respondents' online purchasing behavior. Consequently, trust has shown no significant relationship with the respondents' gender, with a computed p-value of 0.239.

Moreover, the income or allowance of the respondents has a significant relationship with the influence of online purchasing behavior in terms of usefulness, ease of use, product variety, and guarantee with a computed p-value of <0.001. Considering price and trust, no significant relationship has been found with computed p-values of 0.055 and 0.101. Lastly, the frequency of online shopping has shown a significant relationship with the different factors influencing online purchasing behavior. These are the usefulness, ease of use, price, trust and product variety, and guarantee which all have a greater p-value of 0.001.

4.0 Conclusion

The majority of the respondents were students and showed minimal income or allowance. The factors that respondents strongly agreed to have influenced them in online purchasing behavior were perceived usefulness, ease of use, and price. Moreover, age has shown a significant relationship between the usefulness and product variety in online stores; gender and status with usefulness, ease of use, price, and product variety and guarantee; income with usefulness, ease of use, and product variety, and guarantee. The frequency of online shopping has shown a direct link with all the factors influencing online purchasing behavior.

It is recommended that online stores continuously scan their consumers' profiles. It is also encouraged to have mechanisms and systems that will monitor and evaluate the factors influencing the purchasing behavior of consumers. Further, it is encouraged to consider the profile differences and preferences of the customers for the implementation of their operations and services. Also, managers and operators should consider enhancing the services that will secure the personal information of their consumers and the reliability of the payment processes. Future researchers may also replicate this study. Additional factors influencing consumers' online purchasing behavior should be considered.

5.0 Contribution of Authors

The sole author reviewed the final content of the paper.

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7.0 Conflict of Interest

The author declares no conflicts of interest about the publication of this paper.

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Challenges and Coping Strategies of Senior High Students and Teachers: Informing Academic Policies during the Pandemic

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Abstract. The study sought to investigate the extent of problems encountered and the coping mechanism of the 206 students and 22 teachers of the MSU-TCTO Senior High School in terms of distribution, submission, and collection of learning materials/modules, content-related issues in the module, student-teacher communication, learning materials and resources and flexibility during a pandemic. A researcher-made questionnaire with two parts containing checklists and open-ended questions was used. The data obtained were analyzed using the mean rating for the problems encountered, and the coping mechanisms were also identified. This study found that students and teachers rarely encountered problems with distributing, submitting, and collecting learning materials/modules and student-teacher communication. The students sometimes encountered problems with content-related issues in the module, including a lack of examples provided in the module and undetailed and unexplained lessons. In terms of learning materials and resources, they sometimes encountered problems such as poor internet connection, and in terms of flexibility, they experienced emotional stress during a pandemic. The teachers rarely encountered problems with these variables. Other problems among senior high school students and teachers were the lack of focus and the numerous modular activities. Teachers' and students' common coping mechanisms were time management and taking breaks during the pandemic.

Keywords: Academic guidelines; Coping mechanism; Pandemic; Problems encountered; Senior high school.

1.0 Introduction

All agencies in the country and the world have been badly affected. The COVID-19 Pandemic is caused by a retrovirus that spreads quickly and affects many individuals. The ravage brought by the spread of the COVID-19 virus left both sectors of the government and non-government organizations in the world unprepared. Most, if not all, have been vulnerable to the pandemic outbreak. UNESCO (2020) states that the education sector is one of the most affected agencies during the pandemic. The coronavirus has caused a dramatic disruption in the delivery of education and health services in the Philippines. Different government sectors and human beings have also been working to fight and, at least, to reduce the threats and risks brought by the pandemic. Wearing face masks,

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home quarantine, social distancing, getting vaccinated, and the like became the norm in all areas. Moreover, the Inter-Agency Task Force (IATF), a government sector in charge of assessing and evaluating the health situation of the area and disseminating information, has been working hard to protect and secure the community.

In order to prevent and lessen the spread of the virus, various safety measures have been implemented by the Inter-Agency Task Force (IATF) to protect teachers', students', and parents' health and welfare while continuing the teaching and learning process in the country (Anzaldo, 2021). Because of the unforeseen effects of the COVID-19 virus, various education sector strategies were also implemented to continue student learning. Before the pandemic, the teaching and learning setup took place mostly in the four corners of the classrooms and were managed by teachers. Whatever teaching and learning styles were adopted must have occurred in school. Due to the advancement of digital technology, the traditional setup of education in the country has suddenly changed. The usual venue for teaching-learning has become 'empty. Many innovative teaching and learning strategies with the aid of technology have been applied, and different learning modalities have been adopted.

Kim (2020), as cited in the work of Manalo and De Villa (2020), revealed in her study that globally, many schools have already replaced traditional classroom setups with innovative, flexible learning strategies. Moreover, most countries worldwide are focused on starting the new school year within the new normal of teaching and learning without depriving the students of their right to quality education. (Ancheta and Ancheta, 2020). Learning must continue to shape the future of the youth. Innovative educational strategies, such as the modular approach, limited face-to-face, and blended learning instruction, must be developed and applied. The Mindanao State University – Tawi Tawi College of Oceanography and Technology (MSU-TCTO) and other schools in Tawi-Tawi have also adopted feasible plans and strategies for instruction during the pandemic. Different strategies are used for a common purpose- to maximize learning.

The MSU-TCTO Senior High School offers academic programs such as General Academic Strands (GAS), Science, Technology, Engineering and Mathematics Strands (STEM), and Humanities and Social Sciences Strands (HUMSS). It is located in Bongao and extended to other island municipalities of Tandubas, Sibutu, and Mapun, Tawi-Tawi. The Senior High School -Science High (SHS) offers a STEM strand, while the Integrated Laboratory School –Prep High (ILS-Prep) has GAS and HUMSS strands. On the other hand, the College of Arts and Science (CAS) extension Senior High Schools in Sibutu, Mapun, and Tandubas are offering GAS, STEM, and HUMSS strands, respectively. The implementation of the MSU-TCTO Senior High Schools started in the academic year 2017-2018.

Just like the other schools in the country, no single learning method is appropriate for learners' varying characteristics. Despite the many strategies and techniques implemented in MSU-TCTO, there are still problems encountered by the students and teachers that need to be addressed in order to maximize learning. Thus, this study was conceptualized. This study provides valuable insights into the challenges students and teachers face in adapting to the new learning environment. It is crucial to develop effective academic guidelines that can support their educational needs. Further, this study might be used to promote the adoption of effective coping strategies and to provide resources and training to enhance resilience among teachers and students.

2.0 Methodology

2.1 Research Design

This study utilized the quantitative and qualitative research design to gather the data needed. A quantitative research design was used to interpret the data statistically, while a qualitative research design was used to describe the indicator variables. These research designs were used to determine the problems encountered and coping mechanisms of the Senior High School students and teachers through survey questionnaires and open-ended questions.

2.2 Research Locale

This study was conducted at the Mindanao State University –Tawi Tawi College of Technology and Oceanography in Barangay Tubig Mampallam, Bongao, Tawi-Tawi, where the two Senior High Schools are located. The two MSU-TCTO Senior High Schools involved in this study were the MSU-TCTO Integrated Laboratory School -High School Department (ILS-HSD) and the MSU-TCTO Science High School (SHS). The

Integrated Laboratory School -High School Department (ILS-HSD), specifically its Senior High School, offers the Humanities and Social Sciences Strand (HUMSS) and General Academic Strands (GAS), while the Science High School offers Science, Technology, Engineering, and Mathematics (STEM) strand. Just like the other schools in Tawi-Tawi, the problems thought to have been encountered by these schools were similar to those of the other schools in the province. Thus, they can serve as representative schools of the municipality if not the province. Also, the location of the study was purposively selected due to the travel restrictions, accessibility, health protocols, and distance between the threats and risks of the pandemic situation.

2.3 Research Participants

The respondents of this study were two hundred six (206) Senior High School students and twenty-two (22) Senior High School teachers of Grades 11 and 12 under the Senior High School strands, namely General Academic Strand (GAS), Science, Technology, Engineering and Mathematics Strand (STEM) and Humanities and Social Sciences Strand (HUMSS) of the Mindanao State University- Tawi Tawi College of Oceanography and Technology of the school year 2021-2022.

A stratified sampling technique, which was defined as a method of sampling that involves the division of a population into smaller subgroups, was used to select the sample of respondents in this study from the total population. Under each grade level and strand, the student respondents were stratified and purposely selected to represent the needed sample size from the total population. The student respondents were selected by their year level, grade sections, and strands. Out of four hundred fifty-five (455) of the total population, two hundred six (206) were considered a sample of student respondents with a 5.15% margin of error using Slovin's formula. There were two hundred forty-six (246) Grade 11 and two hundred twelve (212) Grade 12 students in the population. Also, for the teachers, there were twenty-two (22) Senior High School teachers available as respondents. Out of the total population, a number of students needed in the study under each strand and grade level who reside in the Bongao area were asked by their advisers to come to school for the survey. Also, the teacher-respondents and the faculty who teach in the senior high school were asked to be present during the survey questionnaires.

2.4 Research Instrument

A research instrument used in this study was a researcher-made questionnaire- checklist. The first part of the questionnaire -checklist was about the problems encountered, and the third part was about the coping mechanisms. The 1st part of the questionnaire is a closed-ended checklist in which students and teachers were asked to indicate their problems encountered other than what was mentioned in the survey questionnaires. The 2nd part was an open-ended questionnaire to give the respondents a freeway to express their coping mechanisms. This part may be answered in whatever language or dialect they may feel more comfortable expressing their thoughts based on their experience. For the instrument's validity, the researcher-made questionnaire checklist was validated by the panel of experts. The panel was asked to comment and give suggestions and recommendations on the clarity and coherence of each item to ensure that the level of questioning and the terms used were appropriate or suitable for the respondents. Furthermore, the instrument's reliability was calculated using Cronbach's Alpha and found at 0.930.

2.5 Data Gathering Procedure

Prior to the distribution of the questionnaires, a letter of communication was sent to the head of the school (Deans, Principals, and Class Advisers) to seek their permission and consent. Information such as the number of students enrolled and teachers was requested. The teachers and student respondents were also requested to be present during distributing the questionnaire checklist. Upon approval, the questionnaires were distributed to the students with the help and assistance of the school principal and class advisers. Safe and healthy protocols like proper wearing of masks and social distancing were strictly observed in the data-gathering procedure. The data gathering among the respondents was conducted in batches and was limited in each classroom. The advisers were also tapped to explain the process of distributing and collecting the questionnaires to the students. The goals and objectives of the study and the manner of distribution and retrieval of the instrument being conducted were also explained to the students. Queries were answered, and the date of questionnaire collection was made clear.

Teachers involved in this study were also informed, and the questionnaire checklist was distributed in the faculty room. Twenty-two (22) Senior High School teachers participated as teacher-respondents. All of the teacher-

respondents were present in one room while the survey was conducted. The assistant principal also helped distribute and collect the data.

Then, for the statistical treatment of the data, the researcher asked the statistician for help tabulating and analyzing the gathered data using statistical tools. Statistical tools such as Mean response to determine the extent of problems encountered by the Senior High School students and teachers were utilized for computations, analysis, and interpretation of the data. Also, differences and similarities were presented, tabulated, and analyzed for the coping mechanisms of both students and teachers.

2.6 Ethical Considerations

For the ethical considerations, this research followed ethical guidelines before this study was conducted. The respondents' permission was sought, and they were briefed about the purpose of the study. In order to guarantee anonymity, secrecy, and the avoidance of harm, all information was handled and held with utmost confidentially by not disclosing the names and identifying the research participants by RA 10173, generally known as the DA Privacy Act.

3.0 Results and Discussion

3.1 Challenges Encountered by Students and Teachers

In terms of Distribution, Submission, and Collection of Modules

Table 1 presents the mean scores of the extent of problems encountered by the students on the distribution, submission, and collection of learning materials/modules. When the student respondents were asked about the problems with the distribution, submission, and collection of learning materials/modules, they responded that they sometimes encountered problems such as unreturned outputs, late submission of outputs, and difficulty adjusting to this new teaching-learning setup. On the other hand, they rarely encountered problems with the delay of the distribution of modules and non-flexible modes of submission and collection of output on time. The students rarely encountered problems with the distribution, submission, and collection of their learning modules, with an average mean of 2.46.

Table 1. Challenges encountered by students in terms of distribution, submission, and collection of modules

Indicators	Mean	Interpretation
1. There is a delay in the distribution of modules	2.34	Rarely
2. Only one type of learning module is distributed.	1.89	Rarely
3. The mode of submission/collection of output is not flexible.	1.99	Rarely
4. Checked/ graded output is not returned.	2.87	Sometimes
5. Only one form of submission of output is allowed.	1.92	Rarely
6. Late submission of output is accepted, but points are deducted.	2.70	Sometimes
7. Teachers do not have time to return the outputs/papers of their students.	2.79	Sometimes
8. It is not easy to adjust to this new teaching-learning setup.	3.33	Sometimes
9. Submitting and collecting learning packets are difficult for students.	2.49	Rarely
10. Students' outputs are strictly submitted on time.	2.27	Rarely
Overall Mean	**2.46**	**Rarely**

Legend: 4.5 – 5.49 Always; 3.5 – 4.49 Oftentimes; 2.5 – 3.49 Sometimes; 1.5 – 2.49 Rarely; 1.0 - 1.49 Never

The above result is similar to the study of Dangle & Sumaoang (2020), which was on the problems encountered in submitting modules to the fifteen students from selected schools in San Gabriel, La Union, and Baguio City, Benguet. The study also revealed that modules were submitted late, and most items were unanswered. With eight modules and 3 to 5 activities to be accomplished in a week, students had difficulty accomplishing the requirements. Some learners could not finish their modules on time or did not answer all questions because they had other chores to be done for the family at home.

Table 2 describes the extent of the problems encountered by the teachers in the distribution, submission, and collection of learning materials/modules. Data show that the teacher-respondents sometimes encountered problems such as insufficient time allocated to checking students' outputs and that they experienced difficulty in adjusting to the new teaching-learning set-up. However, most of them rarely encountered problems with the delay of distribution of modules, non-flexible mode of submission and collection of output, late submission of outputs by the students, and difficulty in the distribution and collection of learning packets. Generally, the extent of

problems teachers encounter in the distribution, submission, and collection of learning modules is rarely encountered, with an average mean of 2.24.

Table 2. Challenges encountered by teachers in terms of distribution, submission, and collection of modules

Indicators	Mean	Interpretation
1. There is a delay in the distribution of modules	2.32	Rarely
2. Only one type of learning module is distributed.	2.05	Rarely
3. The mode of submission/collection of output is not flexible.	2.0	Rarely
4. Checked/ graded output is not returned.	2.87	Sometimes
5. Only one form of submission of output is allowed.	1.86	Rarely
6. Late submission of output is accepted, but points are deducted.	2.14	Rarely
7. Teachers do not have time to return the outputs/papers of their students.	2.27	Rarely
8. It is not easy to adjust to this new teaching-learning setup.	2.77	Sometimes
9. Submitting and collecting learning packets are difficult for students.	2.09	Rarely
10. Students' outputs are strictly submitted on time.	2.23	Rarely
Overall Mean	**2.24**	**Rarely**

Legend: 4.5 – 5.49 Always; 3.5 – 4.49 Oftentimes; 2.5 – 3.49 Sometimes; 1.5 – 2.49 Rarely; 1.0 - 1.49 Never

The above result is similar to the study of Agayon *et al*. (2022) and that of Castroverde & Acala (2021), which revealed that teachers encountered problems with the late submission of outputs and incomplete answers. This may be due to the numerous tasks provided in each module. The data also showed that late module claims caused additional burdens to teachers. In addition, the study by Tsang *et al*. (2021) also revealed that there was adversity in the module distribution, erroneous modules, loss of interest among students, and resistant parents in fulfilling roles supporting their child's education. These challenges include the adversity in the distribution of modules.

In terms of Content Issues in the Module

Table 3 shows the extent of the problems encountered by the students on content-related issues in the module. On the content-related issues in the module or learning package, the students agreed that they sometimes encountered problems such as a lack of examples provided in the module, undetailed and not well-explained lessons, unclear instructions, numerous modular activities, and lack of prior knowledge on the topics. However, they rarely encountered problems with insufficient time allocated to accomplish a task in the module, concepts /topics not being organized, unclear words being written in modules, and difficulty in presenting the lessons. In totality, the extent of the problem students encounter with content-related issues in modules is sometimes encountered with an average mean of 2.60.

Table 3. Challenges encountered by students in terms of content issues in the modules

Indicators	Mean	Interpretation
1. There is an inadequacy of examples for each topic in the module.	2.90	Sometimes
2. Lessons are not detailed and well-explained.	2.78	Sometimes
3. Instructions are unclear and not understandable.	2.61	Sometimes
4. The amount of time allocated to accomplish a task is insufficient.	2.44	Rarely
5. Activities in all subjects consume much of my time.	2.66	Sometimes
6. Concepts /topics are not organized.	2.01	Rarely
7. There is a need for a thorough explanation of the concept.	2.85	Sometimes
8. Students lack prior knowledge of the given topics.	2.99	Sometimes
9. Words written in modules are unclear.	2.33	Rarely
10. Students find teachers difficult in presenting the lessons.	2.43	Rarely
Overall Mean	**2.60**	**Sometimes**

Legend: 4.5 – 5.49 Always; 3.5 – 4.49 Oftentimes; 2.5 – 3.49 Sometimes; 1.5 – 2.49 Rarely; 1.0 - 1.49 Never

The result is similar to the study of Pastore *et al.* (2021) on module content issues, which revealed that students also encountered problems with unclear instructions, numerous activities in the module that could not be completed within the allotted time, and difficult-to-understand lessons that they had to learn on their own. Gueta & Janer (2021) also conducted a similar study on the thirty students of Bulan North Central School of Barangay Aquino, Bulan, Sorsogon, on the Distance Learning Challenges of the Use of Self-Learning Module. The data showed that not enough examples were provided in the modules, so students had difficulty understanding the lessons.

Also, in the study by Dangle & Sumaoang (2021) conducted among fifteen students of San Gabriel, La Union, and Baguio City, Benguet, on problems encountered in the new learning modality, it was found that the late submission of modules and difficulty adjusting to the new learning modality were the most common problems

encountered. Hence, 90% of the participants had difficulty answering their modules. Similarly, Pastore *et al*. (2021) conducted a study among fifteen high school students of different selected schools of Diffun, Quirino; findings revealed that students found difficulty in learning these lessons when modules served as their only learning tool and an inexperienced student, the content was hard to comprehend.

Table 4 describes the extent of problems teachers encounter with content-related issues in the module. Data manifest that the teachers agreed that they sometimes encountered problems such as students' difficulty following instructions, insufficient materials to print the modules/ learning materials, lack of prior knowledge of students on the topics, and difficulty understanding the module's content. However, they rarely encountered problems with a lack of references in the presentation of lessons, not well-presented lessons due to lack of access to the internet, inadequate amount of time allocated to accomplish a task in the module, unorganized topic/concepts, unclear printed modules/ learning packets, and difficulty of teachers in presenting the lessons. The average mean of 2.40 manifests that teachers rarely encountered content-related issues in the modules,

Table 4. Challenges encountered by teachers in terms of content issues in the modules

Indicators	Mean	Interpretation
1. There is a lack of references in the presentation of lessons.	2.27	Rarely
2. Lessons are not well-presented due to lack of access to the internet.	2.27	Rarely
3. Students do not follow instructions well.	3.18	Sometimes
4. The amount of time allocated to accomplish a task in the module is inadequate.	2.0	Rarely
5. Materials (e.g., printer, ink, etc.) to print the modules/ learning packets are insufficient.	3.23	Sometimes
6. Concepts /topics are not organized.	1.68	Rarely
7. Modules/ learning packets are not clearly printed.	1.68	Rarely
8. Students lack prior knowledge of the given topics.	2.82	Sometimes
9. Students hardly understand the content of the module.	2.64	Sometimes
10. Teachers find it difficult to present the lessons.	2.32	Rarely
Overall Mean	**2.40**	**Rarely**

Legend: 4.5 – 5.49 Always; 3.5 – 4.49 Oftentimes; 2.5 – 3.49 Sometimes; 1.5 – 2.49 Rarely; 1.0 - 1.49 Never

The above result is similar to the study of Gueta & Janer (2021), Alvarez (2021), and Agayon *et al.* (2021) on module contents. Their studies revealed that teachers encountered problems with their students' difficulty following the instructions in the modules. In addition, the module contents are hard to understand and very lengthy, and the students have difficulty answering them. Agayon *et al.* (2021) also revealed that limited resources were among teachers' major problems. In this study, teachers have no choice but to find ways to prepare learning materials, especially printed modules. Teachers were challenged because of the lack of resources. As a result, several teachers utilized their own money to purchase printers, bond papers, etc., for their classes.

In terms of Communication

Table 5 presents the extent of the problems encountered by students in student-teacher communication. Data reveal that the students all rarely encountered problems such as unapproachable teachers, first-hand information, unanswered student queries, late responses of teachers, students' awareness of the subject descriptions, the use of radio and other multimedia among teachers, and non-encouragement of online participation, were the problems encountered on the student-teacher communication during a pandemic. This is indicated by the average mean of 2.24.

Moreover, Adnan & Anwar (2020), who conducted a similar study among one hundred twenty-six students of a university in Pakistan, revealed that lack of proper interaction and contact with students and instructors, lack of access to internet facilities, and ineffective technology were the challenges faced by students in the new normal. Also, the studies of Gueta & Janer (2021) and Dangle & Sumaoang (2021) on student-teacher communication conducted among thirty and fifteen students of Bulan North Central School at Barangay Aquino, Bulan, Sorsogon and of San Gabriel, La Union, and Baguio City, Benguet, respectively, revealed that teachers were approachable but responded to student queries late.

Table 5. Challenges encountered by students in terms of communication

Indicators	Mean	Interpretation
1. Teachers are hard to approach.	2.42	Rarely

2. Only first-hand information is allowed on the subject.	2.13	Rarely
3. Internet–assisted form of communication is encouraged.	2.26	Rarely
4. Student queries are not entertained.	2.25	Rarely
5. Answers to questions are given but late.	2.41	Rarely
6. It is hard to contact the teacher.	2.33	Rarely
7. Students are unaware of the description and expectations in the subject.	2.42	Rarely
8. Students' concerns are addressed only during consultation hours.	2.15	Rarely
9. Teachers use radio and other multimedia programs to accommodate students who do not have access to Android or cellular phones.	1.96	Rarely
10. Participation during (online classes, chat rooms, and the like) are not encouraged.	2.11	Rarely
Overall	**2.24**	**Rarely**

Legend: 4.5 – 5.49 Always; 3.5 – 4.49 Oftentimes; 2.5 – 3.49 Sometimes; 1.5 – 2.49 Rarely; 1.0 - 1.49 Never

Table 6 presents the extent of problems encountered by teachers in student-teacher communication. Data show that all of the teachers rarely encountered problems such as student consultation with teachers, showing no concern of students about the lessons, difficulty in contacting their students, students' awareness of the subject descriptions, the use of radio and other multimedia among teachers, and discouragement of online participation. This is manifested by the average mean of 1.97.

Table 6. Challenges encountered by teachers in terms of communication

Indicators	Mean	Interpretation
1. Students have consultation time with teachers.	1.86	Rarely
2. Internet-assisted form of communication is encouraged.	1.91	Rarely
3. Students show no concern about the lessons.	2.36	Rarely
4. Students' queries are entertained through texts, calls, and messenger.	1.5	Rarely
5. Students' answers to questions are addressed.	1.5	Rarely
6. It is hard to contact the students.	2.18	Rarely
7. Students are unaware of the description and expectations in the subject.	2.36	Rarely
8. Students' concerns are addressed only during consultation hours.	1.81	Rarely
9. Teachers use radio and other multimedia programs to accommodate students who lack access to cellular or Android phones.	2.36	Rarely
10. Participation during (online classes, chat rooms, and the like) is not encouraged.	1.86	Rarely
Overall Mean	**1.97**	**Rarely**

Legend: 4.5 – 5.49 Always; 3.5 – 4.49 Oftentimes; 2.5 – 3.49 Sometimes; 1.5 – 2.49 Rarely; 1.0 - 1.49 Never

This study is comparable to the study of Jamon *et al.* (2021) and Tosun *et al*. (2021), whose studies revealed that teacher-student communication is difficult in the new normal. In addition, students said that the teachers were approachable, but their response to students' queries regarding their lessons came late, as revealed in the study by Gueta & Janer (2021).

In terms of Learning Materials and Resources

Table 7 shows the extent of the problems encountered by students on learning materials and resources. Data shows that students often encounter problems with internet access. They sometimes encountered problems such as the unavailability of materials needed to supplement the available learning materials to understand the topic, more time needed for the subject, and the use of mobile data or WIFI to research. However, they rarely encountered problems with the non-provision of video clips, PowerPoint presentations, and other printed materials that are useful for the subject, the use of multimedia among teachers for teaching, and the use of online group activities to encourage student interactions. The average mean of 2.86 indicates that the extent of problems students encounter with learning materials and resources is sometimes encountered. The above result is similar to the study of Gurajena *et al*. (2021), Aboagye *et al.* (2020), Oyedotun (2020), Alvarez (2020), and Dangle & Sumaoang (2020), which reveal that students encountered difficulty with poor or slow internet access in the new normal.

In addition, the study of Aboagye et al. (2020) also reveals that issues among students in Ghana's tertiary institutions, including internet connectivity and using compatible smartphones and laptops, have been identified as problems encountered among students. Furthermore, Alvarez (2020), who conducted a study among twelve students from selected universities in Luzon, revealed that problems such as students' financial limitations, lack of technological devices, and affective or emotional support were encountered as problems under the new normal. Also, Dangle and Sumaoanga (2020) revealed that problems such as self-studying, lack of sleep and insufficient time to answer all the modules, distractions, and lack of focus were identified. Oyedotun (2020) added that the

unavailability of gadgets to facilitate student learning and internet accessibility were among the problems encountered by the students.

Table 7. Challenges encountered by students in terms of learning materials and resources

Indicators	Mean	Interpretation
1. Personal gadgets useful for the subject are unavailable when needed.	2.63	Sometimes
2. Supplementary materials for the subjects are difficult to find. (online or library)	2.82	Sometimes
3. Students need to use personal data or Wi-Fi to do research.	3.28	Sometimes
4. Students need to watch YouTube video clips to understand their lessons.	2.92	Sometimes
5. Students' allowance is not enough to support their studies.	2.99	Sometimes
6. Video clips, PowerPoint presentations, and other printed materials that are useful for the subject are not provided.	2.48	Rarely
7. Internet access is difficult.	4.12	Often
8. Finding time to learn more about the subject is hard for the student.	3.25	Sometimes
9. Teachers use multimedia such as PowerPoint, Facebook video clips, and messengers for teaching.	2.18	Rarely
10. Online group activities such as Facebook and chat are organized to encourage interactions among students.	1.97	Rarely
Overall Mean	**2.86**	**Sometimes**

Legend: 4.5 – 5.49 Always; 3.5 – 4.49 Oftentimes; 2.5 – 3.49 Sometimes; 1.5 – 2.49 Rarely; 1.0 - 1.49 Never

Table 8 describes the extent of the problems teachers encounter with learning materials and resources. Data reveal that they often encountered problems with connectivity/internet access. However, they sometimes encountered problems with the need for teachers to use personal data or WIFI to do research and difficulty in finding time to learn more about the subject the students. While they rarely encountered problems such as the unavailability of personal gadgets useful for the subject, difficulty in finding supplementary materials for the subjects both online or in the library, the need of students to watch YouTube video clips to understand their lessons, students' insufficient allowance for studies, the use of multimedia among teachers for teaching, and the use of the online group activities to encourage interactions among students. The average mean of 2.35 indicates that the teachers rarely encountered problems related to learning materials and resources.

Table 8. Challenges encountered by teachers in terms of learning materials and resources

Indicators	Mean	Interpretation
1. Personal gadgets useful for the subject are unavailable when needed.	2.06	Rarely
2. Supplementary materials for the subjects are difficult to find. (online or library)	2.18	Rarely
3. Teachers need to use personal data or Wi-Fi to do research.	2.82	Sometimes
4. Students need to watch YouTube video clips to understand their lessons.	2.23	Rarely
5. Students' allowance is not enough to support their studies.	2.18	Rarely
6. Video clips, power point presentations and other printed materials that are useful for the subject are not provided.	2	Rarely
7. Internet access is difficult.	3.68	Oftentimes
8. Finding time to learn more about the subject is hard on student's part.	2.68	Sometimes
9. Teachers use multimedia such as PowerPoint, Facebook video clips and messengers for teaching.	1.95	Rarely
10. Online group activities such as Facebook, chat are organize to encourage interactions among students.	1.77	Rarely
Overall Mean	**2.35**	**Rarely**

Legend: 4.5 – 5.49 Always; 3.5 – 4.49 Oftentimes; 2.5 – 3.49 Sometimes; 1.5 – 2.49 Rarely; 1.0 - 1.49 Never

Colebra & Irene (2020) honed similar findings with the present study, which stressed that, on the learning materials and resources, teachers encountered problems with internet connection and weak signals in the new normal. Legaspi *et al*. (2021) also revealed that during the implementation of different learning modalities, teachers encountered problems such as technical issues, lack of technology or personal gadgets, and poor student participation during online activities and in preparing instructional materials.

In terms of Flexibility during Pandemic

Table 9 presents the extent of the problems encountered by students with flexibility in the new normal. In this aspect, the students often encounter problems with emotional stress. However, most of them sometimes encountered problems such as not having enough time for home chores, difficulty in managing time as students, not participating in online discussions due to an unstable internet connection, not having enough time to prepare for examinations, finding online learning not helpful, finding hard to submit outputs on time, undeveloped study habits during pandemic, isolation from their peers and classmates, enjoying playing online games than studying and distraction by their siblings while learning at home.

Table 9. Challenges encountered by students in terms of flexibility during the pandemic

Indicators	Mean	Interpretation
1. I do not have enough time for home chores.	2.80	Sometimes
2. It isn't easy to manage my time as a student.	3.11	Sometimes
3. I find playing online games more enjoyable than studying.	2.50	Sometimes
4. I don't participate in online discussions due to an unstable internet connection.	2.81	Sometimes
5. I do not have enough time to prepare for my examinations.	2.54	Sometimes
6. I am not encouraged to use other means of learning.	2.17	Rare
7. I become distracted during my classes.	2.78	Sometimes
8. Time to prepare for examinations is inadequate.	2.41	Rare
9. I do not find online learning helpful.	2.71	Sometimes
10. I find it hard to submit my outputs in the subject on time.	2.70	Sometimes
11. Students use the online apps to help them in their studies.	2.16	Rarely
12. Study habits may not be developed in this mode of delivery (modular approach/ flexible learning)	2.89	Sometimes
13. Students find themselves isolated from their peers and classmates.	2.77	Sometimes
14. Students are distracted by their siblings while learning at home.	3.27	Sometimes
15. Students have emotional stress.	3.90	Oftentimes
Overall Mean	**2.78**	**Sometimes**

Legend: 4.5 – 5.49 Always; 3.5 – 4.49 Oftentimes; 2.5 – 3.49 Sometimes; 1.5 – 2.49 Rarely; 1.0 - 1.49 Never

A few of them rarely encountered problems, such as not being encouraged to use other means of learning in the subject and using online apps to help them in their studies. The average mean of 2.78 indicates that the extent of the problems encountered by the students regarding flexibility in the new normal is sometimes encountered. The above result is comparable with the study of Calo *et al.* (2021) and that of Gueta & Janer (2021) on the Distance Learning Challenges in the Use of Self-Learning Module, which revealed that stress was identified as a problem. According to Calo *et al*. (2021), in their study on Students' Struggles and their Coping Mechanisms in the New Normal among ten students of Napolan National High School of Napolan, Pagadian City found that stress is related to internet connectivity problems and one cause of stress was the problem on the number of modules to answer over a short period.

Also, the study by Mishra *et al.* (2020) conducted among a total of two hundred sixty students of Mizoram University, north-eastern India, on the Online teaching-learning in higher education during the lockdown period of the COVID-19 pandemic revealed that the problems in the learning environment, connectivity, and video issues due to the remoteness of their location and also household chores were encountered as problems by students during the lockdown period. The result also revealed that having a conducive learning environment and distractions while learning at home and doing household chores adversely affect their studies. The study by Gueta & Janer (2021), conducted among thirty students of Bulan North Central School of Barangay Aquino, Bulan, Sorsogon, on the Distance Learning Challenges in the Use of Self-Learning Module found that problems such as lack of proper scheduling or difficulty in managing time as students and inability to manage workload, too many distractions from outside, self-procrastination even on a work period, less interaction with peers and teachers due to isolation during pandemic were encountered as problems met by students in the new normal. This study also revealed that learners occupy a big portion of their time helping their parents doing household chores, and even if students would like to stay focused on their work, they sometimes lose track.

As shown in Table 10, teachers rarely encountered problems such as not having enough time for home chores, difficulty in managing time as teachers, unprepared for examinations, having insufficient time to prepare the modules/ learning packets, not encouraging the use of other means of learning, distractions during classes, finding online learning not helpful, the difficulty of students to submit their outputs on time, the use of the online apps in their teachings and the students feeling of isolation from their peers and classmates. Hence, the average

mean of 2.17 indicates that the teachers rarely encountered flexibility-related problems during the pandemic. The study by Robosa *et al*. (2021) revealed that teachers considered burnout due to a lack of resources, handling students, and submitting workloads. Dabrowski (2020) also revealed that the COVID-19 pandemic has added stress to the work of teachers in the new normal and brought risks to teachers' physical, mental, spiritual, and emotional well-being.

Table 10. Challenges encountered by teachers in terms of flexibility during the pandemic

Indicators	Mean	Interpretation
1. I do not have enough time for home chores.	2.27	Rarely
2. It is not easy to manage my time as a student.	2.32	Rarely
3. I find playing online games more enjoyable than studying.	3.5	Oftentimes
4. I don't participate in online discussions due to an unstable internet connection.	3.32	Sometimes
5. I do not have enough time to prepare for my examinations.	1.91	Rarely
6. I am not encouraged to use other means of learning.	1.77	Rarely
7. I become distracted during my classes.	1.59	Rarely
8. Time to prepare for examinations is inadequate.	2.05	Rarely
9. I do not find online learning helpful.	2.23	Rarely
10. I find it hard to submit my outputs in the subject on time.	1.62	Rarely
11. Students use the online apps to help them in their studies.	2.09	Rarely
12. Study habits may not be developed in this mode of delivery (modular approach/ flexible learning)	2.64	Sometimes
13. Students find themselves isolated from their peers and classmates.	2.41	Rarely
14. Students are distracted by their siblings while learning at home.	2.77	Sometimes
15. Students have emotional stress.	2.55	Sometimes
Overall Mean	**2.17**	**Rarely**

Legend: 4.5 – 5.49 Always; 3.5 – 4.49 Oftentimes; 2.5 – 3.49 Sometimes; 1.5 – 2.49 Rarely; 1.0 - 1.49 Never

When the students were asked about their other problems or challenges encountered during the pandemic in an open-ended question, the students answered that a) they lack focus and concentration in this new normal, b) there are numerous modular activities that consume much time, c) lack of sleep due to internet connection, d) lack of learning and loss of interest, and mental stress. Some of the students also responded that they also encountered problems such as a) depression, anxiety attacks or emotional breakdown, b) being pressured, laziness, c) too dependent on the internet, d) online games addiction, e) overtime in answering modules, f) difficulty in understanding the lessons in the module, g) no personal gadgets, h) transportation expenses from the island, and i) family problem.

3.2 Common Coping Mechanisms

In terms of distribution, submission, and collection of learning materials/modules, the students and teachers responded that they use their time wisely and have close contact with each other. However, students believed that they should ask for consideration, avoid delay in the submission of modules, and try to adjust to the new normal way of learning while teachers must become more flexible, patient, and considerate and collaborate with other teachers to make their work easier and become more productive.

In terms of content-related issues in the module, the students and teachers answered that they used the internet, watched videos for the lessons, and contacted each other. However, students believed that they should seek help from their siblings, classmates, or friends, do time management and additional time to accomplish tasks in the module while teachers used the library for their additional references, give follow-up instructions through their Facebook and messenger, insert pre-requisite lessons in the module and encourage students to consult them and give additional examples on the given topics.

To address student-teacher communication issues, the students and teachers responded that they stay connected in contact with each other. However, the students agreed that they should go to school to see their teacher while teachers used different forms of communication (online, face-to-face, text/messages, and the like) to reach out and address students' concerns and also communicate with their parents.

Additionally, when it comes to learning materials and resources, the students and teachers said that they were going to places where the internet connection is better/ stable and staying late at night. However, students believed that they needed to buy a mobile load or come to their relatives' or friends' houses for the use of WIFI to

search the internet, and also borrow gadgets from family or siblings while teachers install a home WIFI and also ask friends from other areas with a high internet connection to search for their queries.

Finally, in terms of flexibility during pandemic, the students and teachers answered were time management and taking time to rest/breaks. However, students try their best to focus on their studies during exams and when answering modules, become positive thinkers, pray for guidance, and entertain themselves through playing games, reading novels or watching movies to cope with stress, and add or chat with their classmates and friends on social media. Teachers create lists of tasks to do, give priority to more important or difficult tasks, prepare modules ahead of time, become more considerate of students for submitting output late, especially those from islands, beat the deadline, and spend time with family to cope with stress.

4.0 Conclusion

The following conclusions were drawn based on the above findings: The Senior High School students and teachers of MSU-TCTO both rarely encountered problems with the distribution, submission, and collection of learning materials/ modules, student-teacher communication, and learning materials and resources. Students responded that they sometimes encountered problems with content-related issues in the module and the flexibility during a pandemic, respectively. These problems include unstable or poor internet connection and stress-related problems. Despite the challenges encountered, the students and teachers found ways to cope with their problems and were able to manage them during the pandemic time. The common coping mechanisms of students and teachers were time management, using the internet, close contact with each other, and taking rest/breaks.

The findings of the study imply significant impacts on various aspects of education, policy, and research. This includes to better inform the design and delivery of the curriculum to efficiently meet the needs of students and teachers especially in a pandemic context from the development of online learning resources, the integration of technology into teaching and learning, to the the provision of flexible learning options. This study can also identify effective instructional strategies that can be used to engage students and support their learning in a remote or hybrid learning environment and may include the training of teachers in online teaching and learning with the provision of support for teachers' professional development and well-being.

In addition, the results of this study suggest areas for future research to further explore the problems encountered and coping mechanisms of senior high school students and teachers during the pandemic. This may include the investigation of the long-term effects of the pandemic on student learning and well-being and the evaluation of the effectiveness of educational policies and practices in a pandemic context.

5.0 Contributions of Authors

Nurul-Ainie S. Eldani –writing, encoding
Prof. Sheriffa T. Andas, Ph.D - editing, supervising

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7.0 Conflict of Interests

This study does not have any conflict of interest.

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Eclipsing US Influence in Southeast Asia: China's Belt and Road Initiative

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Abstract. The BRI is a foundational pillar in China's aspiration for national rejuvenation through remaking the ancient 'silk road' into maritime, land, and cyber roads. The paper aims to outline China's purposes and objectives in the BRI in Southeast Asia, the interplay of domestic needs of selected Southeast Asian countries with the allure of the BRI, and the dynamics of these economic-political relationships vis-à-vis the interests of China and the United States in the region. It starts with the claim that, geographically, maintaining a friendly neighbor policy or 'periphery diplomacy' will help secure China's borders and solidify the BRI maritime and land silk roads. In many instances, the dynamics of international political economy or the intertwining relationship of economics and politics come into play. On the other side, domestic politics also affects decision-making on BRI projects. Different contexts show the dynamics of domestic politics and BRI projects. While some praised the intention and promises of the BRI, especially in hitting the development needs of the target countries, particular evidence shows that its portrayed vigor and benevolence to launch its equivalent of a Marshall plan to rehabilitate and aid Southeast Asian countries have encountered various issues on the projects per se and their long-term implications. Ultimately, the findings suggest that the selected Southeast countries' BRI engagement was due to domestic concerns for local socio-economic needs. The evidence also suggests that China intends to outcompete the United States in terms of being the region's leading provider of economic development. As a result, China may stand to dislodge US influence in the region through the continuous improvement of the BRI.

Keywords: Belt and Road Initiative (BRI); ASEAN; China; Geopolitics; US-China strategic competition.

1.0 Introduction

The causes and impacts of China's BRI engagements are varied and complicated. The works of Kuik (2021) and Yu (2017) call for a deeper investigation of the demand and supply of the BRI. In the many countries that have started their BRI projects, certain projects experienced issues of delays, labor-relation problems, challenges from local communities and environmental groups, issues on corruption, issues on debt traps, and doubts about the larger intentions of China on target countries (Cox, 2018; Cichocka & Mitchell; 2024). Certain levels of distrust towards Chinese investments brought about by BRI can be seen across different sectors of society (McBride, 2023; Russel et al., 2020). The distrust takes its root on both sides of the spectrum wherein one side was about local politicians intending to legitimize their stay in their positions and thus resorting to external loan agreements, and on the other side, how the BRI project may bankrupt the government (Wemer, 2023; Rabena, 2018). It is also observable that some BRI projects have received appreciation and proper management because the absorptive

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capacity and the necessary systems to protect the interests of the receiving country are institutionalized such that transparency, efficiency, and effectiveness are felt by all (Overland & Vakulchuk, 2020; Tong & Kong, 2018). Nonetheless, using considering the internal dynamics and responses of the Southeast Asian countries, the BRI will likely increase China's influence in the region (Gong, 2019).

2.0 Methodology

A thorough literature review was conducted using reputable journal articles, books, government documents, and policy statements from national leaders. This study adhered to the protocols and standards set forth by this journal.

3.0 Results and Discussion

China's National Development and Reform Commission is the primary body that oversees the BRI. Together with the other ministries and agencies of China, the BRI intends to open and sustain six economic corridors, namely, the Eurasia land bridge covering Europe Kazakhstan and Russia; China, Mongolia, Russia corridor; China, Central Asia, West Asia Corridor; China Indochina peninsula corridor; China Pakistan corridor and China, Bangladesh, India, Myanmar corridor. It must be clarified hereon that China decides what constitutes a BRI project and what does not.

On the other hand, Southeast Asia is also home to the vital sea lanes of communication where a sizeable chunk of the world's goods passes through. The region is also rich with critical minerals and other raw materials that can support China's development of many emerging technologies. More than sixty percent of Chinese people living outside China live in Southeast Asia. The BRI projects China as the hub for economic development, where countries can avail themselves of infrastructure and other economic development projects. This economic move is part of its larger scheme of China's power projection. In many instances, the dynamics of international political economy or the intertwining relationship of economics and politics come into play.

As China attempts to connect the world to itself, BRI is funded by various Chinese financial institutions that enjoy preferential terms and rates in supporting BRI projects. China also has state-owned enterprises that play a big role in implementing the BRI. Arguably, another source that finances the BRI projects is the debt financing of other countries to China. Domestically, the BRI is a welcome opportunity for its steel, cement, glass, and other construction industries to include their manpower and technical services and expand their reach to Southeast Asia. Along with these, the Chinese government will enjoy popularity among its people as it provides local industries avenues to venture outwards, secures its borders, and strengthens its military (Cavanna, 2019). The Asian Development Bank estimates that developing countries in Asia need 26 trillion dollars to keep their economies moving forward. As a response, BRI countries have agreed to one trillion dollars with China in the first ten years of the BRI implementation. Thus, in itself, BRI is addressing a global investment deficit. As of 2020, BRI recipient countries form at least thirty percent of the world's total General Domestic Product and at least fifty percent of the world's population.

Historically, these countries have proven to be pragmatic in many aspects. After all, the so-called Asian values have emerged from this testing landscape where, while they have embraced democracy, for instance, they have interpreted and shaped it according to the specific contexts and needs of their localities. Singapore is a prime example of this as it grappled to survive after it gained its independence in 1965. The institution of the Association of Southeast Asians, established in 1964, also is a lasting example of the people's pragmatism. After the Second World War and the looming Cold War, the former colonial territories faced problems of national unity, inefficient government systems, weak economies, and internal and external security issues, they gathered to form a coalition to tell the world and the major powers on their aspiration to be a region of peace, stability, and development.

Status of the Belt and Road Initiative in Southeast Asian countries

Philippines

Any assessment of the BRI in the Philippines is colored by the long history of China on Philippine soil and the irresponsible behavior of China in the West Philippine Sea. For centuries, similar to the rest of Southeast Asia, the Philippines has been a home to many Chinese traders. The most prominent economic blocs in the Philippines are

owned by Filipino-Chinese citizens. The arrival of the BRI brought the opportunity to further boost the infrastructure development of the country in the form of seaports, airports, roads, bridges, and railway projects (Rabena, 2018). The highest economic interaction between Beijing and Manila was during the Duterte administration, which expanded to different foreign direct investments covering energy, telecommunications, real estate, finances, and others. However, other sources also note the rise of illicit activities through economic engagements.

There is also a growing concern about a silent creeping proliferation of illegal online gaming operations hidden in different locations in the country. Security analysts are disturbed by the hidden activities and the chosen locations of these illegal facilities, as some appear to be adjacent to or surround security infrastructures. Some sources also claim that China has, through these economic engagements, steadily influenced decision-makers in the security sector. The Kaliwa dam project saw backlash for environmental issues as well as no consultation with stakeholders. Other projects saw issues with the lack of accommodation for the local labor force. Chinese involvement in the Sangley airport, which is strategically located near major naval and air bases and the nation's capital, as well as the share in handling the National Power Grid Corporation, remains controversial.

Coupled with the growing Filipino distrust of the Chinese government over their illegal activities and the suspicion of such a connection with the BRI, the BRI has seen significant implementation issues (De Castro, 2019). Likewise, the Marcos administration has poured cold water over the BRI activities and has thus canceled most, if not all, of them. However, other analysts also call for sobriety and prudence in not engaging with China and reaping the benefits of the BRI, as the country needs capital to sustain its economy. Overall, the Philippines has received the BRI projects due to the international attention emphasizing the disadvantages experienced by other countries. This is coupled with the growing national agitation against China's aggressive and violent actions in the West Philippine Sea that are endangering both government personnel in their vessels and depriving Filipino fisherfolks of their traditional fishing grounds (Chao, 2024).

Singapore

Singapore has had a long, formal, friendly economic relationship with China since 1990. Deng Xiao Ping, who opened the Chinese economy and heavily but gradually reformed China after the misgivings of Mao's administration, was very impressed in visiting the then Singaporean Prime Minister Lee Kwan Yew in 1978. Other authors also note that assessing BRI engagements in Singapore must not be wholly viewed from a geopolitical lens but from a domestic one, as the ruling People's Action Party practices a pragmatic approach to managing the Singaporean economy (Chan, 2021). The paper of Liu, Fan, and Lim (2021) argues that Singapore has a peculiar advantage due to the continuous development of its governance systems as the small city-state has been ruled by one party since its establishment. This 'network state' has made the government an effective hub to connect, collaborate, and respond to government leaders, bureaucrats, and other stakeholders.

This institutionalized 'network state' has several nodes of power to optimize the BRI to favor both China and the national interests of Singapore. In some ways, this puts Singapore in an advantageous position on the BRI. To further capitalize on Singapore's ability to be a financial hub wherein it has capabilities to complement the BRI in terms of service for project development, firms for procurement and construction, service providers, and finance institutions, Chan (2019) suggests that Singapore may assist other countries who engage with the BRI to grow in policy and regulatory framework design, institutional capacity development and sustainable project structuring. In this manner, it can be assumed that issues such as corruption, unfair trade policy, unclear project development, and over-indebtedness are highly reduced given this more mature and articulate system in Singapore.

Malaysia

It must be noted that under Dr Mahathir Mohammad, Malaysia was one of the first countries to open its doors to China after the end of the Cold War. The example of the East Coast Rail Link (ECRL) project funded by the Export-Import Bank of China involving forty tunnels and connecting Kelantan to Selangor elaborates how the BRI was an enticing opportunity as it promised to provide infrastructure development, connectivity, and job generation (Chinyong et al., 2021). Hence, the initial popularity of the BRI to some locals was due to its support for the construction of ports, airports, railways, and other infrastructures and its other economic aftereffects. However, after careful evaluation of the ECRL project, Jamil's paper (2023) observed how the project has been mired by

corruption and debt issues. The defeat of Najib Razak in the 2018 general elections brought to the spotlight the unequal China deals related to the 1 Malaysia Development Berhad. Subsequently, it caused the cancellation of the ECRL project as it may push Malaysia into significant debt to China and be a puppet to do China's bidding (Yeoh, 2020).

However, even if state leaders such as Mahathir Mohamad have voiced serious concerns about the probability of debt traps caused by the BRI, the gains of political elites contribute to the continuation of BRI (Friedman & Bekele, 2022). One of the effects of Mahathir's criticism of the BRI allowed reflection on how Malaysia will likely continue the BRI engagement but derive better benefits apart from infrastructure projects that involve technology transfers, renewable energy, and artificial intelligence. In the same vein, besides the known geopolitical realities that China is asserting influence through the BRI, Malaysia's pragmatic approach in welcoming BRI, aside from the economic benefits for the nation, is also how the ruling business elites legitimize their position through such arrangements (Kluik, 2021). As such, Malaysia will continue to see the need to prioritize its economic plans sustained by all available support channels, including the BRI.

Indonesia

Like Malaysia, BRI projects in Indonesia are highlighted by the China Development Bank-funded Jakarta-Bandung national railway project as a major infrastructure development that started in 2016 and as a contribution to China's thrust to enhance connectivity in other countries. The project symbolizes the peculiar relationship between China and Indonesia. While overrun costs were incurred due to project delays, Indonesia showed its independence in shouldering the costs and, more importantly, scrutinizing the benefits of the details of the China offer, wherein the bidding competitor from Japan lost due to a lack of technology transfers and guarantees of the loan.

Aside from the Jakarta-Bandung national railway project, BRI projects include energy generation, smelters, and mineral mining. The China-Indonesia Morawali Industrial Park, conceived initially as a nickel, iron, and steel production facility, evolved into an essential nickel supplier for the electric vehicle industry. This massive park with 11 smelter facilities was funded by HSBC China, Industrial and Commercial Bank of China, Bank of China, China Development Bank, and Export-Import Bank of China. As connected mines and coastal areas are affected, connected issues to this project are issues of air pollution, water pollution, deforestation, biodiversity loss, and employment issues of location population. The historically pragmatic approach of Indonesia in balancing its political and economic national interests is aptly seen in how it engages with China. Like other authors, Riska (2024) has asserted the need to iron out policy concerns that will serve the interests of Indonesia but see the value for Indonesia to optimize the benefits that the BRI brings to the country.

Cambodia

The work of Cheang and Heng (2021) echoes the same picture found in many Southeast Asian economies but more importantly, paints the description of mainland Southeast Asia society as divided or categorized as elites with major conglomerates, middle class with civil society organizations, and local communities wherein the elites hugely accept the infusion of much capital in the country with the prospect of enlarging their businesses, the middle class with civil society organizations concerned about the probable debt traps and other uneven trade deals, and the local communities concerned with the long-term environmental impacts of BRI projects and the waves of Chinese laborers who will implement the BRI projects. The research of Loughlin and Grimsditch (2021) elucidates how the BRI has helped maintain the status quo of the power of the few as it simply enriched the elites in the country and sustained the large part of the population with low-income industries. What is clear in Cambodia is the need for foreign investments to jumpstart its economy, connect its industries and people, and have greater reach in foreign markets. The BRI is a tantalizing option for a country thirsty for stability, growth, and inclusive development.

Myanmar

Myanmar finds its place in the BRI as it is strategically connected to China on its land border and is a promising gateway for China towards the Indian Ocean. Initially, BRI offerings did not have a strong start in the country. However, after the West had cast any doubts, it suspended many engagements as well as placed several conditions on Myanmar in relation to the Rohingya crisis. BRI engagements with Myanmar were upbeat by 2017 (Mark et

al., 2020). Like other countries, roads and railways formed the bulk of investments. As the country gradually transformed its socialist economy to be more open to attract investments and gain efficiency, large businesses comprised prominent families with usual military affiliations. Thus, BRI projects greatly benefitted the joint ventures of these family-owned businesses for construction projects.

In 2018, Myanmar became a signatory of the Memorandum of Agreement in building the India, Bangladesh, China, and Myanmar Economic Corridor covering more than seven hundred kilometers from Kunming to Yunnan province of China (Gyi, 2019). While there is skepticism about Chinese projects from the public, the reality of needing foreign capital is felt and accepted. This entry of BRI is another manifestation of how developing countries' reliance on foreign direct investment is more accommodating to Chinese offers, especially as they come with the perception that Chinese economic offers have no preconditions for governance and accountability (Zhang, 2022).

Vietnam

Hoa and Nguyen's paper (2021) spoke of the interesting relationship between China and Vietnam as a backdrop for the BRI projects. As the two countries have historical attachments and detachments, both see the strategic significance of their engagement for economic and politico-security purposes. This is manifested by the "two corridors, one belt" initiative that was proposed by Vietnam in 2005 to China. The idea was for the Guangxi of China with Quang Ninh Hai Phong of Vietnam and Yunnan of China with Lao Cai Hai Phong of Vietnam to develop economic corridors (Van Huy, 2020). Chinese projects are also seen with caution in Vietnam; the institutional mechanisms to scrutinize and vet projects are obvious and instructive on how Southeast Asian states will not always accept BRI projects hook, line, and sinker but with critical and interest-laden hands.

Of particular interest to China, Vietnam not only provides opportunities for economic benefits and security to its southern land border but is also an important and active actor against China's ten-dash line claim and its actions in the South China Sea. While there were many fruitful discussions between the leaders and representatives of both countries in praise of connectivity, economic integration, and collaboration between the Chinese and Vietnamese people, on the ground, BRI projects also encountered situations similar to other countries in the region, such as the suspicion of too much economic dependence to China, project infirmities in the form of overruns, delays and poor quality, possible effects in Vietnam's territorial integrity issues with China and economic disparity with China's cheaper production capability with that Vietnam. Thus, Nguyen's (2022) research on determining the opportunities and risks for Vietnam in the BRI saw security, political stability, and legal and regulatory risks as the highest considerations. However, unlike other mainland Southeast Asian countries, Vietnam's relationship with China will be colored by its issue in the South China Sea. Thus, it can be surmised that Vietnam will place economic concerns within its national security policy (Dinh et al., 2024).

Thailand

For some observers, Thailand was one of the countries that pragmatically welcomed the BRI because of China's position on Thailand after its 2014 coup, as China chose to respect the situation using its non-interference principle. While other projects cover special economic zones, tourism, education, and others, Thailand's most prominent and promising BRI project was the proposal for a high-speed railway project (Lu et al., 2018). This was funded by China's Export-Import Bank and China Railway International Company Limited. Relatedly, during this time, competition with Japan on infrastructure projects came to the fore. An example was the railway project between Bangkok and Chiangmai, which initially engaged with Japan but was eventually won by China. By 2015, Japan introduced its Partnership for Quality Infrastructure for Asia as evidence of how Japan must consolidate and reintroduce its brand as a reliable partner for infrastructure support hubs.

If this railway project is the rallying symbol for the BRI engagement, various sectors can see mixed reactions. Some view China's offer with suspicion ranging from its larger scheme to dominate the region, the engagement as a debt trap, and the general mistrust towards the quality of Chinese technology or lack thereof (Punyaratabandhu & Swaspitchayaskun, 2021). However, other analysts also note domestic issues are to blame for the lack or delay in implementing the projects due to bureaucratic anomalies and political party dynamics inside Thailand. Like other Southeast Asian countries, Thailand will balance these domestic political considerations and the potential of the BRI to pursue its various development objectives.

Laos

A similar picture shows how China is projecting itself as a regional investor and reliable donor in the landlocked country of Lao PDR (Vörös & Somsack, 2020). For China, a connectivity project linking Kunming in China to Vientiane of Laos will not only mean a transport hub, tourism opportunity, and logistics channel between the two countries but also a ready link to Thailand, Cambodia, Malaysia, and Singapore. Like other observers in other countries, concerns over indebtedness, environmental risks, chaotic timelines in the construction process, and lack of transparency in decision-making in China are expressed, as how much economic dependence may open the door for undue influence on China. Thus, analysts suggest a more thorough, multi-faceted, and even a cultural understanding of Chinese history to better comprehend the internal convulsions of the BRI as a continuing development (Jensen, 2022). However, like other countries in mainland Southeast Asia, Laos will most likely continue welcoming the BRI to support its much-needed external capital infusion to induce economic growth and contribute to the political stability in the country.

Perceived Advantages and Disadvantages of the BRI

Development is always in everyone's best interest. Southeast Asia has a lot of investment needs in the transportation, health, education, and energy sectors. As the population grows, other related requirements for public good and social protection are needed. All these can only be supported by a robust economy. Following the triadic relationship of security, governance, and development, it is positive to foster ways and means for development issues to be addressed in every corner of the planet. Different theories suggest that a good economy, distributed wealth, and social protection decrease the risk of criminality and other forms of crime. Moreover, this increases the security of the country. Addressing development goals allows a country to contribute and commit resources to larger advocacies of global institutions and aid other countries in their other needs. Public goods like roads, mass transit systems, communication technologies platforms, and ports are vital to jumpstarting and sustaining growth.

While countries like Brunei, Singapore, Malaysia, Indonesia, and to some extent Thailand, Vietnam, and the Philippines are showing vibrant economies in the region, considerable investments are urgently needed to sustain their economies, attend to the welfare of their people, increase productivity and establish connectivity to the rest of the world. In turn, this will help boost a business climate, encourage more tourism, provide easy transfer of goods and people, and generate more opportunities for the people and revenues for the government. The thought of having a ready hand of support for open funding, technology, human resources, and services within competitive terms is a welcome opportunity that is hard to miss. China will optimize this channel if the US shows limited vigor and action in this aspect. It is also in the interest of the world to have a China that is not just willing to open its resources, expertise, and services to partner with other countries but also, along the way, open to inquiries, suggestions, and clamors for improving how it conducts trade with other countries. In doing this, it is hoped that China will take on its role as a responsible member of the international community.

However, several disadvantages for the US have also been deciphered. To understand China, one must consider things from its perspective, away from the Western view of the world. China runs on a different ideology, which is run by the Chinese Communist Party (CCP). As such, its economy is first driven by political objectives. In the eyes of the CCP, national security comes first before other needs. Thus, all its economic endeavors, including the BRI, are superseded by its grand political plans for itself and the world. The BRI must be considered and approached as part of China's great national rejuvenation. The economic short and long-term benefits and the means to employ them will always consider security considerations. For instance, information on technology, people, movements, competencies, locations, and future settings is not only for commercial purposes but also forms part of the larger data of surveillance and forecasting. Acquired lands, technologies, access, and other assets have economic and military potential. These are the disadvantages of the BRI for the US. China views its economic power as its absolute and legitimate means to protect and enhance its political and security power where and when necessary.

For the receiving or client countries, the BRI also means China's assertion for alignment with China's views on many matters. Considering the internal dynamics of many local politicians in the region, the historical pragmatic approach of these countries, and their significant need for foreign direct investments, said countries will most likely accept and gradually work with China to polish the hick-ups of the deals. This may mean a constellation of

countries maintaining a steady and deep economic and political relationship with China. While the prospect of these countries severing their ties with the US is nearly impossible soon, their pragmatism will mean substantial loss for US economic and political engagement in the region.

It is also important to understand that China's history has been instructive in its strategic patience. China views the world in hundreds and thousands of years. China views the US and the West as being short-sighted and easily distracted. On the side of China, its non-democratic political set-up has the advantage of continuity and stability in its planning. Its relentless pursuit as an entrepreneurial state is a monumental success that surprised many worldwide (Grillo & Nanetti, 2018). While other analysts have predicted the demise of Communist states due to their unsustainable ideology and impractical governance in a globalized world, China has surpassed these predictions and has evolved into a communist entrepreneurial state. It must also be remembered that many Southeast Asian countries have historically flirted with Communism in their recent pasts. Though many of these movements have been rendered irrelevant by the local population per se, and the US has contributed to their defeat during the Cold War, the alternative of a new and improved version that can create a middle may mean a comeback in these states. For its part, the US is viewed by China as having many weaknesses brought about by its internal contradictions. Its democratic philosophy and systems have rendered it unstable and vulnerable to influential groups. Hence, it is unable to sustain and maintain any strategic plan. As a world power shouldering all the world's ills, countless issues also burden it, and these distract it from focusing on any issue or place on the planet. Thus, it is perceived that Obama's pivot to Asia lacked the muscle to be perceived as a pivot. This vacuum of lack of focus and energy will be exploited by China through the BRI, whether in Obama's time or in the decades to come.

Short-term Implications

Having seen and studied the various aspects and issues of BRI projects in different countries, the impact of one to other projects in the region, and the overall impact of these on the global connectivity ambitions through the maritime and silk road, we judge that China will most probably adjust its priorities, review its procedures in approving projects and heavily explore on how to address the perception issues of the target countries. It is noteworthy that Nikkei Asia, in 2022, ranked the US and China as the ranking investors in the region with 73.4 billion dollars and 68.5 billion dollars, respectively, between 2018 and 2022.

China will continue the implementation of the BRI and expand it according to the needs of the country vis-à-vis its interests. For instance, it will continue the development of more railways for bullet trains and roads for the transportation of goods and people in Thailand, Myanmar, Cambodia, Vietnam, and Laos, as China shares land borders with them. Connecting them with China will still be in China's interest. Energy development will also rise as a significant BRI potential. Access to cheap and reliable energy is a concern for all countries aspiring to reach their industrial age. Southeast Asian countries will most likely engage with China in this respect regarding the development of traditional sources and emerging or non-traditional sources. BRI may develop coal plants, oil rigs, natural gas extraction, geothermal plants, dams, and solar panel farms. China will use this to access needed minerals in lithium battery manufacturing, nickel for semiconductors, and other minerals for many emerging technologies. Besides railways, maritime Southeast Asian nations like Malaysia, Philippines, Indonesia, Timor Leste, and even other Pacific nations will most likely continue pursuing investments in airport and seaport development for trade, tourism, and movement of people.

Connectivity in cyberspace will exponentially grow as business, education, health, politics, and social existence are creating a hyperconnected world. Thus, developing and improving the intended digital Silk Road are also worth noting. As China is developing a competitor to the Global Positioning System in Pakistan, developing its other digital economies, such as the model of Alibaba company and the deployment of China Telecom and China Mobile, these technologies may soon rival what the US offers and aim to outcompete US' strategic advantage in this area. Connected to the digital silk world is the promising frontier of generative artificial intelligence, biotechnology, and other research that will spell innovations in health, agriculture, food, medicines, productivity, and general well-being. Connected to this are the security concerns of how these will be used for economic competition and plausible surveillance, espionage, and hacking purposes. More serious to this would be how the connection between China and Southeast Asian countries will not only be material but, in some ways, social and

spiritual. Endless collaborations on countless fronts mean opportunities for familiarization and cross-cultural understanding that will address the trust deficit China suffers from.

Soon, the consequences of China's BRI in terms of creating corridors of connectivity will also mean future trade deals that may encompass trade blocs within BRI economies' geographical area. China may probably connect trading blocs located in different economic corridors. This means that even the Regional Comprehensive Economic Partnership (RCEP), touted as the largest economic bloc composing China, New Zealand, Australia, Japan, South Korea, and ASEAN member states covering trade, investment, technical cooperation, dispute settlement, and e-commerce, may be eclipsed by a China that is a door to all other major and developing economies. On the part of the client countries of the BRI, while there is the prospect of development caused or aided by the BRI, the prospect of increasing the strengths of democratic institutions will still follow the "Asian democracy" model whereby said countries will borrow aspects of Western-style democracy and adopt them according to the peculiar cultural patterns of their countries (Neher, 2018). This means the prospect of BRI and the other entanglements from China will likely be entertained and engaged with by said countries and will be adjusted according to their situations.

Long-term Implications

China projects that many developing countries may gradually gravitate towards It. The BRI serves as one of the magnets that attract countries that may be weary of the political conditions provided by US and Western institutions like the United Nations, World Bank, International Monetary Fund, and the like. Because of this perceived 'no strings attached' image of the BRI, it will likely attract more developing countries in need of external resource aid. More so, countries facing sanctions or restrictions from Western-affiliated countries and organizations will probably align themselves with China and its BRI. More disturbingly, this will continue the irrelevance of sanctions as a means of the US and the West as an instrument of foreign policy and compliance to international laws and norms as subject countries will aim to sanction-proof their economies. The soft power approach of China will amplify the BRI as the new Marshall Plan for Southeast Asia and the world. It may also be implied that there is a likelihood that while China is currently portraying itself as following the non-interference principle for inter and intra-state conflicts, there is a moderate likelihood for China to be a mediator for the peace process and conflict management in the future as it attempts to settle the region and continue its economic engagements.

Threats to US Interests in the Region?

As China expands the BRI projects from infrastructure to other projects, the US strategic interests in the region in business, politics, and security will be greatly affected. Southeast Asia has a growing population of more than 600 million people, and opportunities for economic engagement in various sectors are ripe for optimization. While the Association of Southeast Asian Nations notes that the US was its top investor of 37 billion dollars in 2022, China marched forward with 15 billion dollars in 2022. Hence, it is most likely that competition for the Southeast Asian market will continue to be intense and expand in competition in the realm of generative artificial intelligence, research, and general network connectivity.

As Southeast Asia hosts the vital ancient and contemporary sea lanes of communication connecting the Indian Ocean to the Yellow Sea and the Pacific Ocean, and the major factories of the world are in the peripherals of this region, US industry will be greatly affected by the close and unimpeded access of China to these markets. The flow and management of global supply chains will also be affected by the development of these economic corridors through the BRI. The maintenance and viability of US bases and security architecture in the region may also be questioned.

Similarly, the current US allies in the region, like India, Japan, South Korea, and Taiwan, may find themselves in a conundrum as the Chinese maritime roads grow tighter in favor of China. Russia, Iran, North Korea, and other like-minded state actors will likely avail themselves of the BRI and probably be more emboldened in their actions as the economic consequences are diminished due to the BRI's benefits to their country. Diminishing here means a smaller scope of US trade and the presence, movement, initiative, and force of the US dollar versus the Chinese RMB.

Preserving the status quo for authoritarian regimes through BRI will mean states that will preserve patronage politics run by elites and a substantial number of populations that will remain subservient through meager salaries availed through low-income industries. This, in turn, lowers education and social protection levels and higher levels of tendencies for conflict economies, where some may be used for proxy wars. The BRI will also greatly affect ASEAN's future as an institution, as many member countries relate to it. The shape and form of ASEAN's independence and relationship with the US and the West will be transformed in the long run in favor of China if the BRI continues to improve and address the interests of the said countries and no competitive alternatives arrive.

In the realm of ideology, while others may note that ideology is dead, its ability to move emotions and legitimize regimes still exists. The US may fail to achieve its interests in the region if the narrative of democracy and its attendant values are not consistently, comprehensively, and practically understood, appreciated, and felt. The realities of domestic politics speak of politics of the stomach and short-term needs and not the long-term overhauling of the social structures. The pragmatism of people in developing countries may bite the bullet or not mind the source of funds, whether from democratic capitalist or socialist-capitalist hands if these hands bring 'food' to the table. This is also reminiscent of Deng Xiaoping's words that it does not matter whether the cat is black or white if it catches the mice. Moreover, for China's BRI, socialism or its recent Chinese nationalist version, along with its attendant values, may have a renewed taste for some.

4.0 Conclusion

China views its BRI as a major foreign policy tool for Southeast Asia as it supports its domestic stability and economic security and enhances its economic and military potential. More so, like its Southeast Asian counterparts' domestic political needs for greater legitimacy, the BRI adds to the legitimacy of the Chinese Communist Party to continue its reign in China. The study then proves that all foreign policies have domestic inspirations. To a certain extent, Southeast Asian countries will all be independent in how they will accept BRI projects due to their respective domestic political situations and national interests. With this, China will continue to refine its approaches and methods in the BRI vis-à-vis the individual situations of the countries and perceived setbacks to increase its regional politico-economic status. However, the internal weaknesses of corruption, in-party politics, and adherence to Chinese companies' international trade standards and practices must be addressed to do this. In this regard, China will compete with US influence in the region through the BRI. Thus, BRI will remain an important part of the economic agenda of most Southeast Asian countries in supporting their infrastructure and connectivity demands despite the perceived and proven disadvantages. However, more research can be conducted on whether China can displace the US in the different economic corridors, land, maritime, and digital routes.

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Analyzing English Errors of Industrial Technology Students as a Basis for an Intervention Plan

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Abstract. Writing is one of the most complex skills, requiring significant effort and dedication to achieve proficiency. As students strive to improve their writing, errors inevitably emerge. This study investigates the English writing errors of third-year Industrial Technology students at Cagayan State Univeristy-Aparri, focusing on their writing's morphological, syntactic, lexical, and mechanical aspects. The findings reveal that syntactic errors, particularly sentence fragments, were the most common, with 107 occurrences. Mechanical errors followed closely, with capitalization errors being the most prevalent (106 occurrences). Lexical errors were also significant, totaling 70 occurrences, with frequent word choice or form issues. Morphological errors were the least frequent, with 47 occurrences primarily related to subject-verb agreement. Furthermore, mechanical errors show a moderate and significant negative correlation ($r = -0.390$, $p = 0.007$), and lexical errors exhibit a moderate and highly significant negative correlation ($r = -0.424$, $p = 0.003$). The data indicates a higher incidence of mechanical and lexical errors among College of Industrial Technology students. Notably, a significant positive correlation was found between students' religious affiliations and lexical errors, suggesting that religious language practices may influence lexical choices in non-religious writing contexts. The observed influence of religious language on lexical choices underscores the importance of understanding how cultural and linguistic backgrounds shape writing proficiency. It can guide educators, curriculum developers, and language instructors in designing more effective writing programs tailored to diverse student's needs.

Keywords: Error analysis; Lexical, Morphology; Mechanical; Syntax; Types of errors.

1.0 Introduction

Writing is a cornerstone of communication, enabling students to document knowledge, express ideas clearly, and convey information effectively. However, mastering writing skills poses unique challenges, especially in academic and professional contexts where precision and clarity are essential. For students in technical disciplines like Industrial Technology, where emphasis is often placed on practical skills, writing proficiency can be particularly demanding yet equally critical for success. At the College of Industrial Technology at Cagayan State University-Aparri, students struggle with writing tasks, particularly grammar, punctuation, and syntax. While they excel in hands-on applications, their written work often reveals significant gaps in linguistic proficiency, impacting their ability to produce quality documentation and perform well in assessments. This mismatch between practical and written skills underscores a pressing need for interventions to bridge the gap.

Research consistently highlights the prevalence of writing errors among students, particularly in second-language contexts. Common issues include grammar and syntax errors, poor word choice, and mechanical lapses, all

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hindering effective communication (Sulistyo et al., 2019; Indrilla & Ciptaningrum, 2018). In global contexts, English serves as the medium of communication across multiple domains, emphasizing the need for strong writing skills (Christiansen, 2015). Despite the Philippines' emphasis on English in education and business, students face challenges that compromise their readiness for academic and professional demands (Lam et al., 2018).

Although studies have explored writing challenges among general student populations, limited research has focused on technical students whose needs may differ significantly due to the nature of their disciplines. The intersection of technical expertise and writing proficiency is often overlooked, leaving a gap in understanding how to effectively address these students' unique challenges. This study aims to analyze the writing errors of third-year students in the College of Industrial Technology at Cagayan State University-Aparri. The research provides insights that inform targeted instructional strategies by systematically identifying and categorizing these errors. Addressing these errors is not merely about improving grades but equipping students with a fundamental skill to enhance their academic performance, professional readiness, and success in a globalized workforce.

2.0 Methodology

2.1 Research Design

This study utilized a mixed method of research. Qualitatively, it employed content analysis to identify the students' errors in English concerning morphology, syntax, lexical, and mechanical. Quantitatively, it employed a descriptive-correlational method to describe the students' profile in terms of age, sex, religion, major, mother tongue, availability and extent of usage of learning materials, and their performance in the English subject. Further, it determined significant relationships between the aforementioned variables, hence, correlational.

2.2 Research Locale

The study was conducted on selected third-year Industrial students from the College of Industrial Technology of Cagayan State University—Aparri, located in Zone 6, Maura, Aparri, Cagayan. One of the distinguished colleges at Cagayan State University-Aparri is the College of Industrial Technology. This college offers three academic programs: Bachelor of Science in Industrial Technology, major in Automotive Technology; Bachelor of Science in Industrial Technology, major in Electronics Technology; and Bachelor of Science in Electrical Technology, major in Electrical Technology. In the current school year, 2023-2024, the college caters to a substantial enrollment of 504 students, indicating a significant and promising student population contributing to a brighter future.

2.3 Research Participants

The study employed a total enumeration sampling technique, wherein all members of the target population—third-year students from the College of Industrial Technology at Cagayan State University-Aparri—were included as respondents. This method was chosen to ensure that the data collected was comprehensive and representative of the entire group of students from the three sections: Electronics, Electrical, and Automotive majors. Total enumeration is particularly effective in studies involving small, specific populations, as it minimizes sampling bias and ensures the inclusion of diverse perspectives and experiences within the group. By involving all 47 students, the study maximized the reliability and richness of the data, providing a robust basis for analyzing English writing errors and their potential correlates.

2.4 Research Instrument

The study employed a questionnaire to gather data on the students' profiles. After completing the questionnaire, the students were asked to write an introduction on a topic related to their research subject. Forty-seven research introductions were collected, each supervised by the respective research subject teacher. Errors in the students' writing, defined as linguistic units that deviate from the accepted norms of the target language, were identified and categorized. These errors were classified into four main areas: morphology, syntax, lexical, and mechanical errors. The identified errors were underlined and tabulated for analysis. The frequency of each error type was calculated to determine the percentage of occurrence in each category. Analyzing these frequencies, the most common errors made by the students were identified. The findings of this research were then presented in a clear and organized manner, using tables to showcase the distribution and frequency of errors across the different categories.

2.5 Data Gathering Procedure

The researcher sought permission to disseminate questionnaires through an official communication letter addressed to the administration of Cagayan State University-Aparri, the Graduate School, the dean of the target college, and the respondents' subject adviser. Once permission was granted, the researcher instructed the students to complete the questionnaire. Subsequently, with the guidance of their research teacher, students were tasked with drafting an introduction for their chosen title within three hours. The completed questionnaires and student introductions were collected from the College of Industrial Technology at CSU-Aparri participants. In conclusion, the responses were systematically categorized, organized, analyzed, and evaluated.

2.6 Ethical Considerations

Confidentiality and anonymity were maintained throughout the research process. All data were stored securely and were accessible only to the researcher and authorized personnel, ensuring that personal information was protected. In reporting results, identifying information was omitted to protect participant anonymity further. The study's findings were presented honestly and accurately, reflecting a commitment to ethical academic standards. Additionally, this study followed non-maleficence principles and respect for persons by avoiding any harm or discomfort to participants. Finally, all information and data collected were used solely for this research and will be destroyed by university data retention policies upon completion of the study.

3.0 Results and Discussion

31 Profile of the Students

Table 1 provides a comprehensive profile of the 47 students in the study, highlighting key demographic factors. Most students (34.04%) are 21 years old, with a mean age of 21.77 years, reflecting that most are in their early twenties, typical for third-year college students. The data suggests that most students in their third year of college are in their early twenties, which is typical for students at this stage of education. As per the data provided by the Commission on Higher Education (CHED), the average age range of undergraduate students falls within the global norms. Approximately 18% of students enroll in college and advance to their third year by the time they are 20 to 22 years old.

Table 1. Profile of the students in terms of their age, sex, major, mother tongue, and religious affiliation

Category	Frequency (n=47)	Percentage
Age		
20	7	14.89%
21	16	34.04%
22	11	23.41%
23	8	17.02%
24	4	8.51%
25	1	2.13%
Sex		
Male	42	89.36%
Female	5	10.64%
Major/Specialization		
Electrical Technology	21	44.68%
Automotive Technology	16	34.04%
Electronic Technology	10	21.28%
Mother Tongue		
Ybanag	11	23.4%
Iloco	34	72.34%
Tagalog	2	4.26%
Religious Affiliation		
Roman Catholic	36	76.6%
Church of Christ	2	4.26%
Iglesia Ni Cristo	3	6.38%
Jehovah's Witness	3	6.38%
Aglipay	1	2.13%
Others	2	4.26%

A large proportion (89.36%) of the students are male, and the most common major is Electrical Technology (44.68%), followed by Automotive (34.04%) and Electronic Technology (21.28%). In terms of language, the majority speak Iloco (72.34%) as their mother tongue, with smaller groups speaking Ybanag (23.4%) and Tagalog (4.26%).

According to the study of Hernandez (2020), he revealed the profound impact of mother tongue proficiency on students' academic performance and literacy development. It also highlights that a child should have a solid grasp of their mother tongue, which can enhance language skills and catalyze overall cognitive growth and socio-economic well-being. Religiously, most students identify as Roman Catholic (76.6%), with smaller representations from other Christian denominations and a few identifying with "Others." This data underscores the student body's predominance in specific age, gender, academic, linguistic, and religious categories.

3.2 Availability and Extent of Usage of Printed Learning Materials at Home

Table 2 outlines the availability and extent of usage of printed learning materials among students at home. The dictionary is the most available resource, with the highest frequency of 38, indicating it is the most commonly found printed material among students. However, despite its availability, it is used only "sometimes" with a usage frequency of 3.32. This could reflect the changing nature of how information is consumed, with digital sources possibly replacing some of the roles traditionally filled by these printed materials. Overall, the extent of usage aligns with availability to some extent. However, certain materials like the Bible and dictionary stand out as both highly available and highly used, whereas others like almanacs and newspapers, despite being available, are not as frequently utilized.

Table 2. Profile of the students in terms of availability and extent of usage of printed learning materials at home

Availability	Frequency*	Rank	Frequency of Use
Dictionary	38	1	3.32 Sometimes
Encyclopedia	25	6	2.88 Sometimes
Almanac	19	8	2.32 Seldom
Magazines	23	7	3.13 Sometimes
Books	32	3	3.09 Sometimes
Bible	37	2	3.43 Often
Newspaper	27	4	2.59 Seldom
Flyers	26	5	2.42 Seldom

**Multiple-response set*

3.3 Availability and Extent of Usage of Electronic Learning Materials at Home

Table 3 provides an overview of the availability and usage of electronic learning materials at home. Among these resources, the cellphone is the most widely available, with 45 students reporting its presence, and it is also the most frequently used, with a usage frequency of 4.82, indicating that it is used "always." In contrast, the radio is the least available electronic learning material, with 30 students reporting its presence at home. It is also the least frequently used, with a frequency of 2.34, meaning it is used "seldom." In today's rapid technological advancements, students are increasingly tech-savvy and integrate these innovations into their learning processes. Cellphones and internet access are the most essential electronic learning tools for students at home, demonstrated by their high availability and frequent use, surpassing other devices such as televisions, laptops, and radios.

Table 3. Profile of the students in terms of availability and extent of usage of electronic learning materials at home

Availability	Frequency*	Rank	Frequency of Use
Cellphone	45	1	4.82 Always
Television	43	2	2. 3.86 Often
Internet	40	3	4.58 Always
Laptop	34	4	2.94 Sometimes
Radio	30	5	2.34 Seldom

**Multiple-response set*

3.4 Errors Encountered by Students in Learning English Writing

Morphological

Table 4 summarizes the types of morphological errors made by third-year students when learning English writing, along with the frequency and rank of each error. Subject-verb (SV) Agreement was the most common error, occurring 27 times, indicating that students often struggle to match the correct verb form with the subject of their sentences (e.g., "*The researchers focuses on improving the reliability, durability, and efficiency of the DC compressor" instead of "The researchers focus on improving the reliability, durability, and efficiency of the DC compressor*Noun ending errors occurred only once, suggesting that they were relatively rare among the students surveyed. These errors involve issues with pluralization, possessive forms, or using the wrong noun in a sentence.

Table 4. Errors encountered by students in learning English writing concerning morphology

	Frequency*	Rank
Verb Tenses and Forms	19	2
SV Agreement	27	1
Noun ending	1	3

**Multiple-response set*

Syntactic

Table 5 outlines the types and frequencies of errors students encounter in learning English writing concerning syntax. The most frequent error was writing fragments, with a frequency of 63, ranking it first. This indicates that students often write incomplete sentences, which lack either a subject or a verb, resulting in fragmented thoughts that hinder clear communication. Word order was the least frequent, with a frequency of 10, indicating that students sometimes struggle with correctly placing words within a sentence to accurately convey the intended meaning.

Table 5. Errors encountered by students in learning English writing concerning syntactic

	Frequency*	Rank
Word order	10	3
Fragment	63	1
Run on sentence	34	2

**Multiple-response set*

Lexical

Table 6 provides an overview of the lexical errors encountered by students in learning English writing, along with their frequencies and ranks. The most common lexical error was word choice/form, with a frequency of 40, ranking it first. This indicates that students often struggle to select the appropriate words or forms of words that accurately convey their intended meaning. Errors in prepositions were the least frequent, with a frequency of 10, ranking them third. This implies that while prepositions are less common, they still pose a significant challenge for students. Chuang and Nesi's (2006) research on lexical errors made by Chinese learners of English identified overinclusion as a common mistake. They explained this phenomenon as a result of learners overgeneralizing and including unnecessary words, influenced by the word order patterns and structures of their native language.

Table 6. Errors encountered by students in learning English writing concerning lexical

	Frequency*	Rank
Word choice/form	40	1
Errors in preposition	10	3
Errors in pronoun	14	2
Redundancy	6	4

**Multiple-response set*

Mechanical

Table 7 outlines the mechanical errors encountered by students in learning English writing, along with their frequencies and ranks. The most frequent mechanical error was capitalization, with a frequency of 63, ranking it first. This indicates that students often misuse uppercase and lowercase letters, affecting the formal correctness and readability of their writing. Punctuation errors were the least frequent, with a frequency of 5, ranking them third. Although less common, incorrect commas, periods, or other punctuation marks can still lead to run-on sentences, fragments, and unclear sentence structures.

Table 7. Errors encountered by students in learning English writing concerning lexical

	Frequency*	Rank
Spelling	38	2
Capitalization	63	1
Punctuation	5	3

**Multiple-response set*

Research conducted by Smith and Jones (2020) highlights the prevalence of mechanical errors in student writing, particularly in capitalization. In their study, titled "Common Writing Errors in ESL Students," they analyzed the written work of 200 high school students learning English as a second language. The study found that capitalization was the most frequent, accounting for 28% of all mechanical errors. The researchers observed that

students often failed to capitalize the first letter of sentences and proper nouns and frequently used capital letters inappropriately within words and sentences.

Summary Table

Table 8 summarizes errors in morphology, syntax, lexical, and mechanical aspects of English writing, highlighting their frequencies and ranks. Syntactic errors were the most frequent, occurring 107 times and ranking first. Morphological errors were the least frequent, occurring 47 times and ranking fourth.

Table 8. Summary table for errors in morphology, syntax, lexical, and mechanical

	Frequency*	Rank
Morphological	47	4
Syntactic	107	1
Lexical	70	3
Mechanical	106	2

**Multiple-response set*

This data suggests that students primarily struggle with syntactic and mechanical aspects of writing, highlighting the need for targeted instruction to improve overall writing proficiency. Pusoitasari's (2019) study revealed that mechanical errors, particularly in capitalization, were the most prevalent. A common mistake was students failing to capitalize the first letter of the initial word in a paragraph. This issue was attributed to students' limited knowledge, lack of attention in class, and insufficient explanation and detailed examples from teachers. Similarly, Widari et al. (2000) noted that students frequently make syntactic errors in their writing, often due to a limited understanding of target language rules, which leads to incorrect verb usage in English.

3.5 Performance of the Students in English

Table 9 presents the performance levels of students in English. The highest percentage of students, 29.79% (14 out of 47), achieved a "Very Satisfactory" performance level. This indicates that a significant portion of the students perform well above average in their English studies. Conversely, the lowest performance is marked by 8.51% (4 out of 47) of students who failed. Additionally, no students fell into the "Passing" category, indicating that those who did not meet the required standards either performed well enough to avoid failure or did not meet the minimum threshold.

Table 9. Performance of the students in English

Level of Performance	Frequency (n=47)	Percentage
Very Good	2	4.26
Good	10	21.28
Very Satisfactory	14	29.79
Satisfactory	10	21.28
Fair	7	14.89
Passing	0	0
Failure	4	8.51
Mean = 80.98 Satisfactory		

One of the possible reasons was the pandemic's impact on education, particularly through disruptions in traditional learning environments and increased reliance on remote learning, which may have contributed to the observed performance trends. This aligns with findings from Dacanay (2022), who examined the challenges and opportunities in teaching writing online amidst the pandemic in the Philippines. The study highlights the difficulties teachers and students face in adapting to online learning, which may have affected writing performance. Focusing on targeted support for struggling students, enrichment opportunities for high achievers, and addressing the challenges posed by the pandemic's educational context may be key to enhancing the overall English performance in this group.

3.6 Relationship between Students' Errors in Learning English and their Profile

Table 10 shows the correlation test results between students' errors in learning English and their profiles. The correlation between religion and lexical errors is significant, with an R-value of 0.310 and a p-value of 0.034. This positive correlation suggests a statistically significant relationship between a student's religious background and the frequency of lexical errors in their English writing. In other words, students' religion may influence their choice

and use of words, potentially affecting their lexical accuracy in English. Jeynes (2003) revealed that religiously committed urban children generally outperformed their less religious counterparts in most academic measures. This finding is echoed in Taylor and Francis' (2008) research on Black male students, where religious commitment fostered by the church community and belief in God significantly contributed to their academic achievement.

Table 10. Correlation test results between students' Errors in learning English and their profile

	Morphology		Syntax		Mechanical		Lexical	
	r value	Prob	r value	Prob	r value	Prob	r value	Prob
Age	0.093	0.534	0.192	0.195	-0.122	0.414	0.227	0.124
Sex	-0.054	0.717	0.075	0.619	-0.101	0.501	0.218	0.141
Mother tongue	0.068	0.648	-0.102	0.496	-0.072	0.632	0.103	0.493
Religion	-0.010	0.946	0.160	0.281	-0.105	0.482	**0.310***	**0.034**
Major	0.043	0.774	0.147	0.324	-0.075	0.614	0.216	0.145
No. of available learning materials	-0.062	0.681	0.208	0.162	0.017	0.908	0.014	0.925
Extent of usage of learning materials	0.107	0.475	-0.064	0.668	0.096	0.522	0.067	0.654

**Correlation is significant at the 0.05 level (2-tailed).*

Furthermore, the National Longitudinal Survey of Youth data confirms a positive correlation between religious practice and academic success. Students who attended religious services weekly or more often had higher average GPAs than those who attended less frequently. Religious practice also correlated with higher educational aspirations, with those attending church weekly during their upbringing having significantly more years of total schooling by their early thirties than those who did not attend church. These studies collectively suggest that religious commitment and practice can positively influence academic achievement, potentially through the cultivation of cultural and social capital and the instillation of values that promote educational attainment.

3.7 Relationship between the Student's Performances in English and the Other Variables

Table 11 shows the correlation test results between students' performance in English and various variables. Two variables were found to have a highly significant correlation with students' performance. The correlation between mechanical errors and students' performance in English is highly significant, with an r-value of -0.390 and a p-value of 0.007. This negative correlation indicates that as mechanical errors (such as spelling, punctuation, and capitalization errors) increase, students' performance in English becomes poorer. Similarly, the correlation between lexical errors and students' performance in English is highly significant, with an r-value of -0.424 and a p-value of 0.003. This also suggests a negative relationship, meaning that a higher frequency of lexical errors (related to word choice and vocabulary) is associated with lower performance in English. These findings suggest that while errors in morphology and syntax do not substantially affect performance, mechanical (spelling or punctuation mistakes) and lexical (such as incorrect word choice) are significantly associated with poorer English performance. This indicates that low-performing students tend to commit more mechanical type, and high-performing students tend to commit fewer lexical types of errors.

Table 11. Correlation test results between students' performance in English and the other variables

	Value of r	Probability	Statistical Inference
Profile variables			
Age	0.126	0.399	Not Significant
Sex	0.260	0.078	Not Significant
Mother tongue	0.145	0.331	Not Significant
Religion	0.268	0.069	Not Significant
Major	0.188	0.205	Not Significant
Availability and extent of usage of learning materials	-0.135	0.365	Not Significant
Extent of usage of learning materials	0.082	0.583	Not Significant
Difficulties in learning English			
Morphology	-0.034	0.818	Not Significant
Syntax	-0.084	0.573	Not Significant
Mechanical	-0.390**	0.007	Highly Significant
Lexical	-0.424**	0.003	Highly Significant

Dana Ferris, in her book "Treatment of Error in Second Language Student Writing," discusses that mechanical errors (like spelling and punctuation mistakes) can hinder readability and cause misunderstandings, while lexical errors (such as incorrect word choices) can lead to confusion and misinterpretation of ideas. Both negatively

impact communication effectiveness and reflect broader issues in language proficiency, underscoring the need for targeted instruction to improve students' writing performance.

4.0 Conclusion

This study highlights the prevalent writing challenges among third-year students in the College of Industrial Technology, focusing on syntactic, mechanical, lexical, and morphological errors, with sentence structure and capitalization identified as critical areas for improvement. The correlation between religious affiliation and lexical errors emphasizes the role of cultural and contextual influences on language use, suggesting a need for culturally responsive teaching practices. Language teachers should conduct regular assessments, provide targeted supplementary materials, and teach effective error correction strategies through self-editing and peer review to address these challenges. Writing activities should include diverse linguistic and cultural contexts. At the same time, university administrators and policymakers are urged to develop programs that systematically address these errors and prepare students for academic and professional success. Combined with engaging drills and focused instruction, these measures can foster students' writing proficiency and confidence, ensuring their readiness for future opportunities.

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7.0 Conflicts Of Interest

This study was conducted as a requirement for completing a master's degree program. The author declares no conflict of interest related to the research.

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Challenges, Coping Strategies, and Resilience in Implementing the Matatag Curriculum: Insights from Elementary Teachers

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Abstract. This study aimed to explore the challenges, resilience, and coping strategies of elementary educators during the implementation of the MATATAG curriculum. Three teachers from particular Digos City elementary schools participated in the study. This study used a qualitative, phenomenological research approach and was carried out from August to November of 2024. Focus groups and in-depth interviews were used as data collection methods to generate responses. The challenges for elementary teachers in implementing the MATATAG curriculum are resource and material constraints, increased curriculum demands, and the need for enhanced professional development and support. Themes found on the impact of challenges on the resilience of elementary teachers in implementing the new curriculum are mental and emotional stress, doubts about one's ability to cope, and professional identity. Thus, Coping strategies were used with peer and team support, self-motivation, a positive outlook, and professional growth and adjustment. Authorities were advised to invest in supplying the required tools and materials, create professional development plans, and assist educators by creating a creative and encouraging work atmosphere.

Keywords: Challenges; Coping strategies; Elementary teachers; Matatag curriculum implementation; Resilience.

1.0 Introduction

Curriculum reforms require substantial adaptability and resiliency from educators at the forefront of implementation. To raise the caliber of the K–12 curriculum, the Department of Education (DepEd) implemented the MATATAG curriculum, which presented difficulties for teachers in this regard. According to the Department of Education (2023), the revised curriculum emphasizes learning competencies, reading and numeracy, and fewer learning topics. The elementary-level MATATAG curriculum seeks to be implemented successfully. However, this depends on how resilient the elementary teachers are. By emphasizing essential abilities, the MATATAG curriculum aims to lower the board learning competencies compared to the previous curriculum, allowing for more effective learning (David et al., 2023).

Educators' engagement and ability to adapt to new policies influence the curriculum's effectiveness. The study of Flores & Day (2006) concludes that because of changes in curricula, teachers experience stress and workload challenges. These challenges impact mental health and job performance. The study by Albrecht and Saggers (2020)

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proposed that teachers adopt new methods and training that enhance professionalism, aligning with the curriculum's practice and instructional methods. The shifting in curriculum gives educators hindrances in implementing diverse students' needs and adapting the restructured contents and instructional methods. However, the approach of the new curriculum, such as MATATAG, aligns with the global trend that highlights depth rather than breadth of learning content (Cohen & Brown, 2021).

In addition, education resilience is educators' capacity to adapt despite challenges such as new policies, classroom diversity, and workloads (Mansfield et al., 2016). the resilience of elementary teachers is vital in transforming new policies and guidelines of the MATATAG curriculum into effective instructional practices. It enables educators to manage their well-being, professionalism, and job satisfaction (Beltman et al., 2011). Resilience is the capacity of teachers to implement crucial curricular reforms, have a positive mindset, practice reflective practice, and use critical thinking (Gu & Day, 2013). Resilience is the dedication of teachers in the face of adversity (Mansfield et al., 2016). Curriculum modifications help teachers deal with stress, professional growth, classroom management, and pressures (Castro et al., 2010).

According to Howard & Johnson (2004), resilient teachers can adapt to curriculum changes and improve student outcomes. To satisfy the new competency standards in the MATATAG curriculum, educators must reassess their current approaches. Teachers' ability to bounce back under duress is essential to curricular achievement (Hong, 2012). Coping strategies that help manage stress and overcome obstacles include student-centered teaching (Patterson et al., 2004). Moreover, the resilience of educators is critical during educational reform times, yet teachers must adapt to new instructional methods, practices, and strategies in teaching and find effective coping mechanisms (Skaalvik & Skaalvik, 2015). Day and Hong (2016) conclude that teachers are more resilient when receiving support from institutions and peer collaboration. Resources and other organizational support push educators to build resilience (Tschannen-Moran & Woolfolk Hoy, 2007).

In the MATATAG curriculum, educators must reevaluate existing methods to meet new competency standards. Curriculum success depends on teachers' resilience, which allows them to respond under pressure (Hong, 2012). coping strategies like student-centered teaching help people deal with stress and overcome obstacles. Resilient teachers are more able to conceive of interventions, adjust to changes, and safeguard their mental health (Patterson et al., 2004). In order to improve the quality of their instruction, instructors who exhibit signs of stress, sadness, or anxiety should take the same precautions for their mental health that they do for their pupils (Almerez, 2022). Educators at the elementary level show hindrances that affect their teaching performance and resilience, which need coping mechanisms.

MATATAG curriculum is well-structured, but implementation brings hindrances to elementary teachers. As the DepEd mandates the new curriculum, elementary educators have obstacles that hinder their resilience, and their coping strategies should be shared with others. In Digos City, teachers are experiencing obstacles, and their stories of challenges and strategies used to overcome these circumstances have not been disclosed yet. Thus, this research investigates the educators' experience with the promptly implemented curriculum, specifically for the elementary teachers of selected schools in Digos City.

2.0 Methodology

2.1 Research Design

The study used a descriptive-phenomenological approach to explore the lived experiences of elementary school teachers who encountered difficulties with the MATATAG Curriculum.

2.2 Research Locale

The study was conducted in selected elementary institutions in Digos City, Davao del Sur, where teachers implement the new curriculum.

2.3 Research Participants

According to Creswell & Poth (2018), the number of participants in phenomenological research includes 3-10. Through purposeful sampling, approximately three teachers from diverse educational backgrounds will be selected to participate in in-depth interviews and focus group discussions. Participants are teachers who teach at

the elementary level in Digos City. These teachers are specifically teaching in the present academic year in either of these three grade levels: kindergarten, grade 1, or grade 4.

2.4 Research Instrument

This study used interview guide questions. The interview guide questions were evaluated by experts before the data gathering. This was to ensure that the questions asked were appropriate for the study.

2.5 Data Gathering Procedure

Several procedures were used to obtain the necessary data for this investigation. Before the actual interview, participants were aware of what the research was all about. After the orientation, researchers set schedules based on the participants' vacant time. Then, an in-depth interview allowed participants to talk about their shared experiences and viewpoints. The data-collecting period was spread over a predetermined time to accommodate participants' schedules. Thematic analysis was applied to the interviews in verbatim transcriptions. Peer debriefing, member checking, and including detailed descriptions in reporting all help preserve rigor and trustworthiness.

2.6 Ethical Considerations

Ethical factors put into account guarantee reflexivity. Throughout the study, strict adherence to informed consent and confidentiality was maintained. Accurately conveyed the essence of teachers' resilience in the new curriculum; the findings were provided with detailed explanations and direct quotes.

3.0. Results and Discussion

3.1 Challenges Faced by the Elementary Teachers in Implementing MATATAG Curriculum

The MATATAG curriculum is the current trend. The updated curriculum, as mandated by DepEd, has caused problems for elementary teachers in implementation. Table 1 presents the challenges elementary teachers face in implementing the MATATAG curriculum.

Resource and Material Constraints

The theme 'Resource and Material Constraints' captures the frequent challenge of insufficient materials, which hampers teachers' ability to implement project-based learning effectively. A critical challenge in implementing the MATATAG Curriculum is the lack of sufficient resources and materials, which limits teachers' ability to deliver hands-on, engaging, and practical learning experiences. Many classrooms lack essential teaching aids, equipment, and basic materials, preventing teachers from fulfilling the curriculum's project-based requirements. Studies have shown that resource limitations are widespread in curriculum implementation, particularly in public schools with constrained budgets, where large class sizes compound the difficulty of providing individualized support (Al Mamun et al., 2020; Brown & Weber, 2022). Teachers frequently have to use their creativity when resources are limited, sometimes making their materials or buying things with their funds, which can lead to dissatisfaction and fatigue. Since student's experiential learning is essential to the objectives of the MATATAG Curriculum, a lack of sufficient resources eventually impacts both teaching quality and student engagement (Heckman & Sarti, 2023).

Lack of enough tools and materials is one of the main issues elementary teachers have while implementing the MATATAG Curriculum. This curriculum emphasizes experiential and project-based learning, which calls for specialized teaching tools, learning resources, and classroom supplies, which are frequently scarce. Teachers sometimes need help accomplishing curricular goals when classrooms lack essential resources, such as science experiment kits, technology tools, or art supplies. This restriction is especially problematic in large-class institutions where students need individualized attention and various resources to succeed. According to research, teachers frequently modify lessons or look for alternate resources when schools lack resources, increasing their workload and stress levels.

Increased Curriculum Demands

Teachers are also struggling with 'Increased Curriculum Demands' focusing on project-based and interactive learning; the MATATAG Curriculum offers more extensive and complex content. As a result, teachers must be more prepared and employ more effective classroom management and instructional practices. Because teachers must create and execute lessons beyond conventional approaches to involve students in active and hands-on

learning experiences, these increasing demands escalate the workload. However, instructors may feel overburdened in the absence of adequate time, resources, or extra support, impairing their ability to teach effectively and raising their risk of burnout (D'Addiego & Best, 2023; Weber et al., 2023). It is not easy to achieve all expectations when instructors face curriculum intensification. They frequently find it difficult to reconcile these demands with their current duties, such as managing large classrooms and administrative duties (Singh & Sajitha, 2022). These requirements must be met to ensure the curriculum's objectives are met without jeopardizing the instructors' health.

The expanded requirements of the MATATAG Curriculum demand teachers to adapt to more complex teaching practices that go beyond traditional teaching methods, such as project-based learning and interactive, real-world problem-solving. Although these methods increase student engagement, they necessitate much teacher planning and preparation. Teachers are increasingly asked to create classes that meet higher learning criteria, frequently needing more time or advice on how to do so successfully. The extra effort can make teachers feel overburdened, which impairs their capacity to present the curriculum uniformly across all subject areas. Teachers may become frustrated and burn out due to the pressure to reach high curriculum standards without sufficient support. Some of these demands may be reduced by providing flexible lesson plans, streamlining curricular requirements, or guaranteeing sufficient support, making it more straightforward for teachers to carry out the curriculum successfully.

Need for Enhanced Professional Development and Support

One major obstacle is the 'Need for Enhanced Professional Development and Support'. The MATATAG Curriculum implementation requires ongoing professional development and organized assistance. Teachers must embrace new pedagogical approaches to effectively deliver this curriculum, necessitating continuous training in techniques supporting project-based, active learning. Research shows teachers need help understanding and applying complex curriculum frameworks using standard, one-time training sessions (Blake et al., 2021). Ongoing professional development that involves coaching, follow-up meetings, and chances to talk about obstacles and achievements in curriculum implementation is most beneficial to teachers (Smith & Hoy, 2021). Teachers may feel unprepared and unconfident in their skills if they do not receive enough assistance, which can increase stress and lower motivation. Educational institutions and authorities must promote ongoing professional development programs and offer mentorship and classroom support to assist educators in efficiently adjusting to the curriculum's requirements (Lee & McCaffrey, 2023).

To meet the MATATAG Curriculum's goals, teachers require ongoing professional development and in-class support, which are often unavailable. Teachers may experience tension and uncertainty as they attempt to anticipate the curriculum's increasing demands. More than a single training session is needed for effective curriculum implementation; teachers must have access to ongoing, focused professional development opportunities that give them the tools they need to handle particular curriculum requirements, such as project-based assessments or digital literacy. Educators can greatly benefit from in-class support, including classroom aides, coaching, mentorship, and professional development, to address their daily practical challenges more effectively. Teachers may experience isolation without this support, perhaps diminishing their self-esteem and general resilience. The ability of teachers to adapt to the new curriculum would be significantly improved if professional development were accessible and tailored to their needs.

3.2 Challenges Affect Elementary Teachers' Resiliency in the Implementation of New Curriculum

Implementing the MATATAG curriculum presents challenges for elementary teachers. These difficulties impact their ability to adapt to the new curriculum.

Emotional and Mental Strain

Elementary teachers experience severe 'Emotional and Mental Strain' as shown in Table II above, when implementing the MATATAG Curriculum because of the increased workload, scarce resources, and requirement to reach higher curriculum standards. The frequent encounter of stress from managing large class sizes and facilitating hands-on, project-based learning without sufficient materials often leads to exhaustion and emotional fatigue. The ongoing need to perform under these challenging conditions contributes to teachers' anxiety, affecting their mental health and overall resilience. According to numerous studies, instructors who face excessive demands

without sufficient support lose their efficacy and develop burnout and a diminished ability to cope with work-related stressors (Blake et al., 2021; D'Addiego & Best, 2023). In order to address this issue and minimize long-term emotional strain, a supportive work environment and access to mental health resources are necessary (Weber et al., 2023). Given the role of emotional well-being in sustaining teacher resilience, it is critical to provide teachers with tools to manage stress and strategies to balance their responsibilities, thus fostering a more resilient workforce.

Implementing the MATATAG Curriculum has placed significant emotional and mental stress on elementary teachers, primarily due to the heightened demands of the curriculum alongside insufficient support and resources. Instructors must provide interactive, hands-on sessions that require more planning, resources, and time. Teachers may feel more stressed and inadequate as they work to fulfill these high expectations, particularly if they lack the ability to meet each student's unique learning needs. If such stress is not addressed, it might eventually reduce teachers' passion, job satisfaction, and capacity for sustained dedication.

Questioning of Professional Identity and Resilience

Some educators have begun to doubt their resiliency and professional identity due to the implementation of the MATATAG Curriculum. Teachers frequently feel insecure and inadequate when confronted with new teaching techniques and heightened curricular requirements, undermining their self-esteem and established professional responsibilities. Teachers often experience professional dissonance as they attempt to balance the principles of successful teaching with the realities of scarce resources and heightened administrative demands, leading to this identity question. According to studies, teachers in these situations frequently doubt their abilities, which has a detrimental effect on their motivation and resilience (Smith & Hoy, 2021; Weber et al., 2023). To maintain a strong professional identity amidst these challenges, teachers need access to professional support systems that validate their efforts and reinforce their sense of purpose. Providing opportunities to reflect and reinforce core teaching values can help rebuild teachers' confidence and resilience, allowing them to align their professional identity with new curriculum requirements.

The challenges in implementing the MATATAG Curriculum have also led teachers to question their professional identity and capability. As they struggle to meet the curriculum's demands without sufficient support, some teachers doubt their competence, skills, and commitment to teaching. Educators who question their ability to perform effectively may experience self-doubt and diminished professional identity. Teachers may experience disengagement from their mission and enthusiasm for teaching due to doubts over their professional identities, affecting their resilience. The confidence and resilience of teachers diminish with time without reinforcement of their values and skills, complicating their ability to adapt and endure difficult circumstances. Supportive initiatives, including mentorship, validation, and professional development, are essential for assisting teachers in preserving a robust sense of identity and resilience among curriculum obstacles.

3.3 Coping Mechanisms Applied by Elementary Teachers to Address Challenges and be Resilient

During the implementation of the MATATAG curriculum, teachers faced challenges that affected their resiliency. However, they applied coping mechanisms to conquer the said problems.

Collaborative and Peer Support

'Collaborative and Peer Support' is crucial in helping elementary teachers cope with the challenges of implementing the MATATAG Curriculum. Peer cooperation offers teachers professional and emotional support as they navigate the many pressures, from adjusting to new pedagogical frameworks to managing resource constraints. According to studies, teachers participating in collaborative networks report feeling more resilient and satisfied with their jobs. Teachers can lessen feelings of loneliness and foster a sense of community by exchanging resources, ideas, and instructional techniques. This is crucial for stress management and conquering obstacles (Harrison & Westwood, 2020). Peer support also enables educators to collaboratively solve problems and create creative solutions for real-world classroom challenges like a lack of resources or big class numbers. This support system can be very beneficial in demanding educational settings, where more than individual efforts might be required to satisfy the expectations of curricular revisions (Jordan & Garcia, 2022). Peer cooperation has been shown to improve classroom practices, foster long-term professional growth, and boost teachers' confidence in handling the challenges of curriculum changes (Harrison & Westwood, 2020).

Research has shown that such collegiality boosts teachers' morale and resilience, making them more capable of adapting to the demands of new educational reforms. Peer and collaborative support is one of the best coping strategies elementary teachers may use to deal with the difficulties presented by the MATATAG Curriculum. This emphasizes how teachers' supporting ties with their peers give them perseverance and strength. Teachers support one another in handling the increased curriculum demands, which strongly emphasizes project-based and interactive learning activities, by exchanging resources, tactics, and insights. They can discuss adjusting to resource constraints, share workable solutions for classroom problems, and offer emotional support to one another in this environment. Educators feel less alone and more united because of this network of support for one another, which also improves the work environment.

Positive Mindset and Self-Motivation

A positive mindset and strong self-motivation are foundational to teacher resilience, especially when coping with the pressures of the MATATAG Curriculum. Despite obstacles like a lack of resources or an increased workload, teachers with a positive outlook are more likely to concentrate on attainable objectives and find meaning in their profession. Despite challenging conditions, research has consistently demonstrated that instructors who retain a positive outlook can overcome failures, remain motivated, and continue to improve (Robinson et al., 2021). Educators can proficiently mitigate stress and sustain motivation by employing reflective strategies, such as focusing on tiny student achievements or establishing personal goals (Lee & McCaffrey, 2023). Additionally, self-motivation helps educators manage curricular standards autonomously and actively seek solutions to challenges in the classroom. The link between resilience and optimistic thinking highlights the importance of establishing a mindset that views setbacks as opportunities for growth rather than insurmountable barriers (Smith & Hoy, 2021). This kind of thinking supports teachers' long-term job satisfaction and retention in addition to helping them deal with current challenges.

A positive mindset and strong self-motivation are essential personal strategies that help teachers cope with the challenges posed by the MATATAG Curriculum. Teachers who maintain a constructive outlook and focus on incremental successes—such as student progress or small wins in lesson delivery—are better equipped to handle stress and adapt to curriculum demands. This optimistic outlook increases their resilience by keeping them concentrated on their objectives. Self-motivated teachers are more likely to persevere through challenges, especially in the face of increased workloads or a lack of resources. To stay motivated and remind themselves of the importance of their profession, many educators engage in reflective techniques like goal-setting for themselves or acknowledging little successes in the classroom. This mindset enables educators to face obstacles and uncertainty head-on by cultivating a feeling of fulfillment and purpose. Research on resilience shows that self-motivation and a positive mindset are essential for avoiding burnout because they enable educators to cope with stress and stay dedicated to their student's education.

Professional Development and Adaptation

'Professional Development and Adaptation' is one of the coping strategies applied by educators, which is crucial for teachers to successfully implement the MATATAG Curriculum because it gives them the skills and knowledge needed to adjust to changing educational demands. When presented with innovative teaching strategies like project-based learning or competency-based assessments, instructors who engage in ongoing professional development are better equipped to maintain their confidence and flexibility. According to recent research, continuous training improves teachers' pedagogical abilities and builds resilience by increasing teachers' self-efficacy and decreasing feelings of inadequacy (Singh & Sajitha, 2022). Teachers who participate in professional development activities regularly are better equipped to handle classroom issues and adjust to the requirements of the MATATAG Curriculum. Furthermore, by offering coping mechanisms for stress, burnout, and workload demands, professional development can help educators build emotional resilience (Lee & McCaffrey, 2023). A resilient and productive teaching workforce largely depends on teachers' capacity to modify and improve their methods through professional development as curriculum reforms continue to take shape.

Building resilience in teachers adopting the MATATAG Curriculum requires professional development and the capacity to adjust to changing circumstances. Teachers benefit from frequent and focused training that helps them adjust to the intricacies of this curriculum, which calls for creative teaching strategies and practical skills for successful delivery. From project-based learning approaches to classroom management practices, professional

development workshops can cover various tactics, giving educators the skills and assurance they need to fulfill new standards. Additionally, ongoing education keeps educators abreast of best practices, enabling them to adapt their methods in response to criticism and difficulties. This theme underscores that professional development is not just about skill-building; it also enhances teachers' adaptability and self-assurance, which are crucial in facing the evolving demands of curriculum reforms. By supporting teachers' professional growth, educational institutions empower them to implement the MATATAG Curriculum more effectively, fostering a resilient workforce capable of navigating curriculum changes.

4.0 Conclusion

From this study's results, the absence of resources and materials draws attention to a crucial weakness that may restrict the curriculum's ability to have the desired effect on students' learning. Classrooms are under-resourced without the essential teaching aids, especially for the MATATAG Curriculum's hands-on, project-based learning. In order to ensure that all schools, particularly those in locations with limited resources, have enough supplies to meet curricular standards, policymakers must place a high priority on fair resource distribution. Teachers' resilience, general dedication, and mental health are all impacted by the difficulties presented by the MATATAG Curriculum. The results also highlight the necessity of consistent, continuous professional development adapted to the curriculum's requirements. Teachers who get inadequate or one-time training feel unprepared and unsupported, which impacts the quality of curriculum implementation. These problems significantly impact teachers' resilience and well-being, manifesting as emotional and mental strain and a reevaluation of professional identity. Teachers exhibit considerable resourcefulness through collaboration and peer support, the preservation of a positive attitude towards self-motivation and professional development, and adaptability as coping strategies.

Some recommendations could be taken based on the study's findings. First, educational authorities must invest in supplying the resources and tools required by the MATATAG Curriculum. A thorough plan for allocating resources should be created to guarantee that all schools have the necessary supplies, particularly for areas like science and technology requiring specialized equipment. In addition, the education department should provide professional development programs that extend beyond initial implementation training to meet the curriculum's expectations. These should concentrate on particular subject areas, classroom management approaches, and creative teaching methods that complement MATATAG's focus on project-based and active learning. Furthermore, school leaders should also actively assist teachers by creating a helpful and encouraging work environment where teachers can voice concerns and offer solutions at regular feedback sessions with administrators. Lastly, the researchers suggested that more research should be done on the conditions of elementary teachers in the MATATAG Curriculum.

5.0 Contributions of Authors

The authors of this research collaborated to ensure the study's completeness and integrity. Author WRJ played an integral part in the study, considerably contributing to editing, writing, supervision, data analysis, and encoding. This entailed enhancing the paper, supervising the study advancement, doing comprehensive data analysis, and guaranteeing precise encoding for reporting purposes. Conversely, Author *TJL* concentrated on fieldwork and compliance with research ethics, overseeing data collection, transcribing the gathered material, and adhering to ethical guidelines throughout the study. These complementary contributions underscore the collaborative endeavors and mutual obligations to generate a thorough and ethically robust research output.

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7.0 Conflict of Interests

No conflict of interest.

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Work-Related Quality of Life among Public Secondary School Teachers in the City of Manila, Philippines

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Abstract. This study investigates the Work-Related Quality of Life (WRQoL) among public secondary school teachers in the City of Manila, Philippines, focusing on domains such as General Well-being, Home-Work Interface, Job-Career Satisfaction, Control at Work, Working Conditions, and Stress at Work. The research aims to assess the levels of WRQoL and identify differences based on demographic profiles. A descriptive cross-sectional study was employed, involving 190 secondary public school teachers. Data were collected using a standardized WRQoL questionnaire developed by the Quality of Working Life Research Center at the University of Portsmouth. The study utilized convenience and snowball sampling methods, ensuring voluntary participation and adherence to ethical standards. Results indicate that most respondents exhibit a high quality of life, with significant differences observed in stress at work and area of specialization and age-related differences in home-work interface and working conditions. Specifically, 60% of respondents reported higher overall WRQoL, 27.5% had average, and 12.6% had low WRQoL. The study found no significant gender differences across WRQoL subscales. However, age significantly influenced the home-work interface and working conditions, with younger teachers experiencing more favorable conditions. In conclusion, the study highlights the importance of addressing occupational stress and enhancing working conditions to improve teachers' quality of life. The findings suggest that targeted interventions considering age and specialization could further enhance teachers' work-related quality of life, ultimately benefiting educational outcomes.

Keywords: Quality of life; Work-related quality of life; Secondary teachers; Home-work interface; Job-Career Satisfaction.

1.0 Introduction

Teachers anchor every well-developed education system and are key to societal development. The Philippines has always assigned major relevance to education. This even appears in the country's 1987 Constitution and subsequent yearly releases of government funds. Recent problems, though, with regard to the COVID-19 pandemic, economic recession, and lack of resources have all affected the education system in the country. As the academic frontlines, teachers suffer from changing expectations and performance changes. These circumstances have heightened the risks teachers have to deal with physically and mentally, affecting their quality of life, QoL.

The pandemic has changed the educational system's dynamic, creating new stressors such as resource constraints and vague policies. These have further elevated the stress levels of school personnel. Such stresses can have adverse effects on the teachers' QoL and their work performance as well. Teachers, as key figures in education,

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must maintain this balance in order to be able to work effectively. This study determines the work-related quality of life among public secondary school teachers in Manila based on the following domains: General Well-being, Home-Work Interface, Job-Career Satisfaction, Control at Work, Working Conditions, and Stress at Work.

Although work-related quality of life is considered very significant, very few research that consider the specific domains of teachers have considered it a research area of interest. This study, hence, attempts to bridge this gap by evaluating secondary public-school teachers' work-related quality of life and establishing differences based on demographic profiles. In identifying the factors that affect teachers' quality of life, the study is expected to contribute to the improved delivery of education services and support teachers in maintaining a balanced quality of life.

Work-Related Quality of Life (WRQoL)

The World Health Organization (WHO) describes the quality of life (QoL) as "an individual's perception of their position on life in the context of the culture and value systems in which they live and about their goals, expectations, standards, and concerns. It is a broad-ranging concept affected complexly by the person's physical health, psychological state, personal beliefs, social relationships, and relationship to salient features of their environment." It is acknowledged as a significant, multifaceted problem with both good and negative components linked to various aspects of interpersonal interactions (WHO, 2014). This concept represents the premise that quality of life is a subjective assessment anchored within a cultural, social, and environmental setting.

Work-related quality of life, also known as quality of work life, is a concept that encompasses the general well-being of employees. According to Rao et al. (2013), it refers to employees' satisfaction with various aspects of their work life, such as the work itself, financial aspects, working conditions, and skills. Quality of work life is linked to fundamental employment qualities like pay, benefits, working conditions, workload, stress, and opportunities for advancement and career development (Lee et al., 2007). Kumar (2016) defines it as the alignment between employees and their work environment, emphasizing the importance of motivation and job satisfaction for organizational productivity.

Quality of Life for Teachers

The complexity of teaching, with its physical, mental, social, and spiritual demands, significantly impacts teachers' perceived quality of life. An "Educator Quality of Life" survey by the American Federation of Teachers revealed that 61% of educators experience work stress, with 27% reporting bullying incidents (American Federation of Teachers, 2020). In contrast, teachers in Davao City, Philippines, report a good quality of work life, with respect and dignity as key determinants (Bagtasos & Espere, 2010). Factors like wages, benefits, and fair working hours are crucial for motivation and productivity (Kumar, 2016). On the other hand, studies in India found no significant differences in work-related quality of life based on age, sex, or professional membership (Bharathi & Gupta, 2017). Similarly, Rao, Arora, and Vashisht (2013) reported no differences among university professors based on academic designation or subjects taught.

Dimensions of Work-related Quality of Life

Well-being, as defined by the Center for Disease Control and Prevention (2018), involves mental health, life satisfaction, purpose, and stress management. Teacher well-being is critical for educational delivery and student outcomes (Duckworth et al., 2009). Idoiaga-Mondragon et al. (2021) found that psychological health had the highest quality of life scores. Additionally, Sunga (2019) examined the correlation between quality of life and mental health among full-time private school teachers in Malolos, Bulacan, finding a significant inverse relationship. The pandemic has heightened risks to teachers' mental health due to increased stress and uncertainty, compounded by the need to adapt to new educational standards. The pandemic also poses serious risks to teachers' mental health and general well-being due to elevated levels of stress and worry that are made worse by the ongoing uncertainty of the situation. Aside from the possible stress and anxiety that COVID-19 poses to themselves and their families, teachers must also adjust to the latest standard in the context of the educational environment (Besser et al., 2020; Rabacal, n.d.).

Home and work interface, which assesses employees' perceptions of control over their job's timing, location, and manner, contributes to a fulfilling and professional life. Danilewitz (2017) found that Canadian female teachers

experience low quality of life due to stressors related to work-life balance. Similarly, in India, male teachers reported better work-life balance than female faculty. In the Philippines, Canoy (2020) studied public secondary school teachers in Agusan del Sur, revealing that workload demands significantly challenge their quality of life. A notable 20% of respondents reported difficulties attending their children's events due to work commitments.

Job satisfaction reflects employee contentment with their workplace and tasks (Torlak & Kuzey, 2019). Moradi et al. (2012) identified job satisfaction as a composite of job qualities, personal attributes, environment, coworker relationships, supervision, and organizational structure. Sehar and Alwi (2019) found that democratic leadership positively influences teacher satisfaction and engagement. However, Tobias (2017) reported no significant correlation between job satisfaction and leadership styles, possibly due to other factors like job achievements and security.

Control at work, or the perceived empowerment to influence one's work environment, is linked to job satisfaction and organizational commitment (Easton & Laar, 2018; Mohammad et al., 2022). Amoli and Youran (2014) highlighted the positive correlation between teacher empowerment and job satisfaction. Balkar (2015) described "empowering school culture" as encompassing teacher efficacy, satisfaction, social interactions, and leadership. Research by Tindowen (2019) indicates that Catholic University teachers in the Philippines feel valued and empowered but lack participation in decision-making processes. Similarly, Archer and Cameron (2013) found that teachers in Tennessee perceive significant control over their practices but feel limited in leadership and career development opportunities.

In educational systems, it cannot be overstated how important it is to prioritize human resource development. Among the intervention methods that will directly contribute to an increase in the quality of education is a consistent investment in teachers' working conditions. The International Labor Organization (ILO) identified several ways to improve it from increasing their salaries and providing adequate equipment and learning materials to teacher training. The ILO believes that focusing on the teacher’s working conditions would solve problems of teacher attrition and job performance.

Improving teachers' working conditions reduces attrition and enhances performance (Geiger & Pivovarova, 2018). In the Philippines, initiatives like Project "TAO" aimed to improve teachers' working conditions, but funding constraints have hindered full implementation (Dadulo & Canencia, 2010). During the pandemic, Robosa et al. (2021) reported significant challenges teachers face, including stress and burnout. Conversely, studies at private institutions like the University of Mindanao show high satisfaction with working conditions, emphasizing professional growth and resources (Maghanoy, 2021).

Stress can influence job performance positively or negatively. While moderate stress can enhance performance, excessive stress is detrimental (Akrani, 2011). Teachers face workloads, lack of resources, and student behavior issues (Leroux & Théorét, 2014). In China, female teachers report lower quality of life due to stress, which worsens with age (Yang et al., 2009). Jaminal (2015) identified job pressure as a primary stressor for teachers in the Caraga region, affecting their classroom functions.

2.0 Methodology

2.1 Research Design

A descriptive cross-sectional study was utilized to describe the profiled characteristics of the respondents during the actual gathering of data. Characteristics include school age, gender, educational attainment, areas of specialization, and years of teaching experience. A comparative design was also used to ascertain the differences between two variables, specifically the respondent’s work-related quality and the said profiled characteristics.

2.2 Research Locale

The public secondary schools in Manila, recognized as leaders in providing high-quality education, served as the study's setting. It is divided into six different congressional districts. According to the website of the Department of Education in Manila (DepEd Manila), Districts I, III, IV, and V each have five public secondary schools. In contrast, Districts II and VI each have six public secondary schools. The research locale was chosen for the richness of possible respondents.

2.3 Research Participants

The study used convenience and snowball sampling methods to recruit secondary school teachers within the Division of City Schools, Manila. Convenience sampling enabled selecting participants based on their availability and willingness to participate. Snowball sampling complemented this approach by allowing initial respondents to share the questionnaire with other eligible teachers. Respondents' eligibility in relation to the inclusion criteria was determined as public secondary school teachers within the Division of City Schools of Manila, either male or female, between 21 and 65 years old, and currently teaching full-time as described by the law. Teachers with additional administrative duties aside from actual classroom teaching were also included. Respondents who only work as substitute teachers, work outside of Manila, or teach at the elementary or collegiate levels, on the other hand, were excluded.

The study successfully gathered data from 190 participants, surpassing the initial target of 180 respondents. These participants were distributed across six Division of City Schools, Manila divisions. Specifically, Division 1 included 31 respondents, accounting for 16.3% of the total sample. Division 2 comprised 32 respondents, representing 16.8%. Division 3 had the highest number, with 33 respondents, or 17.4%. Division 4 and 5 each contributed 30 respondents, making up 15.8% of each sample. Lastly, Division 6 included 34 respondents, constituting 17.9% of the total participants. This distribution ensured a well-rounded and representative dataset for the study.

2.4 Research Instrument

The research instrument was initially composed of the respondents' demographics. This section contains questions to capture the basic individual information that determines school affiliation, age, gender, educational attainment, and years of teaching experience. Easton and van Laar (2018) initiated the development and standardization of the Work-Related Quality of Life (WRQoL). This is a 23-question psychometric scale that is designed to measure an employee's perceived quality of life across six domains of their work. The WRQoL scale is a tool that helps people, organizations, consultants, and researchers measure and understand people's quality of life at work. The scale is comprised of items that measure six different dimensions, including general well-being (GWB) for questions number 4, 9, 10, 15, 17, and 21, home-work interface (HWI) for questions 5, 6, and 14, job and career satisfaction (JCS) for questions 1, 3, 8, 11, 18, and 20, control at work (CAW) for questions 2, 12, and 23, working conditions (WCS) for questions 13, 16, and 22, and stress at work (SAW) for questions 7 and 19. The responses are given on a Likert scale with five points, one strongly disagreeing and five strongly agreeing; the scores of the three negatively phrased items are reversed (questions 7, 9, and 19). The score for the Overall WRQoL factor is determined by calculating the average of all 23 WRQoL items (the 24th "Overall" item is not included in this calculation). The mean scores of each subscale can be used for comparative and correlational analysis among different variables.

The WRQoL scale is available for free use under the condition that the user commits to utilizing the scale exclusively for non-commercial, educational, or research reasons only. No fee is charged. The coefficients for Alpha range from 0.72 to 0.90, and the coefficient for the total score is 0.94; this demonstrates that the dimensions have strong internal consistency. Test-retest coefficients ranged from 0.77 to 0.88, with a mean score of 0.87 overall (Easton & van Laar, 2018).

2.5 Data Gathering Procedure

While gathering the necessary information, the researcher employed convenience and snowball sampling methods. Using these various sampling strategies, the researcher was able to select respondents based on their availability and willingness to participate in the study. In addition, the respondents could provide others who satisfied the eligibility requirements with a physical copy of the questionnaire. The Work-Related Quality of Life (WRQoL) is a free-to-use public domain funded by the Department of Psychology at the University of Portsmouth's Quality of Working Life Research. The questionnaires were generated in paper format. A hard copy was personally distributed to the respondents with the help of an authorized school administrator. The researcher was personally present during the on-site implementation to ensure that any queries or questions were addressed. Additionally, the researcher's contact information was included for easy communication in case of queries. The respondents took approximately 10 minutes on average to complete the entire questionnaire.

After the respondents had answered the questionnaire, the researcher gathered the data. Once finished, the researchers filtered the data manually. Responses were considered null if a respondent lacked answers, which would prevent the exact calculation of scores. The researcher ensured that all the responses were complete before enlisting the assistance of a statistician to assist with data computation and interpretation. The researcher, at the same time, prepared materials for the transcription process. The treatment of quantitative data involved tallying responses electronically with Microsoft Excel, followed by analysis using SPSS under the guidance of a statistician. Means and standard deviations were calculated to determine overall and domain scores for work-related quality of life and individual work performance, with weighted means facilitating inferential analysis. Percentages and frequency distributions organized demographic data, such as school affiliation, age, gender, educational attainment, areas of specialization, and years of teaching experience. An independent t-test was used to examine variations based on gender, and a one-way analysis of variance (ANOVA) was used to assess differences across three or more demographic variables, such as age or educational attainment, regarding these outcomes. Tukey's post-hoc test was employed alongside ANOVA to identify specific group differences.

2.6 Ethical Considerations

Upon the dissertation advisor's recommendation, the researcher used informed consent, stating vital information for the study. The researcher guaranteed that participation in this study is entirely voluntary. The researcher does not expect any risk during the entire period of the implementation process; nonetheless, respondents can withdraw at any moment. For reasons of confidentiality, the researcher kept this study's records in a secure file. The data was recorded per the Data Privacy Act of 2012, a.k.a. Republic Act 10173. Only the researcher has password-protected access to the electronic file containing the research records.

3.0 Results and Discussion

3.1 Sociodemographic Profiles of the Respondents

The sociodemographic features of the respondents are shown in Table 1. The study's respondents were predominantly young, with 37% aged 20 to 30, while only 16% were between 51 and 65. Females comprised 70% of the sample. Regarding teaching experience, 24% had 16-20 years, 22% over 21 years, and 17% over 1-3 years. In terms of specialization, the largest group was Filipino teachers (17%), followed by science (12%) and mathematics teachers (11%), with MAPEH teachers being the smallest group at 9%.

Table 1. Sociodemographic profiles of the respondents

Profiles		f	%
Age	20-30 years old	70	37
	31-40 years old	49	26
	41-50 years old	40	21
	51-65 years old	31	16
Gender	Male	58	30
	Female	132	70
Years of Teaching Experience	1 – 5 years	36	19
	6 – 10 years	33	17
	11 – 15 years	35	18
	16 – 20 years	45	24
	21 years and above	41	22
Area of Specialization	Mathematics	21	11
	Science	22	12
	English	18	9
	Filipino	32	17
	Social Studies	21	11
	Home Eco	19	10
	Technical-Vocational	20	10
	MAPEH	17	9
	ESP	20	11

3.2 Work-Related Quality of Life of Secondary Public-School Teachers

Table 2 presents secondary public-school teachers' work-related quality of life (QoL), focusing on its dimensions. Most participants (86) reported an average WRQoL, with 84 indicating higher levels and only 20, or 10.5%, reporting lower levels. In the home-work interface (HWI) dimension, which evaluates institutional support for balancing professional and personal lives, 53.2% reported high WRQoL, while 23.2% reported less favorable conditions. Regarding Job and Career Satisfaction (JCS), 76.3% of participants experienced high WRQoL, 18.9% moderate, and 9.0% low. The Control at Work (CAW) scale showed that 51.6% of respondents believed they had a high control over their work environment, followed by 29.5% with moderate and 18.4% with low control scores. The Working Conditions Score (WCS) revealed that 50.5% of respondents reported high WRQoL related to

resources and job security, 46.8% reported average, and 30.5% reported low levels. Finally, 89 respondents experienced average stress at work, 75 reported a low quality of life, and only 26 indicated a higher quality of life.

Table 2. Level of Work-Related Quality of Life (WRQoL) among the Respondents

	Level of Quality of Life					
	Higher		Average		Low	
	f	%	*f*	%	*f*	%
General Well being	84	44.2	86	45.3	20	10.5
Home-Work Interface	101	53.2	45	23.7	44	23.2
Job/Career Satisfaction	145	76.3	36	18.9	9	4.7
Control at Work	98	51.6	56	29.5	35	18.4
Working Conditions	96	50.5	36	18.9	58	30.5
Stress at Work	26	13.7	89	46.8	75	39.5
Over-all WRQoL	**114**	**60**	**52**	**27.5**	**24**	**12.6**

3.3 Gender Differences Across the Subscales of Work-Related Quality of Life

Table 3 revealed no significant gender differences across the subscales of work-related quality of life (WRQoL) among public secondary school teachers. This finding aligns with Balasbas's (2022) study in Davao City, which reported no statistically significant gender-based differences in work-life quality. Similarly, research by Saxena (2018) among teachers in India underscored that school policies and quality-of-life management programs were equally effective for both male and female groups.

Table 3. Comparability of Work-Related Quality of Life (WRQoL) among respondents according to gender

WRQOL Subscale	Gender	N	X + SD	t-value	p-value	Decision
General Well being	Male	58	3.57 + 0.53	0.002	0.969	Accept
	Female	132	3.62 + 0.57			
Home-Work Interface	Male	58	3.67 + 0.7	2.802	0.096	Accept
	Female	132	3.83 + 0.77			
Job/Career Satisfaction	Male	58	4.05 + 0.5	0.032	0.859	Accept
	Female	132	4.09 + 0.54			
Control at Work	Male	58	3.79 + 0.61	0.969	0.326	Accept
	Female	132	3.78 + 0.71			
Working Conditions	Male	58	2.72 + 0.76	0.353	0.553	Accept
	Female	132	2.92 + 0.85			
Stress at Work	Male	58	3.86 + 0.56	3.848	0.051	Accept
	Female	132	3.76 + 0.69			
Over-all WRQoL	**Male**	**58**	**86.14 + 9.76**	**1.846**	**0.176**	**Accept**
	Female	**132**	**87.51 + 11.7**			

Note: Subscale from the Work-Related Quality of Life Questionnaire by Easton and van Laar (2018).
Accepted the Null since the p-value is greater that 0.05 level of significance.
Mean and Standard Deviation is represented as X±SD

The fact that male teachers' mean scores are higher than female teachers may indicate that they are under more stress. A local study by Manalo (2019) found that male instructors report higher stress levels due to interpersonal issues, role conflicts, and a lack of understanding of their jobs, supporting this conclusion. It found that although there is no discernible gender difference in teachers' occupational stress, male instructors report higher stress levels. The study further suggested that giving male teachers additional authority, involvement opportunities, and decision-making responsibilities can reduce their stress levels.

3.4 Differences in Work-Related Quality of Life Among Respondents According to their Age

Table 4 presents the differences in work-related quality of life among respondents according to age. Only a significant age difference exists between the home-work interface (p-value = 0.000) and the working conditions (p-value = 0.046).

Table 4. Comparability of Work-Related Quality of Life (WRQoL) among respondents according to age

WRQoL Subscale	Age	Mean	SD	F-value	p-value	Sig	Decision
General Well being	20-30	3.688	0.489	2.365	0.072	NS	Accept
	31-40	3.456	0.544				
	41-50	3.550	0.589				
	51-65	3.726	0.635				
Home-Work Interface	20-30	3.938	0.745	6.677	0.000	S	Reject
	31-40	3.388	0.734				
	41-50	3.833	0.675				
	51-65	3.957	0.693				
Job/Career Satisfaction	20-30	4.110	0.542	0.443	0.7223	NS	Accept
	31-40	4.024	0.487				
	41-50	4.046	0.527				
	51-65	4.140	0.568				
Control at Work	20-30	3.905	0.652	1.167	0.324	NS	Accept
	31-40	3.707	0.596				
	41-50	3.742	0.681				
	51-65	3.720	0.710				
Working Conditions	20-30	3.890	0.685	2.713	0.046	S	Reject
	31-40	3.578	0.706				

	41-50	3.742	0.647				
	51-65	3.935	0.599				
	20-30	2.793	0.853				
	31-40	2.847	0.751				
Stress at Work	41-50	2.725	0.832	2.060	0.107	NS	Accept
	51-65	3.177	0.842				
	20-30	**88.271**	**11.408**				
	31-40	**83.816**	**9.733**				
Over-all WRQoL	**41-50**	**86.675**	**10.319**	**2.522**	**0.059**	**NS**	**Accept**
	51-65	**90.129**	**12.701**				

*Note: *Significant at 0.05 level of significance*
Tukey's test was used to identify differences in between variables
S = Significant difference; NS – No Significant Difference

3.5 Comparability of Work-Related Quality of Life Among Respondents According to Teaching Experience

The result also yielded no significant difference in the work-related quality of life and the respondent's teaching experience, as seen in Table 5. All the probability values are above the 0.05 level of significance, thus accepting the null hypothesis. This signifies that the well-being of teachers is equally the same regardless of the longevity of their teaching career.

Table 5. Comparability of Work-Related Quality of Life (WRQoL) among respondents according to teaching experience

WRQoL Subscale	Teaching Experience	Mean	SD	F-value	p-value	Sig	Decision
	1 – 5 years	3.646	0.533				
	6 – 10 years	3.685	0.593				
General Well being	11 – 15 years	3.583	0.543	0.680	0.614	NS	Accept
	16 – 20 years	3.496	0.486				
	21 years and above	3.632	0.620				
	1 – 5 years	3.740	0.871				
	6 – 10 years	3.964	0.777				
Home-Work Interface	11 – 15 years	3.722	0.706	0.650	0.625	NS	Accept
	16 – 20 years	3.595	0.738				
	21 years and above	3.868	0.663				
	1 – 5 years	4.109	0.518				
	6 – 10 years	4.122	0.649				
Job/Career Satisfaction	11 – 15 years	4.093	0.500	0.349	0.840	NS	Accept
	16 – 20 years	3.996	0.483				
	21 years and above	4.089	0.496				
	1 – 5 years	3.760	0.689				
	6 – 10 years	3.928	0.758				
Control at Work	11 – 15 years	3.824	0.475	0.569	0.684	NS	Accept
	16 – 20 years	3.722	0.624				
	21 years and above	3.729	0.702				
	1 – 5 years	3.833	0.808				
	6 – 10 years	3.847	0.735				
Working Conditions	11 – 15 years	3.787	0.586	0.668	0.617	NS	Accept
	16 – 20 years	3.651	0.694				
	21 years and above	3.829	0.588				
	1 – 5 years	2.953	0.700				
	6 – 10 years	2.824	0.944				
Stress at Work	11 – 15 years	2.847	0.782	0.875	0.474	NS	Accept
	16 – 20 years	2.702	0.827				
	21 years and above	2.965	0.862				
	1 – 5 years	**87.906**	**12.491**				
	6 – 10 years	**88.027**	**12.749**				
Over-all WRQoL	**11 – 15 years**	**87.167**	**9.269**	**1.42**	**0.229**	**NS**	**Accept**
	16 – 20 years	**84.333**	**10.589**				
	21 years and above	**88.302**	**10.586**				

*Note: *Significant at 0.05 level of significance*
Tukey's test was used to identify differences in between variables
S = Significant difference; NS – No Significant Difference

3.6 Comparability of Work-Related Quality of Life Among Respondents According to Area of Specialization

Lastly, Table 6 provides a comparative analysis of Work-Related Quality of Life (WRQoL) among respondents based on their area of specialization, covering several subscales: General Well-being, Home-Work Interface, Job/Career Satisfaction, Control at Work, Working Conditions, Stress at Work, and Overall WRQoL. Notably, in the Stress at Work subscale, scores vary from 2.500 in Social Studies to 3.833 in ESP, and a significant difference is observed (F-value: 2.187, p-value: 0.030). Lastly, in the overall WRQoL, the mean scores ranged from 85.524 in Social Studies to 89.381 in Mathematics, with no significant differences (F-value: 0.329, p-value: 0.954).

Table 6. Comparability of Work-Related Quality of Life (WRQoL) among respondents according to area of specialization

WRQoL Subscale	Area of specialization	Mean	SD	F-value	p-value	Sig
	Mathematics	3.706	0.695			
	Science	3.644	0.573			
	English	3.620	0.517			
General Well being	Filipino	3.651	0.536	0.264	0.977	NS
	Social Studies	3.516	0.560			
	Home Eco	3.614	0.481			
	Tech-Voc	3.558	0.550			

	MAPEH	3.520	0.603			
	ESP	3.575	0.550			
	Mathematics	3.810	0.688			
	Science	3.712	0.737			
	English	3.611	0.551			
	Filipino	4.052	0.758			
Home-Work Interface	Social Studies	3.619	0.798	0.925	0.497	NS
	Home Eco	3.719	0.870			
	Tech-Voc	3.817	0.662			
	MAPEH	3.863	0.913			
	ESP	3.633	0.748			
	Mathematics	3.789	0.655			
	Science	4.143	0.561			
	English	4.144	0.525			
	Filipino	4.037	0.346			
Job/Career Satisfaction	Social Studies	4.104	0.607	0.185	0.993	NS
	Home Eco	4.016	0.527			
	Tech-Voc	4.096	0.446			
	MAPEH	4.017	0.580			
	ESP	4.088	0.537			
	Mathematics	3.746	0.674			
	Science	3.939	0.579			
	English	3.630	0.646			
	Filipino	3.917	0.605			
Control at Work	Social Studies	3.810	0.688	0.675	0.712	NS
	Home Eco	3.684	0.741			
	Tech-Voc	3.667	0.658			
	MAPEH	3.902	0.724			
	ESP	3.717	0.660			
	Mathematics	3.794	0.645			
	Science	3.833	0.747			
	English	3.722	0.639			
	Filipino	3.906	0.758			
Working Conditions	Social Studies	3.778	0.609	0.281	0.972	NS
	Home Eco	3.667	0.762			
	Tech-Voc	3.733	0.645			
	MAPEH	3.706	0.706			
	ESP	3.833	0.626			
	Mathematics	3.167	0.856			
	Science	2.523	0.698			
	English	3.194	0.667			
	Filipino	2.891	0.868			
Stress at Work	Social Studies	2.500	0.791	2.187	0.030	S
	Home Eco	3.132	0.684			
	Tech-Voc	2.825	0.832			
	MAPEH	2.647	0.981			
	ESP	2.850	0.829			
	Mathematics	89.381	12.687			
	Science	86.000	11.322			
	English	87.056	8.558			
	Filipino	88.750	12.292			
Over-all WRQoL	Social Studies	85.524	10.505	0.329	0.954	NS
	Home Eco	86.684	11.081			
	Tech-Voc	85.550	11.297			
	MAPEH	87.471	11.684			
	ESP	86.500	10.841			

*Note: *Significant at 0.05 level of significance*
Tukey's test was used to identify differences in between variables
S = Significant difference; NS – No Significant Difference

In the DepEd 2020 – 2021 education data, there is a total of 30,017 junior high school and 3,997 senior high school in the National Capital Region (NCR), among which more than 5,000 teachers are assigned in the division of Manila. In terms of gender, according to the census as presented by the study of Olores-Regalado is 2017, the teaching profession in the Philippines is predominantly occupied by women. In both public elementary and secondary schools, the number of female school teachers exceeds that of male teachers. Despite the predominance of women in the teaching profession, male administrators continue to hold the top occupational positions and receive the highest salaries. In the study, it also reveals that majority of the teachers are not yet done or not engaged in graduate studies. The study of David et al., (2020) even suggested that there is a great disparity of enrolment to graduation ratio in a state university in Manila with only 10:1. The study suggests that in order to ensure successful degree completion without compromising the quality of thesis and dissertation research, it is advisable to consider revisiting and implementing evidence-based practices.

Given that a significant proportion of the participants exhibit moderate levels of overall well-being, it is important to examine the variables that impede their ability to attain higher standards of living, including physical health. Amit and Malabarbas (2020) conducted a study among 200 public-school teachers in the Philippines, which found that musculoskeletal disorders have an impact on the physical wellbeing of teachers. The lower back and legs were the areas with the highest incidence of musculoskeletal discomfort. The outcome serves as a reliable measure of how school administrators, curriculum and policy designers, and other stakeholders ought to improve the

working environment of educators. This finding has been replicated in various studies conducted in Asia, as evidenced by Althomali et al. (2021) and Wang et al. (2019). Moreover, the mental well-being of educators may also be a contributing factor, given that the nation is only beginning to resume normalcy in the wake of the COVID-19 pandemic. The mental wellbeing of secondary school teachers in Batanes was investigated by Billote et al. (2022). The findings suggest that the individuals experience moderate levels of anxiety, depression, and stress. The impact of the pandemic and the suspension of face-to-face instruction had a noteworthy effect on teachers, particularly in terms of work-related stress.

Remarkably, majority of the teachers have a higher home-work interface. The result supports the study conducted by Ramos & Galleto in 2020. It revealed that the majority of teachers in the district of Zamboanga del Sur had a healthy balance between their schoolwork and personal life outside of work. In addition to personal, academic, curriculum and instruction planning, classroom administration, and social accomplishments, they were also extraordinarily productive. Therefore, scheduling tasks and organizing activities frees up time that can be used for other purposes, such as boosting productivity.

The result of obtaining higher job and career satisfaction among respondents also supports the study conducted by Bona in 2020. Overall, the findings indicated that teachers are highly satisfied with their teaching profession in terms of the organization's supervision and planning, functions within the school, workplace conditions, relationship with the principal, pay, and benefits. In addition, instructors concur that they are pleased with training, professional development, and available resources. This is true in the Division of Manila; according to their website, there are numerous activities that ensure the welfare of their teachers. These include continued procurement of teaching materials, in-service trainings, and promotion, among others.

The respondents' scores on the subscales of control at work and working conditions were found to be higher. According to Caliba's (2022) study, the establishment and development of a cooperative atmosphere within the school's premises are closely interrelated. This finding suggests that various measures have been implemented to foster a collaborative environment, such as enabling all members of the school to participate in decision-making processes and empowering them to become influential and significant contributors. Lastly, the stress at work subscale scores reveals that majority only have average quality of life. With this, occupational stress together with general wellbeing must be given attention due to its possible relationship with work performance. Mingoa (2017) found that elementary and secondary school teachers experience significant levels of stress. Many reasons contribute to this, including those within the realm of work, such as excessive paperwork, unrelated extra responsibilities, overcrowded classrooms, and inept superiors, as well as those within the realm of the personal, such as interpersonal relationships, and the economic, such as a low wage and high cost of living.

The result of the study regarding home-work interface and age is supported by the study conducted by Richert-Kamierska & Stankiewicz in 2016, which found a statistically significant difference in how people view their life-work balance based on their age, with a focus on people in the 55–70 age group compared to those who are younger. According to Rook (2020), the multi-generational definition of work-life balance may also affect the difference in results. Boomers, or those who were born in the 1960s, are competitive and employer-loyal, placing their careers above all other aspects of their lives. They labor long hours and frequently neglect family and school occasions. While younger generations, such as Generation X, are more likely to make a career switch when dissatisfied with their current job or career path.

There is also a difference in working conditions and quality of life among respondents according to age. A possible reason for the difference is the capacity of younger teachers to switch working environments easily, such as by applying for more productive work abroad. There is no doubt that due to their academic expertise, particularly in teaching the English language, Filipino educators are highly regarded abroad. Since many non-English countries are now incorporating English as a subject or course into their curricula, Filipino instructors are in high demand abroad. It is important to determine their teaching experience since it does not only affect wellbeing but also teaching effectiveness (Kini & Podolsky, 2016). It is also remarkable to note that the study conducted by Kourmousi & Alexopoulos (2016) found an inverse relationship between seniority and stress levels among teachers. Specifically, it was observed that as teachers grew older, they experienced lower levels of stress in relation to work-related stress factors, time management, professional distress, and professional investment

stressors. Analogously, extended tenure was found to be linked with diminished occupational distress, as well as lower levels of stressors related to professional discipline and motivation, and a decreased perception of stress.

Aside from the fact that different subjects have different demands, the study conducted by Co et al. in 2021 stated that mismatched subject assignments at the elementary, secondary, and tertiary levels are one of the issues that have garnered significant attention. The phenomenon of instructors teaching non-discipline-specific subjects without adequate education or training has been overlooked. The result of the study further stated that the lived experiences of secondary teachers demonstrated difficulties, obstacles, and widespread negligence that increased their stress at work. The study is limited only to comparative study to lay a foundation for future investigation. It does not determine the causal relationship and predictive values of the variables. It will only focus on the perception of the respondents on their work-related quality of life does determine other factors that are not within the scope of the study. Due to convenience sampling, the samples collected for this study are unlikely to be representative of all secondary public-school teachers in the Philippines.

4.0 Conclusion

This study ascertained the work-related quality of life among public secondary school teachers in the division of Manila. The study concludes that in terms of home-work balance, job/career satisfaction, control over one's work environment, and working circumstances, most secondary public-school teachers in Manila enjoy higher quality of life. On the other hand, average levels of overall well-being and workplace stress are present. The study also determines the multi-faceted aspects of individual work performance of the respondents. The result shows that majority of the respondents are goal oriented in finishing their task performance. Most of the respondents are also actively participating in meeting and school consultations as part of their contextual performance. Lastly, a vast majority of the respondents do not make problems bigger than they seem.

The results show that both male and female secondary public-school teachers have equal levels of general wellbeing, home-work interface, job satisfaction, control at work, working conditions and occupational stress. However, there is only a significant difference in terms of age with the home-work interface and the working conditions. The results of the study on individual work performance shows that only counterproductive behavior and educational attainment have a significant difference, rejecting the null hypothesis. The study can be used for policy implementation to enhance understanding of work-related quality of life and individual performance. It suggested examining additional sociodemographic factors, such as socioeconomic status and school location, and extending research to private school teachers. Future studies could explore health-related quality of life for teachers with orthopedic disabilities and those nearing retirement. Investigating factors that help teachers manage work-related stress and assessing their application in other divisions were also recommended. Strengthening contextual work performance through volunteer opportunities aligned with teachers' interests was advised. The researcher suggested examining the causal relationship between counterproductive work behavior and educational attainment, particularly for younger teachers balancing graduate studies or family commitments. Lastly, Educational administrators were encouraged to support initiatives promoting teacher welfare and work-life balance.

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Indicate the contribution of each author:
Nil Edward F. Panuelos – editing, writing, data analysis, supervising
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Link Between Academic Performance and Board Exam Results of Civil Engineering Graduates

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Abstract. This study explores the relationship between academic performance and board exam outcomes among Bachelor of Science in Civil Engineering graduates at Nueva Vizcaya State University (NVSU) from 2018 to 2022. The research addresses a critical gap in understanding how specific academic subjects contribute to board exam success, providing insights essential for curriculum improvement and student support. Specifically, the study aims to determine the significance of academic performance in Mathematics, Hydraulics, and Design in predicting board exam results, identifying influential subjects, and developing a predictive model. Using descriptive research design, secondary data on academic grades and board exam ratings were collected from the NVSU Registrar and the Professional Regulation Commission. Correlation and regression analyses revealed that academic performance in Hydraulics had a moderate positive relationship with board exam outcomes, contributing significantly to overall results ($r = 0.287$, $p < 0.05$). In contrast, Math and Design exhibited mixed relationships, with some weak negative correlations suggesting the influence of additional factors. Regression analysis indicated that Hydraulics positively predicted board exam results ($\beta = 9.844$, $p = 0.045$), while Math and Design showed less significant or negative contributions. The findings emphasize strengthening the Hydraulics curriculum and aligning Math and Design courses with board exam expectations. With 85.3% of the variance in board exam performance explained by the model ($R^2 = 0.853$), the study highlights the substantial impact of academic preparation while recommending targeted interventions and further exploring non-academic factors. This research provides actionable insights for enhancing engineering education and improving licensure exam outcomes.

Keywords: Academic performance; Board examination; Civil Engineering; Design; Hydraulics; Mathematics.

1.0 Introduction

The correlation between academic performance and licensure exam results is important in higher education, particularly in professional fields such as civil engineering. Universities and educators strive to equip students with the knowledge and skills necessary for success in board examinations, which serve as critical gateways to professional practice. For civil engineering graduates, these exams assess their grasp of technical concepts and readiness to contribute to the profession. Despite the emphasis on academic performance during undergraduate studies, questions remain about how effectively these measures predict success in licensure exams. Understanding this relationship is essential for improving curricula, instructional strategies, and student support systems. By identifying patterns and factors that contribute to performance in board exams, educators can better align academic programs with the demands of professional certification

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Education is a vital tool that enables individuals to find their place in the world, pursue better employment opportunities, and achieve success in life. Consequently, academic institutions should respond positively and effectively to their graduates' educational needs and expectations by providing high-quality instruction to their stakeholders (Raqueno & Yabut, 2013). Members of the academic system are also responsible for ensuring the success of their graduates. For example, specific board courses like engineering, this can be achieved by implementing education and experience requirements as prerequisites for board exams (Mohammed & Mohammed, 2017). The Licensure Examination for Engineering programs assesses and ensures the quality of engineers entering the workforce of diverse manufacturing industries in the Philippines and abroad. Licensure examinations for professional practice are a regulatory mechanism implemented by the State. The Professional Regulations Commission (PRC) has consistently regulated graduates of all board courses, granting professional licenses to those graduate examinees who successfully pass the board exam.

Academic performance is an indicator of student outcomes, reflecting how students learn from the instruction of any course. It is a significant concern in universities, and teachers, as facilitators of science learning, play a crucial role in the success of the teaching and learning process. They act as catalysts in transferring knowledge and skills to the next generation of innovators. How students comprehend the subject matter and apply its principles to practical situations demonstrates their understanding of the intended learning outcomes. Student academic performance in professional courses and mathematics is considered vital in contributing to the outcomes of their future endeavors, particularly the licensure examination.

Furthermore, the assurance of engineering professionals' preparedness is an ongoing process facilitated by accreditation. Accreditation serves as a platform for collaboration between industry and engineering educators, enabling the development of assessment techniques to enhance classroom management, courses, and curricula. Accreditation also ensures that instructional strategies are adapted to prepare students for the expected outcomes of graduates. These strategies include assessing academic aptitude and self-image to predict board exam performance, offering intervention courses to help students prepare for the board examination, improving the curriculum, and analyzing the profiles of successful examinees (Tamayo & Canizares, 2014). Additionally, evaluating, correlating, and assessing the board exam performance of engineering graduates helps us align with AACUP recommendations, provides essential data for the Regional Quality Assessment Team (RQUAT), contributes to SUC leveling, and ultimately establishes a foundation for curriculum development and enhancement of the university's engineering programs.

According to the research of Agnes M. Ramos (2015), the Evaluation of the Performance of Isabela State University Accountancy Graduates in the CPA Board Examination focused on the Comparison of ISU Passing Percentages with the National Passing Percentages, the Relationship between the Socio-economic Profile of the Respondents, the Relationship between the Grades of the Respondents in some General Education and Business Core subjects, Relationship between the Grades of the Respondents in Accounting and Finance Education subjects, Projected Performance in CPA Board Examination (3-Pass in one take,2-Pass in two takes, 1-Fail), according to her conclusion some factors affected the board examination performance like the difficulty of the subject according to rank, encountering several problems while preparing and taking the board examinations like insufficient funds, lack of self-confidence and too many topics not discussed in the classroom.

Determinants of performance in the board examination for Mechanical Engineering graduates of the Nueva Vizcaya State University, Bambang campus. According to their research, undergraduate students should develop a study habit of understanding the concepts, principles, and manipulation of equations or formulas rather than memorization. Abaya, Montalbo, and Orig (2016) focused on developing a model prototype for predicting the possible student passers and the performance of students who will take the board exam. Their prediction variables included academic grades, age, gender, and pre-board scores. Their model would be able to identify who among the pool of board takers might pass or fail the board and the possible passing percentage of the institution as compared to the national passing rate.

In addition, Dizon and Laguador (2013) focused on the board exam performance rating of two courses and the academic achievements of engineering graduates in the cognitive and affective domains. On board exam performance ratings, their study revealed that mechanical engineering examinees obtained the highest average

score in machine design, followed by math subjects, while they obtained the lowest rating in power plant design. This study explores the link between the academic performance of civil engineering graduates and their results in board exams. It aims to provide insights into how academic metrics, such as grades and cumulative GPAs, correlate with exam outcomes. Ultimately, the findings can inform policies and practices that enhance future civil engineers' academic preparation and professional success.

2.0 Methodology

2.1 Research Design

The study used the descriptive method of research, which emphasizes the present status of a phenomenon, describes a current situation, determines the nature of prevailing conditions or practices, and seeks an accurate description of entities, objects, persons, and processes (Dulay, 2003). The data on academic grades and board ratings are secondary as they are readily available from the University Registrar and Professional Regulation Commission (PRC), respectively.

2.3 Research Participants

The respondents for this study comprise 294 graduates of the Bachelor of Science in Civil Engineering program at Nueva Vizcaya State University (NVSU) from 2018 to 2022. These individuals were selected based on their program completion and participation in the Civil Engineering Board Examination, ensuring relevance to the study's focus on the relationship between academic performance and licensure exam outcomes.

2.4 Research Instrument

The academic grades of the respondents were gathered from the Nueva Vizcaya State University (NVSU) SIAS, and the board exam rating was requested from the Professional Regulation Commission (PRC). The data gathered was encoded in Excel by listing the names with their corresponding subject rating and academic grades.

2.5 Data Analysis

The data will be treated using the following statistical tools: Correlation and Regression Analysis were used to determine if there is significant relationship between the independent variables, the academic grades in mathematics, allied and professional subjects and the dependent variables is the engineering board examination rating.

2.6 Ethical Considerations

The study complied with institutional and ethical guidelines, ensuring that the respondents did not suffer physical, emotional, or reputational harm. Data were collected, analyzed, and reported with honesty and transparency, ensuring the findings were accurate and unbiased. Finally, the results are intended solely for academic and institutional purposes, aiming to improve education and support for future professionals.

3.0 Results and Discussion

Table 1 illustrates the relationship between academic performance in Math, Hydraulics, and Design and the corresponding board exam performance in the same subjects and overall board exam output.

Table 1. Relationship between academic performance and board exam performance during May CELE

	Math		Hydraulics		Design	
	Pearson Correlation	**Sig. (2-tailed)**	**Pearson Correlation**	**Sig. (2-tailed)**	**Pearson Correlation**	**Sig. (2-tailed)**
brmath	-0.106	0.283	0.119	0.227	-0.156	0.113
brhydraulics	0.256**	0.008	0.109	0.267	0.287**	0.003
brdesign	-0.172	0.079	-0.021	0.835	-0.164	0.094
Average	**0.214***	**0.028**	**0.067**	**0.494**	**0.239***	**0.014**

It shows a weak and direct relationship between academic performance in hydraulics and board exam performance in math and design ($r = 0.256$, $p < 0.05$). This means that higher academic achievement in hydraulics was associated with higher board exam scores in math. Further, the relationship between academic performance in hydraulics and board exam scores in design was also significant ($r = 0.287$, $p < 0.05$), meaning there was a weak relationship between academic and board exam outcomes in these areas. The positive correlations between academic performance in Hydraulics and board exam scores in Math and Design suggest that students who

excelled in Hydraulics tended to perform better in these board exam subjects. A strong foundation in mathematics often correlates with success in hydraulics and design.

Moreover, the overall board exam performance in both Math and Design academic scores were positively related to their achievement. For Math, the correlation with overall board exam results ($r = 0.214$, $p < 0.05$) indicates that stronger academic performance in Math was slightly correlated to overall board exam scores. Also, academic performance in Design demonstrates a slight but statistically significant positive correlation with overall board exam results ($r = 0.239$, $p < 0.05$), showing a slight but positive relationship. This suggests that stronger performance in these subjects contributed slightly to better board exam results. However, the weak/slight correlations indicate that other factors likely contested a more significant role in overall board exam results. On the other hand, the relationship between academic performance in Math and corresponding board exam scores in Math was weak and non-significant ($r = -0.106$, $p > 0.05$) this reflects that there was a weak inverse relationship. Further, the relationship between Math academic performance and Hydraulics board exam scores was slightly positive but also non-significant ($r = 0.119$, $p > 0.05$). The correlation with Design board exam scores was weakly negative ($r = -0.156$, $p > 0.05$), but this too was not statistically significant. This aligns with some studies that suggest that board exam results may be influenced by other factors beyond mere academic performance in individual subjects.

The model summary indicates a moderate positive relationship between academic performance in math, hydraulics, and design and board exam results with a correlation coefficient ($R = 0.592$). These suggest that performance in these subjects is associated with exam scores. The R-squared value of 0.853 reveals that approximately 85.3% of the variance in board exam results could be explained by these three predictors, indicating a strong model fit. Further, the adjusted R-squared value of 0.584 shows that the model remains robust after accounting for the number of variables while the standard error of the estimate (11.02486) reflects a moderate level of prediction accuracy.

Table 2. Model summary (May CELE)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.592[a]	0.853	0.584	11.02

a. Predictors: (Constant), Math, Hydraulics and Design
b. Dependent Variable: Board Exam Results

The findings emphasize the significant role that Math, Hydraulics, and Design play in influencing board exam performance. These suggest that teachers should prioritize these subjects to enhance student outcomes in standardized assessment and other factors beyond academic performance in Math, Hydraulics, and Design may also influence board exam outcomes. This highlights the presence of other influencing factors, such as practical experience, exam-taking skills, and psychological factors that may not be captured in the model.

Table 3 Shows the regression analysis between academic performance in Math, Hydraulics, and Design and Board Exam Results. The results indicate a statistically significant negative relationship between math and design scores and board exam performance with coefficients of -9.792 and -7.116, respectively. This suggests that the lower scores in these subjects correlate with lower board exam results. In contrast, Hydraulics demonstrated a positive relationship with a coefficient of 9.844, suggesting that strong performance in this area may enhance students' exam outcomes. Moreover, the significance levels for all predictors indicate that the observed effects were statistically strong with p-values below the conventional threshold of 0.05.

Table 3. Regression analysis on academic performance as predictors of board exam results (May CELE)

Coefficients[a]						
		Unstandardized Coefficients		Standardized Coefficients		
	Model	B	Std. Error	Beta	t	Sig.
1	(Constant)	77.80	21.39		3.636	0.000
	Math	-9.790	7.278	-0.153	-1.345	0.015
	Hydraulics	9.844	7.031	0.137	1.400	0.045
	Design	-7.116	4.381	-0.181	-1.625	0.007

a. Dependent Variable: Board Exam Results

These results align with the idea that performance in subjects like Hydraulics, which require both technical knowledge and problem-solving skills, is crucial for licensure success.

Table 4 illustrates the relationship between academic performance in Math, Hydraulics, and Design and the corresponding board exam performance in the same subjects as well as overall board exam output. Math and Board Exam Results There's a moderate positive correlation between Math performance and overall board exam results ($r = 0.277$, $p < 0.001$). This suggests that stronger Math skills are associated with better overall exam performance. However, the correlations between Math performance and individual board exam subjects (Math, Hydraulics, Design) are mixed A weak positive correlation exists between Math and Hydraulics board exam results ($r = 0.258$, $p < 0.001$). A weak negative correlation exists between Math and Design board exam results ($r = -0.163$, $p = 0.025$).

Table 4. Relationship between academic performance and board exam performance (November CELE)

	Math		Hydraulics		Design	
	Pearson Correlation	**Sig. (2-tailed)**	**Pearson Correlation**	**Sig. (2-tailed)**	**Pearson Correlation**	**Sig. (2-tailed)**
brmath	.258**	0.000	-0.094	0.198	-.163*	0.025
brhydraulics	.283**	0.000	-0.122	0.095	-.186*	0.010
brdesign	.198**	0.006	-.162*	0.026	-.240**	0.001
Average	**.277****	**0.000**	**-.147***	**0.044**	**-.234****	**0.001**

Hydraulics and Board Exam Results A strong positive correlation exists between Hydraulics performance and board exam results in all subjects (Math, Hydraulics, Design, and Overall), indicating a strong association. Design and Board Exam Results A strong negative correlation exists between Design performance and board exam results in Math and Hydraulics ($r = -0.162$, $p = 0.026$ and $r = -0.240$, $p = 0.001$, respectively). This suggests that lower grades in Design might negatively impact performance in these board exam subjects. A weak positive correlation exists between Design performance and overall board exam results ($r = 0.198$, $p < 0.006$), suggesting that Design skills might still contribute slightly to overall exam success. This aligns with some studies that suggest that board exam results may be influenced by other factors beyond mere academic performance in individual subjects. This finding is consistent with previous studies that highlight Hydraulics as a critical subject that reflects not just theoretical knowledge but practical problem-solving abilities, which are essential for board exams.

Table 5 illustrates the provided model summary and presents key statistics related to the regression analysis between academic performance in Math, Hydraulics, and Design and board exam results. The correlation coefficient (R) of 0.386 indicates a moderate positive relationship between the predictor variables and the dependent variable, suggesting that the model explains a portion of the variation in board exam scores. However, the R-squared value of 0.149 and the adjusted R-squared value of 0.135 indicate that the model's explanatory power is relatively limited, suggesting that other factors may be influencing board exam results.

Table 5. Model summary (November CELE)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.386[a]	0.149	0.135	10.72

a. Predictors: (Constant), Math, Hydraulics and Design
b. Dependent Variable: Board Exam Results

Additionally, the standard error of the estimate (10.71642) is relatively high, indicating that the model's predictions may not be highly accurate. Overall, while the model suggests a moderate positive relationship between academic performance and board exam results, its explanatory power is limited, indicating that further research is needed to explore other factors influencing board exam outcomes. Moreover, the significance levels for all predictors indicate that the observed effects were statistically strong with p-values below the conventional threshold of 0.05. This lower value suggests that the academic performance in the three subjects (Math, Hydraulics, and Design) explains only a small portion of the variation in board exam scores, and other external factors may play a more significant role in determining overall exam success. This aligns with findings from similar studies that suggest the complex interplay of multiple variables affecting licensure exam outcomes, such as personal motivation, time management skills, and exam anxiety.

Table 6 illustrates the regression analysis presented in the table examines the relationship between academic performance in Math, Hydraulics, and Design and subsequent board exam results. These findings highlight the importance of strong performance in Hydraulics and Design for success on the board exam, while Math scores may have a less significant impact. Hydraulics continued to show a significant negative relationship with board exam results (coefficient = -10.641, p = 0.001), indicating that lower grades in Hydraulics are strongly associated with lower board exam scores. Conversely, Design demonstrated a positive coefficient (0.348, p = 0.000), suggesting that strong performance in Design may have a positive impact on licensure exam results. The relatively less significant role of Math, with a non-significant coefficient (p = 0.664), reinforces the notion that success in the licensure exam may depend more on specialized subject knowledge, such as Hydraulics and Design, rather than on general Math proficiency.

Table 6. Regression analysis on academic performance as predictors of board exam results (November CELE)

Coefficients[a]						
		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
Model		B	Std. Error	Beta		
1	(Constant)	93.35	12.73		7.328	0.000
	Math	-2.135	4.911	-0.032	-0.435	0.664
	Hydraulics	-10.64	3.051	-0.260	-3.488	0.001
	Design	0.348	0.078	0.305	4.434	0.000

a. Dependent Variable: Board Exam Results

The findings suggest that instructors and curriculum planners should focus on strengthening students' foundations in subjects like Hydraulics and Design, which seem to play a more significant role in licensure exam success. While Math remains important, its impact on board exam performance appears to be less direct, which may warrant a reevaluation of the weight placed on this subject in preparing students for the CELE. The results also suggest the need for targeted interventions for students who struggle in Math and Hydraulics, as lower academic performance in these subjects may negatively impact board exam results. This could include supplementary tutoring, adaptive learning technologies, and strategies that promote active learning and problem-solving skills. In contrast, for students who excel in Design, the emphasis could be placed on refining their application of theory to practical problems, ensuring that their performance on the licensure exam reflects their academic achievements.

In conclusion, while academic performance in Math, Hydraulics, and Design plays a significant role in predicting board exam outcomes, other factors must be considered to provide a comprehensive understanding of licensure exam success. Further research into additional predictors, such as professional experiences, exam strategies, and personal factors, will be essential for enhancing student performance in the CELE. These results are congruent to the findings of Osabel, et. al. (2018), Felicitas, et.al. (2024), and Arboleda , (2024) who also did not establish academic performance as a determinant or predictor of civil engineering graduates' performance in the licensure examination.

4.0 Conclusion

This study examined the relationships between academic performance in key subjects—Math, Hydraulics, and Design—and the corresponding results in the Civil Engineering Board Examination. Findings revealed a weak to moderate positive correlation between academic performance in Hydraulics and overall board exam results, indicating that strong performance in this subject tends to contribute to better exam outcomes. The relationship between Math and Design scores and board exam results showed mixed patterns. While higher grades in these subjects were generally associated with better performance, other factors may also influence board exam scores. Furthermore, the model used in the study explained a moderate portion of the variance in board exam results, highlighting the role of additional factors beyond academic performance in determining exam outcomes.

5.0 Contributions of Authors

The sole author was responsible for all stages of the research process, including conceptualization, methodology design, data collection, analysis, interpretation, and the writing and revision of the research paper. All tasks were conducted independently, and the author assumes full responsibility for the study's content and conclusions

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7.0 Conflict of Interests

The authors declare no conflicts of interest about the publication of this paper

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Student's Experiences Using ChatGPT for Academic Purposes

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Abstract. The presence of technology has made our lives more convenient, especially as it advances and develops over time. Compared to previous generations, it is evident that technology has greatly aided humans in reducing the number of tasks. However, the use of technology comes with great responsibility. Technology's convenience can sometimes be misused, leading to overuse. This can result in humans relying on artificial intelligence instead of using their natural intelligence. The main objective of this qualitative study is to explore the important insights of senior high school students using ChatGPT in their academics and the meanings ascribed to their experiences. Data was generated from in-depth semi-structured interviews utilizing the transcendental phenomenological design and analyzed through thematic analysis. The analysis revealed that as students become more familiar with ChatGPT, their perspectives change, recognizing its importance and limitations. They acknowledge ChatGPT's potential as the future of education, but caution against excessive reliance and potential loss of essential learning experiences. They now accept it as a helpful guide, not a means of cheating. The findings suggest that students should use ChatGPT, as a supplement to their thinking and learning process, balancing technology with personal experiences. Moreover, educators and school administrators should promote responsible use of AI tools like ChatGPT. Students to critically evaluate information and cross-reference it with reliable sources.

Keywords: Academic journey; Artificial Intelligence; Ascribed experiences; ChatGPT; Technology education.

1.0 Introduction

Imagine a world where students can instantly access information, generate essays, and even write code with the help of a powerful AI language model. The presence of technology has made our lives more convenient, especially as it advances and develops over time. Compared to previous generations, it is evident that technology has greatly aided humans in reducing the number of tasks as it does not require much effort. However, the use of technology comes with great responsibility. Technology's convenience can sometimes be misused, leading to overuse. This can result in humans relying on artificial intelligence instead of their natural intelligence, causing potential harm to our daily lives.

Undeniably, Al technology affects several aspects of human society, specifically in the education sector. The integration of AI technology into the education of students is already present in the concept of educational technology. AI can be beneficial for students in the teaching-learning process. Thus, students must become aware of this technology to benefit from its applications while also remaining informed on the fatal flaws that these

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technologies can bring, such as factual inaccuracies (Stanford University Human-Centered Artificial Intelligence, 2023). Wentworth and Middleton's (2014) research highlights the impact of technology on student academic performance. As technology advances, its use in educational settings becomes more prevalent.

The rise of artificial intelligence (AI) on the internet has significantly impacted various communities, particularly in the educational sector (De Mántaras, 2017), and improved human life by managing tasks and calculations beyond human capability (Psychology Today, 2021). The rapid and unprecedented development of AI technology has led to an AI boom during the pandemic that has accelerated the adaptation of analytics and AI (McKendrick, 2021); current AI technologies still lack the adaptability of human cognition, limiting their flexibility and contextual judgment across varied contexts (Psychology Today, 2021).

One of the prominent AI tools, ChatGPT, has sparked debate about the potential impact on student learning and academic integrity. ChatGPT is an artificial intelligence made by OpenAI that can provide quick and well-formulated answers to a given question by the user (Coursera, 2023). This technology emphasizes the creation of works over the learning experience. However, ChatGPT's academic usage has flaws, as it offers a singular response to inquiries and lacks mechanisms to detect and prevent factual inaccuracies (Kool, 2023). Wu (2023) also posited that a flaw in the current model of ChatGPT is that it is prone to providing biased and factually inaccurate information. This reality is emerging, raising critical questions about the future of education.

Moreover, Kool (2023) mentioned that ChatGPT affects critical thinking; an overreliance could lead the students to abuse the software for exams, adversely affecting their critical thinking and writing skills. However, AI technology is not inherently negative or positive because how people use these technologies determines its effects on society. The author does not advocate for ChatGPT in academics; however, Kool further mentioned the integration of AI technology in the education of students, stating that teachers can use ChatGPT to generate closed exam questions. ChatGPT simplifies information gathering and organization for students and teachers (Dilmegani, 2023), and it also has the potential for producing inaccurate data and spreading misinformation due to overreliance on the software, requiring careful human oversight to mitigate potential harms (Vanian, 2023).

Furthermore, improper use of ChatGPT can lead to misinformation and plagiarism, as students may use information without proper citations (Baidoo-Anu *et al.*, 2023). Lack of AI technology teaching methods can also affect students' ability to analyze and filter information, affecting their ability to think critically and assess information. There is a lack of awareness of the proper utilization of AI technology due to its rapid development (Ali & Brunton, 2023). According to Myers (2022), only two-thirds of individuals surveyed know about artificial intelligence in society. Hence, AI technology, including voice assistants, image recognition, Google search, and social media, is already present in human society, and awareness of its advancements can lead to their benefits.

The theory of learning constructivism by Piaget, as mentioned by Brau (2020), states that humans create knowledge through a combination of experiences and ideas and how individuals use knowledge to give meaning based upon these experiences. The notions of Piaget's theory of learning constructivism focus on individuals as the center of the knowledge creation and acquisition (Mcleod, 2020). Learning constructivism enables personalized learning experiences for students using AI technology to form knowledge and meaning (Grubaugh, 2023). The effectiveness of AI in education depends on students' usage, identifying factual inaccuracies and skepticism, and adjusting knowledge frameworks to prevent misinformation and mistakes (Halkiopoulos & Gkintoni, 2024).

Piaget identifies two elements of Research on children's cognitive development: accommodation and assimilation (Brau, 2020). Accommodation involves adjustments made within an individual's knowledge to cope with concepts that do not fit their existing framework, transforming their current interpretation of reality. Assimilation involves interpreting new knowledge within an existing understanding framework (Cherry, 2022). These concepts are crucial for research, as students use ChatGPT as a source of information to form a basis of knowledge on technical or general concepts.

Furthermore, the Cognitive Load Theory by Sweller (1988) states that humans have a working memory, which refers to the limited capacity of information that a person can carry in mind at a given time (Loveless, 2023). The

Cognitive Load Theory focuses on maximizing learning methods by avoiding an overload of working memory, as it affects a human's ability to store information (Likourezos, 2021). The theory discusses how people store information through short-term and long-term memory. Exceeding the working memory capacity can overload the short-term memory and affect the learning ability of individuals. Al technology can assist in dealing with cognitive overload as machines such as computers can process information faster than humans (Whitney, 2017). AI technology in education can lead to new opportunities and ways of personalized learning for students. Teachers can utilize AI technology to create learning plans based on student assessment data, and it can provide live feedback for teachers and students on the lacking learning areas and the progress of students (Llego, 2022).

The study aimed to explore the experiences of senior high school students using ChatGPT at the University of Northern Philippines, School Year 2023-2024. This was to understand how students utilize ChatGPT in their academics and their thoughts and opinions surrounding the possible benefits and adverse effects of using ChatGPT. Specifically, it sought to answer the important insights of senior high school students using ChatGPT in academics and the meanings ascribed to their experiences.

Furthermore, it can be noted that ChatGPT is a technology tool that is not inherently good or bad as technology in society. It is necessary to help people utilize AI technology properly; some students may abuse this software to create academic outputs. Learning about the positive aspects of ChatGPT and the negative aspects of this technology is necessary to cultivate a proper approach to using AI technology in education and utilization in society.

2.0 Methodology

2.1 Research Design

The study utilized the transcendental phenomenological design of qualitative research. Transcendental phenomenology, a method developed by Moustakas (1994), is a systematic method for analyzing lived experiences (Cordes, 2014). It eliminates the Cartesian dualism between objectivity and subjectivity by aggregating the subjective experiences of multiple individuals. The research primarily aimed to explore the lived experiences and meaning-making processes of senior high school students at the University of Northern Philippines using ChatGPT for academic purposes. Hence, the transcendental phenomenological research design relies on individual experiences, allowing stories from participants' voices to be told, aligning with human science research. This approach is useful when researchers have identified a phenomenon and have individuals who can describe it. The two questions, "how" and "what," are used to ask questions and record answers to uncover the underlying experiences of the students engaging ChatGPT for their academic purposes.

2.2 Research Locale

The study was conducted in the Senior High School and laboratory Schools of the University of Northern Philippines, Tamag, Vigan City, Ilocos Sur.

2.3 Research Participants

The research participants were senior high school students at the University of Northern Philippines, School Year 2023-2024. The study participants were selected using purposive sampling, wherein the inclusion criteria described senior high school students with experiences using ChatGPT. Likewise, the study excluded students without experience using ChatGPT. The study considered ten (10) participants (Creswell, 2002).

2.4 Research Instrument

This study employed a semi-structured interview guide as a data collection method to gain insights into the student's experiences using ChatGPT. The guide questions were designed and anchored in the framework of van Manen (2014), ensuring that the constructed questions elicit valuable insights from the participants. The guide questions were communicated to the participants through open-ended questions that allowed them to express their experiences and allowed the researcher to do probing.

2.5 Data Gathering and Analysis Procedure

Before the data gathering procedure, the researcher requested permission from the principal through proper consent before gathering data. Upon being given permission, the researcher asked from each class for students

who have experience in using ChatGPT. The researcher then asked for permission from the students to participate in the study using the consent or assent form and permission to record the conversations for the semi-structured interview for verification purposes of their statements. Thematic analysis was employed to analyze the data gathered. Verifying the participant's responses was done by returning to the participants to avoid reflexivity or biases in the findings. In addition, inter-coding was conducted with an expert in thematic analysis. This is to verify if the generated codes and themes align with the investigated problem.

The data were analyzed using the thematic analysis by Caulfield (2019). The first step in analyzing the data using the thematic analysis was Familiarization; it is a viewing of the answers by the participants on the questionnaire to understand and become familiar with the data. Read and re-read the data (transcripts, documents, observations) multiple times to familiarize yourself with the content. The second step in using the thematic analysis was Coding, wherein phrases or sentences are labeled or summarized into a single word or phrase that can act as a code, breaking down the data into meaningful units of text that represent key ideas. The third step enabled the researcher to generate themes based on the codes that combine or remove several labels or codes. Look for the connections, similarities, and differences between the codes. Cluster-related codes are developed together from these clusters, and the themes are clearly described. The fourth step was to review the themes and identify themes that could best represent the data to ensure the consistency of the themes generated. The fifth step included formulating the researcher's definitions of the themes and how these definitions would allow the researcher to understand the data. Finally, the sixth step was interpreting the researcher's data based on the previous themes, codes, and labels. Explain the significance of the themes in the context of the research questions and existing literature. The analysis and statement of the gathered data uncovered the meaningful themes and patterns found in the data.

2.6 Ethical Considerations

This research study followed ethical guidelines. The proper authorities requested permission to gather data. The researcher provided informed consent for the respondents, assuring their names' anonymity. For the conflict of interest there were no conflicts of interest in the study. The researcher focused on determining students' experiences using AI technology such as ChatGPT. The researcher also considered privacy and confidentiality. Any records and documentation acquired were used for the study only. The questionnaire was not shared with people other than the researcher. Records were properly sealed and stored in a safe box. Records were destroyed a year after the study was completed. The terms and conditions of the study will be put in the Informed Consent Form. The rights of the respondents were also included in the form. The forms were given personally before the study was conducted and retrieved later. The respondents were senior high school students at the University of Northern Philippines, School Year 2023-2024. The participation of the respondents was voluntary. They were recruited personally via consent form. There was a minimal risk for those who participated in the study. It is about the confidentiality of the students' answers, but it was assured to be properly kept safe and would be destroyed a year after the completion of the study. The results of this study were used to help improve the learning process and to lessen the burden on teachers and students. There is no compensation associated with the study.

3.0 Results and Discussion

Different themes were shown, and the corresponding excerpts offer a concise and organized summary of the information relevant to the research question, which encapsulates the overall experience of being a senior high school student using ChatGPT in academics. The study's results revealed important insights into the experiences of senior high school students using ChatGPT in academics. The discussion revolves around the identified themes: motivation and curiosity, initial thoughts and opinions, impact on academic tasks, and evolving perspective.

The theme of motivation and curiosity emerges from the participants' motivations for exploring ChatGPT. Students are driven by innovative features and curiosity to explore futuristic technology, expressing a desire to expand knowledge and experience new tools for academic pursuits. P1 claimed, "*Due to its innovative features, as my classmates have described, I was drawn to trying it.*" Likewise, P2 states, *"What motivated me to use ChatGPT is to expand my learnings to my extent. Moreover, I am curious about this Futuristic technology."* Moreover, P3, P4, P5, P6, P7, P8, and P10 stated that it is just out of curiosity: *"I became curious, and I tried it."* They express being motivated by its innovative features and a curiosity to explore its capabilities. This reflects a desire among students to expand

their knowledge and experience futuristic technology. The participants' curiosity highlights their interest in exploring new tools that can be used for future academic purposes.

The initial thoughts and opinions theme explores the participants' perspectives upon using ChatGPT. Students' initial thoughts on ChatGPT reveal its fast and accurate responses but also highlight concerns about misinformation and cheating, indicating a discerning approach to academic use. The initial thought by P10 stated, "*My first thoughts on using ChatGPT is that it is very accurate and the technology of information from it is correct.*" Likewise, P9 also stated, "*My initial thought of ChatGPT was this help to academics, it will help improve your works.*" Many students are amazed by the fast and accurate responses it provides; as P1 claimed, "*I was impressed by how fast it functions and how it could give you your needed information instantly.*" However, there are concerns about misinformation and cheating. P8 stated, "*I was amazed by how developed the technology is, but I cannot help but think that this might cause cheating and sharing of unreliable or fake news.*" Students recognize the potential for unreliable information and the ethical implications of using ChatGPT for academic purposes. This indicates a discerning approach and an awareness of the need to evaluate the information provided critically.

The theme of impact on academic tasks reveals the practical implications of using ChatGPT in student workflows. ChatGPT's practical impact on student workflows, including grammar checking, idea generation, and academic task supplementation, also acknowledges some students' preferences for intellect. P8 claimed that "*ChatGPT helped me accomplish my academic task faster, especially when cramming. It also helped me to improve my academic tasks like writing an essay and formulating sentences or paragraphs.*" Students appreciate its ability to save time, particularly in grammar checking and generating ideas. It is a helpful tool for supplementing academic tasks, providing support, and enhancing the quality of work. As P9 stated, "*ChatGPT helps to improve your work. I use ChatGPT to search for words for my basis. It also helps me ensure ideas are related to the topic.*" Likewise, P4 claimed that "*ChatGPT is like a summary of information that comes from Google and such, so it is getting information from other sources.*" The convenience and efficiency of ChatGPT allow students to improve their writing skills and accomplish tasks more quickly; as P5 stated, "*It was good because it somehow helped me finish my work faster.*" However, it is important to note that some participants expressed a preference for relying on their intellect and using ChatGPT as a supplement rather than a primary source of information, as P6 claimed that "*It was overwhelming at first, but the feeling quickly became underwhelming as I realized that the only thing it is doing is copying things from the internet. That is why I rely on my intellect to accomplish my academic tasks.*"

The theme of evolving perspective sheds light on how students' views on ChatGPT change over time. Students' perspectives on ChatGPT have evolved from initial skepticism to acceptance, recognizing the need for responsibility and balancing with intellectual abilities, viewing it as a useful guide. Initially skeptical, as P6 stated, "*As I became more familiar with ChatGPT, I now see it as a helping guide that can direct one to better perform in their academics*." students become more accepting of the technology as they become familiar with its capabilities. They recognize the need for caution in using it responsibly and balancing its usage with their intellectual abilities. As P7 stated, "*I rely on it, especially on essays, as it gives me ideas I did not think of*." Their perspective evolves from viewing ChatGPT as a potential "cheat code" to considering it as a useful guide that can assist in their academics.

Several research studies provide supporting evidence and insights into the impacts and perspectives of using AI tools, such as writing assistants and chatbots, in educational settings. Li and Liu's (2020) study reveals that machine learning writing assistants enhance students' writing quality and confidence, highlighting the potential of AI tools in academic tasks. Likewise, Giger and Miller's (2020) meta-analytic review highlights the positive impact of chatbots on online learning, highlighting their ability to enhance learning outcomes, student engagement, and satisfaction. Kim's (2017) study on AI teaching assistants in academics highlights their effectiveness in providing quick responses but emphasizes the need for responsible usage and human involvement.

Moreover, other research studies further support the findings, emphasizing the positive influences of AI tools, such as personalized support, timely feedback, and peer/self-assessment, on learner engagement, motivation, and learning outcomes. The study of Kizilcec *et al.* (2013) reveals that personalized support and AI tools like ChatGPT can enhance learner engagement and retention in Massive Open Online Courses. Likewise, Kulkarni *et al.* (2015)

highlight the positive impact of peer and self-assessment in Massive Open Online Classes, aided by AI tools like ChatGPT, which can positively impact students' learning outcomes and self-regulated learning skills.

On the other hand, the different themes and codes that capture the impact and significance of ChatGPT in academics that arise from the excerpts encompass the appreciation for ChatGPT's assistance and time-saving benefits, the significance and meaning attached to the experiences, the immediate answers and inspiration it provides, the impact on self-confidence and academic identity, and the future implications and exploration enabled by AI technology like ChatGPT. The result of the study provides a rich understanding of the meanings of senior high school students ascribed to their experiences using ChatGPT in their academic endeavors. The discussion revolves around several themes: appreciation and benefits, significance and meaning, immediate answers and inspiration, self-confidence and identity, and future implications and exploration.

The theme of appreciation and benefits highlights the students' recognition of ChatGPT as a valuable tool that serves as a helpful hand and lessens their academic tasks and workloads, as P2 stated, *"It lessens the academic tasks and workloads."* Students appreciate ChatGPT as a valuable tool that reduces academic workloads and saves time, highlighting its practical advantages and convenience in their academic pursuits. Likewise, P9 stated, "It lessens the academic workload since when you input a question, the ChatGPT app answers it *immediately."* They appreciate its aid and its ability to save time. As P1 claimed, "ChatGPT is a good helping hand in a way that it provides you all that you need with *just one click*." This proves the practical advantages and convenience that ChatGPT offers in their academic pursuits; as P3 stated, *"I translate what I know to how I use ChatGPT, obviously not copying things. It is my last resort when Google gets too technical, but other than that, I can live without using it."*

The significance and meaning theme reveals that the students attach meaningful interpretations to their experiences with ChatGPT. Students value ChatGPT's significance and interpretation, viewing it as a tool for enhancing learning, adapting to new concepts, inspiring ideas, and fostering intellectual growth. They view it to enhance their learning and adapt to new concepts. P4 claimed, "*The meanings I attach to these experiences are centered around learning and adaptation. Each conversation allows me to gather more knowledge and refine my understanding of various subjects."* ChatGPT provides them with inspiration and innovative ideas, expanding their knowledge base and fostering intellectual growth; as P8 stated, *"ChatGPT is a great helping hand and dependable for students."*

The theme of immediate answers and inspiration underscores ChatGPT's ability to give direct answers and serve as a source of inspiration. ChatGPT offers immediate answers and inspiration, enhancing students' academic tasks and generating ideas through innovative resources like instant responses. Students appreciate its rapid responses, which help them obtain immediate information and support their academic tasks; as P5 claimed, "*We all know that a Bot controls this site, so we do know if the answers are correct; however, it gives you a direct answer."* Likewise, P6 stated, *"I interpret my experiences as simply looking for inspiration or current ideas. Therefore, the significance I can attach to these is its role as a "sample" or "guide."* They see ChatGPT as an innovative resource for generating ideas and exploring complex concepts; as P4 claimed, *"This ChatGPT serves as a source of inspiration and a gateway to new knowledge. I use it as a tool to explore complex concepts, generate ideas, and dig deeper into topics that catch interest."*

The theme of self-confidence and identity delves into the impact of ChatGPT on students' confidence and self-perception. The impact of ChatGPT on students' self-confidence and identity highlights the need for balance between its benefits and keeping intellectual capabilities. While they recognize the benefits, there is also an acknowledgment that overreliance on ChatGPT could lead to self-doubt and a questioning of their abilities, as P1 claimed: *"Despite its advantages, this could make doubt my ability as I tend to compare the human ability to it. When doing stuff alone, I tend to fact-check what I am doing through ChatGPT."* Students reflect on the balance between leveraging ChatGPT's aid and keeping their intellectual capabilities; as P3 stated, "*It made processing information easier, thereby helping me to understand things better. It shapes my academic identity by making things easier to understand."*

The theme of future implications and exploration examines the students' perspectives on the future of using ChatGPT or similar technologies in education. ChatGPT and AI in education are explored, highlighting potential etiquette, ethics, and the importance of personal writing and critical thinking. Some envision artificial intelligence as the future of education, anticipating its widespread adaptation and recognizing the need for proper etiquette and ethics, P2 stated, "Artificial intelligence is the future of education; we *cannot deny that in the future, we will*

appreciate the use of AI. I envision a rightful etiquette and ethics and avoid abusing the advantages of Artificial intelligence." Likewise, P1 claimed that *"It widens our perspective or source of information or basis."* However, concerns exist about potential over-dependency and the importance of maintaining personal writing skills and critical thinking abilities; as P10 claimed, *"It is crucial to recognize that while AI technologies have the potential to support and enhance learning, they should not replace human interaction, guidance, and mentorship, the role of educators in facilitating meaningful learning experiences and fostering critical thinking remains essential."* Moreover, P7 also said, "ChatGPT would be a great and bad implication at the same time; while it would make learning easier, *the accuracy of the information is not 100% correct."* Consequently, P4 also said, "*… actual classroom learning experiences are still more accurate and essential in our academic journey."*

Various research studies provide supporting evidence and insights into the impact of AI technologies and the need for critical evaluation in educational settings. The study of Cramer (2019) emphasizes the importance of critical evaluation in evaluating the emotional impact of AI tools like ChatGPT, highlighting both positive and negative aspects. Likewise, Tan and Theng (2020) explore AI's impact on education, emphasizing human interaction and recommending a balance between technology tools like ChatGPT and personal learning experiences. Moreover, Selwyn (2018) highlights learning analytics challenges in education, emphasizing critical evaluation and AI biases. It recommends fostering critical thinking and digital literacy to navigate AI tools effectively.

Furthermore, other research studies provide further evidence and insights into the impact and implications of AI tools in education. Buckingham (2019) explores the ethical and pedagogical implications of integrating AI in schools, emphasizing the need for critical engagement and educators' role in evaluating AI tools. Likewise, the study of Koedinger and Aleven (2007) highlighted the role of AI-based tutoring systems in student learning, emphasizing the need for a balance between aid and critical thinking skills development.

Based on students' experiences with ChatGPT, educators and school administrators should promote responsible use of AI tools like ChatGPT, encouraging students to evaluate information and critically cross-reference it with reliable sources. They should also provide guidance on ethical considerations, highlighting the potential for misinformation and the need to avoid cheating. Developing critical thinking skills is crucial for students to navigate the potential limitations of AI tools. Educators can integrate ChatGPT into academic tasks and provide guidelines for its use. Continuous monitoring and evaluation of AI technologies are essential for finding potential issues and allowing for future improvements. Students should use ChatGPT to supplement their thinking and learning process, balancing technology with individual experiences.

4.0 Conclusion

ChatGPT is a valuable tool for senior high school students, offering fast, accurate responses and efficient task completion, aiding inspiration and saving time. However, concerns about misinformation and cheating persist. As students become more familiar with ChatGPT, their perspectives change, recognizing its importance and limitations. They acknowledge ChatGPT's potential as the future of education but caution against excessive reliance and the potential loss of essential learning experiences. They now accept it as a helpful guide, not a means of cheating. Moreover, this implies that using AI tools like ChatGPT needs a balanced approach, critical evaluation of information, and the importance of developing one's skills alongside AI technology. By striking this balance, students can fully leverage the potential of ChatGPT while preserving their unique abilities and identities as learners.

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7.0 Conflict of Interests

This research has no conflict of interest.

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The Age of Screens: Investigating the Influence of Screen Media on the Language Choice and Identity Construction of Primary Grade Learners

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Abstract. This study aimed to explore the impact of mobile screen media on the language choice and identity construction of primary-grade learners. A descriptive research design was used, and five primary-grade students aged 6-11 from Iligan City were interviewed. One-on-one interviews were conducted to gather data. Findings indicate that the language profile of the participants included a mix of English, Tagalog, and Bisaya languages, with English being the primary language used at school and home. Factors influencing language choice included the languages spoken by those around them, the prestige of English, and exposure to media and gadgets. Screen media exposure positively and negatively affected children's self-perception: it enhanced their understanding of different cultures and sense of worth. It fostered cross-cultural identities and made some feel estranged from their families and peers. The findings underscore the importance of recognizing the quality and nature of interactions between children and screen media.

Keywords: Identity construction; Language choice; Primary grade learners; Screen media.

1.0 Introduction

In recent years, the introduction of mobile screen media into everyday life has significantly impacted primary-grade learners' language use and identities. This phenomenon has had far-reaching consequences on how children learn and interact. Mobile devices have allowed children to access information more quickly and efficiently. This prompts them to adopt new language practices that are often at odds with traditional practices and educational methods. For example, children learn through in-person lectures, textbooks, and assignments. However, with the introduction of mobile devices, children have adopted new language practices. These include language learning platforms and mobile apps. As such, it is essential to consider how these changes may influence the development of a child's language choice and identity formation.

According to (Neumann & Neumann, 2013), students in this age group are increasingly exposed to digital devices such as tablets, computers, smartphones, and video games. Hence, mobile technology is transforming how learners interact and express themselves linguistically (Hutchison et al., 2012). Moreover, mobile screen media's influence on young people's language goes beyond its use for entertainment purposes. For example, many children are developing their literacy skills by writing stories and creating content with the help of apps such as iMovie or Toontastic 3D (Sullivan et al., 2019). Furthermore, mobile devices provide access to social networks where users can converse with their peers (Phuangsuwan et al., 2023). As a result, these digital platforms may affect language use by primary-grade learners due to their constant exposure.

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According to one study by Hu (2018), there is a growing trend for young people aged 8-13 to develop multiple online personas across social networking sites such as Facebook and Twitter. As a result, this age group develops an awareness of how words can be used differently on different platforms to shape their identity according to their desired audience. For example, Maurya et al. (2022) mention that excessive exposure to digital media may lead to increased communication use of abbreviations or short phrases. Likewise, Wilson (2018) notes that overuse of social media affects students' conventional way of writing. His research found that students' excessive usage of social media platforms such as WhatsApp, Twitter, and Facebook affects their spelling ability, especially when writing examinations and letters.

Furthermore, mobile screens may also influence how children create and perceive their identities. Children may be exposed to images or messages that inform how they view themselves and others as they explore different media types on their devices (Dezuanni, 2018). For instance, a child's slang words or phrases could be influenced by what they see or hear from apps or videos online (Hilton et al., 2016). In addition, Thomas and Laycock (2018) found that media consumption can shape gender roles. They further argued that through mobile devices, adolescents often engage in activities such as playing mobile games, which emphasize traditional gender stereotypes.

Shibuya et al. (2017) found that increased access to technology allows young people to experiment with various aspects of identity through role-playing games or creating avatars in virtual worlds. This exploration allows children to express themselves freely without being judged or constrained by traditional expectations from family or peers, which may have previously limited them. Digital media can certainly have its downsides, mainly when it is used indiscriminately by young people. Although research has demonstrated that mobile screen media can improve literacy skills among children (Furió et al., 2014), studies have found that too much time spent on smart devices is causing problems in several areas of children's development. For instance, according to Mackson et al. (2019), children may experience inappropriate behaviors such as cyberbullying or trolling as they interact with each other. As such, these activities may lead to a negative self-image among primary-grade students, which can affect their use of language.

It is clear from these studies that media exposure can have a significant impact on primary-grade learners' choice of language and identities. This impact can be seen in language skills and how children define themselves. The dualistic effect of computerized screen media and its relationship with language use and identities have prompted exploration. It is jarring to see children suddenly glued to mobile screens that fit into their hands due to its ubiquity and accessibility. Likewise, it is also alarming to see children navigate the digital space with little to no parental supervision. Specifically, this research focused on how screen media shapes primary-grade learners' communicative behavior in terms of their choice of language and the factors of such choice. At the same time, this study also examined how these choices affect the children's construction of their identities.

This study is significant because it timely explores the dualistic effects of screen media on primary-grade learners' language use and identity formation. This research addresses an urgent need to comprehend how these digital tools are reshaping fundamental aspects of children's development. Such understanding is essential for parents, educators, and policymakers to develop informed strategies that support healthy language acquisition and positive identity construction in an increasingly digital world.

2.0 Methodology

2.1 Research Design

The study used qualitative descriptive research to explore how mobile screen media shapes primary-grade learners' language choices and identities. To accomplish this, one-on-one interviews with primary-grade learners were conducted. The interview audio recordings served as a tool for collecting data about how mobile screen media has influenced the participants' language choice and identity formation.

2.2 Research Locale

Five primary-grade learners aged 6-11 from Iligan City participated in the study. They were selected using convenience non-probability sampling, precisely the snowball technique.

2.3 Research Participants

Before selecting the participants, a thorough selection process was conducted to ensure that only those individuals who met specific criteria were chosen for inclusion in the study. Participants should have access to a touchscreen device like a tablet computer or smartphone for at least 2 hours daily. The study only applies to children who use touchscreen devices for more than the recommended maximum amount of time (i.e., two hours for older children) set by the American Academy of Pediatrics (AAP). Participants must not have any known cognitive disability that would impair their ability to understand or respond accurately to interview questions.

Guardians must also provide consent for their children's participation in this study. The researcher requested that the guardians be present during the interview so their children would feel supported and comfortable. In addition, all participants need to possess sufficient language skills to comprehend questions and express meaningful responses without hesitation or difficulty. This is necessary for the participants to provide clear answers during the study about how mobile screen media influences their language choice and identity formation.

2.4 Research Instrument

The researcher conducted one-on-one interviews with students in primary grades. The data collection focused on exploring how participants' language choice is affected by their experiences with mobile devices such as tablets and smartphones. During these interviews, participants described their typical experiences interacting with mobile devices.

2.5 Data Gathering Procedure

Before the interview, the researcher introduced herself to the children and explained why she was conducting the study. Then, the researcher asked the participants open-ended questions about their mobile screen media use. Likewise, the researcher asked more specific questions to probe further and explore any particular points that arose during the interview. Questions were asked in English. Moreover, some questions were modified and adapted according to the participant's level of understanding, age, preference, and other factors determined by the researcher to ensure comprehension. Each interview lasted approximately 30 minutes over one day to maximize accuracy and obtain meaningful information. During the interview, the researcher refrained from imposing her views upon the participants and allowed them to express themselves freely. Lastly, all interviews were audio recorded so that responses could quickly be transcribed and reviewed later for further analysis.

2.6 Data Analysis

The researcher employed thematic analysis outlined by Braun and Clarke (2006) to ensure a rigorous analysis of the qualitative data collected from the interviews. All audio-recorded interviews were transcribed verbatim to capture the participants' exact words. Non-verbal cues and pauses were also noted where relevant. The researcher thoroughly read and re-read the transcripts to familiarize the content. Notes and observations were also made in the margins to capture early impressions and significant points.

Afterward, data were significantly coded by identifying meaningful segments of text related to the research questions. The codes were examined for patterns and grouped into potential themes that reflected the emerging ideas from the data. The initial themes were reviewed and refined by checking them against the coded data extracts and the entire data set. Based on this review, some themes were combined, separated, or discarded. The researcher ensured that each theme specified what aspect of the data it captured and how it related to the research questions. Likewise, sub-themes were also identified to provide a detailed understanding. The final themes were used to structure the findings in the Results and Discussion sections. Direct quotations from participants were included to illustrate each theme and were used to provide evidence for the interpretations. Such analysis was linked to the research questions and existing literature to contextualize the findings.

2.7 Ethical Considerations

The researcher endeavored to adhere to ethical considerations. Entry protocols, such as disseminating letters and informed consent forms, were sent to the participant's parents or guardians. Their participation was voluntary, and they were informed of their right to withdraw should they feel uncomfortable. They were also assured that the audio recordings would be kept confidential and that their names remain anonymous. To ensure privacy, no

real names were used in this study. Lastly, the researcher made earnest efforts to prevent physical or psychological harm to the child participants.

3.0 Results and Discussion

3.1 The Language Profile of the Participants

Table 1 summarizes the participants' demographic information and language use.

Table 1. Participants' demographic information and language use

Participant	Age	Gender	Languages Spoken	Language Used at Home	Language Used at School
Catalina	7	Female	English	English	English
Inigo	10	Male	English	English	English
Sam	9	Male	English	English	English
Dani	7	Female	English, Bisaya	English, Bisaya	Bisaya
Lexi	11	Female	English	English	English

The Languages Spoken

Most participants in this study were exposed to both English and Bisaya, their primary languages. Bisaya is commonly spoken in their locale, while English is an educational requirement. The participants used these languages interchangeably depending on the audience and context. It should be noted that some participants also had limited exposure to either language due to certain social and cultural factors. These include living with non-English-speaking relatives or attending schools where regional languages (e.g., Bisaya) predominate.

Regarding literacy, most participants have basic reading abilities in Tagalog and English, although they vary between grade levels. Notably, some need help reading and speaking the Bisaya language. At home, most participants read more often in English than in Tagalog books. However, it should be noted that television shows, books, mobile applications and games, and movies that feature content from English and Tagalog languages were part of their daily lives. Additionally, there were significant differences between genders. Male children used more direct phrases with less sophisticated words, while female participants used more complex syntaxes and sophisticated vocabulary. Overall, the language profile of primary-grade learners reflects an environment influenced by multiple languages, which can impact their identity formation and language choice.

The Language Use at Home

For 7-year-old Catalina, her mother proactively encourages and strongly emphasizes speaking English. Catalina studies in a private school in Iligan City, where most subjects are taught in English. It could be argued that the mother sees English as having a higher prestige or utility than other languages spoken at home.

"Mom always speaks to me in English. She also wants my baby brother to speak in English."

In the Philippines, using English in the home setting is becoming increasingly popular. According to Chavez (2022), proficiency in English is believed to lead to better educational opportunities and greater social mobility. English is also seen as a status symbol and means of upward social climbing within Philippine society (Tollefson, 2000). As such, many parents, including Catalina's, may encourage their children to use English at home to gain access to these potential benefits.

It might also be argued that using English at home allows for more effective communication between family members with different native languages (Puripunyavanich & Soontornwipast, 2018). With so much ethnic diversity among Filipinos, dialects and even unique vocabularies across different regions often vary. Therefore, having everyone speak the same language—in this case, English—may be beneficial as it allows for more efficient communication without confusion.

The Language Used at School

Inigo, a 10-year-old boy, attends a private school. His teachers communicate with him in English, highlighting the importance of language use and fluency in determining a student's academic success.

"My teacher speaks to me in English all the time."

The use of English in schools is a prominent issue among Filipino children. The language has a long history of being used as a tool for social mobility and economic success in the country. English has been grafted into local customs, creating an ever-changing internationalized version unique to the Philippines. Moreover, it has also become a symbol of national pride and identity, allowing Filipinos to conduct business and communication on a global level. This is especially true for 10-year-old Inigo, who is at the forefront of this shift. However, despite the perceived benefits of learning English, there are also some drawbacks. For instance, this may negatively impact other language subjects, such as Filipino. Inigo mentioned that he finds the Filipino subject difficult.

"I find Filipino subjects difficult. Sometimes I get confused."

Inigo's statement, "I get confused," may suggest that he does not fully understand the material being taught in class. This can negatively affect his academic progress and overall success in school. It considers the importance of promoting English proficiency and preserving the national Filipino language.

Using English as the primary language of school instruction has long been a contentious issue in the Philippines. While some individuals argue that children must learn English to gain an advantage in the globalized world, research suggests that frequent use of English by young Filipino children can have a variety of adverse effects.

First, the extensive use of English at school may limit the development of fluency and proficiency in Filipino languages, especially in Inigo. Quoting Chureson (2013), "The more time students spend using English at school, the less time they spend learning and using Philippine languages." This phenomenon is relevant for Bisayan speakers who are already disadvantaged regarding access to formal education due to their limited fluency in Filipino languages (Magno & Veloso-Lorenzo, 2017). Furthermore, even among those who do not have difficulty speaking Tagalog, native speakers still have fewer opportunities to practice their language skills, mainly when teachers use exclusively English instruction (Martin, 2018).

3.2 Factors Affecting Language Choice

Language is an integral part of a child's development. Children begin developing their communicative and language capabilities from the earliest stages. However, what are the primary factors that influence a child's language choice in these early years? This question forms the basis for exploring the factors that can shape a child's language ability during primary school. Table 2 provides a detailed summary of these factors and the participants most influenced by each.

Table 2. Factors Influencing Participants' Language Choice

Factor	Description	Participants Affected
Languages Spoken by Surroundings	Children adopt languages used by family and peers	Sam, Dani
Prestige of English Language	English associated with social status and opportunities	Sam, Inigo
Exposure to Media and Gadgets	Media consumption in English influences language acquisition	Catalina, Lexi
Personal Language Preference	Individual motivation or readiness to learn a language	Sam

The Languages Spoken by the People Around Them

This quote is from a 9-year-old boy named Sam. He was raised by his single mother, who is an English teacher. Sam may have grown up in an environment where the Bisaya language was not prevalent or hardly spoken. Bisaya is widely spoken in Mindanao, especially in his locale, but it is interesting to note that it was not prevalent in Sam's environment in his early childhood. This could also be explained by his mother's upbringing, noting that she is Sam's primary English teacher and caregiver.

"*Nobody spoke Bisaya next to me when I was a kid.*"

Jackson and Hoff-Ginsberg (2005) argue that parental language plays a fundamental role in their children's cultural, linguistic, and cognitive development. Parents play a significant role in developing and maintaining their children's mother tongue and cultural identity. They further suggest that parents exposed to English use it when communicating with their children. This shows parents' pivotal role in influencing their children's language development.

It has been observed that many Filipino parents tend to prefer English over Tagalog or other regional languages when speaking with their children at home (Ledesma & Morris, 2005). One of the driving forces behind this trend can be attributed to the rise in immigration and globalization in recent decades. This has reinforced the value of English as a global lingua franca (House, 2012). Another factor contributing to this shift is that English is used as a medium of instruction in schools and universities throughout the Philippines (Gonzalez, 1998). This incentivizes parents to speak English at home so their children's education may be supported early.

In addition, Lim-Ramos et al. (2020) argue that Filipino parents believe that teaching their children English is a ticket and an investment to their future academic and economic success. Since knowing multiple languages can open up new opportunities for employment and financial stability, many Filipino families want to give their children these advantages by introducing them to English during the early stages of development. Furthermore, speaking Tagalog and English could give Filipino youth an edge when pursuing higher education or professional development outside the Philippines (Watzke et al., 2022).

The Prestige of the English Language

The monolingual Sam spends much of his time playing mobile games and watching movies in English. This indicates a deep connection to the language and cultural content. Sam values the prestige of the English language over his heritage. The quote shows that he may identify more with English culture or values than his ethnicity. This reflects how English has become a symbol of pride and identity.

"Even if I have black hair, I have an English soul inside me."

Several factors can affect the language chosen by Filipino children. One of the most significant is the prestige associated with different languages. Schroeder et al. (2022) state that prestige is essential to language choice. It can determine whether or not a given language is considered socially desirable. For example, it is believed that English generally carries more prestige among Filipino children than other languages due to its status as an international lingua franca. Further, it is also used in many domains, such as education and business (Lopez-Carranza, 2010). Filipino children are highly motivated to learn and use English (De Guzman et al., 2017).

Furthermore, the government and educational institutions in the Philippines have heavily promoted English. The government has invested significantly in English language teaching and learning initiatives over the last few decades (Tupas, 2003). Likewise, educational institutions have adopted an 'English First' policy, which privileges English over other languages (Kirkpatrick, 2012). All in all, these factors have made English more accessible and desirable among Filipino children.

Exposure to Media and Gadgets

Catalina, a grade one student, grew up in a household where Western TV shows, news, songs, and movies are the norm. Even at a young age, she can access smartphones and tablets, and she frequently watches TikTok and YouTube in English. The quote shows how Catalina acquired the English language primarily through exposure to English-language media during her early childhood. This highlights the role of media in facilitating language acquisition and development.

"*I never knew it [Bisaya or Filipino language]. Because, as a baby, I only watch English stuff. That is why I learned about the language, English.*"

Children's exposure to different languages, particularly media and gadgets, is far-reaching. According to González (2001), children are often more receptive to the language they hear constantly. This means they are more likely to absorb the language when they hear it frequently. Hence, the language children are exposed to through these mediums can heavily influence their choice of language.

When children are exposed regularly to a particular language, such as television programs or mobile applications, their ability to comprehend and use that language increases; such is the case for Catalina. The widespread use of media and gadgets featuring English as the primary language presents benefits and drawbacks for these young learners. The increased exposure indeed ensures that Philippine youth obtain a high level of proficiency in English.

However, without sufficient input from other languages – such as Tagalog or Bisaya – there is a risk that these languages could become minimized or even neglected within Philippine culture (Melanie et al., 2022).

A Preference for One Language over Another

Even though the Bisaya language is commonly spoken in his locale, Sam has had limited exposure to it. Although he shows interest in learning the said language, he feels he is not yet ready or prepared. For some, learning a new language can be an exciting experience. However, for others, it can be challenging. Regardless of the reasons, this statement shows the role of preference and motivation in language learning.

"*Because I never know the language (Bisaya). I want to learn it, but I do not think I am ready yet.*"

Language preference among children is a significant factor that affects language choice. This also leads to the development of an individual's identity. According to Alshehri (2023b), an individual's language skills and usage development can impact his sense of self and ability to express his identity and ideas. Hence, when presented with multiple languages, an individual will tend to gravitate towards certain ones due to comfort level or perceived difficulty in learning. Hence, preference for a particular language over others plays a critical role in influencing Filipino children's choice of language.

3.3 Children's Perceptions of Identity and Screen Media Influence

With the rise of mobile phones, tablets, and other digital media devices, children are exposed to more screen time than ever before. While these devices can offer various educational opportunities for young learners, there is growing concern about how these technologies may affect and shape children's identities. Table 3 summarizes how participants' interaction with screen media has shaped their perceptions of their identities. The table aims to provide a concise overview of the dual role of screen media.

Table 3. Children's Perceptions of Identity and Screen Media Influence

Participant	Influence of Screen Media	Perception of Identity
Dani	Exposure to Bisaya through family	Feels prettier when speaking Bisaya; desires to conform
Lexi	Interest in Korean media	Drawn to Korean culture; adopts cultural elements
Inigo	Association of English with success	Feels proud and intelligent due to English proficiency
Sam	Identification with English culture	Views language as core to identity; may feel isolated

Shapes Understanding of their Own and Different Cultures

Dani is a 7-year-old first grader at a public school. Born and raised in a multilingual household, Dani was exposed to both English and Bisaya languages by her parents. However, with both parents working, she spends most of her time with her grandmother. Dani shared that her grandmother uses both languages but uses Bisaya most of the time, especially when scolding her. Dani is surrounded by teachers and classmates who speak in Bisaya. They also have other language subjects, such as Mother Tongue and Filipino. This makes Dani aware that speaking Bisaya is considered the norm or the typical behavior in her community. The quote shows that Dani wants to conform to this norm and actively chooses what language to use based on social cues and expectations. This highlights the dynamic nature of a child's sense of self, shaped by the social and cultural context in which they live.

"I sometimes speak in Bisaya because I want to act like normal people do."

Dani grew up in a multilingual environment, with her grandmother primarily caring for her. Dani likewise mentioned that when her grandmother is happy with her, the latter showers her with praises in Bisaya, such as "*gwapa*" (beautiful) and "*nindot*" (nice). Dani's close relationship with her grandmother has led her to see her as a role model, which may have impacted Dani's self-identity and language preferences. The quote shows that Dani has formed a positive emotional association with speaking Bisaya. Moreover, that she perceives herself as more attractive when speaking the language. This may be due to her being close to her grandmother and constantly hearing praises from Bisaya. Further, the quoted statement shows that Dani may prefer speaking Bisaya but speaks in English because it is her dominant language, which is spoken in her upbringing.

"But when I speak in Bisaya, it makes me feel that I am even prettier. I love Bisaya. I like speaking Bisaya a lot, but most of the time, I speak English because I grew up speaking in English."

Gal (2021) and Gumperz (1982) note that language and identity are closely related. They further argue that individuals have multiple identities associated with different languages. In the case of Dani, her identity appears to be shaped by her experiences with different languages. For example, her experiences in speaking Bisaya are associated with positive emotions. Likewise, her experiences in speaking English are tied to her upbringing. This implies that identity construction is complex and multi-faceted, as many factors influence it. Moreover, the statement forwards the complexity of the language-attitude relationship, which explains the relationship between individuals' language use and their attitudes toward the language (Giles et al., 1977). Dani may have a positive attitude towards Bisaya and may feel more attracted to speaking it, but the fact that she grew up speaking in English makes her use it more often than Bisaya.

Lexi is an 11-year-old girl and a fifth grader. She is an avid fan of Korean dramas and enjoys watching Mukbang videos on YouTube in her free time. She has learned some Korean phrases and often gushes over her favorite Korean dramas on Netflix. Although she grew up in a different cultural background, Lexi is drawn to some unique aspects of Korean culture, such as Mukbang. The quoted statement shows that Lexi is interested in the cultural phenomenon of Mukbang, a popular trend in South Korea where individuals record themselves eating large amounts of food. This also implies that she recognizes that Mukbang is particularly popular in South Korea and that the trend is associated with that culture.

"I love watching Mukbang videos on YouTube. The Koreans are fond of doing it. "

The research of Elseewi (2015) and Cho (2017) shows that media consumption can impact individuals' perceptions of other cultures and how this can encourage them to adopt specific trends. This can also play a role in shaping their cultural identity. In Lexi's case, she became interested in learning more about South Korean culture through watching Mukbang videos and Korean dramas. This is consistent with "cultural proximity," which suggests that people tend to be more interested and attracted to cultures they perceive as similar (Phinney, 1990; Triandis, 1989).

A Greater Sense of Worth and Confidence

Inigo may associate his proficiency in the English language with a sense of pride and intelligence. His belief in his ability to understand and speak English well contributes to this positive self-image. This statement underscores the role of language as a marker of one's sense of identity and self-esteem.

"I feel proud and smart. I think because I can understand English so well."

Research has shown that language proficiency is closely related to self-perception, self-esteem, and self-efficacy (Dörnyei, 2013; Pekrun et al., 2009). In this context, Inigo's English proficiency contributes to his sense of pride and intelligence. Several studies show that mobile screen media can be critical in developing a sense of worth and confidence among primary-grade learners. For instance, research conducted by Finley and Ostenson (2019) indicates that the use of educational gaming apps, such as Prodigy Math Game, has positively affected primary learners' feelings of self-worth and self-confidence. Participants noted feeling more motivated to learn when using the app and felt proud when they achieved success.

Develop a Cross-cultural Identity

Sam views his English identity as tied to his ability to speak English. Despite not being of English descent, he has a solid identification with the English language. This shows that language can be a marker of social identity. It also implies that regardless of one's origin and ethnicity, language can shape one's cultural experiences and beliefs (Barrett & Dovchin, 2019).

"I am English. I have black hair. Nevertheless, the only soul I have is English. What I meant was this soul. I referred to that as language."

Furthermore, the quoted statement suggests that Sam significantly emphasizes language as a identity marker, even excluding other characteristics such as physical appearance. This is consistent with Barrett and Dovchin's (2019) contention that language is a tool for constructing and maintaining social identities. This also aligns with

the notion that language and culture are closely intertwined and shape how we understand and interact with the world. This statement was uttered when Sam was asked about his response or reaction when he could not understand the language. Sam prefers to avoid or disengage from conversations rather than to engage or respond actively.

"I would say nothing and walk away."

It is vital to consider some potential risks associated with prolonged smartphone exposure. Specifically, individuals may become overly reliant on technology, leading to feelings of isolation or disconnection from others (De Ramos, 2023). Moreover, exaggerated smartphone use may also lead to low self-esteem, inappropriate social behaviors, fear of relating, social anxiety, lack of self-confidence, and shyness. As a result, children may struggle to form meaningful relationships outside their digital personas – a problem that could further complicate existing struggles around identity development.

Accordingly, Livingstone and Helsper (2007) argue that substantial exposure to mobile screen media causes children to become desensitized towards human emotions, including empathy for others. In other words, regular engagement with technology may lead learners away from understanding the feelings and needs of those around them, making it difficult for them to interact effectively with people in their physical environment. Consequently, this could result in negative social experiences that further reinforce feelings of isolation or alienation from peers.

4.0 Conclusion

This study proves that mobile screen media significantly impacts language choice and how primary-grade learners perceive their identities. Using mobile screen media has both positive and negative impacts. The participants of this study primarily used English at home and in school, which indicates that English has become the leading language among the participants. Several factors affected the language choice of the participants, such as the languages spoken by people around them, the prestige of the English language, and exposure to media and gadgets. In addition, it was evident that screen media positively and negatively impact how children perceive their identities. They were more likely to understand different cultures, have a greater sense of worth and confidence, and develop a cross-cultural identity. Due to this, some children also felt estranged and disconnected from their families and peers.

For further research, a bigger sample size may be used to gain a more comprehensive understanding of the influence of screen media on children's language choice and identity perceptions. Parents should also ensure their children have healthy media diets and incorporate language-rich activities like reading, storytelling, and conversation into their daily routines. They should also use varied languages such as Tagalog and Bisaya when engaging in these activities with their children. Furthermore, educators should strive to create a classroom environment where multiple languages are recognized so that all students, regardless of whether they speak Tagalog or Bisaya, can feel included and respected.

Despite its insight, the study has several limitations that warrant caution in interpreting and generalizing the findings. The small sample size of only five participants from Iligan City limits the broader applicability of the results. It suggests a need for studies with larger and more diverse groups to enhance reliability. Moreover, convenience non-probability sampling, precisely the snowball technique, may introduce selection bias and potentially affect the results' representativeness. Lastly, the study only provides a snapshot of participants' experiences without a longitudinal perspective, which could offer deeper insights into the enduring effects of screen media on language and identity over time. Acknowledging these limitations highlights areas for further exploration to deepen our understanding of how screen media shapes children's linguistic and identity development.

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7.0 Conflict of Interests

There is no conflict of interest to declare.

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Advancing Swine Management in Buenavista, Guimaras: Foundations for Effective Extension Program

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Abstract. This research paper was created to assess the management practices of swine raisers in Buenavista, Guimaras. The health of livestock and the economic sustainability of the farming sector in Guimaras, Philippines, are contingent upon the management and disease prevention strategies employed in pig farming. This study employed a descriptive design utilizing quantitative methods to analyze data through frequency counts and percentages, assessing swine management techniques among fifty swine raisers in Buenavista, Guimaras. The sample comprised fifty swine producers, predominantly aged between 46 and 58. Women represented 54% of the respondents, with 60% indicating that their spouses predominantly managed pig farming activities. Moreover, 58% of interviewees indicated they lacked primary authority within their households. Seventy-four percent of participants commenced pig farming between 2012 and 2022, with the majority (ninety-two percent) possessing between one and forty pigs. Seventy-seven percent of farms provide triennial feeding for pigs, indicating a general consistency in feeding practices. Ninety-six percent of all option groups indicated a preference for grower feed and a rejection of swill feeding. Although they adhered to the standards for normal feeding, their sanitation practices were inconsistent; merely 52% reported cleaning pigpens thrice daily, and only 24% utilized disinfectants. A similar trend in recordkeeping was noted: just 64% of pig producers kept a journal of their operations. 84% of respondents indicated their swine efforts were adjacent to a pig-rearing farm.

Keywords: Disinfectant; Feeding line; Hygiene; Pig farming; Pork; Swill feeding.

1.0 Introduction

Raising pigs in the Visayas area of the Philippines is a notable agricultural activity that embodies cultural traditions and economic prospects. The indigenous pig population, especially the Philippine native pigs (PhNP), is essential to local economies and cultural traditions. These pigs are generally reared in low-input systems, frequently as part of familial traditions that have persisted for generations. Studies reveal that households in the Philippines participate in pig husbandry for an average of 20 years, with each family managing approximately five animals (Banayo, 2023). This customary practice provides sustenance and functions as a source of money and social standing within communities (Quintua et al., 2019).

The Visayas region, especially Western and Central Visayas, is distinguished by its significant swine population, with reports showing around 1.14 million heads in Central Visayas alone (Bollido et al., 2022). This region constitutes a substantial segment of the national swine inventory, underscoring its significance in the nation's pork supply chain. The demand for pork is notably elevated, with a significant portion of the population consuming it (Bollido et al., 2022). The pig farming sector encounters obstacles, such as veterinary care issues and antibiotic residues in swine waste, which threaten human health and the environment (Ymas, 2023).

Management and disease prevention techniques for pig farming in Guimaras, Philippines, are crucial for maintaining livestock health and the industry's economic sustainability. Due to the region's distinctive agricultural environment, management strategies must be customized to local requirements, encompassing biosecurity protocols, antibiotic stewardship, and disease surveillance. Biosecurity is essential for regulating swine health and averting disease outbreaks. Establishing stringent biosecurity measures can markedly diminish the likelihood of disease spread within and among farms. This encompasses measures such as regulating farm access, upholding hygiene standards, and guaranteeing that equipment and vehicles are disinfected before accessing pig housing areas (Kouam et al., 2019). Maintaining a closed herd can reduce the influx of diseases from external sources, which is especially crucial in areas such as Guimaras, where smallholder farms may possess few resources for disease management (Mallioris, 2023).

Consequently, it is essential to conduct training programs for farmers on enhancing swine management methods to prevent disease and boost output. The researcher aims to investigate management methods among swine raisers to establish a foundation for building an extension program that would enhance their swine production management. This research report aimed to assess the management techniques of swine producers in Buenavista, Guimaras.

2.0 Methodology

2.1 Research Design

A descriptive research design was used, employing the quantitative method in analyzing data using frequency counts and percentages. A Universities Federation for Animal Welfare (UFAW) (2022) questionnaire was adapted and used as a data-gathering tool. The one-on-one interview was conducted to ensure the accuracy of the answers given by the interviewees. Moreover, addressing the sensitivity of some questions and the need for clear, sharp, and explicit answers compel the need for a personal interview approach.

2.2 Research Locale

This study focused on the municipality of Buenavista, Province of Guimaras. Buenavista is located at the northern tip of Guimaras Island and is one of the five towns comprising the Province of Guimaras. The northern and northwestern parts of the town overlook Panay Island, and the north-eastern portion faces Negros Island. It is two miles away from Iloilo City and four miles from Negros. The municipality is separated from the former by the Iloilo Strait and by the Guimaras Strait from the latter. The Municipality of Buenavista has 36 barangays, composed of 17 coastal barangays and 19 inland barangays. Seven (7) barangays were classified as urban, and 29 were classified as rural barangays. It has a total of 6,320.7509 hectares of agricultural land.

2.3 Research Participants

The researcher used the purposive sampling technique since the respondents were already identified as swine raisers in the municipality of Buenavista. They were identified based on the list of swine raisers from the municipality's Department of Agriculture. Interviews and small group discussions were conducted to gather data and information from the participants.

2.4 Research Instrument

Profile of the swine raisers (age, sex, pig, position in the household, involvement in pig raising, number of animals raised, and year started in pig raising) management information, and disease preventive strategies were simultaneously collected on the municipality using the questionnaire of the Universities Federation for Animal Welfare (UFAW) (2022) adopted and utilized by the researcher.

2.5 Data Gathering Procedure

The researcher secured a letter of request for permission to conduct the study to the municipality's respective office, especially the Department of Agriculture (DA); thus, the researcher also sent a letter to the respective swine raisers. Furthermore, in gathering information from the raisers mentioned above, the researcher and trained enumerators have translated the words in the questionnaire according to the dialect the animal raisers spoke. The instrument used was subjected to the face validation technique, also known as validation by jury opinion. This will require that the test instrument be presented to a jury of experts for their opinion on whether the instrument

could gather the needed data as intended. The researchers developed a survey questionnaire with inputs based on interviews and feedback discussion.

2.6 Ethical Considerations

The author followed ethical principles in conducting the research and preparing the manuscript. All the data, which include personal identification and responses, are recorded and kept, and treated as a record with high confidentiality. The content of the questionnaires was discussed first to let them understand and know what data would be collected from their responses. They answered the questions voluntarily.

3.0 Results and Discussion

3.1 Profile of the Swine Raisers

Table 1 shows the distribution of animal raisers according to the age of Buenavista. The largest age group among respondents is 46-58, comprising 54% of the sample. This age group is considered active in swine raising, resilient, and ready to accept modern technologies in swine raising. Following this, the age group 59-71 constitutes 18%. Most raisers of this age group are still active and experienced, but they are more traditional and cannot easily adopt modern technologies. The 33-45 age group represents 16%, and the 72 and above group represent 10%. The smallest age group is 20-32, making up only 2%. This implies that very few young people intend to engage in swine raising. As supported by the findings of Qui et al. (2020), information on age is needed because the age of farmers plays a significant role in their farming practices and productivity. Older farmers might be more engaged in traditional practices, affecting their adaptability to modern farming techniques and disease management strategies (Olana, K. O. A., and Baldrias, L. R., 2022). Moreover, younger farmers may be more inclined to adopt innovative practices and technologies than their older counterparts, who might rely on traditional methods (Widayati et al., 2018).

Table 1. Distribution of swine raisers according to age

Age	Frequency	Percentage
20-32	1	2
33-45	8	16
46-58	27	54
59-71	9	18
72-Above	5	10

Data revealed that females slightly outnumber males at 54%. Male involvement is 46%. In a farm setting, most females or wives facilitated the feeding, providing water, and cleaning of the pig pen. Because most of the male farmers have other farming activities aside from swine raising, it implies that females actively participate in swine farming in Buenavista. This is consistent with findings from other agricultural contexts that women often participate in less visible, supportive tasks (Smyth et al., 2018). For instance, women may be involved in feeding, cleaning, and caring for the pigs, but their contributions are frequently undervalued and not formally recognized (Bollido et al., 2022).

Table 2. Distribution of swine raisers according to sex

Sex	Frequency	Percentage
Male	23	46.0
Female	27	54.0

The majority of respondents (58%) identified themselves as "other" in the household, possibly indicating they were not the head of the household. This group consists mostly of wives and other household members involved in swine raising. The 42% had identified themselves as the head of the household. This implies that the management of swine raising at home is not solely the responsibility of the head of the household. It involves other members who feed, clean and care for the pigs. As supported by Carter et al. (2017) regarding household dynamics, the roles and responsibilities associated with pig farming can vary significantly based on gender and family structure. Research emphasizes the importance of understanding gender norms and decision-making processes within households, noting that men and women may have different perceptions and responsibilities regarding pig farming.

Table 3. Distribution of swine raisers according to position in the household

Position	Frequency	Percentage
Head	21	42.0
Other	29	58.0

Most pig farming responsibilities fall on wives, with 60% of respondents indicating them as in charge. A significant portion (36%) reported that the head of the household was in charge, while smaller percentages indicated that others did not respond. This implies that even the heads of households are the decision-makers and managers of livestock operations; they support the wives who are responsible for conducting management activities to make their pigs healthy and productive. Bollido et al. (2022) reported that women may be involved in feeding, cleaning, and caring for the pigs.

Table 4. Distribution of swine raisers according to involvement in pig-raising

Involvement	Frequency	Percentage
Head	18	36.0
Respondents	0	0.0
Wife	30	60.0
Other	2	40.0

Most respondents (92%) own between 1 and 40 piglets. A small proportion (6%) own between 41 and 80 piglets. Only one respondent reported owning between 81 and 20 piglets. The number of piglets they raise is limited by their available resources, experience, and family members involved in swine raising. This implies that most respondents can manage only 41–80 piglets, and very few can handle the operation with 41–120 piglets, as supported by Okello et al. (2021), farmers in the Visayas often face challenges such as poverty, which limits their ability to invest in better breeding stock, feed, and veterinary care. The economic viability of pig farming is closely linked to market access and the ability to sell pig products profitably. When farmers perceive pig farming as a viable income source, they are more likely to invest in their operations, leading to increased piglet production (Nguyen-Thi-Duong et al., 2022).

Table 5. Distribution of swine raisers according to the number of piglets raised

Number of piglets	Frequency	Percentage
1-40	46	92.0
41-80	3	6.0
81-120	1	2.0
121-above	0	0.0

Most respondents (74%) started keeping pigs between 2012 and 2022, indicating a relatively recent engagement in pig farming. Some respondents (16%) started between 2001 and 2011. Fewer respondents started between 1990 and 2000 or from 2023 onwards. The farmers' experience relies on the length of time they have been in the business. It implies that as they are involved for more years, the more they will know about management, biosecurity, feeding, and disease treatments. This is further supported by Motsa'A et al. (2019), who found that a majority of farmers with extensive experience in pig farming were more likely to implement effective feeding and housing practices, which are essential for optimal production.

Table 6. Distribution of swine raisers according to year started in pig raising

Year Started	Frequency	Percentage
1990-2000	1	2.0
2001-2011	8	16.0
2012-2022	37	74.0
2023-present	4	8.0

3.2 Pig Management Information

Table 7 shows that the watering frequency varies among respondents: The majority (77%) provide water to their pigs three times a day. Other frequencies include 4 times (12%). Giving water twice a day and with free access is 8%. The data implies that the raisers understand the need for water for the pigs; almost all are given water 3-4 times a day. Water is important to pigs because of its functions: facilitating digestion, maintaining body temperature, promoting blood circulation, lubricating the skeletal system, aiding in milk production for sows, and many others.

Table 7. Access of pigs to water

Access	Frequency	Percentage
Free access	4	8.0
2 x a day	4	8.0
3 x a day	36	77.0
4x a day	6	12.0

Novak et al. (2020) confirmed that the frequency of water provision to pigs is a critical factor influencing their overall health, welfare, and productivity. Pigs, being prandial drinkers, exhibit a strong correlation between their eating and drinking behaviors, with studies indicating that up to 75% of their daily water intake occurs during feeding bouts. Inadequate water availability can lead to decreased drinking behaviors, adversely affecting their hydration and overall well-being.

Most respondents (94%) feed their pigs three times daily, ensuring regular feeding, and very few practice giving it twice daily. No raisers give their pigs free access to feed or practice an ad libitum feeding system. Feeding them freely and more times a day can improve their feeding efficiency and average daily gain. The more they have access to feed, the more they can maintain their energy and nutrient levels in their bodies. They will eat less and gain more.

Table 8. Feeding schedule practiced by the swine raisers

Schedule	Frequency	Percentage
Free access	0	0
2 x a day	3	6.0
3 x a day	47	94.0

As supported by Le Naou et al. (2014), pigs that are fed multiple times a day tend to exhibit improved growth rates compared to those on less frequent feeding schedules. A study indicated that pigs fed six times daily had better feed efficiency than those fed twice daily, suggesting that increased meal frequency can enhance nutrient absorption and utilization.

Table 9. The practice of swill feeding

Swill feeding	Frequency	Percentage
Yes	2	4.0
No	48	96.0

It is good to note in Table 9 that only 4% of respondents practice swill feeding. Most of the raisers said no (96%), and this is a very notable management practice. Swill feeding is the practice of feeding pigs leftovers or food waste (fresh or cooked) from household kitchens, restaurants, or processing plants. It is not allowed because it can be a good source of disease transmission, especially African swine fever. A research finding confirmed that swill feeding is highly discouraged during the ASF disease outbreak to prevent viral transmission. Studies have shown that improper management of swill can lead to outbreaks, as seen in various countries where swill was linked to disease transmission (Bansal et al., 2017; Schembri et al., 2006; Dione et al., 2015).

Grower feeds are the most commonly used feeding line, reported by 40% of respondents. Starter pellets are used by 32% of respondents, and lactating feeds are used by 26% of respondents. By knowing the feeding lines used, the type of population of pigs that the raisers have in their pigpens can be easily identified. Based on the responses, there is a higher population of grower pigs (91–120 days old), followed by a population of starter pigs (35–90 days), and a presence of breeders, especially lactating sows. This implies that the raisers are following the recommended feeding guide because, by this practice, it can be assured that the pigs under their care are provided with the needed nutrients for growth and better performance.

Table 10. Feeding lines used by swine raisers to feed their pigs

Feeding line	Frequency	Percentage
Starter	16	32.0
Grower	20	40.0
Lactating	13	26.0
No response	1	2.0

Furthermore, as reported by Sung (2024), and Soleimani & Gilbert (2020), the importance of adhering to feeding guidelines for pigs is multifaceted, impacting growth performance, health, and overall productivity. Proper nutrition is essential for optimizing growth rates and feed efficiency, which are critical for the economic viability of pig farming. Research indicates that the formulation of diets must consider various factors, including the breed, growth stage, and specific nutritional requirements of pigs.

All raisers responded that they have a regular cleaning schedule, as presented in Table 11, but at different frequencies. The most common cleaning frequency is three times (52%) daily. Others responded the whole week (22%), any time of the day (20%), and twice a day (6.0). This implies that all the raisers are already aware of the importance of maintaining the cleanliness of the pigpens at different frequencies.

Table 11. Cleaning schedule of the pigpens by the raisers

Cleaning schedule	Frequency	Percentage
2 times	3	6.0
3 times	26	52.0
Anytime	10	20.0
Whole week	11	22.0

As supported by Singh (2023), regular cleaning can help reduce the exposure of pigs to contamination and harmful microorganisms capable of causing pig diseases. Leaving animal waste inside the pens longer will provide a good breeding ground for pathogens and may increase methane gas production, which may cause respiratory disease. The presence of urine and pig manure may also cause contamination of feeds and drinking water. Also, regular cleaning practices can mitigate the risks associated with pathogens that thrive in contaminated environments, such as the African Swine Fever (ASF) virus and other zoonotic diseases.

Table 12 presents the survey results on the use of disinfectants. Only 24% confirmed using disinfectant, and 68% are not cleaning the pigpens. Most of them are using only water without any disinfectant mixed with it. Disinfectant is a chemical substance used to kill harmful microorganisms, and it will stay longer on surfaces in the pens, thus preventing the reoccurrence of pathogens. It implies that only a few of the swine raisers appreciated the importance of disinfectant in cleaning pigpens.

Table 12. Use of disinfectant in cleaning the pig pen

Using disinfectant	Frequency	Percentage
Yes	12	24.0
No	34	68.0
No response	4	8.0

Research findings discussed that disinfectants are vital in reducing microbial loads in the environment, which can otherwise lead to infections and compromised animal welfare. For instance, studies have shown that effective disinfection protocols can significantly reduce the presence of pathogens such as *Salmonella* and *Brachyspira hyodysenteriae*, which are notorious for causing severe health issues in pigs (Gómez-García et al., 2022; Martelli et al., 2017; Argüello et al., 2011). Applying disinfectants, particularly after thorough mechanical cleaning, is essential to eliminate residual pathogens that may survive in the environment (Zigo et al., 2020; Argüello et al., 2011).

64% of respondents claimed that they kept logbooks or records for their pigs, indicating monitoring of their pig farming practices. However, 36% said they are not keeping records, as shown in Table 13. This implies that most of the swine raisers in Buenavista have already practiced record keeping.

Table 13. Record keeping

Practice Record Keeping	Frequency	Percentage
Yes	32	64.0
No	18	36.0

As suggested by Staaveren et al. (2017), as a raiser, it is important to keep records of your daily activities and future activities to monitor operations if you are doing them on time. Record keeping in pig raising is a fundamental practice that significantly enhances management efficiency, animal welfare, and farm productivity.

Accurate and systematic documentation of various aspects of pig farming, such as health status, breeding, feeding, and growth performance, allows farmers to make informed decisions that can lead to improved outcomes. For instance, studies have shown that farms with robust record-keeping practices tend to have better management standards, which correlate with lower incidences of issues such as tail-biting and other welfare concerns.

As shown in Table 14, 84% of respondents reported that neighboring pigs were present near their swine project. This implies that their swine projects were vulnerable to disease transmission. As supported by Patterson et al. (2022) and Filippitzi et al. (2017), the occurrence of pigs near the distance of other pigs will affect the biosecurity of your area. Raising pigs away from neighboring pigs is a crucial practice that significantly enhances biosecurity, animal health, and overall farm productivity. This separation helps mitigate the risk of disease transmission, which is particularly important in highly contagious diseases such as African Swine Fever (ASF) and Porcine Reproductive and Respiratory Syndrome (PRRS). The proximity of pigs can facilitate the spread of pathogens, as studies indicate that higher animal densities correlate with increased disease prevalence.

Table 14. Presence of neighboring pigs

With neighboring pigs	Frequency	Percentage
Yes	42	84.0
No	8	16.0

4.0 Conclusion

The researcher concluded that swine raisers in Buenavista, Guimaras, demonstrate consistent feeding practices but exhibit less diligence in cleaning and sanitation. Women predominantly manage pig farming, though many respondents are not the primary decision-makers in their households. The recent growth in pig farming highlights the need for better management practices, especially in hygiene, biosecurity, and recordkeeping. An extension activity for "Sustainable Swine Management Training/Workshop," tailored specifically for swine raisers in Buenavista, Guimaras, is recommended. This activity would focus on improving hygiene, biosecurity, and recordkeeping practices that shall include (1) practical demonstrations of effective cleaning techniques and sanitation protocols to minimize disease risks; (2) basic biosecurity practices to reduce disease transmission, including isolation procedures for new or sick animals; (3) hands-on sessions where participants learn to set up barriers or footbaths; (4) train swine raisers on simple and effective methods for tracking feed, medication, and breeding schedules; (5) supply templates or tools (e.g., record books or digital options) to assist with consistent data logging; (6) include a session focusing on building confidence in decision-making related to swine farming; (7) encourage discussions that highlight women's valuable role and provide strategies for more active participation in household decision-making; (8) encourage peer group meetings where swine raisers can discuss progress, share experiences, and support each other in implementing improved practices.

5.0 Contributions of Authors

This paper is solely authored. The author conducted editing, writing, data analysis, and encoding.

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7.0 Conflict of Interests

The author declares no conflicts of interest concerning this article's research, authorship, and publication.

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Examining How Candidate Attributes Shape Gen Z Perceptions for the 2025 Philippine Senate Elections Using Conjoint Analysis

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Abstract. Understanding Generation Z's political preferences is essential for candidates who engage this influential demographic in the 2025 Philippine Senate elections. Despite the growing importance of Gen Z in the electorate, limited research exists on the specific candidate attributes that shape their voting decisions. This study, conducted in Davao City, addresses this gap by examining how Gen Z perceives various candidate attributes through the lens of Multi-Attribute Utility Theory (MAUT) and Rational Choice Theory (RCT). Using conjoint analysis with the PAPRIKA method, the study evaluated the relative importance of six key attributes: political experience, educational background, stance on issues, party affiliation, campaign style, and age group. Data from 1,380 respondents were analyzed to ensure a robust representation of Gen Z preferences. Results reveal that political experience (31.0%) and educational background (18.1%) are the most influential factors, followed by stance on issues (17.2%) and party affiliation (15.8%), with campaign-style (10.8%) and age group (7.2%) being less significant. Gen Z voters in this study preferred candidates with substantial experience, advanced academic credentials, and a progressive stance on social and environmental issues, favoring digital over traditional campaign strategies. These findings have theoretical and practical implications, enriching the understanding of Gen Z's decision-making processes and highlighting their prioritization of competence, authenticity, and modern communication. Politicians can use these insights to develop targeted campaign strategies that resonate with Gen Z values, emphasizing progressive policies, qualifications, and digital engagement. By aligning campaign approaches with Gen Z's expectations, candidates have a strategic opportunity to connect meaningfully with this emerging voting bloc in the Philippine political landscape.

Keywords: Conjoint analysis; Electoral preferences; Generation Z; PAPRIKA method; Political marketing.

1.0 Introduction

As the 2025 Philippine Senate elections approach, understanding the factors influencing voter preferences, particularly among the growing Gen Z demographic, becomes increasingly crucial. Recent studies highlight the evolving importance of candidate attributes in shaping voter choices, especially among younger generations. This shift in focus presents an opportunity to explore how Gen Z voters in the Philippines evaluate potential senatorial candidates.

Several studies have employed conjoint analysis to investigate voter preferences in various contexts. In Japan and the Philippines, researchers found that voters prioritize competencies such as political experience, education, and profession over traditional factors (Anabo, 2021; Murcia & Bolo, 2017; Horiuchi et al., 2018). Explicitly focusing on

younger voters, Timoteo Jr. (2021) observed that Gen Z and Millennial voters in the Philippines prefer candidates who are not corrupt, wise, and have a solid moral character. The political landscape in the Philippines is complex, with various factors influencing voting behavior. While party identification and pre-election surveys shape voting preferences, issue orientation, and candidate orientation appear less significant (Batara et al., 2021). Interestingly, Horiuchi et al. (2018) noted that voters' preferences for personal attributes often diverge from the observed characteristics of elected officials, suggesting the influence of party recruitment strategies and electoral systems.
Gen Z voters, in particular, exhibit unique characteristics that may influence their political preferences. Putra et al. (2024) and Vira et al. (2024) emphasized the pivotal role of social media in shaping political awareness and participation among youth. This digital savviness extends beyond politics, as seen in their approach to financial decision-making. Sumatra (2023) found that effective social media campaigns and competitive interest rates are crucial for Gen Z in financial contexts, which may also affect their political engagement.

The Multi-Attribute Utility Theory (MAUT), developed by Keeney and Raiffa in the 1970s, provides a framework for analyzing complex choices by assessing the value individuals assign to multiple attributes (Keeney & Raiffa, 1976; Dyer, 2016). This approach has been applied in various contexts, including evaluating presidential candidates (Murcia & Bolo, 2017). For Gen Z, environmental consciousness, attitudes, and self-efficacy significantly influence their behaviors, as observed in their green travel choices (Khan, 2023). Complementing MAUT, the Rational Choice Theory (RCT) suggests that Gen Z's decisions, including voting, are based on perceived costs and benefits aligned with personal goals (Becker, 1976). This theory helps explain the value-driven approach observed in Gen Z's decision-making across various domains, from food choices (Garai-Fodor, 2021) to technology adoption in educational settings (Persada et al., 2019).

Building on established theories and methods, this study's Conceptual Framework, as shown in Figure 1, illustrates how key candidate attributes—such as political experience, stance on issues, and campaign-style—are identified and assessed through the PAPRIKA method within the conjoint analysis. This approach enables the generation of preference data that captures the unique priorities of Gen Z voters in Davao City, setting the foundation for nuanced insights into their electoral decision-making.

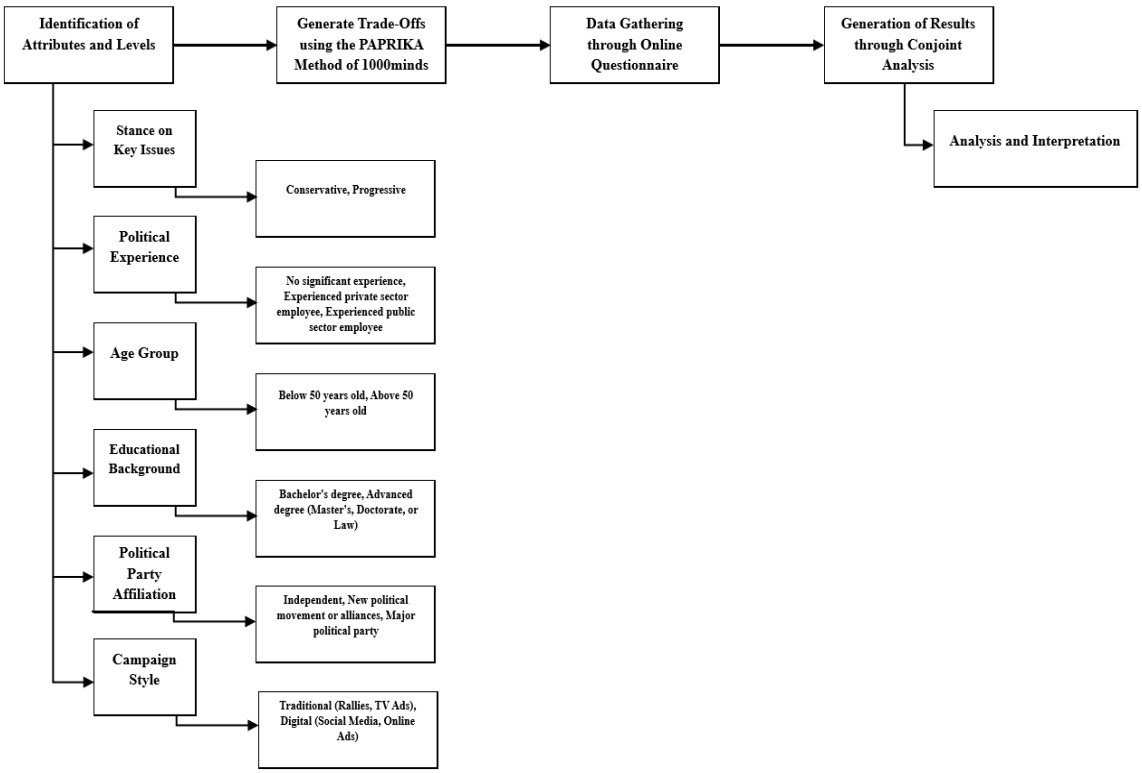

Figure 1: Conceptual Framework.

A compelling method for conjoint analysis is the PAPRIKA method, introduced by Hansen and Ombler (2008). This method allows for the evaluation of multi-attribute options through pairwise comparisons. PAPRIKA has been applied in various fields, from healthcare prioritization to agricultural breeding programs (Hansen & Ombler, 2008; Balogun et al., 2021). Political science is gaining traction for studying voter preferences, especially in developing countries and among younger generations (Department, 2018; Anabo, 2021; Murcia & Bolo, 2017). Conjoint analysis, including methods like PAPRIKA, enables researchers to identify causal effects of multiple components and test several hypotheses simultaneously (Hainmueller et al., 2013). This approach provides a detailed examination of voter preferences. For instance, it has been used to study voter behavior in Japan's 2014 House of Representatives election (Horiuchi et al., 2016). By highlighting nuanced preferences across complex, multi-attribute profiles, conjoint analysis offers valuable insights into how voters evaluate candidates on multiple dimensions (Horiuchi et al., 2016; Hainmueller et al., 2013).

While these studies provide valuable insights, more literature is still needed to address Gen Z voters' preferences in regional areas of the Philippines, such as Davao City, especially in upcoming Senate elections. Previous research has extensively explored how candidate attributes shape voter choices; however, the unique context of Gen Z voters in Davao City offers a novel perspective that existing literature must fully capture. This study aims to bridge this gap by identifying the most valued candidate attributes and the combinations of attribute levels that resonate most strongly with young voters in this region. These insights could contribute uniquely to understanding and influencing youth voter turnout in the Philippines, particularly in regional and urbanized areas where voter dynamics may differ.

This study aims to identify the most preferred candidate attributes and combinations of attribute levels among Gen Z voters in Davao City for the 2025 Philippine Senate elections. By employing conjoint analysis, this research aims to provide a nuanced understanding of how this demographic evaluates multi-attribute profiles, including a candidate's stance on issues, experience, age, education, party affiliation, and campaign style. This investigation will offer valuable insights for political candidates and parties, enabling them to tailor their outreach efforts effectively and potentially influence youth voter turnout and overall candidate success.

2.0 Methodology

2.1 Research Design

The study utilizes a quantitative, cross-sectional research design, employing Conjoint Analysis to explore Gen Z college students' preferences for candidate attributes in the 2025 Philippine Senate elections. Conjoint analysis has proven to be a valuable tool for examining multidimensional preferences in fields like political science and consumer behavior (Bansak et al., 2021). Research in the Philippines indicates that younger voters, including students, value candidate attributes such as political experience, competence, and track record (Anabo, 2021; Timoteo Jr., 2021; Murcia & Bolo, 2017). The PAPRIKA method, central to this analysis and utilized within the 1000minds platform, specifically supports real-world decision-making comparisons by assessing the relative importance of each candidate attribute. This method achieves this by simulating trade-offs between attributes like stance on critical issues, political experience, age group, educational background, party affiliation, and campaign style. By focusing on pairwise comparisons, PAPRIKA allows participants to reveal implicit priorities, offering a choice-based approach that provides insights into the priorities of Gen Z voters. Understanding their electoral behavior is invaluable for developing effective voter engagement strategies. Additionally, research suggests that factors such as party identification and pre-election surveys can further shape voting preferences (Batara et al., 2021), reinforcing the utility of conjoint analysis in uncovering nuanced voting dynamics.

2.2 Research Participants

This study focused on Gen Z college students aged 18 to 26 residing in Davao City. A multi-stage sampling approach was employed to ensure a representative sample of this population. Quota sampling was used to establish a sample size of 300 respondents, deemed adequate for conjoint analysis in similar research on voter preferences (Murcia & Bolo, 2017; Sumatra, 2023). Participants were identified through Purposive Sampling, specifically targeting Gen Z students in Davao City, while Convenience Sampling helped distribute surveys via personal and professional networks. Snowball Sampling further expanded the study's reach, as initial respondents shared the survey link within their networks, facilitating more involvement within the target demographic. This combination of methods was strategically designed to ensure that the sample adequately represents the Gen Z

college student population in Davao City. This multi-stage approach aligns with best practices in electoral research (Burger & Silima, 2006; Lunsford & Lunsford, 1995), balancing practicality and representativeness. Clearly defining the target population and applying structured inclusion criteria, the research gathered high-quality data for reliable insights into Gen Z electoral behavior (Zickar & Keith, 2022).

2.3 Research Instruments

Data for this study was collected using an online survey created on the 1000minds platform, specifically designed for PAPRIKA Conjoint Analysis. This method is highly regarded for examining multidimensional preferences in political science and marketing research (Hainmueller et al., 2013; Department, 2018). Respondents assessed hypothetical candidate profiles with varying attributes such as Stance on Key Issues, Political Experience, Age Group, Educational Background, Political Party Affiliation, and Campaign Style. By requiring respondents to choose their preferred candidates, the PAPRIKA method ranked the importance of each attribute, providing insights into the factors that influence Gen Z college students' candidate preferences. Conjoint analysis has proven effective in political contexts, allowing researchers to simulate real-world decision-making by presenting respondents with randomized profiles and identifying the causal effects of different attributes on preferences (Bansak et al., 2021). This method, widely used in studies on voter preferences (Anabo, 2021; Murcia & Bolo, 2017), has shown that younger voters value attributes like political experience, competence, and issue stances. Therefore, this approach is crucial for understanding and predicting Gen Z's voter behavior and informing political and educational research in various fields.

2.4 Data Gathering Procedure

Data collection for this study took place from September 29 to October 11, 2024. An online survey link was shared through various channels to reach Gen Z college students and gather their preferences for the 2025 Philippine Senate elections. Initially, the survey was distributed through personal and professional networks. Participants were encouraged to share the survey with other eligible respondents to expand their reach, leading to a snowballing effect. The survey remained open for a specific period, and at least 300 completed responses were collected, sufficient for Conjoint Analysis. Responses were gathered digitally on the 1000minds platform, facilitating complex preference studies in political science, education, and healthcare (Bansak et al., 2021). Conjoint analysis has proven effective in studying voter preferences, with recent studies showing that attributes like political experience, competence, and profession often influence voting decisions (Anabo, 2021; Murcia & Bolo, 2017). Ensuring respondent anonymity and emphasizing voluntary participation, this approach provided insights into how Gen Z students evaluate candidate profiles. This aligns with similar studies on multidimensional preferences in various sectors, from social media content to leadership styles in healthcare (Orte & Diño, 2019; Santos et al., 2022).

2.5 Data Analysis

The data gathered in this study were analyzed using the 1000minds PAPRIKA method. This method allowed for precise ranking of attribute levels based on respondent preferences. The analysis began by calculating utility scores for each attribute level, which served as quantitative representations of preferences and allowed for identifying the most preferred attribute. Following this, relative importance scores were derived across attributes, enabling a detailed understanding of which Gen Z voters prioritized candidate characteristics. Conjoint analysis, widely applied in political science and education fields, offers insights into voter behavior by simulating real-world attribute trade-offs (Bansak et al., 2021; Department, 2018). To achieve the study's objectives, results pinpointed the most preferred single attribute and the most favorable combination of attribute levels, which were used to simulate market share for a hypothetical candidate based on this optimal combination. Descriptive statistics supplemented the Conjoint Analysis, summarizing participant demographics and frequencies of attribute levels, further supporting a comprehensive analysis of Gen Z college students' electoral preferences. This method's application in similar studies has demonstrated its ability to reliably capture complex preferences and inform targeted decision-making strategies (Hauber et al., 2016; Castillo & Yee, 2023).

2.6 Ethical Considerations

Ethical considerations were a priority in this study to ensure the responsible handling of participant data, especially given the digital context and Gen Z participants' concerns about privacy (Jabar et al., 2024). Informed consent was obtained digitally before participation, ensuring that involvement was voluntary and confidential, a

crucial practice in studies involving voting preferences and young demographics (Swedan et al., 2020; Joseph, 2023). Participants were informed of their right to withdraw from the study at any time, and personal identifiers were excluded to maintain respondent anonymity throughout the data collection and analysis processes (Nii Laryeafio & Ogbewe, 2023). In the context of Conjoint Analysis for electoral research, ethical frameworks were adapted to accommodate both emerging methodologies and digital communications, respecting intellectual ownership, transparency in data handling, and participant autonomy (Oliver, 2003; Nebeker et al., 2020). This approach reflects best practices in research ethics, ensuring that privacy, data confidentiality, and transparency are foundational to the study's structure.

3.0 Results and Discussion

3.1 Demographic Profile of Respondents

A total of 1,561 respondents initially participated in this study. After applying rigorous exclusion criteria to ensure response quality and data reliability, 1,380 valid responses were retained for analysis. The exclusion criteria included several automated checks: participants were removed if they failed two or more consistency check questions, repeatedly selected only the "they are equal" option, consistently chose either the "left" or "right" option or answered any question too quickly (less than one second per question or with a median response time below two seconds). These rules were implemented to identify and exclude respondents who might not have engaged genuinely with the survey content, refining the dataset to focus on reliable responses.

The demographic profile of the remaining respondents highlights a predominantly young, diverse group of Generation Z college students from Davao City, aged 18 to 26, as shown in Table 1. With the majority (74.0%) in the 18-20 age range, this sample reflects a relatively younger subset of Gen Z, who may hold distinct perspectives compared to older cohorts. The notable representation of women (57.1%) indicates a female-majority sample, which may influence the overall preferences expressed in the study, as previous research suggests that young female voters tend to prioritize progressive values and social issues in political candidates. Additionally, including respondents who identify as LGBTQ (4.3%) and non-binary (1.0%) suggests an openness within this demographic to diverse gender identities, reflecting Gen Z's broader inclination toward inclusivity.

Table 1: Demographic profile of 1,380 valid respondents in the study

Category	Subcategory	Frequency
Age Range	18-20 years old	1021
	21-23 years old	336
	24-26 years old	23
Gender	Female	788
	Male	504
	Non-binary	14
	LGBTQ	59
	Rather not say	15
Current/permanent residence in Davao City	District 1	611
	District 2	531
	District 3	238

The geographical distribution, with nearly half of the respondents residing in District 1 (Poblacion & Talomo), followed by District 2 (Agdao, Buhangin, Bunawan, & Paquibato) and District 3 (Baguio, Calinan, Marilog, Toril, & Tugbok), is significant. Each district has unique socio-economic and cultural attributes that may influence voter priorities. For instance, District 1, being more urbanized, may align with the digital engagement and progressive political stances that the study found appealing to this demographic. Conversely, students from the more rural or less centralized District 3 may approach political engagement differently, potentially valuing candidates with experience addressing issues relevant to diverse community needs. This demographic context provides a foundational understanding of the Gen Z electorate in Davao City. Its diversity and regional distinctions underscore the need for candidates to adopt tailored approaches that resonate with young, socially aware, and geographically varied voters.

3.2 Relative Importance of Candidate Attributes

The relative importance of candidate attributes in this study reveals that Gen Z college students in Davao City prioritize Political Experience above all other factors when evaluating Senate candidates, with a relative importance score of 31.0%, as shown in Table 2.

Table 2. Relative importance of attributes

Factor	Political Experience	Educational Background	Stance on Key Issues	Political Party Affiliation	Campaign Style	Age Group
Political Experience (31.0%)		**1.7**	**1.8**	**2.0**	**2.9**	**4.3**
Educational Background (18.1%)	0.6		**1.0**	**1.1**	**1.7**	**2.5**
Stance on Key Issues (17.2%)	0.6	1.0		**1.1**	**1.6**	**2.4**
Political Party Affiliation (15.8%)	0.5	0.9	0.9		**1.5**	**2.2**
Campaign Style (10.8%)	0.3	0.6	0.6	0.7		**1.5**
Age Group (7.2%)	0.2	0.4	0.4	0.5	0.7	

This preference suggests that young voters in this demographic place a high value on demonstrated competency and a proven track record, likely viewing experience as a foundation for reliable leadership. The emphasis on experience aligns with global trends among younger voters, who increasingly seek candidates capable of handling complex issues with informed judgment. Following political experience, Educational Background holds substantial influence, with a score of 18.1%. This preference for candidates with advanced academic credentials suggests that Gen Z voters may associate higher education with credibility and expertise. Given that many Gen Z individuals are engaged in their educational journeys, they likely perceive advanced educational qualifications as indicators of commitment and capability in public service. The Stance on Key Issues is also highly valued (17.2%), reflecting this generation's interest in candidates' social, economic, and environmental positions. Gen Z's inclination towards issue-based politics underscores their desire for leaders who take clear, actionable stands on society's challenges. Meanwhile, Political Party Affiliation is less critical (15.8%), indicating that while party identity is relevant, it does not override other qualifications. This may reflect Gen Z's broader trend toward valuing individual merit and issue alignment over traditional party loyalty.

Lastly, Campaign Style and Age Group scored the lowest in importance (10.8% and 7.2%, respectively), showing that stylistic elements and demographic alignment are less impactful for this demographic. This de-emphasis on campaign-style suggests that Gen Z voters may value substance over style, focusing on what candidates have accomplished and stand for rather than how they present themselves. The age group's low influence reflects Gen Z's openness to leadership across different generations as long as candidates resonate with their values and priorities. These insights are valuable for campaign strategists aiming to connect with Gen Z voters, as they reveal a demographic that values experience, qualifications, and progressive issue stances over traditional factors like party alignment or age.

3.3 Most and Least Preferred Candidate Profiles

The analysis of the Most and Least Preferred Candidate Profiles among Gen Z college students in Davao City highlights a clear preference for candidates who demonstrate progressive values, digital engagement, substantial qualifications, and a specific openness to older candidates. As shown in Table 3, Candidate 144 embodies these priorities, achieving a perfect preference score of 100%. A progressive stance on critical issues characterizes this candidate, significant public sector experience, an advanced degree (Master's, Doctorate, or Law), affiliation with a major political party, and a digital campaign strategy (social media and online ads). Notably, this candidate is also over 50 years old. The preference for an older candidate suggests that Gen Z voters value experience and professional accomplishments over age, associating these qualities with reliability and expertise.

Table 3. Most and least preferred combinations of attribute levels

Alternative	Rank	Total Score	Stance on Key Issues	Political Experience	Age Group	Educational Background	Political Party Affiliation	Campaign Style
Candidate 144	1st	100.0%	Progressive	Experienced public sector employee	Above 50 years old	Advanced degree (Master's, Doctorate, or Law)	Major political party	Digital (Social Media, Online Ads)
Candidate 132	2nd	92.8%	Progressive	Experienced public sector employee	Below 50 years old	Advanced degree (Master's, Doctorate, or Law)	Major political party	Digital (Social Media, Online Ads)
Candidate 142	3rd	92.6%	Progressive	Experienced public sector employee	Above 50 years old	Advanced degree (Master's, Doctorate, or Law)	New political movement or alliances	Digital (Social Media, Online Ads)
Candidate 3	142nd	8.4%	Conservative	No significant experience	Below 50 years old	Bachelor's degree	New political movement or alliances	Traditional (Rallies, TV Ads)
Candidate 13	143rd	7.2%	Conservative	No significant experience	Above 50 years old	Bachelor's degree	Independent	Traditional (Rallies, TV Ads)
Candidate 1	144th	0.0%	Conservative	No significant experience	Below 50 years old	Bachelor's degree	Independent	Traditional (Rallies, TV Ads)

On the other hand, Candidate 1, who received a 0% preference score, represents attributes that appear less appealing to Gen Z students in this study. This candidate's conservative stance on issues, lack of significant political experience, bachelor's degree as the highest educational qualification, and traditional campaign style (rallies and TV ads) diverge from the values that resonate with this demographic. Being under 50 years old, this candidate's profile indicates that youth alone cannot appeal to Gen Z voters. Instead, they emphasize progressive values, experience, and effective digital engagement over demographic similarity in age.

These findings suggest aspiring senators should highlight progressive policy positions, emphasize their experience and advanced educational credentials to engage Gen Z voters, and effectively adopt digital outreach platforms. The openness to candidates over 50 demonstrates that this demographic values expertise and qualifications more than age alignment. Candidates relying on traditional campaign strategies and conservative stances may struggle to connect with these voters, who seek modern, progressive, and digitally accessible representation.

These findings are relevant to the 2025 Philippine Senate elections, where candidates must appeal to a highly discerning Gen Z demographic. Given this generation's emphasis on progressive values, digital accessibility, and a proven track record, candidates with demonstrated expertise in addressing social, economic, and environmental issues will likely resonate more with Gen Z voters. In the current socio-political climate, where youth are increasingly vocal about issues such as environmental sustainability and social equity, Senate candidates who clearly articulate their stance on these matters could gain an advantage. Furthermore, as Gen Z prioritizes candidates who embody competence over traditional party loyalty, those who can showcase a robust portfolio of impactful initiatives may appeal more directly to this demographic.

3.4 Consistency in Attribute Rankings

The consistency in attribute rankings, measured by Kendall's W and Spearman's rank correlation coefficient, demonstrates a strong agreement among Gen Z college students in evaluating candidate attributes. Kendall's W value of 0.845 and Spearman's rank correlation of approximately 0.844 indicate significant alignment among participants' preferences, suggesting that this demographic holds cohesive views on the attributes they prioritize in Senate candidates. This substantial agreement underscores the reliability of the ranking data and provides confidence in the validity of the overall patterns and preferences identified in this study.

According to Moslem et al. (2019), Kendall's W is instrumental in assessing consensus in ranked data, making it suitable for understanding group agreement in preference-based research. With a Kendall's W value close to 1 indicating perfect agreement and a value near 0 showing no consensus, the observed value of 0.845 reflects substantial consensus in the Gen Z sample, supporting that preferences for attributes like political experience, educational background, and progressive stances are collectively significant. This uniformity suggests that respondents' prioritization of specific attributes is neither random nor highly individualistic but represents a standard set of values within this demographic.

Spearman's rank correlation coefficient, another critical measure of agreement, complements Kendall's W by assessing the direction and strength of this consensus, reinforcing the robustness of these findings. Prion and Haerling (2014) highlight that using multiple consistency measures helps validate the dependability of ranked data in research, especially in preference studies. The substantial alignment indicated by Kendall's W and Spearman's correlation suggests that the preferences identified in this study reflect a reliable pattern, providing insight into the shared political priorities of Gen Z college students in Davao City. The high degree of consistency in rankings demonstrates that the attributes most valued by this demographic—such as progressive stances, substantial political experience, and digital engagement—reflect broader trends within Gen Z. This level of agreement not only enhances the study's validity but also strengthens the conclusion that Gen Z voters in Davao City possess well-defined and consistent expectations for Senate candidates.

3.5 Simulated Market Share and Candidate Preferences

The simulated market share and candidate preferences analysis highlight a distinct set of priorities among Gen Z college students in Davao City, who favor candidates embodying progressive values, significant experience, advanced educational qualifications, and effective digital engagement. Table 4 shows Candidate 144 emerged as the clear favorite, securing 100% of first-place votes. This candidate's profile, characterized by a progressive stance on crucial issues, extensive experience as a public sector employee, advanced degree (such as a Master's, Doctorate, or Law), and affiliation with a major political party, strongly aligns with this demographic's values. Additionally, Candidate 144 is over 50 years old, showing that while Gen Z voters appreciate youth, they highly prioritize experience and qualifications, viewing age as secondary to these attributes when selecting a candidate.

Table 4. Participants ranking alternatives 1st, 2nd, 3rd

Alternative	1st	2nd	3rd
Candidate 144	100.0%	0.0%	0.0%
Candidate 132	0.0%	37.0%	23.4%
Candidate 142	0.0%	28.6%	28.5%
Candidate 143	0.0%	19.0%	16.3%
Candidate 120	0.0%	6.6%	11.8%
Candidate 72	0.0%	5.2%	8.3%
Candidate 138	0.0%	3.7%	4.6%
Candidate 140	0.0%	0.0%	6.8%
Candidate 96	0.0%	0.0%	0.2%

Candidate 132 ranked as the second most preferred, with 37% of participants choosing this candidate as their second choice and 23.4% as their third. Candidate 132 shares key attributes with Candidate 144, including a progressive stance, public sector experience, and advanced educational background. However, Candidate 132 is under 50, which may appeal to participants who value the same qualifications but lean toward younger representation. This distinction suggests a nuanced preference among Gen Z voters, who value experience and appreciate candidates closer to their generation if they meet their other priorities.

In third place, Candidate 142 received 28.6% of second-choice votes and 28.5% of third-choice votes. This candidate aligns with the top two selections in having a progressive stance, extensive public sector experience, and advanced educational credentials. However, Candidate 142's affiliation with a new political movement rather than a major party may account for the lower ranking. This openness to candidates affiliated with newer or independent political movements indicates flexibility in party allegiance among Gen Z voters as long as core values and qualifications align with their expectations.

These findings suggest that Gen Z college students in Davao City are drawn to candidates who exhibit progressive viewpoints, strong qualifications, and digital campaign strategies, regardless of age. While there is some appreciation for younger candidates, the demographic shows an evident willingness to support older candidates if they demonstrate the experience, values, and digital engagement Gen Z expects. This analysis provides valuable insight into the ideal candidate profile for this demographic, emphasizing that qualifications, progressive stances, and modern campaign approaches are paramount in engaging Gen Z voters effectively.

3.6 Key Findings

The study provides valuable insights into the preferences of Gen Z voters in Davao City for Senate candidates, highlighting a clear prioritization of qualifications, values, and modern engagement methods. The findings show that Gen Z voters value political experience and advanced educational credentials most highly, associating these attributes with credibility and competency. Additionally, Gen Z respondents strongly prefer candidates with progressive stances on key issues and a digital-first approach to campaigning, aligning with their generational expectations for modern, accessible communication.

Traditional factors, such as party affiliation and conservative policies, rank less important, indicating a generational shift toward candidates who embody personal merit and progressive values over party loyalty. The high consistency in attribute rankings, coupled with simulated candidate preferences, reinforces the profile of an ideal candidate for this demographic—someone who combines progressive values, substantial political experience, and digital outreach strategies. These preferences suggest that Gen Z voters in Davao City are drawn to candidates who reflect their values of authenticity, professional qualification, and adaptability to modern communication platforms.

3.7 Implications for Political Candidates

Several targeted strategies can enhance the appeal and resonance of candidates seeking to engage Gen Z voters. First, candidates should highlight their political experience and educational background, focusing on a proven track record in public service and advanced academic achievements. Gen Z voters prioritize competency and credibility, viewing these qualifications as essential indicators of a candidate's capacity to lead effectively. Moreover, adopting a progressive stance on critical issues is crucial. Gen Z voters prefer candidates who advocate for social, environmental, and political reforms that align with modern values. To connect effectively, candidates should articulate their positions transparently and authentically, demonstrating a genuine commitment to addressing pressing societal challenges. Clear and actionable policy positions resonate with Gen Z's desire for meaningful change, making authenticity and transparency paramount.

With the 2025 elections approaching, candidates will benefit significantly from recognizing the digital savviness of Gen Z. This demographic, known for their social media engagement, expects campaigns to go beyond traditional outreach and embrace interactive, transparent, and digitally accessible platforms. Leveraging platforms like Instagram, TikTok, and YouTube for policy discussions, Q&A sessions, and authentic, behind-the-scenes insights could create a sense of connection and trust. Additionally, data-driven approaches that personalize content and respond to Gen Z's values—such as environmental awareness and inclusivity—will likely resonate. This shift toward digital platforms is not merely an option but a strategic necessity in engaging a demographic that seeks immediacy, relevance, and authenticity in political communication. Digital engagement, therefore, not only broadens outreach but also reinforces the candidate's relevance to younger voters.

Finally, candidates can benefit from adopting a flexible approach to party affiliation. While party alignment still holds some significance, Gen Z voters focus more on values and qualifications than traditional political loyalty. This openness allows candidates affiliated with new or independent political movements to attract Gen Z support, provided they embody values that align with this generation's expectations. This adaptability signals that non-traditional affiliations can be an asset if core values—such as progressiveness, experience, and a commitment to impactful policies—resonate strongly with Gen Z voters.

3.8 Theoretical and Practical Implications

This study's findings strongly reinforce the frameworks of Multi-Attribute Utility Theory (MAUT) and Rational Choice Theory (RCT) applied to Gen Z's voting behavior. According to MAUT, voters assess candidates by evaluating the utility of various attributes. Here, Gen Z voters demonstrate a highly utility-driven approach,

placing considerable weight on attributes that convey experience, advanced qualifications, progressive stances, and digital engagement. This pattern shows that Gen Z values tangible indicators of competency and alignment with their values over superficial or stylistic factors.

RCT is also evident in Gen Z's rational, benefit-based approach to candidate selection. Gen Z voters prioritize attributes they perceive as benefiting their social and political interests, such as a candidate's progressive policies, digital accessibility, and readiness to address pressing societal issues. This pragmatic focus on value alignment over traditional party loyalty or age similarity underscores a shift in voter behavior among younger generations toward value-driven, pragmatic decision-making.

Practically, these insights emphasize the importance of tailored voter engagement strategies that align with Gen Z's unique set of expectations. Campaigns prioritizing transparency, digital communication, and progressive policy commitments are more likely to resonate with this demographic. Additionally, these findings provide a foundation for future studies on generational voting behavior, suggesting a need to explore how younger generations balance values and practical considerations in candidate evaluation. As these theoretical and practical insights reveal, Gen Z's approach to voting reflects an evolving political landscape where attributes signaling competence, authenticity, and progressive alignment take precedence.

3.8 Limitations

The study's focus on Gen Z college students in Davao City may only partially reflect the diversity of preferences among Gen Z voters across other regions in the Philippines. By concentrating on this specific geographic and demographic group, the findings provide valuable insights but may need more breadth for generalization. Expanding the geographic scope in future studies could offer a more comprehensive perspective on Gen Z's electoral preferences nationwide, capturing regional variations and enhancing the applicability of the results.

Another limitation lies in the study's reliance on stated preferences through conjoint analysis, which may only sometimes align with actual voting behavior in real-world elections. Various factors influence real-life decisions, including campaign dynamics, peer influence, and socio-economic conditions, which may lead to deviations from preferences expressed in a controlled survey environment. Considering these external factors in future research could provide a more accurate reflection of Gen Z's voting patterns.

Additionally, the study's attribute selection, while focused on relevant candidate characteristics such as political experience, stance on issues, and campaign style, may have overlooked other influential factors. Attributes like endorsements, financial transparency, and voter accessibility could be essential in Gen Z's decision-making process. Exploring these additional attributes in future studies could yield a more nuanced understanding of the factors shaping Gen Z's electoral preferences.

3.9 Future Research Directions

Future research could benefit from exploring several vital directions to gain a deeper understanding of Gen Z's electoral preferences. First, broadening the geographic and demographic scope to include Gen Z voters across various regions in the Philippines and internationally could offer comparative insights into how cultural and regional differences shape candidate preferences. This expanded focus would help validate the current findings and potentially reveal variations in Gen Z's prioritization of candidate attributes based on location and cultural context.

Another valuable area for future research is examining real-world voting behavior through longitudinal studies that track actual voting patterns alongside stated preferences. By observing how external factors—such as media influence, peer networks, and socio-political events—impact voting decisions over time, researchers could better understand how preferences identified in conjoint analysis translate into concrete actions during elections. This approach would enhance understanding of the factors that bridge stated and actual electoral behavior.

Incorporating additional candidate attributes, such as financial transparency, ethical endorsements, and social influence, could also enrich future studies. Expanding the set of attributes would provide a more nuanced view

of the criteria Gen Z voters use to evaluate candidates, recognizing that Gen Z's preferences may extend beyond the traditional qualities assessed in this study.

Finally, since Gen Z shows a marked preference for digital campaign strategies, future research could investigate which types of digital content—such as social media platforms, online ads, or influencer endorsements—most effectively engage this demographic. Insights from such research would offer practical guidance for digital political marketing, helping campaigns target Gen Z with tailored digital strategies. These suggested directions for future research would not only address the limitations of the present study but also contribute to a broader understanding of Gen Z's evolving political engagement.

4.0 Conclusion

In conclusion, this study provides a detailed analysis of the electoral preferences of Gen Z college students in Davao City, highlighting the specific candidate attributes this demographic values the most. The findings reveal a strong preference for candidates with significant political experience, advanced educational qualifications, and progressive stances on vital societal issues, reflecting Gen Z's prioritization of competence, integrity, and alignment with forward-thinking values. Gen Z's preference for digital campaign strategies underscores the importance of adapting political outreach to meet this generation's digital-first communication style, indicating a shift away from traditional campaign methods.

While these insights offer a foundational understanding of Gen Z's electoral inclinations, limitations exist due to the study's focus on a single geographic area and demographic subset. Future research that expands to various regions, tracks real-world voting behavior, and explores additional candidate attributes—such as transparency, social impact, and inclusivity—could provide a broader view of the diverse factors influencing Gen Z's political engagement. Such expanded studies will deepen understanding of Gen Z's role in shaping the political landscape and enhance the ability of candidates to connect meaningfully with this emerging voter base, fostering a more informed and engaged electorate.

5.0 Contributions of Authors

There is only one author for this study.

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7.0 Conflict of Interests

The author declares no conflict of interest.

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The Use of Social Networking Sites Influencing the Academic Performance of Students

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Abstract. This study investigated the impact of social networking site (SNS) usage on students' academic performance. It explored the frequency, purpose, and access to SNS alongside academic performance across four subjects (English, Science, Mathematics, and Filipino) over three grading periods. A descriptive-correlational research design was used, with data collected through questionnaires from purposively sampled Grade 7 to Grade 10 students. Statistical tools included mean, standard deviation, and Pearson correlation. Results showed occasional SNS use for specific purposes. Facebook was frequently used, YouTube occasionally, while Twitter, Myspace, and Instagram were rarely used. Students' academic performance was generally satisfactory. A moderate relationship was found between Facebook usage and academic performance across all subjects, a low relationship with YouTube, and negligible relationships with Twitter, Myspace, and Instagram. Students reported enjoying entertainment activities like watching movies and celebrities and listening to music through SNS. Schools are encouraged to conduct time management and productivity workshops to help students balance academic and leisure activities effectively.

Keywords: Academic performance; Agusan del Sur; Education; Philippines; Social networking sites.

1.0 Introduction

In recent years, the rapid growth and widespread adoption of social networking sites (SNS) such as Facebook, Twitter, Instagram, and TikTok have profoundly reshaped how people communicate, interact, and share information. Among the most impacted groups are students, who use these platforms for social engagement and academic purposes. The ubiquitous presence of SNS in students' lives has sparked debates among educators, parents, and researchers regarding its potential impact on academic performance. While some view social media as a tool that fosters collaboration and access to academic resources, others argue that it may serve as a distraction that hampers concentration and time management (Karpinski,2009).

Previous studies have explored various aspects of this relationship, producing mixed findings. For instance, Ellison, Steinfield, and Lampe (2007) found that Facebook use could improve students' academic engagement by fostering social capital and strengthening peer support networks. Similarly, Junco (2012) suggested that certain SNS features, like collaborative study groups, enhance learning outcomes.

On the other hand, Kirschner and Karpinski (2010) argued that heavy use of social networking sites negatively correlates with academic performance due to time management issues, with students spending more time socializing online than focusing on their studies.

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These contrasting findings reflect the complexity of SNS usage and its impact on academic performance, underscoring the need for further research to reconcile these discrepancies. Factors such as the intensity and purpose of SNS use, individual student differences, and contextual influences may all play critical roles in determining whether SNS has a positive or negative effect on learning outcomes (Muriithi & Muriithi, 2013).

Despite the growing body of literature on this topic, significant gaps remain in understanding how specific patterns of SNS usage relate to students' academic success. Much of the existing research focuses on either the general use of SNS or the frequency of usage without delving deeply into the nuanced ways these platforms are used—for academic purposes, social engagement, or procrastination. Furthermore, most studies have been conducted in Western contexts, with limited research examining this relationship in diverse educational settings. Additionally, the rapid evolution of SNS technologies and the changing nature of student engagement with these platforms necessitate ongoing investigation.

This study seeks to fill these gaps by exploring the relationship between students' use of social networking sites and their academic performance. It focuses not only on the amount of time spent on SNS but also on the nature of the activities performed. Doing so aims to provide a more comprehensive understanding of how different types of SNS engagement influence academic outcomes. This research investigates how students use social networking sites to affect their academic performance and identifies the conditions under which SNS usage may enhance or impede academic success. The findings will offer insights that could guide educators, administrators, and students in optimizing the use of SNS for educational purposes while minimizing its potential drawbacks. The significance of this study lies in its potential to inform evidence-based strategies for incorporating SNS into academic environments in a way that maximizes benefits and minimizes risks.

2.0 Methodology

2.1 Research Design

This study employed the descriptive-correlation method of research, using the questionnaire as the data-gathering tool. After identifying who used/availed of the SNS, the researcher used a purposeful sampling of students from Grade 7 to Grade 10. Using the baseline survey method, the researcher identified and asked who among the students used/accessed the Internet.

2.2 Research Locale

This study was conducted in the four public secondary schools of Veruela, Division of Agusan del Sur, located in the eastern part of the CARAGA Region. Veruela has five National High Schools: La Fortuna National High School, Sampaguita National High School, Sinobong National High School, Veruela National High School, and Nueva Era National High School. Except for the Nueva Era National High School, all four schools are considered in this study.

2.3 Research Participants

The study participants were the Grade 7 and Grade 10 students of the public secondary schools of the Veruela district. It was identified that 202 students used the SNS. The researcher took all the 202 students as participants in the study. Purposive Sampling is a non-probability sampling technique where researchers select participants based on specific characteristics, traits, or knowledge that align with the purpose of the study. Instead of relying on randomization, the researcher exercises judgment to ensure that the sample includes individuals most likely to provide relevant and insightful data for the research objectives.

2.4 Research Instrument

After formulating the items in the questionnaire, the thesis adviser checked them and presented them to the thesis committee for their suggestions, comments, and approval. A researcher-made questionnaire was used in this study. With the guidance of the thesis adviser, the statements/items were constructed based on the literature and materials on the use of social networking sites and the student's academic performance. The items were categorized according to the different components. The ICT Coordinators in the District of Veruela validated the questionnaire for content and content accuracy, appropriateness, and clarity.

Content validity of the instrument was conducted on 30 Trento National High School students. Time allotment was taken into consideration in the completion of the questionnaire to determine the time frame for answering the respondents. The students were asked to rate the specific items and whether these were applicable or not appropriate for the use of social networking sites by the students. They were also requested to write their comments on the applicability of the items under each component area. The experts who validated the content indicated that all the items were applicable and relevant to each component area using social networking sites.

A reliability test was also done using the Cronbach Alpha test. A reliability coefficient of 0.74 indicated that the items are highly reliable. They are consistent, trustworthy, accurate, and provide correct results. The questionnaire is divided into two parts. Part 1 asked for information on the high school general point average (GPA). These are asked to measure the student's academic performance in all subject areas. Part 2 includes using social networking sites visited by high school students. These contained items/statements that were scored following a five-point Likert Scale.

2.5 Data Gathering Procedure

The researcher followed proper protocol by asking permission and approval to conduct the study. Communication letters were requested from the Superintendent and principals of the schools considered in this study. After securing a permit from the Schools Division Superintendent of Agusan del Sur, the researcher personally administered the questionnaire to the students who used/availed the Social Networking Sites (SNSs). The researcher requested the assistance of the school heads to allow him to meet the students and request them to answer the questionnaire. The completed questionnaires were retrieved immediately to have 100% retrieval. The researcher also conducted an interview, and during the focus discussion, the students were asked about their personal experiences with the use of social networking sites. After gathering the data, the results were tabulated, analyzed, and interpreted.

2.6 Ethical Considerations

This study complied with all ethical standards for research involving human participants. Before data collection, approval will be obtained from the University Research Ethics Committee. Participants were informed about the purpose of the study, their rights to confidentiality, and their right to withdraw from the study at any point without any consequence. Informed consent was obtained electronically from all participants before they completed the survey.

Data was stored securely and anonymized to ensure the privacy and confidentiality of all participants. To conduct this study, the researcher considered the following ethical considerations throughout the implementation of the study: to protect the rights of the participants, enhance the research validity, and maintain the integrity of the research. The participants participated voluntarily in the research and can withdraw or leave anytime. The researcher informed them that they did not need to explain why they did not participate. The researcher presented vital information about the research, such as the study's benefits, time frame, and purpose when approaching the participants to participate.

3.0 Results and Discussion

3.1 Use of SNSs in terms of Access

Table 1 presents the students' use of social networking sites in terms of access. The data show that students sometimes utilize social networking sites at home, in classrooms, and in internet cafés. They can access the internet using Wi-Fi or Broadband at home, in schools, and in internet cafés. Many students do not own this kind of device. The absence of these ICT gadgets is the primary reason why these are sometimes utilized at home. Since many students have no internet connection or Broadband at home, they occasionally visit Facebook and other social networking sites.

Table 1. Use of social networking sites by the students in terms of access

Indicators	Mean	SD	Interpretation
Home	3.39	1.19	Occasionally
School	3.32	1.37	Occasionally
Internet Cafe	3.07	1.21	Occasionally
Overall	**3.26**	**1.26**	**Occasionally**

According to Chou et al. (2021), the lack of Internet connection at home may be due to economic reasons and parents' low educational background since 83 percent of the non-users are public school students. Using social networking media could make the students more attentive and more interested in the lessons despite the good performance of students. They can easily learn complicated concepts. Karpinski (2009) mentioned that using these media significantly affects the cognitive aspects of the viewers. It is noted from the interview of some students that they also used other gadgets to access social networking, like cell phones, computers, video materials, and laptops in their homes and schools.

This is similar to one of Stevens's findings (2009), which stated that access to social media and networking was sometimes implemented in secondary schools due to the limited number of computers with internet connection. Since there is a limited number of computers with internet connection in public secondary schools of Veruela, the students occasionally surf the internet for their reports of the different subjects such as Language, Science, Mathematics, and Makabayan and occasionally visit the social networking sites such as Facebook and other websites. A study by Omeje (2018) strongly argued that it is very important for secondary teachers to study the relationship between SNSs and students' academic performance. During the interview, the students said they occasionally visited their favorite social networking site because they lacked internet connection at home. This is also because of economic reasons. They cannot afford a computer at home, much more with the internet and wifi connections. Students can apply other tools and techniques even without Wi-Fi or Broadband. The use of cellphones can be utilized. Doing hands-on operations using cell phones and laptops could help the students learn the lessons better. Students can have access to the internet using their hi-tech cellphones. Since only a few have this kind of cell phone, students can access the internet by borrowing others' cell phones and computers or flocking to internet cafes if they have money.

3.2 Use of SNSs based on Usage

Table 2 shows that the students seldom use social networking sites. It obtained an overall mean that is quantitatively described as seldom used. This means that the students rarely use social networking sites. The obtained standard deviation shows that the student's responses are slightly dispersed. On Facebook and YouTube, their responses are more heterogeneous than on Myspace, Instagram, and Twitter. It is noted that only Facebook is often used by students at home and in the classroom. Facebook represents potentially useful tools in educational contexts. Many students are always familiar with Facebook. It allows students to ask more minor questions they might not otherwise feel motivated to visit a teacher during office hours. It also allows students to manage their privacy settings.

Table 2. Use of social networking sites by the students based on usage

Indicators	Mean	SD	Interpretation
Facebook	3.53	1.17	Often
YouTube	3.13	1.26	Occasionally
MySpace	1.26	0.62	Never
Instagram	1.23	0.53	Never
Twitter	1.22	0.53	Never
Overall	**2.07**	**0.82**	**Seldom**

LaRose and Eastin (2004) found a positive association between internet and SNS use and student users' academic performance. Students who frequently used the internet scored higher on reading skills tests and had higher grades. Muriithi and Muriithi (2013) revealed in their study that students and teachers often utilized Facebook to integrate their lessons in English. This is because the students in the classrooms can easily facilitate it. The students on social networking sites occasionally use YouTube. This is seldom used in the classrooms. Students can watch videos, answer questions, discuss content, and create videos to share with others. Junco (2012) pointed out that YouTube increases participation, personalization, and productivity and can provide opportunities for peer learning and problem-solving. Not only this, but it also improved my digital skills and helped me recall concepts from the world application course. YouTube allows students to upload, view, and share videos. Since this site is not always visited, the students only utilized this in some situations.

The students never used Twitter, Myspace, and Instagram on social networking sites. This means the students are unfamiliar with these networking sites' services. Twitter enables users to send and read short character messages called "tweets." The student users cannot reach this particular website. Myspace had a significant influence on

pop culture and music. Instagram is an online mobile photo-sharing, video-sharing, and networking service that enables users to take pictures and record videos. The students cannot visit these social networking sites since they are unfamiliar.

3.3 Use of SNSs in Terms of Academic Purpose

Table 3 shows the use of social networking sites in terms of academic purposes. This is described as occasionally used by the students in the secondary schools. The qualitative description of the overall mean was occasionally used, which means that social networking was only used in some situations. The standard deviation indicates that the responses of the respondents are slightly dispersed. The findings show that students have been using websites but only occasionally. This might be because they have a limited internet connection at home, in school, and in internet cafés.

Table 3. Use of social networking sites in terms of academic

Indicators		Mean	SD	Interpretation
1.	Work on the assignments given by the teachers.	3.42	1.64	Often
2.	Surf my reports in the Internet café.	3.41	1.17	Often
3.	Watch videos about important events and tourist spots.	3.21	2.02	Occasionally
4.	Search for scientific terms and symbols.	3.03	1.18	Occasionally
5.	Locate and synthesize information about the lessons in all subjects.	3.00	1.38	Occasionally
6.	Collect data and information from the internet to solve problems.	2.98	1.09	Occasionally
7.	Uploads historical events and issues concern.	2.95	1.40	Occasionally
8.	Exploit the reference tools on the internet such as online dictionaries.	2.92	1.28	Occasionally
9.	Interpret data and information from the internet in solving mathematical problems.	2.91	1.40	Occasionally
10.	Use the internet in problem-solving, the definition of terms, and in systematic counting, estimating, and approximating.	2.90	1.37	Occasionally
11.	I conduct academic discussions and research online with my subject teachers.	2.85	1.22	Occasionally
12.	Make and record observations using computers.	2.83	1.35	Occasionally
13.	Search for the outstanding contributions of scientists on the internet that have enhanced the quality of life and levels of thinking.	2.78	1.30	Occasionally
14.	Creates and publishes work in the form of digital storytelling.	2.67	1.25	Occasionally
Overall		**2.99**	**1.36**	**Occasionally**

Usually, teachers give assignments that are doable to the students even if they cannot surf the internet. This is because the teachers know too well that many or most students have limited access to computers at home. According to some teachers interviewed by the researcher, they require their students to surf in the internet café. However, the Internet café attendant will charge them every hour using the websites. They cannot use the internet most often. They only use the internet sometimes when they need it. This correlated with the findings of Sayogo (2019), who stated that students sometimes visited Internet cafés because they could not afford to pay the charge per hour.

Looking at the specific items, it is shown that out of 14 indicators, the students often use social networking sites for academic purposes when they work on the assignments given by their teachers and when they surf the reports on the internet. This is because the teachers often require their students to surf the internet or computers to look for scientific terminologies and other symbols and news worldwide. They can only find complete information on their assignments and reports online. Since their schools have limited time schedules to allow them to use the Internet, they must go to Internet cafes to access the needed data for their assignments. They usually go to the internet when they have money.

Oskouei (2010) stated that students use the Internet to search for answers to their assignments. Some private schools even give their students online quizzes, thus requiring their students to use the Internet. This finding indicates that the students only used social networking sites most of the time when working on assignments where teachers required them to access the net. Other component indicators cannot be done most of the time because the students have no money to pay per hour's charges. It is noted that they occasionally used social networking sites for academic purposes. This means they used social networking sites in some situations, like locating and synthesizing information about the lessons in all subjects and collecting data and information to solve problems. The students could only visit the internet café when they had available money.

Some teachers said that they have difficulty facilitating their lessons when they have to use the SMSs. Creating and publishing works in the form of storytelling, like on Facebook, was the last indicator occasionally done by the students. This means that many of the students did not do this activity. Only those students with internet access can comply with this assignment. Sometimes, even those with access to the internet cannot even make their assignment because they are distracted by the games and other activities that the web can offer. Facebook, for instance, could divert their attention to other activities rather than working on the assignment. As Saiphoo et al. (2020) point out, students sometimes use the Internet in their academic subjects because they have very rare access to an Internet connection. Sometimes, even if they have computers or laptops, they cannot access data from the World Wide Web when there is no Internet connection. Their computers have to be Wi-Fi or broadband connected to open the Internet.

3.4 The Use of SNSs in Terms of Non-Academic Purpose

Table 4 presents the use of social networking sites for non-academic purposes. Generally, this is described as occasionally used by students in secondary schools. This means that social networking is only used sometimes in some situations. The standard deviation indicates that the respondents' responses are not clustered toward the mean. There is heterogeneity of responses. The findings show that the students only used social networking websites occasionally. This is because many students have no laptops or computers. They can access the internet using their cellphones, but it is costly because they spend money on the load to have internet access. They can access the internet at home if they have Wi-Fi or Broadband. Similarly, they can access it in school without an internet connection. If the school has Wi-Fi, they can use an internet connection. There are instances when, even if the school has an internet connection, they still cannot access the web because of poor connectivity.

Table 4. Use of social networking sites in terms of non-academic purpose

Indicators	Mean	SD	Interpretation
Play games using cell phones.	4.00	1.30	Often
Watch movies and celebrities.	3.45	1.30	Often
Log on to the computer/ television to watch entertainment and musical shows.	3.37	1.40	Occasionally
Scan pictures of friends and community updates.	3.35	1.19	Occasionally
Listen to music and rhymes and upload them.	3.26	1.30	Occasionally
Watch game shows like “Laban or Bawi.	3.21	1.30	Occasionally
Make social interactions with friends online.	3.11	1.27	Occasionally
Play online games like “Candy Crush Saga”.	3.09	1.33	Occasionally
Post pictures of any celebrations at home and in school.	3.02	1.18	Occasionally
Chat with friends and family members abroad.	2.93	1.37	Occasionally
Search for long-lost friends and classmates.	2.89	1.30	Seldom
Play puzzles and games on my laptop.	2.56	1.35	Seldom
Play games like DOTA and other online games on the PC or Personal computer.	2.42	1.33	Seldom
Send e-mail ads to my classmates and friends.	2.40	1.64	Seldom
Overall	**3.08**	**1.32**	**Occasionally**

Arnold and Paulus (2010) stated that about two out of five (38%) respondents have one computer in their homes. A significant proportion (42%) has no computers in their homes, with Mindanao respondents reporting the highest percentage (63%) of zero computers. This is because many families could not afford to buy computers. They would rather have TV sets because the whole family can view the shows simultaneously. On the other hand, the computer is mostly an individualized activity. From the casual interviews with students, they said that their parents do not find the computer a necessity in their homes.

They still view this as something luxurious that they can forego to buy. There are more necessary things that could be prioritized rather than buying a laptop or computer. Not all teachers own a computer or laptop, which gives reasons for students' inability to work with computers. Looking at the specific terms, it is observed that out of 14 indicators, the students often used social networking sites for non-academic purposes when playing games using cellphones and watching movies and celebrities on the internet. Students are very interested in playing games, especially at this age level. Playing games on the cellphones are very easy to access. They can access free internet if they load their cellphones for twenty to fifty pesos. Aside from this, students can play games without accessing the internet because some games can be installed on their cell phones.

According to Kirschner and Karpinski (2010), playing games on cell phones is among the top three in the survey of Luzon, Visayas, and Mindanao. This is because children are drawn to cellphone games since they get satisfaction from them. Saiphoo et al. (2020) observed that "teens and twenty-somethings tend to patronize games more." The same report noted that cellphone games make up 80 percent of the total cellphone use in the country.

The students are also very fond of and interested in watching movies and celebrities at this age. They have idols and models to follow. The money intended for recess is utilized at the internet café for their satisfaction. Sayogo (2019) said that most students use social networking for social connections, entertainment, and educational and professional reasons. It is noted that these social networking sites were occasionally used for non-academic purposes. This means they use social networking in some situations, like listening to music and rhymes, uploading them, and interacting with friends online. The students could surf the internet if they have money to load in their cellphones, or they have to prepare fifteen to twenty pesos for rental services at the internet café.

The item "sending e-mail ad to my classmates and friends" was the last indicator seldom done by the students. This means that few students do this activity. This is because the students can surf the internet if they have money as payment for a load of Wi-Fi and the rental services at the internet cafe, and therefore, they have little knowledge of how to make e-mail ads. Another reason for the low internet usage for sending e-mail ads to classmates and friends is that children are not generally interested in e-mail ads. This confirms the findings of Tuckman (2005) that children are not generally interested in news and sending e-mail ads. Sending emails would also require them to write letters or make some compositions, which students find cumbersome and taxing. They would rather view pictures or post pictures rather than write letters.

3.5 Academic Performance of Students

Table 5 presents the level of academic performance of students in the first, second, and third grading periodicals in English, Mathematics, Science, and Filipino. The table shows that the Science subject obtained the highest rating, followed by Makabayan, and the lowest was for English. The result indicates that the students' ratings perform satisfactorily in these subjects. This performance is just average and within the bracket of 81-84. They could still perform better than satisfactory, considering that if they utilize extensively their internet sources, they are open to a vast array of knowledge and information from the world wide web.

Table 5. Academic performance of students

Subjects	1st	2nd	3rd	Average	Description
English	80	81	82	81.0	Satisfactory
Math	81	82	82	81.6	Satisfactory
Science	86	83	84	84.3	Satisfactory
Filipino	83	84	84	83.6	Satisfactory
General Average	**82.5**	**82.5**	**83**	**82.7**	**Satisfactory**

It is noted that the ratings showed an increase of one point for English, Math, and Filipino in the second grading but a decrease of three points for Science. In the third grading, there was an increase of one point for English and Science, but steady for Math and Filipino. The increase was not substantial because the average grade is still within the bracket range of satisfactory performance. There was no extraordinary rise or fall in the grades of the students. One could not attribute the students' performance to using the SNS because no experimentation was done. According to Stollak et al. (2011), it can be inferred that students' academic performance might increase when social networking sites are used purposely in the teaching-learning situation. Using educational media technologies improves students' academic achievement.

3.6 Relationship Between the Use of SNSs and the Academic Performance of Students

Table 6 reflects the relationship between using social networking sites and students' performance. It can be seen that the use of Facebook has a moderate relationship with the academic performance of students in English, Mathematics, Science, and Filipino. The result falls on the moderate relationship, which means that Facebook influenced students' performance in the four subject areas. This indicates that the student's use of Facebook has moderately contributed to their academic performance. This could be because using Facebook could provide information to students studying the four subject areas.

Table 6. Correlation between academic performance and the use of social networking sites

SNS	English		Math		Science		Filipino	
	R	Desc.	R	Desc.	R	Desc.	R	Desc.
Facebook	0.41	Mod.	0.42	Mod.	0.42	Mod.	0.44	Mod.
YouTube	0.30	low	0.34	low	0.40	low	0.38	low
Twitter	0.24	low	0.20	negligible	0.22	low	0.30	low
Myspace	0.18	negligible	0.10	negligible	0.20	negligible	0.12	negligible
Instagram	0.16	negligible	0.11	negligible	0.10	negligible	0.11	negligible

Since students in all curricular subjects often use Facebook, they can easily organize whatever assignments are given to them. It can contribute to the learning of the students. Their language skills can be developed, and they can locate information. The use of Facebook can develop their Mathematics and scientific skills, too. According to Stevens (2009), students' use of Facebook will result in better academic performance. Social Networking sites could increase students' learning through student interactions. Challenges arise when social networking sites are incorporated into an academic course. Facebook promotes social connections among students. The use of Facebook can enhance communication building and critical thinking.

There is a low relationship between the use of YouTube and students' academic performance in English, Math, Science, and Filipino. In Twitter, except for Math, which has a negligible correlation, there is a low relationship with students' academic performance in English, Science, and Filipino. The students in their academic subjects have not used these two social networking sites. YouTube mostly contains entertainment materials, such as songs and videos. Twitter is also more concerned with entertainment news and materials. These are probably why students do not utilize these in academic subjects. It is noted that Myspace and Instagram have negligible correlations with students' academic performance. This means that they did not affect or influence students' academic performance. The students are not familiar with Myspace and Instagram. The students whom the researcher interviewed said they were unfamiliar with Myspace and Instagram and, therefore, had never visited these social networking sites.

3.7 Experiences of Students in Using SNSs

The researcher interviewed the participants, and during the focus discussion session, the participants said that foreign movies are very suspenseful and unpredictable. They use modern technology that appears to be real. This is the very reason why they liked watching foreign movies aside from the local ones. According to Dennen, Jung, Cargill, and Hedquist (2021), many students frequently download videos. The popularity of downloading videos may be due to children's inclination to foreign culture and anything new in the video scene. It helps them relate with other children through watching local and foreign movies. It is indicated that the students like to watch celebrities on YouTube. According to the students, during the interview conducted by the researcher, they like to follow or imitate the actions of their favorite models and actors or actresses. They are also updated on the latest news of famous models and celebrities.

Today's generation has much exposure to SNSs because of the many advertisements on television and the movies they see. They follow this up on the internet through Facebook, YouTube, and other SNS. The study of Jabr (2011) found that the topics most frequently discussed in chat rooms/forums are love and relationships (43%), family (39%), education (39%), movies and celebrities (36%), and games (34%). Respondents in Metro Manila and Visayas are more "showbiz oriented." Since the respondents are high school students and are in their adolescence stage, they are inclined to talk about their experiences and views about love and relationships. It is good to know that they also talk about their education, perhaps their school subjects.

It is observed that students' emotions are affected while playing DOTA. The new media have affected children's and youth's social and emotional development. How they relate to their parents and peers is largely influenced by their exposure to these various media. For example, Kirschner and Karpinski (2010) cited that equality in online communications among computer users of all ages tends to erode authority structures. This development means that children now may be less accepting of parental authority. Strangers and acquaintances, thus forming "weak ties" that provide less social support than real relationships with family and friends.

As to social connections, the Internet has become an instrument for maintaining relationships with close friends and close family members. However, it also creates new online, virtual relationships. There are several instances

when they could even start courtship via cell phones or Facebook. They can establish love relationships through these media. There are also instances where they can bully others through the SNSs, posting pictures and words that could disparage or create bad relationships.

From the interview with the students, they are attuned to their new technological gadget, the cell phone. They love to listen to music using their headphones. It is noted that the students are relaxed and happy while listening to the sound of music. Based on the interview, the cellphones and computers of the students have a lot of downloaded music, whether local or foreign. According to the study by Dennen et al. (2021), most students upload music. Uploading music and videos has been facilitated by the accessibility and affordability of cell phones with camera and video capabilities. Likewise, digital cameras, which have become affordable, have made picture-taking user-friendly and popular, especially among children.

4.0 Conclusion

Based on this study's findings, the following conclusions can be drawn: Students used social networking sites (SNS) occasionally, both for academic and non-academic purposes. This indicates that while SNS were accessed for various reasons, they were not consistently utilized as a primary tool for academic work. Despite this occasional use, students demonstrated satisfactory performance across all subject areas, suggesting that SNS usage alone does not significantly influence academic performance. A moderate relationship was found between Facebook usage and students' performance in subjects such as English, Math, Science, and Filipino, implying that Facebook may have some impact on academic outcomes. In contrast, other platforms such as YouTube, Twitter, MySpace, and Instagram showed no significant effect on students' performance across these subjects. Additionally, the enjoyment students experience using Facebook and YouTube suggests that these platforms may influence their academic activities and their broader non-academic lives. Future studies could explore more specific patterns of SNS usage and their long-term effects on academic performance. Research could also investigate how different features of SNS contribute to both positive and negative academic outcomes, potentially offering more targeted recommendations for optimizing SNS use in educational contexts.

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7.0 Conflict of Interests

The author declares no conflicts of interest related to this research study.

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Technological Leadership Behavior and Technological Formation as Predictors of Education 4.0 Competency Determination of Educators in Region XII: A Convergent Design

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Abstract. This study determined the influence of technological leadership behavior and technological formation on Education 4.0 competency determination of educators in Region XII, Philippines. This study utilized mixed methods research, mainly convergent design. In the quantitative phase, adapted and validated survey questionnaires were employed, while an interview guide was utilized in the qualitative phase during in-depth interview (IDI) and focus group discussion (FGD). The statistical tools used in analyzing the quantitative data included mean, standard deviation, and multiple linear regression analysis, while thematic analysis was used for the qualitative data. The results revealed that the status of technological leadership behavior, technological formation, and Education 4.0 competency determination of educators were rated high. Moreover, technological leadership behavior and technological formation significantly influenced Education 4.0 competency determination. Further, facing limitations in the pedagogical and conceptual competencies related to Education 4.0, encountering inadequacy of resources, engaging in ICT upskilling and technology capacity-building activities, and becoming a proactive teacher were the themes generated from the lived experiences of educators. Furthermore, the themes extracted from the role of experiences that shaped their beliefs included learning is a continuous process, teaching is a vocation and bearing accountability to students. Likewise, manifesting resiliency, keeping a spirit of positivity, and embodying appropriate values were the themes generated from the experiences that shaped their attitude. Along with this, the themes that surfaced from the experiences that shaped the commitment of teachers involved visioning for knowledgeable students and manifesting passion for teaching. Finally, the nature of data integration revealed merging-converging.

Keywords: Convergent design; Education 4.0 competency determination; Technological formation; Region XII, Technological leadership behavior.

1.0 Introduction

Education 4.0 competency determination focuses on determining the expected competency of teachers to develop their knowledge and skills related to digital technologies and their ability to apply these new technologies in the learning environment (Turan-Güntepe & Abdüsselam, 2022). It aspires to develop digitally competent teachers using fundamental digital education available to all students to meet society's needs in the inventive age (Hariharasudan & Kot, 2018). However, despite the advent of technology, educators are reluctant to incorporate technological tools into the pedagogical framework despite a notable willingness among students to acquire

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proficiency in emerging technology (Qureshi et al., 2021). Primary problems in ICT infrastructure and technical and pedagogical content competencies have resonated in Africa and Sweden's Education 4.0 competency determination of teachers (Van Wyk & Waghid, 2023). This data is also congruent with the data obtained from 26 participating countries by PricewaterhouseCoopers (2016) survey, which suggests that Education 4.0 competency determination faces challenges related to a need for digital culture and training (50%) and support from school leaders (40%).

Furthermore, as noticed by Alda et al. (2020), the need for more proficiency in utilizing learning management, the limited availability of virtual laboratories, and digital infrastructure are significant barriers to determining the Education 4.0 competency of teachers in the Philippines. In fact, Ventayen et al. (2019) mentioned that educators in the Philippines need more skills in preparing online content and assessments due to the unfamiliar use of technological tools. Likewise, Almacen et al. (2023) noticed that lack of financial resources and inadequate infrastructure are among the barriers to technical skills acquisition by teachers. However, in Region XII, Education 4.0 has become the focal point of innovation in teaching, stressing the need for DepEd and other education agencies to provide Filipino students with technology and internet resources. However, Macaranas and Robles (2023) found that despite the high responsiveness of STEM programs to Education 4.0 today in secondary schools, educators still need help in coping with the required competencies of Education 4.0 in General Santos City. This finding is also noted by Gonzales et al. (2022), who mentioned that educators face challenges developing Education 4.0 competencies due to limited training resources, high costs, inadequate technologies, skills and knowledge gaps, and complex learning platforms.

In the same way, Alkrdem (2014) found a positive connection between the principal's technological leadership behavior and the development of teachers' competencies in Education 4.0. This highlights the importance of technological leadership skills for robust, technology-oriented curriculum instruction as they influence the formation of teachers' technical skills. This is supported by Mendoza and Catiis (2022), who pointed out that school heads' technological leadership behavior affects teachers' technology skills in navigating their Education 4.0 competency determination.

On the other hand, upon reviewing the current literature, the researchers have found that most articles discussed Education 4.0 competency as one primary variable in their studies through surveys. Some literature focuses only on the association between technological leadership behavior and Education 4.0 competency determination and technological leadership behavior to teachers' competence in Education 4.0 through correlational study. Others were done through the correlation between the technological formation of teachers and competency determination in Education 4.0. In addition, some studies were conducted on groups of pre-service and higher education teachers abroad, and most studies utilized descriptive, descriptive-correlational, and some employed qualitative research design. Thus, less has been done in the Philippine setting.

As a result, the researchers felt the urgency to delve into the combined influence of technological leadership behavior and technological formation on Education 4.0 competency determination of educators in the Philippines, focusing on Region XII. Compared to the current study, this study is unique as it employed mixed methods research, mainly convergent design.

2.0 Methodology

2.1 Research Design

This study utilized a mixed methods approach, particularly the convergent design. As Creswell and Creswell (2017) emphasized, mixed methods research involves combining quantitative and qualitative data, integrating them, and deriving interpretations based on the combined strengths of both sets to understand research problems. In this study, the two data sets from the quantitative and qualitative strands were gathered from the participants; the quantitative and qualitative findings were then combined through data integration utilizing the convergent design methods to see whether the two data sets corroborate, converge, or diverge in results.

2.2 Research Locale

This study was conducted in Region XII comprises eight school division offices. In particular, the schools were selected based on the following criteria: a.) The school is categorized as a large school with at least 100 regular

teachers based on DepEd Memo No. 68, 2015, who could serve as sources for information gathering; b). The school is implementing a science, technology, engineering, and mathematics (STEM) curriculum.

2.3 Research Participants

There were 352 respondents in the quantitative phase derived from a 4,061 total population computed using the Raosoft sample size calculator set to a five percent margin of error (MoE) and a 95 percent confidence interval. Also, a stratified random sampling technique was utilized to determine the sample size needed for each identified public secondary school in Region XII. Moreover, 19 educators from the different public secondary schools in Region XII participated in the qualitative phase. The study's participants were selected through a purposive sampling technique based on the inclusion criteria set by the researchers. In particular, 12 participants were invited to participate in the IDI, and 7 were invited to participate in the FGD.

2.4 Research Instrument

In the quantitative phase, the researchers used an adapted and validated research survey questionnaire that had undergone validity and reliability tests. The research instrument is adapted from Durnali (2022), which assessed the technological leadership behavior; Erdogmus et al. (2021), which assessed the teachers' technological formation; and Turan-Guntepe and Abdusselam (2022), which assessed the teachers' determination of their Education 4.0 competency, with an overall Cronbach's alpha of 0.814. Furthermore, a researcher-made interview guide was utilized in the qualitative phase, which a panel of experts validated. The validated research interview guide was utilized to extract the participants' lived experiences concerning their education 4.0 competency determination.

2.5 Data Gathering Procedure

The data collection of both the quantitative and qualitative data was conducted simultaneously. As part of the research protocol, the researcher secured an Ethical Clearance from the UIC - Research Ethics Committee (UIC-REC) to guarantee the ethical soundness of the study. Moreover, the researchers obtained the respondents' consent to partake voluntarily in the quantitative phase. The respondents were informed about the study's entire procedure. The informed consent form (ICF) was personally given to the respondents before administering the survey questionnaire. The respondents were asked to answer the survey questionnaires about their school heads' technological leadership behavior, teachers' technological formation, and Education 4.0 competency determination. The respondents' responses were combined and totaled, and the appropriate statistical tools were used to analyze the quantitative data.

Furthermore, in the qualitative phase of the study, the researchers conducted an IDI and FGD on the study participants. The execution of the qualitative strand adhered precisely to the established protocols. The ICF indicated that participation in the study was voluntary and was given to the participants for approval. The procedures, such as goals, potential hazards, and discomforts, were disclosed to the participants. More so, they were guaranteed to keep their responses private and allowed to protect their identities using pseudonyms. Further, they were also informed of their rights to decline to answer the questions and withdraw from the study.

2.7 Ethical Considerations

This study adheres to ethical standards by submitting it to the UIC-REC guidelines and following the required procedures while interacting with participants. The ten ethical considerations were strictly observed, including social value, informed consent, participant vulnerability, risks, benefits, privacy, confidentiality, justice, transparency, researcher qualification, facility adequacy, and community involvement. Moreover, before the study's conduct, Ethical Clearance (Protocol Code: GS-0088-02-24) was secured from the UIC - Research Ethics Committee (UIC-REC) to guarantee the ethical soundness of the study. The participants were personally given the informed consent form (ICF), seeking their voluntary participation in the study before administering the surveys, IDIs, and FGDs. They were permitted to remain unknown in the entire process through a pseudonym, and their responses were guaranteed to be kept confidential. They were also informed of their rights to decline or withdraw at any given time without any legal sanction. Further, a full review of the ethics committee on the study's design, methods, and procedures was done, ensuring that the study met the ethical standards. All ethical guidelines were followed precisely during the study's implementation.

3.0 Results and Discussion

3.1 Status of Technological Leadership Behavior

The status of the technological leadership behavior of educators in Region XII was measured through its four indicators: motivation, orientation, precaution, and support (see Table 1). Computations yielded an overall mean of 3.84, which is described as high. This implies that technological leadership behavior is oftentimes evident among educators in public secondary schools in Region XII. Moreover, the overall standard deviation is .77, which is less than 1, indicative of a minimal range of dispersion.

This implies that school heads create expectations on the use of technology and are fully aware of its importance at school while supporting the emergence of technology, particularly the technological needs of teachers inside the classroom. The school heads recognize the vital role of technology in today's educational setting as an essential part of education today, which makes them active in providing essential tools for the teachers' effective integration of technology in the classroom.

Table 1. Descriptive statistics of the status of technological leadership behavior

Indicators/Items	Mean	SD	Description
A. Motivation			
1. trying to address concerns about the use of technology at school.	4.00	.82	High
2. guiding about the safety precautions should be taken when in use of technology at school.	3.96	.86	High
3. creating clear expectations about the use of technology at school.	4.01	.82	High
4. motivating to use technology at school.	4.22	.88	Very High
5. giving access to technology on an equal basis with other employees in the school.	4.01	.90	High
6. informing about the unnecessary use of technology at school.	3.93	.92	High
Category Mean	**4.00**	**.74**	**High**
B. Orientation			
1. enabling to internalize the importance of using technology at school.	4.13	.82	High
2. enabling to apply technology successfully to the teaching process at school.	4.19	.82	High
Category Mean	**4.10**	**.74**	**High**
C. Precaution			
1. ensuring that the information technology tools needed at school are ready for use.	3.89	.82	High
2. providing the software(s) needed in the teaching process at school.	3.64	.93	High
3. providing the equipment needed in the teaching process at school.	3.66	.95	High
4. providing the hardware upgrades needed in the teaching process at school.	3.50	.98	High
Category Mean	**3.67**	**.82**	**High**
D. Support			
1. showing awareness of the legal issues related to the use of technology.	3.87	.90	High
2. ensuring that the software(s) used at school are licensed.	3.80	1.00	High
3. taking measures to prevent illegal copying of the software(s) used at school.	3.77	.99	High
4. leading the use of computers in accordance with ethical values at school.	3.94	.90	High
5. leading to take measures to prevent possible IT-based crimes that may occur at school.	3.85	.93	High
Category Mean	**3.83**	**.88**	**High**
Overall Mean	**3.84**	**.77**	**High**

Motivation

This indicator obtained a category mean of 4.00 with a description of High and interpreted as oftentimes evident. Looking at the individual items, the mean rating of this category ranges from 3.93 to 4.22. In particular, the item motivating to use technology at school, received a mean rating of 4.22. Meanwhile, the item informing about the unnecessary use of technology at school registered a mean rating of 3.93. This indicates that the school heads support teachers' integration with technology, as they have a positive outlook on utilizing technology in school, giving teachers free access and equal opportunity to better facilitate their technological needs inside the school. This finding aligns with the study of Soy and Behcet (2021), who showed that a high level of motivation affects the instructional style and direction of teachers in the utilization of technology. Moreover, the study's results support the findings of Andriani et al. (2018), who pointed out that the high level of motivation and leadership skills shown to the teachers contributed to the increase in teachers' competence, particularly when embracing the new era of learning today. However, the study contradicts the study of Kou (2024), who found that the leader's behavior does not influence high motivation to do the work tasks.

Orientation

This indicator reveals a category mean of 4.10 with a description of high. By looking at the individual items, the mean rating of this category ranges from 4.13 to 4.19. The item enabling to apply technology successfully to the

teaching process at school, got a mean rating of 4.19. While the item enabling to internalize the importance of using technology at school, obtained a mean rating of 4.13. This means that the technological leadership behavior of school heads shows awareness of the importance of technology in school, which influences the successful application of technology among teachers. The school heads high orientation level further indicates that they have embraced the emergence of technologies, emphasizing the importance of applying them in school and allowing teachers to use these new technologies as part of classroom instructions. This finding supports the study of Mubarak and Petraite (2020), who found that a high orientation level of school leaders in technology use improved active learning environments. Moreover, the study is also congruent with the findings of Gurr and Drysdale (2020), whose paper underscores that guiding an educational organization to increase adaptability requires a high level of school leader orientation on the advent of technology to develop individual competence and enhance the adaptive competence of the teachers. In addition, Gyeltshen (2021) highlighted that a moderate level of leadership orientation influences teachers' use of technology in classroom teaching and learning, which can be effective in school practice in Bhutan.

Precaution

This indicator accumulated a category mean of 3.67, described as high. Looking at the individual items, the mean ratings ranged from 3.50 to 3.89. In particular, the item ensuring that the information technology tools I need at school are ready for use obtained a mean rating of 3.89. Likewise, the item providing the hardware upgrades needed in the teaching process at school also got a mean rating of 3.89. This suggests that school principals are supportive enough to provide for the technological needs of the teachers and ensure that the equipment needed is ready to facilitate the learning process of the students inside the classroom. The results support the finding of Kumar et al. (2019), whose paper highlighted the teacher use of technology tools that facilitate student learning, effective management of the classroom environment, and efficient carrying out of tasks can be attributed to a high level of precaution of the school principal on the use of technology at school. On the other hand, Karabatak and Karabatak (2018) emphasized that inadequate school leader support for technology tools and information for teachers may affect their technological literacy.

Support

This category obtained a mean of 3.83, which is described as high. Looking closely at the individual items, the mean rating of this category ranges from 3.77 to 3.94. The item leading the use of computers by ethical values at school got the mean rating of 3.94. The item taking measures to prevent illegal copying of the software(s) used at school has a mean rating of 3.77. The high support for teachers shows the grasp of school heads on the use of technology and the observance of ethical values for the use of technology. This may prevent teachers from committing a serious offense by exploiting this technology. The result agrees with the study of Pollock (2020), whose findings revealed that school leaders with a high level of support promote safe school practices and establish a framework for the use of technology to guide learning initiatives through the utilization of technology. As a matter of fact, Andriani et al. (2018) accentuated that technology integration in schools is influenced by technologically proficient principals who adhere to ethical principles.

3.2 Status of Technology Formation

The status of the technological formation of educators was measured in terms of content development, interactive object development, problem solving, and creativity (see Table 2). The computations yielded an overall mean of 3.49, which is described as high. This suggests that technological formation is oftentimes demonstrated among educators in public secondary schools in Region XII. More so, the overall standard deviation is .66, which is less than 1, indicative of a minimal range of dispersion on respondents' responses.

This implies that teachers can handle various aspects of online educational media, including mobile content and technology integration into lessons, despite a partially strenuous field of robotics education. Likewise, teachers can also utilize various ways to enhance lesson content using electronic circuits and educational technology tools while involving planning, collaborating with experts for successful results, and adapting to new technological tools. Choosing appropriate digital resources through problem-solving skills reciprocates to enhancing technological competence among teachers.

Table 2. Descriptive statistics of status of technological formation

Indicators/Items	Mean	SD	Description
A. Content Development			
1. making online educational media (animation, video, educational game).	3.82	1.05	High
2. fictionalizing an educational media (animation, video, educational game) step by step.	3.56	1.02	High
3. making custom pages on the online platforms used.	3.56	1.02	High
4. customizing the software used based on my needs.	3.40	1.12	High
5. making a blog or blogs that students can use to discuss and submit ideas.	3.49	1.04	High
6. preparing creative lesson content with mobile devices (smartphone, tablet).	3.88	.97	High
7. writing unique scenario for educational media (animation, video, educational game).	3.54	1.01	High
8. preparing online interactive lesson presentation	3.80	1.05	High
9. preparing different concept maps and drawings online.	3.59	1.06	High
10. creating game with online game providers for both educational and fun.	3.26	1.10	Moderate
11. designing a unique character for educational media (animation, video, educational media).	3.22	1.08	Moderate
12. building an online platform to evaluate my students.	3.38	1.12	Moderate
13. deciding on specific online platforms or simulation development apps to use based on lesson content.	3.38	1.05	Moderate
14. designing a page/platform where students get lesson content with social networks.	3.33	1.07	Moderate
15. planning and process a mobile app development step by step.	3.12	1.10	Moderate
16. deciding which computer hardware will be used based on needs.	3.50	1.05	High
17. studying with different simulation, virtual reality or augmented reality apps.	3.42	1.03	High
18. designing simple simulations to use in my lessons.	3.41	1.03	High
19. developing websites about different departments.	3.11	1.16	Moderate
20. preparing online survey, quiz etc. for students to fill.	3.78	1.07	High
21. understanding which websites use technologies.	3.66	1.06	High
22. surviving the hardship in the process of mobile app development.	3.43	.99	High
23. developing virtual reality app or augmented reality to enrich my lessons.	3.17	1.03	Moderate
24. re-enriching a printed lesson material with virtual reality or augmented reality.	3.43	1.01	High
25. making brochure or poster with desktop publishing app (MS Publisher etc.).	3.57	1.13	High
26. preparing lesson content about mobile app development.	3.42	1.07	High
27. editing my images with photo editor app.	3.77	1.12	High
28. designing creative interface design for my mobile app.	3.40	1.14	High
29. installing different operating systems (Windows, Linux, MacOS).	3.35	1.21	Moderate
30. knowing what formats (apx, php, html etc.) on the address bar means.	3.35	1.20	Moderate
Category Mean	**3.49**	**.87**	**High**
B. Interactive Object Development			
1 enriching lesson content by using electronic circuit (Arduino, Raspberry Pi, Tinker Board, UDOO etc.).	2.77	1.17	Moderate
2 building a project with electronic circuit (Arduino, Raspberry Pi, Tinker Board, UDOO etc.).	2.65	1.13	Moderate
3 deciding components to be used in electronic circuit (Arduino, Raspberry Pi, Tinker Board, UDOO etc.).	2.61	1.14	Moderate
4 developing an app with electronic circuit (Arduino, Raspberry Pi, Tinker Board, UDOO etc.).	2.50	1.12	Low
5 developing the products which support lesson content by using electronic circuit (Arduino, Raspberry Pi, Tinker Board, UDOO etc.).	2.56	1.14	Low
6 enriching my lesson content by using block-based app (Scratch, Codu etc.)	2.55	1.13	Low
7 developing lesson content by using educational robot kits.	2.60	1.17	Moderate
Category Mean	**2.59**	**1.08**	**Low**
C. Problem Solving			
1 mathematically expressing the solution of the problems faced in daily life.	3.60	.98	High
2 thinking can learn better the instructions made with the help of mathematical symbols and concepts.	3.62	.97	High
3 thinking have a special interest in the mathematical processes.	3.62	1.02	High
4 having problems in the issue of where and how should use the variables such as X and Y in the solution of a problem.	3.14	1.11	Moderate
5 trying to solve the complex problems.	3.58	.10	High
6 preparing regular plans regarding the solution of the complex problems.	3.50	.94	High
7 making use of a systematic method while comparing the options at hand and while reaching a decision.	3.60	.95	High
8 applying the solution planned respectively and gradually.	3.69	.94	High
9 having no problems in the demonstration of the solution to a problem in mind.	3.60	.92	High
10 producing so many options while thinking of possible solutions to a problem.	3.62	.91	High
11 immediately establishing the equity that will give the solution of a problem.	3.57	.89	High
12 thinking will attain more successful results because of working in a group, in cooperative learning.	3.83	.93	High
Category Mean	**3.59**	**.80**	**High**
D. Creativity			
1 liking people who are sure of most of their decisions.	4.31	.83	Very High
2 liking fair and realist people.	4.41	.82	Very High
3 believing that dreaming is caused by my desire to showcase my important projects.	4.14	.83	High
4 trusting myself to conduct the plan while planning to solve problem.	4.12	.81	High
5 having faith in solving the problems when come across a new situation.	4.11	.81	High
6 adapting to a new technologies.	4.07	.90	High
Category Mean	**4.20**	**.72**	**Very High**
Overall Mean	**3.49**	**.66**	**High**

Content Development

This category has a mean of 3.49 with a description of high. Looking at the individual items, the mean ratings ranged from 3.11 to 3.88. In particular, the item, preparing creative lesson content with mobile devices (smartphone, tablet), and the item, building an online platform to evaluate my students, and the item deciding on specific online platforms or simulation development apps to use based on lesson content obtained a mean rating of 3.88. While the item, developing websites about different departments, got a mean rating of 3.11. This implies that teachers are using various technological platforms for educational drives in their classroom instruction. This result is congruent with the study of Emre (2019), who revealed that teachers with a high content development level are inclined to create an online platform, simulate development applications, and create a social media platform for their lesson content. Moreover, Unal and Uzun (2019) stressed that using technology is complicated and that teachers encounter strenuous technology platforms that infuse moderate content development skills. Thus, teachers should adapt technologies flexibly.

Interactive Object Development

This category garnered a mean of 2.59 with a description of low, which is seldom demonstrated. Looking at the individual items, the mean rating of this category ranges from 2.50 to 2.77. Specifically, the item enriching lesson content by using an electronic circuit obtained a mean rating of 2.77 with a description of moderate and is interpreted as sometimes demonstrated. Meanwhile, the mean rating of 2.50 was obtained by the item developing an app with an electronic circuit**.** The result demonstrates low interactive object development skills among teachers, suggesting they need to be more confident in handling electronics and robotics education. This can be a barrier to integrating robotics education into their lessons. The result of the study contradicts the study of Roemintoyo et al. (2022), whose paper found that senior high school teachers have very high interactive object development skills for learning in classroom activities in Indonesia. In connection, Schina et al. (2021) added that with the rapid spread of technology advancement and educational robotics, a low interactive object development level necessitates teachers to attend training and technological pedagogy programs.

Problem Solving

This indicator gained a category mean of 3.59 with a description of high and interpreted as oftentimes demonstrated. Looking at the individual items, the mean rating of this category ranges from 3.14 to 3.83. In particular, the item thinking will attain more successful results because of working in a group, in cooperative learning, acquired a mean rating of 3.83. While the item having problems in the issue of where and how I should use the variables such as X and Y in the solution of a problem, obtained a mean rating of 3.14. The result suggests that teachers can achieve more when working collaboratively to demonstrate a systematic solution to a problem. This result affirms the study of Treffinger et al. (2023), whose findings revealed a high level of problem-solving among individuals who can innovatively provide a problem-solving technique that utilizes mathematical skills to demonstrate the solution. Moreover, Nelson et al. (2019) underlined that teachers become adept at preparing regular plans and creating a systematic decision-making method when they have high problem-solving skills.

Creativity

This category has a mean of 4.20 with a very high description and is described as always demonstrated. Looking at the individual items, the mean rating of this category ranges from 4.07 to 4.41. The item liking fair and realist people, got a mean rating of 4.41. Meanwhile, the item adapting to a new technologies obtained a mean rating of 4.07. This implies that creativity is always evident among teachers; they work effectively with their peers and are committed enough to their decision-making process while solving particular problems when encountering new situations, necessitating careful planning. This finding is aligned with the study of Kettler et al. (2018), whose paper highlighted that teachers with very high creativity levels are more innovative in embracing technologies and tend to go along with individuals who are confident with most of their decisions. Furthermore, as Bereczki and Karpati (2018) noted, creative teachers have faith in solving problems when faced with new situations that strengthen their technological formation. Teachers' creativity has been observed to positively impact the acceptance of technological innovation among teachers in gaining their technological formation.

3.3 Status of Education 4.0 Competency Determination

The status of Education 4.0 competency determination of educators in Region XII was measured in terms of mastery of digital technology, information management, and active participation in the process (see Table 3).

Computations yielded an overall mean of 3.49, which is described as high. The results suggest that Education 4.0 competency determination is very satisfactory among educators in public secondary schools in Region XII. Moreover, the overall standard deviation is .73, which is less than 1, indicative of a minimal range of dispersion. This means that teachers have acquired the necessary skills to deal with digital technologies and have relevant knowledge of its various platforms.

Table 3. Descriptive statistics of the status of Education 4.0 competency determination

Indicators/Items	Mean	SD	Description
A. Mastery of Digital Technology			
1. knowing about cloud technologies.	3.24	1.13	Moderate
2. knowing about smart technologies such as wearable technologies and smart glasses.	3.40	1.18	High
3. knowing about robotic programming.	2.71	1.11	Moderate
4. knowing about mobile technologies.	3.58	1.11	High
5. knowing about Bitcoin and Blockchain technologies.	2.98	1.17	Moderate
6. knowing about three-dimensional (3D) technologies.	3.16	1.14	Moderate
7. knowing which software to use to do 3D printing.	2.93	1.18	Moderate
8. knowing about artificial intelligence.	3.49	1.17	High
9. writing program using code blocks.	2.63	1.14	Moderate
10. knowing the intended purposes of wearable technologies and smart glasses.	3.00	1.19	Moderate
Category Mean	**3.11**	**1.01**	**Moderate**
B. Information Management			
1. taking security measures while using information and communication technologies.	3.57	.97	High
2. paying attention to ethical principles when using information and communication technologies.	3.77	.90	High
3. knowing what to do when encountering a security incident while using information and communication technologies.	3.51	.93	High
4. questioning the accuracy of information in digital resources.	3.43	.95	High
5. choosing the correct information digital resources.	3.59	1.00	High
Category Mean	**3.59**	**.88**	**High**
C. Active Participation in the Process			
1. directing training depending on personal needs.	3.72	.90	High
2. participating in project-based studies.	3.75	.90	High
3. using time effectively in the learning process.	3.90	.86	High
4. easily solving the problems encountered in the learning process.	3.78	.84	High
5. knowing from whom to get help when faced with difficulties in the learning process.	3.90	.85	High
6. conducting interdisciplinary studies.	3.65	.90	High
Category Mean	**3.79**	**.75**	**High**
Overall Mean	**3.49**	**.73**	**High**

Mastery of Digital Technology

The mastery of digital technology of educators in Region XII generated a category mean of 3.11, which is described as moderate. Looking at the individual items, the mean rating of this category ranges from 2.63 to 3.58. The item knowing about mobile technologies obtained a mean rating of 3.58. Meanwhile, the item writing my program using code blocks got a mean rating of 2.63. This indicates that teachers in public secondary schools are satisfactorily knowledgeable about the technological tools and software needed in their Education 4.0 competency determination**.** However, some relatively difficult aspects of digital technologies require more skills for teachers to embrace them, particularly in classroom settings. The result of the study is congruent with the findings of Amhag et al. (2019), which revealed that teachers who used digital tools occasionally for pedagogical purposes are less acquainted with the use of technologies in Education 4.0 due to a moderate level of mastery of digital technology. On the other hand, Nasution et al. (2020) suggested that to improve the mastery of digital technology, schools should implement digital initiatives and socialize digital activities to motivate others to transform into digitally competent individuals.

Information Management

The information management reveals a category mean of 3.59 with a description of high. By looking at the individual items, the mean rating of this category ranges from 3.43 to 3.77. In particular, paying attention to ethical principles when using information and communication technologies obtained a mean rating of 3.77. Likewise, the item questioning the accuracy of the information in digital resources got a mean rating of 3.43. This implies that teachers have very satisfactory knowledge of information management principles and understand the accuracy of information from digital resources. The high level of information management further denotes that teachers are well-informed about the ethical principles of using technology. This result is consistent with the findings of

Licorish et al. (2018) that teachers with high information management levels embrace technology advancements as preventive measures to reduce workloads and secure the accuracy of information in digital resources based on this advancement. More so, Sánchez-Cruzado et al. (2021) reiterated that teachers often need a higher self-perception of their digital skills, especially with high information management skills, to better prepare for security incidents.

Active Participation in the Process

This category obtained a mean of 3.79, which is described as high. By looking at the individual items, it can be observed that the mean rating of this category ranges from 3.65 to 3.90. It can be noted that the two items have the same mean rating of 3.90: knowing from whom to get help when faced with difficulties in the learning process and using time effectively in the learning process. This indicates that educators who participate extensively in digital literacy activities can collaborate with their peers on project-based learning development activities that allow them to devise a plan to effectively address learning challenges efficiently. The result of the study is consistent with the study of Aslan (2021), which highlighted that teachers with high active participation in digital literacy show competence in embracing the trends of education today that require problem-solving, decision-making, and understanding of technological concepts. Furthermore, Joseph et al. (2021) underscore that even with less technology adoption, teachers with high active participation in the process could find ways to gain knowledge on digital literacy depending on their needs and the effective use of their time in the learning process in gaining their Education 4.0 competency determination.

3.4 Significance of the Influence of Technological Leadership Behavior and Technological Formation on Education 4.0 Competency Determination

The results of the multiple regression analysis which purpose is to determine the influence of technological leadership behavior and technology formation on Education 4.0 competency determination indicate that technological leadership behavior (β=.150, p<.05) and technology formation (β=.621, p<.05) significantly predict the education 4.0 competency determination of educators in Region XII (see Table 4). This means that the regression weights for technological leadership behavior and technological formation in the prediction of Education 4.0 competency determination are significantly different from zero at the 0.05 level (two-tailed). This suggests further that for every unit increase in technological leadership behavior, there is a corresponding increase in the Education 4.0 competency determination by .150. More so, for every unit increase in technological formation, there is a corresponding increase in the Education 4.0 competency determination by .621. In other words, a strengthened technological leadership behavior and technological formation would contribute to the enhancement in Education 4.0 competency determination of educators. Furthermore, the finding reveals in the results of the multiple regression analysis in which 49.2 percent of the variance of Education 4.0 competency determination can be explained by the model as indicated by R^2 = .492. This implies that 50.8 percent of the variance of Education 4.0 competency determination can be attributed to the other factors aside from technological leadership behavior and formation.

Table 4. Significance of the influence of technological leadership behavior and technological formation on education 4.0 competency determination

Model	Unstandardized Coefficients		Standardized Coefficients	t	p-value	Remarks
	B	Std. Error	Beta			
(Constant)	.513	.161		3.184	.002	
Technological Leadership Behavior	.144	.038	.150	3.770	.000	Significant
Technological Formation	.694	.045	.621	15.584	.000	Significant

Note: R=.702, R-squared=.492, F=193.405, p=.000

This implies that the more supportive the school heads are in the development and integration of technology by providing the necessary tools for teachers, the more enhancement in the Education 4.0 competency determination is manifested among teachers. Likewise, as teachers' technological skill sets in the utilization of technology increase, so does their Education 4.0 competency determination. The findings of the study affirm the claim of Thannimalai and Raman (2018), whose paper emphasized that the principal's technological leadership behavior had a positive influence on the Education 4.0 competency determination of teachers, making the leadership behavior a substantial effect on the advancement of teacher competence in overcoming the barriers of education 4.0. Moreover, the study confirms the study of Suharyatia et al. (2019), which noted that technological formation influences the development of education 4.0 competency determination of teachers, which plays a crucial role in

shaping their ability to foster creativity and innovation. In fact, the current findings validate the Transformational Leadership Theory of Bass and Riggio (2006), which posits that making teachers aware of the task value, prioritizing the organizational goals, and providing and supporting teachers with their needs can significantly transform their vision. More so, the findings also validate the Self-determination Theory of Deci and Ryan (2012), which states that teachers are motivated by their innate needs for autonomy, relatedness, and competence, which give them a sense of control over what to adapt to technological tools inside their classroom. In the same way, the findings also support the Self-efficacy Theory of Bandura (2000) that human competencies are cultivated and demonstrated in many ways, involving distinct sets of knowledge and skills across various domains of functioning like the cognitive, motivational, emotional, and selection processes. This particular set of domains embedded in the minds of teachers influences their belief in their abilities to succeed in the advent of technology today that rapidly develops their technological skills and competence towards attaining their Education 4.0 Competency Determination.

3.5 The Lived Experiences of Participants Concerning Education 4.0 Competency Determination

In the IDI and FGD (see Table 5), the essential themes generated from the participants' statements concerning their lived experiences in Education 4.0 competency determination are as follows: facing limitations in the pedagogical and conceptual competencies related to Education 4.0, encountering inadequacy of resources, engaging in ICT upskilling and technology capacity building activities, and becoming a proactive teacher.

Table 5. Lived experiences of participants as regards Education 4.0 competency determination

Essential Themes	Core Ideas
Limitations in the Pedagogical and Conceptual Competencies related to Education 4.0	Having insufficient knowledge about some areas of Education 4.0 although computer literate.
	Lacking some skills to access varied applications of technological platforms for classroom instruction.
	Some teachers are unfamiliar with the technological processes of Education 4.0
	Integrating ICT in the learning process but not well-acquainted with Education 4.0 processes.
	Understanding Education 4.0 as an era of computers and utilizing technology such as Zoom, Google meet, PowerPoint presentations in the lessons.
Inadequacy of Resources	Lacking computer units in the laboratory for the students
	Experiencing poor internet connection in some school campuses.
	Receiving insufficient funds during competitions particularly in Robotics
	Having most students with no personal gadgets like laptop or cellphone
Engaging in ICT Upskilling and Technology Capacity Building Activities	Being able to attend seminars and trainings for ICT upskilling
	Having school administrators providing and, or, sending teachers to computer literacy and ICT seminars
	Maximizing LAC sessions to share knowledge among teachers about e-learning, Education 4.0, and other fields.
	Being allowed to join Robotics competitions in various levels
	Having school heads ensuring the availability of necessary technological resources no matter how mean are they in quantity
	Collaborating with experts and other stakeholders for guidance related to ICT and other technological fields
Becoming a Proactive Teacher	Taking initiatives to self-learn about technology and its application in instruction as well as appropriate teaching strategies.
	Utilizing innovative and interactive tools for an enriched classroom teaching
	Doing lots of readings and research about Education 4.0 and motivated for its employment to the teaching and learning processes

Limitations in the Pedagogical and Conceptual Competencies related to Education 4.0

When asked about the experience of teachers regarding Education 4.0 competency, the participants revealed that they lack the knowledge and skills on Education 4.0. Despite being computer-literate, the participants were not proficient at employing technological platforms for classroom instruction. Their lack of exposure to ICT integration and familiarity with Education 4.0 procedures led to their inability to use technological tools effectively and integrate them into classroom instruction. With this, the participants felt that Education 4.0 could be embraced as an era of computers and that technology applications could be employed to improve the technological skills of the teachers. This implies that participants need to be exposed to and acquainted with some technological applications in the classroom, particularly in the technological process of Education 4.0. Although they use

computers as part of their daily school tasks, when it comes to applying new technologies in classroom instruction, they still need to gain skills in utilizing technological applications to enhance the learning process in their respective classes. This finding aligns with the idea of Sousa and Roucha (2019), who highlighted that minimal teacher exposure to technological advancements limits their acquisition of the skills essential for digital transformation and adapting to the technical framework of Education 4.0. In connection, the finding confirms the study of Artacho et al. (2020), which revealed that there is still a perceived deficit in digital teaching and problem-solving skills and competence among teachers today, particularly in digital content creation

Inadequacy of Resources

It was found that school laboratories lack computer units and have poor internet connections. Sometimes, financial resources are also limited. These inadequacies confronted the teaching and learning process to utilize technology effectively. The limited resources hinder the teachers from maximizing learning, including school participation in out-of-campus competitions like robotics and other competitions, where the schools need gadgets like laptops and cellphones, making it challenging for teachers to enhance Education 4.0 competency determination and improve access to personal gadgets. This implies that the need for more equipment and facilities confronted teachers to facilitate learning, which is essential in Education 4.0. With the advent of technological tools in the era of Education 4.0, the technical support needed seemed insufficient to cope with the advent of technologies. The school has a limited supply of technological equipment like laptops and internet connection since schools need more funds to provide these technological needs. The result corroborates with the study of Awang et al. (2020), which emphasized that IT infrastructure, like the availability of computers and technological facilities, is among the main challenges of Education 4.0 today. Moreover, the results support the claim of Costan et al. (2021), who pointed out that financial support in operationalizing IT infrastructure, such as internet connectivity, was among the barriers to Education 4.0.

Engaging in ICT Upskilling and Technology Capacity Building Activities

The participants pointed out that to capacitate teachers in the emergence of technology, they must attend seminars and training relative to computer literacy and ICT upskilling to acquire the skills needed for Education 4.0. They also highlighted that sharing knowledge about e-learning and Education 4.0 could greatly enhance the skills of teachers in technology integration. More particularly, venturing into other fields of technological advancement, like participating in robotics and other technology-related competitions, would capacitate teachers to acquire the skills. The results indicate that attending seminars and upskilling activities for ICT enhances the Education 4.0 Competency Determination of the participants; this can be strengthened by sending them to seminars and maximizing school-based activity training to share knowledge on facilitating e-learning and the Education 4.0 learning process among teachers. This finding affirms the study of Wilk et al. (2020) that professional training of teachers must focus on enhancing Education 4.0 competency determination to adapt to the trends and changing landscape of education today. Thus, school administrators should provide facilities and programs that support the enhancement of the technological competence of the teachers at school and send their teachers to seminars and training (Agustini et al., 2020).

Becoming a Proactive Teacher

Teachers emphasized the importance of looking at the needs in the trends in education and working with experts and stakeholders to improve further their skills in coping with the advancement of technology. It is also imperative for teachers to continuously explore the possibilities of learning the new era of technology by self-learning about technological tools and using these innovative tools to enrich classroom teaching, learning experiences, and skills in Education 4.0. More so, the teachers engage in extensive readings and research about Education 4.0 and are motivated to apply it to the teaching and learning process to elevate Education 4.0 competency. The result emphasized that becoming proactive in learning various technological applications enhances Education 4.0 Competency Determination. They emphasized the critical role of working together with ICT specialists for guidance while taking the initiative to acquire and discover innovative tools for teaching instruction enhancement. This finding confirms Emre's (2019) claim that teachers with positive perceptions of Education 4.0 collaborate more with experts to enhance their skills in technology manipulation. Further, Kochan (2022) added that teachers who proactively use digital technologies motivate students to embrace technological developments and are willing to collaborate with other teachers to acquire the technical skills needed.

3.6 The Role of the Experiences in Shaping the Beliefs of the Participants

The roles of experiences in shaping the participants' beliefs on Education 4.0 competency determination generated essential themes from the participants' statements that underlined the following ideas: learning is a continuous process, teaching is a vocation, and bearing accountability to the students (see Table 6). This implies that participants recognized the significant role of experiences that led to a change in beliefs and perspectives as to how to gain their Education 4.0 Competency Determination in the teaching-learning process of the Education 4.0 era. By realizing these themes, educators in Region XII can further enhance their technological skills and contribute to their professional growth.

Table 6. Role of the experiences in shaping the beliefs of the participants

Essential Themes	Core Ideas
Learning is a Continuous Process	Open to any advancement in the educational landscape. Must learn to adapt and apply the changes in the educational processes. Determined to learn new things. Upgrading oneself is a necessity in strengthening one's capability. Demonstrating effectiveness at work while applying the new knowledge learned.
Teaching is a Vocation	Teachers are molders of students. Delivery of instruction to students with passion and dedication. Looking at difficulties as a source of inspiration to strive more and become better. Learning from experiences for self-enhancement.
Accountability to Students	Having profound responsibilities to the students and the school. Provision of proper educational foundation to students Feeling accountable to the future of the student. Preparing students to become digital citizens. Development of the students in applying the latest trends in education.

Learning is a Continuous Process

The study results show that continuous learning is essential for teachers in enhancing technological skills in the Education 4.0 era. This means that to gain their Education 4.0 Competency Determination, teachers were adaptive and open to any advancement in today's educational processes, particularly 21st-century skills. More so, they believed that continuous learning strengthens their competencies and improves effectiveness at work by applying the new knowledge gained. This finding is aligned with the study of Caena and Redecker (2019), which underlined that teachers' continuous learning is necessary for improving their digital skills in the education 4.0 era and significantly impacts students' learning process. Furthermore, Billiot (2023) highlighted that teachers must acquire and apply new knowledge, develop new attitudes, and change learning behavior to help the school undergo endless changes shaped by technological advancements by continuously learning about the advent of technology today to engage students in today's educational landscape.

Teaching is a Vocation

As the interview continued, the participants accentuated that teaching is not just conveying knowledge but a commitment to assist students in capitalizing on learning experiences to drive them toward their goals. It is essential to be internalized by the teachers that they are the molders of tomorrow's future, the students. With this idea, teachers also strive to deliver instruction with passion and dedication to the students, which could cultivate their potential to strive more for learning and succeed in time. With this, teachers consider difficulties as their inspiration to improve themselves professionally and personally, emphasizing the importance of learning from experiences for personal growth. Based on the study's results, teachers considered teaching a vocation driven by passion and dedication to education. This implies that teachers mold students by carrying out instruction with passion and dedication while looking at the challenges as a motivation to grow and continually improve from learning experiences. The challenges brought about by Education 4.0 due to rapidly increasing technological tools motivate teachers to persevere in maximizing their knowledge and staying attuned to technology. This result confirms the findings of Alfalah (2018) that dedication is essential in making the learning process more engaging and motivating for students. In the same way, Daskan (2023) pointed out that passionate teacher possesses enthusiasm, desire, effort, dedication, and commitment to deliver compelling learning experiences for the students despite the challenges of the emergence of technologies, which are significant contributors to the success of education.

Accountability to Students

The participants emphasized the realization of the responsibilities of teachers bearing accountability to their students. Teachers shed light on providing a solid educational foundation for students, especially in this era of Education 4.0. Teachers must prepare students to be effectively adept with the technological world and the emergence of digital applications to actively and responsibly engage in these platforms. This would promote the development of their ability to apply current educational trends to effective learning. Thus, it is a significant responsibility for teachers to help students navigate in the era of Education 4.0. This emphasized the substantial roles of teachers in providing strong educational groundwork for the student's future by nurturing digital citizenship and integrating the modern educational trends in Education 4.0 for their growth and development. The finding corroborates with the statement of Thibaut et al. (2018) that teachers' accountability in a technology-driven society offers opportunities for students to succeed; it is then the responsibility of teachers to be equipped with technological skills to ensure that students have the necessary competencies to face a digitally information-driven education landscape in preparing them in the future. Moreover, Aslan (2021) stressed that dedicated engagement of teachers in digital literacy can provide effective learning acquisition and maximize students' preparedness for Education 4.0.

3.7 Role of the Experiences in Shaping the Attitudes of the Participants

In the interview (see Table 7), the roles of experiences in shaping the participants' attitude generated three essential themes from their statements: manifesting resiliency, keeping a spirit of positivity, and embodying appropriate values.

Table 7. Role of the experiences in shaping the attitude of the participants

Essential Themes	Core Ideas
Manifestation of Resiliency	Willingness to accept latest trends in education.
	Enthusiasm in handling challenges due to advancement in Education 4.0.
	Becoming innovative in teaching approaches.
	Strong determination to learn, accept and adapt new landscape of education.
	Embracing the challenges at work.
Keeping a Spirit of Positivity	Always searching for solutions when unexpected scenarios come.
	Building self-confidence in the midst of being unskilled about Education 4.0.
	Emphasizing self-reflect to continue self-learning.
	Practicing a not settling for less character.
Embodiment of Appropriate Values	Emanating patience and perseverance.
	Striving more to perform effectively being a responsible educator.
	Demonstration of humility especially when collaborating with colleagues and stakeholders for assistance and guidance.

Manifestation of Resiliency

The manifestation of participants unveiled the idea of their resilience in the era of Education 4.0. This shows that teachers are willing to embrace modern trends in the new education landscape, particularly in technology. The need for teachers to be determined and passionate in dealing with the challenges brought about by the advancement in Education 4.0 is essential in elevating teachers' interest in exploring new digital tools available for teaching-learning. The determination to adjust to situations leads to innovative teaching methods by learning, accepting, and adapting to the new landscapes of education. This can be an excellent pathway for enhancing teachers' capabilities and accepting the challenges of today's educational trends. This finding underscores that resiliency plays a critical role in Education 4.0 competency determination of teachers. More so, embracing the challenges of Education 4.0 is necessary to develop the necessary skills to face the advent of technology today. This finding affirms the study of Borah (2021), who stressed the essence of teachers' resiliency in enhancing the necessary skills in technology-based instruction geared toward adapting to the Education 4.0 landscape. Moreover, Subedi and Subedi (2020) reiterated that teachers' resiliency amidst the emergence of technological developments is about how someone can successfully adapt to the changing environment.

Keeping a Spirit of Positivity

The participants revealed that keeping a spirit of positivity is vital in improving their Education 4.0 competency determination. They underlined that teachers feel encouraged to explore and search for solutions when unexpected scenarios come despite their limited skills in Education 4.0; this optimistic viewpoint benefits teachers in evolving their skills in several technological applications. Thus, internalizing the importance of self-learning

and not settling for less character can significantly develop teachers' positive attitudes toward acquiring new skills related to Education 4.0. The results of this study manifested the spirit of positivity to self-reflect and continuously learn things to build self-confidence in overcoming the challenges of Education 4.0 despite having little knowledge about it. This shows that teachers must be good problem solvers in searching for solutions to develop their skills by not just settling for less but continuing to explore the advent of technology to enhance their Education 4.0 Competency Determination. These findings aligned with the study of Vongkulluksn et al. (2018), which highlighted that a positive attitude toward Education 4.0 coupled with good problem-solving skills, the teachers are most likely to manifest better outcomes despite limited knowledge. Further, Lu et al. (2024) asserted that teachers with a high degree of optimism, resilience, and emotional regulation are more likely to have a better attitude toward embracing technology-enhanced teaching.

Embodiment of Appropriate Values

When asked about embodying appropriate values, the participants highlighted exhibiting patience and perseverance to gain the necessary skills in Education 4.0. They also emphasized the importance of fostering ethical values, particularly in collaborating with colleagues and other experts to seek guidance toward acquiring the digital skills necessary to become an effective teacher in the recent educational landscape and making a greater effort to perform effectively as responsible educators foster good values that teachers should possess. This finding proved that part of the Education 4.0 Competency Determination of the teachers is the ability to demonstrate ideal values, which implies that teachers should be responsible enough to strive to perform effectively and embody the core values of patience and perseverance. The teachers should collaborate with their colleagues to seek their support and guidance with humility to ensure a positive and effective working environment. Parallel with this finding, Miranda et al. (2019) magnified the ideal values of collaborating with others that plays a crucial role in surmounting the challenges associated with Education 4.0. The result supports the study of McCulloch et al. (2018), which revealed the core values of perseverance when teachers strive to use technology effectively.

3.8 Role of the Experiences in Shaping the Commitments of the Participants

The role of experiences in shaping the participants' commitments generated two themes from their narratives (see Table 8): vision for knowledgeable students and manifesting passion for teaching.

Table 8. Role of the experiences in shaping the commitments of the participants

Essential Themes	Core Ideas
Vision for Knowledgeable Students	Providing the students with the needed competencies of the new trends in education. Developing students for life-long learning. Improving the desirable skills or potentials of the students aligned with the Education 4.0. Realizing that students deserve to receive quality education from teachers. Strengthening teacher-student engagement through the utilization of student-centered teaching approaches.
Manifestation of Passion for Teaching	Being a dedicated educator to practice the technological advancement of Education 4.0 for the development of students. Having the necessity as teachers to be equipped with the skills, expertise, and competencies aligned with Education 4.0 for the benefit of students especially. Becoming technologically skillful and competent to become an effective teacher. Keeping a mission to teach students appropriately despite difficulties Undergoing ICT upskilling to share one's knowledge and expertise to others.

Vision for Knowledgeable Students

The participants revealed the idea of a vision for knowledgeable students. Students have to be provided with the skills needed for this new era of education. In developing students with life-long learning, teachers strive to impart knowledge focusing on enhancing the desirable skills or potentials of the students, which can be directly aligned with the necessary skills needed in Education 4.0. This is an essential aspect of producing a well-rounded student. When the teacher is committed to realizing that students deserve to receive quality education, it could strengthen the learning engagement through the student-centered teaching approach essential for developing a knowledgeable and skillful student. This suggests that teachers should prepare students with the necessary knowledge aligned with the new trends of Education 4.0, which supplements their skills and potential in digital technology tools, nurturing lifelong learning by providing a quality education that reinforces engagement through the student-centered teaching approach. The contribution of these findings to the study of Kumar et al. (2019) informs teachers that equipping students with desirable knowledge in digital technology tools facilitates effective

learning acquisition, enabling students to be knowledgeable enough to cope with Education 4.0. Moreover, Vongkulluksn et al. (2018) emphasized that the commitment of teachers to acquiring technical skills in the emergence of technologies is an essential factor in understanding the use of technology in the classroom, their vision of how technologies can be utilized for effective classroom instruction helps maximize their resources to immerse students in a technology-driven instruction that promote lifelong learning.

Manifestation of Passion for Teaching

The teachers' dedication to optimizing the development of the students is necessary. Students are motivated by demonstrating enthusiasm and welcoming new ideas in Education 4.0. Upskilling activities and sharing one's expertise can provide competitive skills and expertise aligned with Education 4.0 among teachers to benefit their students, essential in manifesting passion for teaching. More so, becoming technologically skillful teachers who are competent in utilizing technology could help students succeed by providing effective learning experiences despite difficulties encountered in implementing Education 4.0. This implies that staying equipped with the relevant knowledge, skills, and expertise through ongoing ICT upskilling can foster the commitment to effective teaching for the benefit of students. Moreover, the result confirms the study of Mannila et al. (2018), who highlighted that more than just training, the teachers must be passionate enough to actively participate in the learning process of technology, particularly in knowing what is relevant and how to incorporate digital skills into classroom instruction effectively. Likewise, ElSayary (2023) magnified that the development of teachers' digital competence is greatly influenced by the upskilling training program, which directly enhances the knowledge and skills of the teachers to acquire positive attitudes toward utilizing technology in the classroom.

3.9 Joint Display of the Salient Qualitative and Quantitative Findings

The salient points of the quantitative and qualitative strands of the research study focusing on technological leadership behavior, technological formation, and Education 4.0 competency determination of educators in Region XII has four major parts (see Table 9): shown in the first column the aspect of focal point, the second column pertains to the quantitative findings, the third column refers to the qualitative findings, and the fourth column pertains to the quantitative and qualitative findings nature of integration. In connection, the two data sets were compared for similarities and differences and integrated to draw a complete result related to converging ideas generated from the two strands. As Fetters et al. (2013) emphasize, merging two databases for analysis involves integrating data collection and analysis at multiple points. Integration at the interpretation and reporting level involves narrative, data transformation, and joint display, with the fit of integration determining the coherence of qualitative and quantitative findings. To see if the quantitative data corroborates with the qualitative data, the two data sets are compared; thus, similarities were found, making the nature of integration merging-converging.

Table 9. Joint display of the salient qualitative and quantitative findings

Aspect or Focal Point	Quantitative Findings	Qualitative Findings	Nature of Integration
Technological Leadership Behavior	Table 1 on technological leadership behavior, under indicator motivation, the item motivating to use technology at school, is rated High, M= 4.00, SD=.737	Table 5 on Lived Experiences, has core ideas, doing lots of readings and research about Education 4.0 and motivated me for its employment to the teaching and learning processes, with theme, becoming a proactive teacher.	**Merging-Converging**
	Table 1 on technological leadership behavior, under indicator, orientation, on item, enabling to apply technology successfully to the teaching process at school, is rated High, M= 4.10, SD= .744	Table 5 on Lived Experiences, has core ideas, utilizing innovative and interactive tools for an enriched classroom teaching, has a theme, becoming a proactive teacher	**Merging-Converging**
	Table 1 on technological leadership behavior, under indicator, precaution, on item, ensuring that the information technology tools needed at school are ready for use, is rated High, M= 3.67, SD= .820	Table 5 on Lived Experiences, has a theme, engaging in ICT upskilling and technology capacity building activities, has core ideas, having school heads ensuring the availability of necessary technological resources no matter how mean are they in quantity.	**Merging-Converging**
	Table 1 on technological leadership behavior, under indicator, support, on item, leading the use of computers in accordance with ethical values at school, is rated High, M= 3.83, SD= .883	Table 5 on Lived Experiences, has a theme, engaging in ICT upskilling and technology capacity building activities, has core ideas, collaborating with experts and other stakeholders for guidance related to ICT and other technological fields.	**Merging-Converging**
Technological Formation	Table 2 on technological formation, under indicator, content development, on item, preparing creative lesson content with mobile devices, is rated High, M=3.49, SD= .868	Table 5 on Lived Experiences, has a theme, becoming a proactive teacher, has core ideas, taking initiatives to self-learn about technology and its application in instruction as well as appropriate teaching strategies.	**Merging-Converging**
	Table 2 on technological formation, under indicator, interactive object development, on item, enriching lesson content by using electronic circuit, is rated Low, M= 2.59, SD= 1.079	Table 5 on Lived Experiences, has a theme, facing limitations in the pedagogical and conceptual competencies related to Education 4.0, has core ideas, having insufficient knowledge about some areas of Education 4.0 although computer literate.	**Merging-Converging**

	Table 2 on technological formation, under indicator, problem solving, on item, thinking will attain more successful results because of working in a group, in a cooperative learning, is rated High, M= 3.59, SD= .795	Table 5 on Lived Experiences, has a theme, becoming a proactive teacher, has core ideas, collaborating with experts and other stakeholders for guidance related to ICT and other technological fields.	**Merging-Converging**
	Table 2 on technological formation, under indicator, creativity, on item, liking fair and realist people, is rated Very High, M= 4.20, SD= .720	Table 7 on Role of Experiences, has a theme, embodying appropriate values, has core ideas, demonstrating humility especially when collaborating with colleagues and stakeholders for assistance and guidance	**Merging-Converging**
Educ 4.0 Competency Determination	Table 3 on Educ 4.0 competency determination, under indicator, mastery of digital technology, on item, knowing about mobile technologies, is rated Moderate, M= 3.11, SD= .1.01	Table 5 on Lived Experiences, has a theme, becoming a proactive teacher, has core ideas, doing lots of readings and research about Education 4.0 and motivated for its employment to the teaching and learning processes.	**Merging-Converging**
	Table 3 on Educ 4.0 competency determination under indicator, information management, on item, paying attention to ethical principles when using ICT is rated High, M= 3.59, SD= .881	Table 7 on Role of Experiences, has a theme, embodying appropriate values, has core ideas, demonstrating humility especially when collaborating with colleagues and stakeholders for assistance and guidance.	**Merging-Converging**
	Table 3 on Education 4.0 competency determination, under indicator, active participation in the process, on item, knowing from whom to get help when faced with difficulties in the learning process, is rated High, M= 3.79, SD= .751	Table 5 on Lived Experiences, has a theme, becoming a proactive teacher, has core ideas, collaborating with experts and other stakeholders for guidance related to ICT and other technological fields	**Merging-Converging**
Influence of Technological Leadership Behavior and Technological Formation on Education 4.0 Competency Determination	The standardized coefficients and p-values indicate that Technological Leadership Behavior and Technological Formation significantly influenced Educ 4.0 Competency Determination (R-squared=.492, p<.05	Strengthened technological leadership behavior and technological formation would contribute to the enhancement in Education 4.0 competency determination of educators.	**Merging-Converging**

Merging-Converging. The salient findings across quantitative and qualitative data in the aspect of technological leadership behavior is under the motivation indicator, which includes the item of motivating to use technology at school, supporting the theme of becoming a proactive teacher with a core idea of doing lots of readings and research about Education 4.0 and motivated for its employment to the teaching and learning processes. The results of the two data sets are converging since they point out the idea of motivation among the teachers. This implies that teachers' proactive engagement and motivation with new educational trends are key to effectively utilizing technology in teaching and learning. Himmetoglu et al. (2020) mentioned that in the teaching of Education 4.0, teachers' motivation to remain committed to integrating various technological applications effectively in the teaching and learning process is needed to make it more appealing to the learners. The school heads' empowerment to adapt to the innovative trends in the teaching and learning process is essential (Soraya et al., 2019). Added on, on the focal point of technological leadership behavior under the indicator orientation, the quantitative data, which talks about the idea of enabling the application of technology successfully to the teaching process at school when seen through the lens of qualitative data, converges directly on the idea about utilizing technology and interactive tools for an enriched classroom teaching. These two data sets, when merged, resulted in a merging-converging nature. The converging results of the two data sets are evident in quantitative and qualitative data, highlighting the idea of applying innovative technology for better classroom teaching and learning processes and outcomes. Qureshi et al. (2021) underscore that the ability of teachers to utilize digital and interactive technologies in classroom instruction as part of Education 4.0 brings massive changes to the educational process that strengthen the value of educational growth and the development of high-tech skills in improving the classroom learning process.

Moreover, the nature of the integration of the focal point technological leadership behavior under the indicator precaution is merging-converging. By merging, the quantitative data, which focuses on the idea of ensuring that the information technology tools needed at school are ready for use, which is done using a survey questionnaire, converges directly with the qualitative data about the idea of having school heads ensuring the availability of necessary technological resources no matter how mean are they in quantity which is done through an interview. The results of the two data sets converge because they highlighted the idea of ensuring the availability of technology tools at school. This means that regardless of limited resources, school heads must ensure the availability of technological means for teachers to receive the necessary upskilling activities in ICT, enabling them to develop their digital proficiency. The contribution of this finding to the study of Alemdag et al. (2020) informs school heads that providing teachers with necessary technology materials despite its limited resources contributes to the enhancement of digital proficiency among teachers in utilizing technologies. Likewise, on the indicator support, the nature of integration is merging-converging. In particular, the quantitative data, which talks about leading the use of computers by ethical values at school, when seen through the lens of qualitative data by

merging, directly converges with the idea that talks about collaborating with experts and other stakeholders for guidance related to ICT and other technological fields. The results of the two data sets are converging since they emphasize promoting the ethical and responsible use of technology at school among teachers. This implies that school heads should promote the ethical use of computers while supporting upskilling and capacity-building by collaborating with experts to ensure that teachers receive proper guidance on the use of ICT. As Hatlevik and Hatlevik (2018) emphasized, the school heads' support for collegial collaboration among teachers contributes to effectively utilizing ICT tools in their classroom instruction while promoting ethical and responsible use of technology.

Furthermore, for the focal point technological formation under the indicator content development, the quantitative data that points out the idea of preparing creative lesson content with mobile devices; when merged with the qualitative data, it directly converges with the idea of taking initiatives to self-learn about technology and its application in instruction as well as appropriate teaching strategies, thus, the nature of integration is merging-converging. The converging result of the two data sets is that they emphasized the same idea about using technological tools to enhance classroom instruction and the learning process. This suggests teachers should be more committed to continuous learning to adapt to new skills and effectively utilize technology to create innovative lesson content. This finding supports the study of Goh and Abdul-Wahab (2020), which emphasized that in facing the intricacy of Education 4.0 in utilizing new technologies today, teachers should be committed to developing their skills in adapting several technologies to the teaching-learning process. More so, as an indicator of interactive object development, the nature of integration is merging-converging. By virtue of merging, the quantitative data that talks about the idea of enriching lesson content by using electronics directly converge with the qualitative data, which points out the idea of having insufficient knowledge about some areas of Education 4.0 although computer literate. Thus, the two data sets are converging since they highlighted the idea of teachers' engagement in technology education while recognizing the gaps in their skills on advanced technology tools and concepts. This implies that despite the literacy on the use of computers, teachers must develop their pedagogical and conceptual skills related to Education 4.0, particularly in areas where advanced technologies like electronic circuits are being used to enrich lesson content. This finding corroborates the study of Ismail et al. (2020), who stated that teachers in the era of Education 4.0 must overcome the drawbacks of pedagogical skills and conceptual understanding in confronting the impact of technological advancement in the teaching and learning process due to the rapid progress of technologies in the Era of Education 4.0.

In addition, the indicator of problem-solving, when the quantitative data that pertains to thinking will attain more successful results because of working in a group, in cooperative learning when seen through the lens of qualitative data by process of merging, it directly converges with the idea of collaborating with experts and other stakeholders for guidance related to ICT and other technological fields. Thus, by virtue of integration, it resulted in merging-converging. The converging result of the two data sets revealed the same idea of teacher collaboration. This means that teachers must have a proactive teaching strategy, collaborate with experts, and seek guidance in effectively integrating ICT and other technological fields to achieve more successful learning outcomes. This finding aligns with the study by Tondeur et al. (2019), which emphasized that learning from other experts and peer collaboration are productive strategies for proactive teaching, in which the teachers have to obtain more knowledge and skills by seeking guidance from experts for the effective integration of ICT and other fields of technology, particularly in applying and integrating into a classroom teaching instruction to make it more effective. In connection, the quantitative data that points out liking fair and realistic people, when merged with qualitative data, directly converges on demonstrating humility, especially when collaborating with colleagues and stakeholders for assistance and guidance under the indicator of creativity. When combined by virtue of integration, the two data sets resulted in merging-converging. The converging result of the two data sets is due to the reason that they shed light on the same idea about the role of fairness and humility when collaborating with others. This implies that beyond technical skills, part of the Education 4.0 competency determination of teachers is their ability to demonstrate ingenuity, particularly in valuing fair and realistic individuals by showing humility, respectfulness, and inclusive environment when collaborating with colleagues and stakeholders in seeking assistance and guidance. The findings align with the study by Kettler et al. (2018), which informs individuals that beyond technological proficiency in Education 4.0, the interpersonal skills of teachers are essential for those with realistic and unbiased views who are confident in most of their decisions; these values are embodied in individuals who can work collaboratively and innovatively valuing humility and respect when seeking the experts' guidance.

In the same way, for the focal point of Education 4.0 competency determination under the indicator of mastery of digital technology, the nature of integration is merging-converging. When the qualitative data points out the idea of knowing about technology and is seen through the lens of qualitative data by merging, it converges with the idea of doing lots of readings and research about Education 4.0 and motivated for its employment to the teaching and learning process. The result is converging since the two data sets pointed out the same idea about exploring mobile technology applications in enhancing classroom instruction. These findings suggest that teachers should be committed to mastering their skills in digital technologies through continuous learning and exploration of new technologies in Education 4.0, particularly mobile technologies. Widana (2020) made a point that in today's technological progress, teachers must be committed to immersing themselves and exploring new technologies to master digital technology skills, particularly in the use of mobile technologies in teaching, which are essential aspects of Education 4.0. Adding on, the indicator of information management is that the nature of integration is merging-converging. In particular, the quantitative data about paying attention to ethical principles when using ICT converges directly with the statement, which points out the idea of demonstrating humility, especially when collaborating with colleagues and stakeholders for assistance and guidance. This makes the results of the two data sets converge since they emphasize ethical and professional behavior when collaborating. This means that teachers must go beyond the technical skills to comprise the ethical principles and collaborative dimension of information management, emphasizing the critical role of humility and appropriate values when utilizing ICT, mainly when collaborating with colleagues and stakeholders to seek assistance and guidance. The result confirms the statement of Ing et al. (2019) that teachers should acknowledge the value of collaborative relationships, which demonstrate humility while recognizing the critical role of continuous improvement when working with colleagues; this is vital in establishing a positive and supportive collaboration among other field experts.

Subsequently, the nature of the integration of the active participation in the process indicator is merging-converging. Notably, by merging, the quantitative data that talks about knowing from whom to get help when faced with difficulties in the learning process when seen through the lens of qualitative data converges directly with the data that pertains to collaborating with experts and other stakeholders for guidance related to ICT and other technological fields. These two data sets are converging since they magnified the importance of collaboration among teachers, particularly when seeking experts' guidance. The findings emphasize that teachers must be proactive collaborators and learners in participating in the learning process of ICT, particularly in seeking help when challenges come their way. This finding is parallel with the study of Nguyen and Ng (2022), which highlighted that in overcoming the challenges of Education 4.0, social reinforcement and commitment to learning improvement, such as peer collaboration and seeking assistance from experts in the use of ICT, are essential for teachers to enhance their understanding of the effective use of technologies in the teaching-learning process.

Finally, the salient quantitative and qualitative findings support the idea that strengthened technological leadership behavior, and technological formation would contribute to the enhancement of Education 4.0 competency determination of educators. In the aspect of the influence of technological leadership behavior and technological formation on Education 4.0 competency determination, the salient quantitative and qualitative finding is that technological leadership behavior and technological formation are significant predictors of Education 4.0 competency determination. This indicates that positive technological leadership behavior and technological formation of educators in Region XII contribute to the determination of Education 4.0 competency. It promotes collaboration, accountability for continuous learning, appropriate values, and support. The strong support of school heads in utilizing technology at school and teachers' technological inclination to handle new technological tools would then influence the determination of teachers' Education 4.0 competency. Similarly, the finding supports the study by Oberer and Erkollar (2018) that pointed out that the development of competence in Education 4.0 is significantly influenced by the leadership behavior of school heads, which plays a critical role in maximizing the ability of teachers to utilize technological tools in developing technological formation which can also be a contributory factor for the enhancement of Education 4.0 competency of the teachers. In fact, management and policy decision-making in industry revolution 4.0 trends (Ramírez-Montoya et al., 2021) and the technological skills of school administrators to remain abreast of educational trends significantly influenced the increase in teachers' competence in Education 4.0 (Kadiyono et al., 2020).

4.0 Conclusion

The status of technological leadership behavior was rated high, which shows that school heads support the use of technology in school, particularly motivating teachers to utilize technology and enabling them to apply it effectively by providing the facilities and necessary tools. Likewise, the technological formation of teachers was rated high, indicating that teachers can handle the advent of technology today and have acquired the necessary technical skills. However, teachers are confronted by the emergence of robotics and electronics, making them less competent in this area. More so, teachers' Education 4.0 competency determination status was rated high, indicating that ethical principles in using technology are observed among teachers. However, teachers still need more training in knowledge and background in programming and writing codes. Moreover, the technological leadership behavior and technological formation significantly influenced the Education 4.0 competency determination of educators in Region XII. The positive leadership behavior of the school principal on the use of technology and the formation of technological skills of the teachers provide an opportunity to gain mastery of the technology, increase information management, and inspire teachers to collaborate and participate actively in the learning process of improving their Education 4.0 competency determination.

In the same way, facing limitations in the pedagogical and conceptual competencies related to Education 4.0, encountering inadequacy of resources, engaging in ICT upskilling and technology capacity-building activities, and becoming a proactive teacher were the themes generated in the participants' lived experiences regarding Education 4.0 competency determination. In connection, the role of lived experiences of the educators shaped their beliefs, attitudes, and commitments toward Education 4.0 competency determination. They believed that learning is a continuous process, teaching is a vocation, and bearing accountability to students. Likewise, the participants have shaped attitudes on manifesting resiliency, keeping a spirit of positivity, and embodying appropriate values. Added on, participants have shaped their commitments to visioning for knowledgeable students and manifesting passion for teaching, leading to corroborated findings by data integration between the quantitative and qualitative data, which resulted in merging-converging.

5.0 Contributions of Authors

The principal author contributes to the study's writing, encoding, and implementation. The co-author edits, supervises, and analyzes the data.

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7.0 Conflict of Interests

The authors declare that there is no conflict of interest concerning the publication of this paper.

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Entrepreneurial Resiliency: Assessment of Entrepreneurs of Catarman, Northern Samar, Philippines

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Abstract. Entrepreneurial resilience is vital for sustaining enterprises, particularly in rural areas where economic instability and natural disasters are prevalent. In the Philippines, where micro, small, and medium enterprises (MSMEs) significantly contribute to economic development, understanding the factors influencing resilience remains underexplored. This study examines entrepreneurial resilience among 111 entrepreneurs in Catarman, Northern Samar, using a descriptive-correlational methodology and quantitative analysis. Data were collected through structured interviews and validated questionnaires. The findings reveal that entrepreneurs possess strong skills in opportunity recognition, creativity, problem-solving, product development, and networking, significantly enhancing resilience. However, limited government support emerged as a key challenge, with no significant relationship found between structural or environmental factors and entrepreneurial resilience. These results highlight the importance of individual entrepreneurial skills in fostering resilience while calling for increased governmental assistance to support rural entrepreneurs. This research addresses a critical gap by focusing on entrepreneurial resilience in a rural context, offering insights for policymakers and stakeholders to develop targeted interventions. By strengthening entrepreneurial skills and improving support systems, the sustainability of MSMEs in economically and environmentally vulnerable regions can be enhanced.

Keywords: Entrepreneurial resilience; Entrepreneurial skills; Environmental factors; Structural factors.

1.0 Introduction

Micro, small, and medium enterprises (MSMEs) are critical to the Philippine economy, accounting for 99% of registered businesses, and vital to job creation and economic growth (Department of Trade and Industry, 2020). However, the sustainability of these enterprises is often threatened by various challenges, including economic fluctuations, natural disasters, and limited access to resources. Provincial areas like Catarman, Northern Samar face unique adversities such as frequent typhoons and the recent COVID-19 pandemic, making the study of entrepreneurial resilience essential (Mendoza, 2015; Duchek, 2018). Entrepreneurship plays a crucial role in driving economic growth and fostering innovation. Entrepreneurs create jobs, stimulate technological advancements, and contribute to overall societal progress. However, entrepreneurship is fraught with challenges, and overcoming these challenges is often the defining factor between success and failure.

Resilience—the ability to persist through adversity, recover from setbacks, and maintain a positive outlook—is central to the entrepreneurial journey (Linnenluecke, 2017). Resilience is not a fixed trait but a dynamic quality that can be developed and strengthened through experience, training, and organizational support (Kaiser et al.,

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2020). Entrepreneurial resilience, the capacity to adapt, recover, and thrive amidst challenges, is a crucial characteristic for entrepreneurs who aim to navigate hardships (Tredgold, 2018). Resilient entrepreneurs cannot only bounce back from failures but also capitalize on new opportunities, thereby ensuring the continuity and growth of their businesses (Garrett, n.d.; Bullough, 2013).

Research on entrepreneurial resiliency has identified several key factors contributing to this capacity. Blatt (2009) emphasizes the role of communal schemas and contracting practices in fostering resilience in entrepreneurial teams. Garrett (n.d.) expands on this, defining entrepreneurial resilience as a set of capabilities, a process, and an outcome and linking it to a greater likelihood of venture survival. Duchek (2018) further explores the concept, identifying situational and process-related factors such as parents' behavior and experience, entrepreneurial learning and experience, and work attitudes and behaviors as influential in developing entrepreneurial resilience. These studies collectively highlight the importance of individual and team-level factors in building and maintaining resiliency in the entrepreneurial context.

Opportunity recognition and creativity are vital aspects of entrepreneurship. Hulbert (2015) and Dinh (2021) highlight the role of entrepreneurial skills, self-efficacy, and imaginativeness in identifying opportunities, while Ardichvili (2000) emphasizes entrepreneurial awareness, social networks, and market knowledge. Patzelt (2011) extends this to sustainable development opportunities, focusing on environmental knowledge and altruism. Creativity, essential for recognizing opportunities and driving innovation, can be cultivated through education (Byrge, 2018; Gundry, 2014). It is closely linked to problem-solving, a key skill for overcoming entrepreneurial challenges and achieving success (Mallick, 2013; Panchanatham, 1999).

Several factors have been identified to influence entrepreneurial resilience, including entrepreneurial skills, organizational structures, and external environmental conditions. Entrepreneurial skills such as decision-making, problem-solving, and emotional regulation are key elements that enable entrepreneurs to overcome setbacks and remain motivated in the face of challenges (Vanevenhoven & Liguori, 2019). Structural factors, such as the quality of leadership, organizational culture, and access to resources, also significantly affect an entrepreneur's resilience. A supportive organizational environment can provide entrepreneurs the resources and guidance necessary to navigate adversity (Chadwick et al., 2021). Environmental factors, such as economic stability, market trends, and access to professional networks, further shape the resilience of entrepreneurs, either enhancing or hindering their ability to bounce back from failures (Ayala & Manzano, 2014).

The rural context of Catarman presents specific challenges, including infrastructural limitations and a perceived lack of government support, which respondents have highlighted in prior studies (Penker, 2019). Despite these challenges, many local entrepreneurs have demonstrated impressive persistence, contributing significantly to the local economy. This study explores the factors influencing entrepreneurial resilience, particularly the skills and traits that empower entrepreneurs to succeed despite adversities. The literature emphasizes that skills such as opportunity recognition, creativity, and problem-solving are essential for enhancing resilience (Hulbert, 2015; Mallick, 2013).

This study aims to investigate the factors contributing to entrepreneurial resilience by focusing on entrepreneurial skills, organizational structural factors, and environmental conditions. This study is significant not only for the entrepreneurs of Catarman but also for the broader economic landscape of the Philippines. Determining the pathways to resilience aims to enhance the sustainability of MSMEs and contribute to the region's overall economic development, ultimately supporting the assertion that resilience is a vital trait for entrepreneurial success (Tredgold, 2018). It has been observed that several entrepreneurs in Catarman, Northern Samar, enjoy ample share of the market and have shown no signs of slowing down despite adversities. On the other hand, several businesses in Catarman had already faced bankruptcy, and owners of the latter opted not to venture into business again. Knowing the lessons, values, and practices regarding an Entrepreneur's resiliency is therefore valuable for both existing and aspiring entrepreneurs, thus the conduct of this study. Furthermore, the findings from this research can provide policymakers and local government units (LGUs) with key insights into the specific needs and challenges faced by entrepreneurs in rural areas. By understanding the factors contributing to entrepreneurial resilience, targeted support mechanisms and policies can be developed to foster a more enabling environment for MSMEs (Blatt, 2009; Darling, 2007).

2.0 Methodology

2.1 Research Design

This study employed a descriptive correlational research design, which is appropriate for identifying and examining the relationships between different variables without manipulating them. The primary objective was to explore how various factors—namely Entrepreneurial Skills, Structural Factors, and Environmental Factors—correlate with Entrepreneurial Resilience among the respondents. By utilizing a quantitative approach, the research sought to provide statistical insights into these relationships, thereby enhancing the understanding of entrepreneurial dynamics in Catarman.

2.2 Research Locale

The study was conducted in Catarman, Northern Samar, a first-class municipality in the Philippines characterized by its unique entrepreneurial landscape. In Eastern Visayas, Catarman is exposed to various challenges, including natural disasters like typhoons, due to its positioning along the Pacific Ring of Fire. This context provides an essential backdrop for understanding the resilience of local entrepreneurs amidst adversities. The research locale is a hub for micro, small, and medium enterprises (MSMEs) and a community where entrepreneurship is crucial for economic sustenance.

2.3 Research Participants

The sample population consisted of 111 registered MSME entrepreneurs in Catarman. To ensure a representative sample, the study adopted a purposive sampling technique to select participants from a pool of entrepreneurs who have been in business for at least three years. This criterion ensures that the participants have enough experience to provide valuable insights into the factors influencing their resilience. The demographic diversity among the respondents regarding business type, ownership structure, and years of operation provided a comprehensive understanding of entrepreneurial resilience in the region.

2.4 Research Instrument

The primary data collection instrument was a structured questionnaire specifically designed to measure various constructs related to entrepreneurial skills, structural factors, environmental factors, and entrepreneurial resilience. To ensure the instrument's reliability, a Cronbach's alpha test was conducted, resulting in an exceptional reliability coefficient of .99. This high rating confirms the instrument's consistency and reliability in measuring the intended variables, thereby strengthening the validity of the research findings. The questionnaire included sections that assessed skills such as opportunity recognition, problem-solving, creativity, leadership, and networking, along with questions addressing structural factors (e.g., years of operation, business type, number of employees) and environmental factors (e.g., government support, social values).

2.5 Data Gathering Procedure

Data collection involved the distribution of patterned questionnaires, which enabled systematic quantitative data collection. Hierarchical Regression analysis was used to measure the effect of the factors on the entrepreneur's resilience. In contrast, frequencies and percentages were used for descriptive data such as years of operation, ownership, type of business, number of employees and business size, and weighted mean for entrepreneurial skills and environmental factors. Hierarchical regression analysis has been widely used in recent studies to assess the relationships between multiple predictor variables and an outcome variable such as resilience. This statistical method helps identify the relative contributions of each predictor, allowing for a more nuanced understanding of the factors that influence entrepreneurial outcomes (Sharma et al., 2020). By evaluating the incremental impact of each set of predictors, hierarchical regression provides valuable insights into the most significant drivers of entrepreneurial resilience. The study tested the following hypotheses: a) entrepreneurial skills positively impact the level of resilience in entrepreneurs, b) structural factors within an organization contribute significantly to entrepreneurial resilience, and c) environmental factors play a key role in shaping entrepreneurial resilience.

2.6 Ethical Considerations

Ethical considerations in research, particularly in studying entrepreneurial resiliency among rural entrepreneurs, were ensured for the integrity and credibility of the findings. Researchers prioritized informed consent, ensuring participants fully understand the study's purpose, procedures, and potential impacts on their businesses and

communities. Confidentiality was ensured, especially regarding personal and business information, to protect the identities and data of the participants.

3.0 Results and Discussion

3.1 Entrepreneurial Skills, Structural Factors, and Environmental Factors

The results in Table 1 provide data on the entrepreneurial skills and structural and environmental factors of micro, small, and medium enterprises (MSMEs) in Catarman, Northern Samar.

Table 1. Entrepreneurial skills, structural factor, and environmental factors of MSMEs

Entrepreneurial Skills	**F**	**%**	**Mean**	**Interpretation**
Recognition of Opportunity;			3.84	Skilled
Creativity;			3.76	Skilled
Problem-solving skills;			4.05	Skilled
Leadership and communication Skills;			4.12	Skilled
Development of new products and services;			3.78	Skilled
Networking			3.76	Skilled
Weighted Mean			*3.88*	*Skilled*
Structural factors				
Years of operation			12	
3 - 6	37	33%		
7 - 10	22	20%		
11 - 14	14	13%		
15 - 18	14	13%		
19 - 22	12	11%		
23 - 26	2	2%		
27 - 30	5	4%		
31 - 34	1	0.9%		
35 - 38	1	0.9%		
39 - 42	0	0		
43 - 46	0	0		
47 - 50	3	3%		
Ownership				
Sole Proprietorship (1)	95	86%		
Partnership (2)	10	9%		
Corporation (3)	6	5%		
Type of Business				
Commerce (1)	81	73%		
Industry (2)	10	9%		
Service (3)	20	18%		
Number of Employees			3.84	
1 - 4	83	74.77%		
5 - 9	21	18.92%		
10 - 14	2	1.80%		
15 - 21	4	3.60%		
22 - 25	1	0.90%		
Size of Business				
Micro Enterprise (1)	107	96%		
Small Enterprise (2)	4	4%		
Medium Enterprise (3)	-	-		
Large (4)	-	-		
Environmental Factors				
Social Values			3.22	Valued
Government Support			2.69	Less Supportive
Cognitive Dimension			3.83	Knowledgeable

The data reveal a weighted average score of 3.88, indicating that entrepreneurs in the locality possess high entrepreneurial skills. This finding aligns with literature suggesting that Filipino entrepreneurs exhibit positive entrepreneurial behaviors and competencies (Philippines, APS, and NES, 2015). As to entrepreneurial skills, the breakdown of specific skills highlights those respondents who scored highest in problem-solving skills (4.05), leadership and communication skills (4.12), and the ability to adapt creatively (3.76). These areas are critical for entrepreneurial success, supporting Tredgold's (2018) assertion that resilience is bolstered by an entrepreneur's ability to navigate challenges and innovate. The ability to recognize opportunities (3.84) also underscores the proactive mindset essential in a competitive landscape, particularly in a region facing significant economic

stresses. Conversely, while entrepreneurial skills were rated highly, the perceived lack of government support (2.69) is notable. Entrepreneurs indicated feeling less supported by government initiatives, which echoes the findings of Bullough (2013), who identified the necessity for increased government engagement to foster resilience among entrepreneurs. This gap in support could hinder the potential for growth and sustainability in the region, especially considering that government assistance is often vital for MSMEs to thrive.

Regarding structural factors, years of operation and type of business revealed an average lifespan of 12 years for most enterprises. A significant portion of the respondents identified as sole proprietors (86%), indicating a trend towards micro-enterprises, which often have fewer resources and less resilience against economic shocks. The data also showed that most businesses are classified as micro-enterprises, employing an average of three employees. This finding is consistent with studies suggesting that many businesses struggle to scale beyond micro status, further indicating the importance of developing robust entrepreneurial skills to enhance resilience.

The environmental factors detailed in the results highlight the entrepreneurs' evaluation of social values (3.22) and cognitive dimensions (3.83), reflecting a positive perception of societal support and personal knowledge concerning business operations. However, the less favorable rating of government support again emphasizes a critical area for improvement. The low score for government support (2.69) suggests that while entrepreneurs recognize the importance of external assistance for fostering resilience, there is a significant disconnect between the available support and the entrepreneurs' needs. This finding is particularly relevant in the context of the Philippine economy, where government initiatives are essential for the growth and sustainability of MSMEs (Department of Trade and Industry, 2020).

Overall, the findings indicate that while entrepreneurs in Catarman exhibit strong entrepreneurial skills that contribute to their resilience, they face substantial challenges due to a lack of structural support and inadequate government engagement. The study's findings align with the existing literature, reinforcing that both opportunities and challenges characterize the entrepreneurial landscape in the Philippines. Tredgold's (2018) perspective on resilience emphasizes the need for entrepreneurs to develop robust skills to maintain their operations despite external pressures. Similarly, Bullough (2013) advocates for enhanced government support to foster an environment conducive to entrepreneurial growth.

3.2 Entrepreneurial Resiliency

Based on Table 2, entrepreneurs in Catarman perceive themselves as possessing strong resilience. It can be inferred that surviving the first three years—especially during the global pandemic and the typhoons that struck the province—was a crucial period for their businesses. Despite these challenges, these entrepreneurs managed to endure and overcome their difficulties. Furthermore, this strong sense of resilience suggests that they have the potential to enhance their business operations further, provided they receive adequate support from both the government and other support groups. They view themselves as capable of achieving their goals despite obstacles, remain undeterred by failures, and perceive themselves as exceptionally resilient individuals. This indicates that personal qualities play a vital role in their businesses' success and overcoming challenges.

Table 2. Level of entrepreneurial resiliency

Entrepreneurial Resiliency	Mean	Interpretation
I can adapt when changes occur	3.96	Strong Resiliency
I can deal with whatever comes my way	4.06	Strong Resiliency
I try to see the humorous side of problems	3.88	Strong Resiliency
coping with stress can make me stronger	4.10	Strong Resiliency
I tend to bounce back after illness, injury or other hardships	4.19	Strong Resiliency
I can achieve my goals, even if there are obstacles	4.22	Exceptional Resiliency
I stay focused under pressure	4.15	Strong Resiliency
I am not easily discouraged by failure	4.24	Exceptional Resiliency
I think of myself as a strong person	4.33	Exceptional Resiliency
I can handle unpleasant or painful feelings.	4.15	Strong Resiliency
Mean Score	**4.13**	**Strong Resiliency**

This result aligns with the broader literature that emphasizes the role of resilience in entrepreneurial success. Linnenluecke (2017) posits that resilience is essential for navigating crises and sustaining business operations, particularly in environments marked by volatility and uncertainty. Similarly, Ayala and Manzano (2014) highlight

that personal qualities such as self-efficacy, optimism, and managing stress significantly influence an entrepreneur's ability to overcome challenges. The findings from this study corroborate these insights, as the high scores on traits like "not easily discouraged by failure" (4.24) and "thinking of oneself as a strong person" (4.33) suggest that these personal attributes are instrumental in ensuring business continuity. Moreover, the findings emphasize the importance of coping mechanisms in building resilience. For instance, the ability to "bounce back after illness, injury, or other hardships" (4.19) and "handle unpleasant or painful feelings" (4.15) reflect an adaptive capacity to deal with stress. These align with Kaiser et al. (2020), who argue that resilience involves enduring hardships and leveraging such experiences to foster growth and improve business strategies. Entrepreneurs in Catarman demonstrate this ability, particularly in their capacity to maintain focus under pressure (4.15) and achieve goals despite obstacles (4.22), both of which indicate a proactive approach to overcoming adversity.

3.3 Hierarchical Regression for Level of Entrepreneur's Resiliency and its Predictor Variables

Using three models, the hierarchical regression analysis (see Table 3) examined the relationship between entrepreneurial resiliency and its predictor variables. Each model progressively added predictors—entrepreneurial skills, structural, and environmental factors—to assess their incremental impact on explaining the variability in entrepreneurial resiliency. The results highlight several critical insights into the role of these predictors.

Table 3. Hierarchical regression for the level of entrepreneur's resiliency and its predictor variables

Predictors	**Model 1**		**Model 2**		**Model 3**	
	β	*p-value*	*β*	*p-value*	*β*	*p-value*
Entrepreneurial Skills						
Recognition of Opportunity	-018	.813	.029	.719	.043	.601
Creativity	-.142	.089*	-.156	.073*	-.131	.130
Problem-Solving Skills	.190	.011**	.204	.010**	.195	.012**
Leadership & Communication Skills	.133	.106	.119	.186	.081	.368
Development of New Products & Services	.140	.058*	.143	.069*	.098	.215
Networking	.151	.026**	.153	.031**	.138	.050**
Structural Factors of the Business						
Years of Operation			.000	.966	-.001	.829
Type of Ownership			.089	.374	.130	.203
Type of Business			-.024	.699	-.057	.365
Number of Employees			.005	.761	.005	.752
Size of Business			-.243	.404	-.383	.193
Environmental Factors						
Social Values					.082	.346
Government Support					.048	.382
Cognitive Dimension					.105	.122
$\boldsymbol{R^2}$	.392	.000***	.399	.00***	.439	.00***
Adjusted $\boldsymbol{R^2}$	.356		.331		.355	
Change in $\boldsymbol{R^2}$	.392		.008	.940	.039	.094*

Model 1 focused on entrepreneurial skills as predictors of resiliency, showing an R^2 of .392, indicating that entrepreneurial skills account for 39.2% of the variance in entrepreneurial resiliency. This model was statistically significant (p = .000), affirming the strong predictive power of entrepreneurial skills on resiliency. Specifically, problem-solving skills (p = .011) and networking (p = .026) emerged as significant predictors at the 95% confidence level. These findings align with Vanevenhoven and Liguori (2019), who emphasize that problem-solving capabilities enable entrepreneurs to navigate complexities while networking provides access to resources and social support essential for overcoming challenges. Additionally, creativity (p = .089) and development of new products and services (p = .056) were significant at the 90% confidence level. This suggests that entrepreneurs who foster innovation and adaptability in their offerings are better equipped to handle adversities. However, the negative relationship between creativity and resiliency (-.142) is noteworthy and could indicate that highly creative entrepreneurs may face unique challenges, such as resource constraints or market acceptance issues, that demand further investigation.

Including structural factors like years of operation, type of ownership, business type, number of employees, and business size in Model 2 resulted in a marginal increase in R^2 to .399, accounting for an additional 0.7% of the

variance in resiliency. While the model remained statistically significant (p = .000), the Change in R^2 value of .008 (F-change=.940) suggests that structural factors had negligible impact on resiliency. These results highlight that structural attributes of businesses in Catarman may not play a significant role in influencing entrepreneurial resiliency. This contrasts with the findings by Chadwick et al. (2021), who argued that structural factors such as organizational size and resource availability are pivotal in enhancing resiliency. The discrepancy could stem from the context, as small and medium enterprises in resource-constrained regions like Catarman may rely more on individual attributes than organizational characteristics for resiliency.

Adding environmental factors like social values of entrepreneurship, government support, and cognitive dimensions of entrepreneurship—to Model 3 further increased R^2 to .439, accounting for 43.9% of the variance. This represents a Change in R^2 of .039, which was statistically significant at the 90% confidence level (p = .094). These findings suggest that while contributing modestly to resiliency, environmental factors play a supplementary role. The significance of environmental factors echoes the arguments of Ayala and Manzano (2014), who highlighted the importance of external conditions, such as societal perceptions and government interventions, in shaping entrepreneurial outcomes. However, in this study, variables like government support (p = .382) and social values of entrepreneurship (p = .346) were not individually significant. This suggests that entrepreneurs in Catarman primarily rely on intrinsic capabilities rather than external support, potentially due to the region's limited access to institutional resources or ineffective support systems.

The findings demonstrate that entrepreneurial skills are the most significant predictors of resiliency, with problem-solving skills and networking standing out as critical drivers. This aligns with Kaiser et al. (2020), who argued that personal capabilities, such as effective problem-solving and building social capital, are foundational to entrepreneurial success in volatile environments. The marginal contributions of structural and environmental factors further reinforce the importance of intrinsic qualities over external influences, particularly in resource-limited contexts. However, the role of environmental factors, though limited, cannot be overlooked. Entrepreneurs in regions with better institutional support and favorable societal values may experience enhanced resilience, as suggested by Sharma and Yadav (2020). For Catarman entrepreneurs, improving government support and fostering a culture of entrepreneurship could amplify the resilience already present due to their strong personal skills.

4.0 Conclusion

Entrepreneurs in Catarman, Northern Samar, demonstrate a strong capacity for resilience, attributed largely to their entrepreneurial skills. These skills, particularly in problem-solving, opportunity recognition, and networking, enable them to navigate through adversities such as natural disasters, competition, and the challenges posed by the COVID-19 pandemic. Despite minimal government support, these entrepreneurs continue to persevere. The findings suggest that while structural and environmental factors may not significantly influence entrepreneurial resilience, the development of core entrepreneurial skills plays a critical role. Moreover, businesses that have survived more than a decade highlight the importance of continued support and learning to foster long-term sustainability.

The following recommendations are proposed to strengthen entrepreneurial resiliency among entrepreneurs in Catarman. These initiatives aim to address the study's key findings, implement actionable strategies, and outline areas for future research. First, focusing on entrepreneurial skills development is essential, particularly in problem-solving, networking, and creativity. Training programs, workshops, and mentorship opportunities should be organized to enhance these competencies. These initiatives could be implemented over one year, with the following timeline: planning and collaboration with local government units and business organizations in the first quarter; conducting training programs and workshops from the second to fourth quarters; and evaluating program outcomes in the final month of implementation. Resource requirements include funding for program facilitators, workshop materials, and venues. Partnerships with academic institutions, non-governmental organizations, and local entrepreneurs could provide additional support and expertise.

Second, efforts to strengthen government and institutional support should be prioritized. This includes establishing streamlined processes for accessing government grants, loans, and business support services. A task force should be formed within three months to assess the specific needs of local entrepreneurs and design

interventions tailored to these requirements. Resources needed for this initiative include funding for administrative support, training of local government staff, and the development of accessible online platforms to facilitate communication between entrepreneurs and government agencies.

Third, there is a need to foster a culture of entrepreneurship by promoting its social values and encouraging collaboration among entrepreneurs. Quarterly networking events, local business expos, and knowledge-sharing sessions could be organized. These events should aim to build a stronger entrepreneurial ecosystem, enabling entrepreneurs to share best practices and form collaborative partnerships. Resources for this initiative include event organization costs, marketing, and logistical support.

For future research directions, the study's reliance on self-reported data may have introduced biases, as respondents might have misjudged their resiliency. Future research should adopt mixed methods, combining quantitative and qualitative interviews, for a more comprehensive understanding. Additionally, the sample size may not fully capture the diversity of Catarman entrepreneurs. Expanding the sample across industries and regions could enhance generalizability. Longitudinal studies could investigate the long-term effects of entrepreneurial skills on resiliency while exploring creativity's interaction with market dynamics and the role of informal support networks. Research could also assess how digitalization and technology adoption impact resiliency in resource-constrained rural areas.

5.0 Contributions of Authors

Korina P. Legaspi- conceptualization, writing, data gathering, data analysis
Tia Mare L. Ebdane- conceptualization, writing, data gathering, data analysis
Jane D. Sanoria- data gathering, data analysis, writing
Mar L. Formaran- data gathering, data analysis, writing

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7.0 Conflict of Interests

None

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Impact of Extreme Weather on Construction Projects in Koronadal City, Philippines

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Abstract. This research investigated the impact of extreme weather on construction projects in Koronadal City. This study aimed to (1) identify the specific types of extreme weather events affecting construction projects; (2) measure the perceived level of impact of extreme weather on construction project timelines, budgetary allocations, labor productivity, equipment performance, and the overall project quality; (3) identify the potential health and safety hazards that might be encountered by individuals in the construction industry; and (4) measure the perceived level of effectiveness of the existing resilience measures employed by construction projects in Koronadal City to mitigate the adverse impact of extreme weather. Data were gathered using survey questionnaires from various respondents, including engineers and construction workers. A survey involving 177 respondents identified frequent weather-related challenges, with heat waves being the most prevalent, followed by heavy rainfall and less frequent occurrences of floods, tropical cyclones, and tornadoes. The study also explored the impact of extreme weather on the health and safety of construction personnel, highlighting issues such as physical strain, heat-related illnesses, and increased risks of accidents due to adverse weather. The findings indicate significant disruptions to project timelines and financial planning, with a considerable majority reporting that extreme weather necessitates project management and budgeting adjustments. Furthermore, the study reveals the effectiveness of current resilience measures, including providing adequate hydration and regular breaks in shaded areas and utilization of adequate rest breaks, rotating tasks, and employee wellness programs. This paper underscores the urgent need for enhanced adaptive measures and more efficient risk management strategies to ensure the safety and effectiveness of construction practices in regions vulnerable to extreme weather.

Keywords: Construction projects; Extreme weather; Health hazards; Resilience measures; Safety hazards.

1.0 Introduction

The construction industry is critical for infrastructure development and economic progress but is highly vulnerable to the adverse impact of extreme weather. Its reliance on outdoor, labor-intensive activities exposes it to significant risks, exacerbated by the increasing frequency and intensity of extreme weather due to climate change. Studies consistently emphasize the detrimental impact of extreme weather on construction productivity, worker safety, financial stability, and project quality (Alshebani & Wedawatta, 2014).

Heatwaves are among the most significant challenges faced by the construction industry. Prolonged exposure to high temperatures can cause heat stress, leading to health risks and decreased productivity for workers performing physically demanding tasks outdoors (Kiefer et al., 2016). Gubernot et al. (2013) documented a global rise in heat-related injuries from 2006 to 2017, highlighting the vulnerability of construction workers to extreme

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heat. Similarly, Dunne et al. (2013) projected that environmental heat stress could reduce global labor productivity by 20% by 2050. Regionally, Al Alawi (2020) found that in Oman, extreme temperatures extend project timelines by up to 38% beyond planned schedules. Alaghbari et al. (2006) corroborated these findings, identifying heatwaves as a leading cause of construction delays. Karthick et al. (2022) further highlighted that outdoor workers face heightened risks of heat strokes, extreme fatigue, and accidents, including slips and falls, during periods of high temperatures. These findings underscore the urgent need for heat-mitigation measures in construction.

Economic implications are also significant. Schuldt et al. (2021) reported that 45% of construction projects globally are delayed by extreme weather, resulting in billions of dollars in revenue losses annually. Gandhi et al. (2014) also identified heatwaves as a critical factor affecting labor productivity, logistics, and financial planning. Their study emphasized the need for integrating weather-resilience strategies into construction planning to minimize these impacts. In the Philippines, the risks are amplified due to the country's tropical climate. Guadalupe (2018) predicted that Mindanao could experience year-long heatwaves by 2050 under worst-case scenarios. However, existing safety protocols are insufficient to mitigate these risks, leaving workers and projects highly vulnerable (Mills, 2003).

Heavy rainfall presents another formidable challenge for the construction industry. El-Rayes and Moselhi (2001) identified its profound impact on road-building projects, including erosion, sedimentation, and flooding. Pathiranage and Halwatura (2010) noted that these issues often halt operations, leading to delays and increased costs. In addition, Akomah and Jackson (2016) highlighted that heavy downpours can damage exposed structures, cause excavation collapses, and render roads impassable. In the Philippines, the frequency and severity of tropical cyclones have risen in recent decades, causing catastrophic flooding and severe disruptions in construction projects. On average, 20 tropical cyclones enter Philippine waters annually, with eight or nine making landfall (Yang, 2012). These events frequently surpass the threshold of 100 mm of rainfall in 24 hours, leading to widespread destruction and delays.

Despite the evident challenges posed by extreme weather, regulatory measures in the Philippines remain inadequate. Seposo et al. (2017) highlighted the lack of comprehensive heat-health action plans, while Gubernot et al. (2013) noted that existing regulations are too general to address the specific risks posed by extreme weather. Moreover, much of the available literature focuses on global trends or developed countries with advanced infrastructure and safety protocols. Studies such as those by Mora et al. (2017) and Zander et al. (2018) provide valuable insights but are often not directly applicable to the Philippine context due to differences in infrastructure and socio-economic conditions. This gap underscores the need for localized research that examines the unique vulnerabilities of the Philippine construction industry, particularly in smaller urban areas like Koronadal City.

Localized research is imperative to address the specific vulnerabilities of the construction sector in regions like South Cotabato, where outdoor, labor-intensive activities are highly susceptible to extreme weather. This study systematically investigated the impact of extreme weather on construction projects in Koronadal City. The objectives included identifying the prevalent types of extreme weather affecting construction activities, quantifying their perceived impact on project timelines, budgetary allocations, labor productivity, equipment performance, and overall project quality, and evaluating the health and safety hazards faced by workers. Furthermore, the research assessed the perceived effectiveness of existing resilience measures employed to mitigate these impacts.

Despite the growing body of literature on the consequences of climate change and extreme weather on construction globally, the focus predominantly remains on developed regions with advanced infrastructure and adaptive measures. Developing regions like South Cotabato remain underexplored. This study bridges the identified research gap by offering a comprehensive analysis of how extreme weather influence the construction sector in Koronadal City. The findings provide actionable recommendations to enhance safety protocols, fortify resilience strategies, and mitigate risks, thus contributing to the adaptive capacity of the local construction industry in the face of escalating climate challenges.

2.0 Methodology

2.1 Research Design

The purpose of this research is to evaluate the impact of extreme weather on construction projects in Koronadal City. This study employs a descriptive quantitative research design. By measuring variables such as the frequency of extreme weather, the level of impact these events have on construction projects, and the effectiveness of resilience strategies, this approach enables precise and objective analysis through statistical measures of central tendency.

2.2 Research Locale

This research was conducted in Koronadal City, situated in Region XII, Philippines. The coverage of this study is the jurisdiction of the City Engineers Office of Koronadal City for the implementation of their civil work projects. Koronadal City, also known as Marbel, is a city located in South Cotabato, Philippines. The city is divided into 27 districts and is a small cultural center, where three dominant cultures (Christian, Muslim and local) are mixed up in a unique manner. The issuance of Executive Order No. 304, issued by former President Gloria Macapagal Arroyo, designating the City of Koronadal as the Regional Center and seat of SOCCSKSARGEN Region, further boosted the development of Koronadal City. It is the capital of the province of South Cotabato, regional administrative center of SOCCSKSARGEN, and the second most populous city after General Santos City.

2.3 Research Participants

The researchers obtained a total of 325 workers from the reply letter of the Koronadal City Engineers' Office. Upon obtaining the names from the City Engineers Office of Koronadal City, the researchers used the stratified random sampling technique, specifically, proportionate sampling. To have a 95% confidence level, the researchers needed to have a sample size of 177 workers to ensure a real value within ± 5% of the surveyed value. Using the proportionate stratified random sampling technique, the total workers required for the technical, skilled, and unskilled workers are 17, 66, and 94 workers, respectively. The researchers divided the total population of respondents into three strata: technical, skilled, and unskilled workers. The workers included in the technical worker's stratum are the civil engineers, project managers, foremen, quality control aide, leadmen, contractors, electrical engineers, electricians, and surveyors. For the skilled workers, the equipment operators, steelmen, painters, masons, carpenters, ceiling installers, welders, and scaffolders were involved. Lastly, for the unskilled workers, only the general laborers were included.

2.4 Research Instrument

This research employed a survey questionnaire which is adapted and modified from previous research entitled "Evaluation of the Impacts of Extreme Weather Events on the Infrastructure Development of the Construction Industry in Ontario" by Rizwan. Modifications were made to the survey questions such as excluding the occurrence of weather events like the frost and snowfall since these are not applicable where the study is conducted. The demographics part of this study was modified to the present organizational structure of construction industry. Most of the questions in this material are in the form of a Likert Scale, which were useful in addressing the research objectives.

2.5 Data Gathering Procedure

The researchers handed out the questionnaires to the respondents in person. The data gathering took place from March 21 to 23, 2024, in Koronadal City.

2.6 Data Analysis

This study used the Weighted Mean to analyze the data gathered for the assessment of the impact of extreme weather on construction projects in Koronadal City. The Weighted Mean was used to calculate the average scores assigned to various aspects through questionnaires. Table 1 shows the Likert Scale used in the study.

Table 1. Five-point likert scale, mean ranges, and descriptions used in the study

Weight Scale	Mean Range	Descriptions
5	4.20 – 5.00	Always / Highly Significant Impact / Highly Effective
4	3.40 – 4.19	Often / Considerable Impact/ Considerably Effective
3	2.60 – 3.39	Sometimes / Moderate Impact / Moderately Effective
2	1.80 – 2.59	Seldom / Slight Impact / Slightly Effective

1	1.00 – 1.79	Never / Negligible Impact/ Ineffective

2.7 Ethical Considerations

This research was conducted in strict adherence to ethical guidelines, ensuring the protection of the rights and well-being of all participants. Informed consent was obtained from all respondents prior to their participation, and their responses were kept confidential throughout the study. The data collected will be used solely for research purposes and will not be disclosed or used in any manner that could harm or be used against the respondents.

3.0 Results and Discussion

3.1 Frequency of Occurrence of Extreme Weather Events

Table 2 highlights the frequency of various extreme weather impacting construction projects. The findings reveal that heat waves pose a significant challenge for construction workers, with a high weighted mean of 4.74, indicating that this condition is almost constant, occurring "always" or more than five times a week. These results align with Guadalupe (2018), who reported that the Philippines has ranked as the fifth most affected country by extreme weather events over the past two decades. Furthermore, projections suggest that Mindanao could face year-long heat waves by 2050.

Table 2. Frequency of occurrence of extreme weather events

Weather Events	Weighted Mean	Description
Heat Waves	4.74	Always
Heavy Rainfall	3.07	Sometimes
Floods	1.78	Almost Never
Tropical Cyclones	1.77	Almost Never
Others (Earthquake)	1.20	Almost Never
Tornadoes	1.19	Almost Never

The frequent occurrence of heat waves corroborates the findings of Mora et al. (2017), who identified a threshold where high temperatures and relative humidity can become life-threatening. Their research suggests that 30% of the global population is exposed to these dangerous conditions for at least 20 days annually, a percentage that is projected to rise. The data indicate that heavy rainfall occurs relatively frequently, with a weighted mean of 3.07, categorizing it as "sometimes," and typically experienced up to three times a week. In contrast, tropical cyclones and floods are much less common, with weighted means of 1.77 and 1.78, respectively, placing them in the "almost never" category, indicating occurrences of no more than once every two weeks.

However, these patterns are expected to change significantly as global temperatures rise. Projections suggest an increase in the intensity of extreme rainfall events, estimating a 4.3% rise in rainfall intensity for each degree Celsius increase in global mean temperature (Villafuerte et al., 2015). Additionally, by 2100, the 20-year return value of annual maximum daily precipitation will increase by 8.5-17% across various climate scenarios. Regional assessments indicate that northwestern and eastern coastal areas will likely experience more pronounced increases in heavy rainfall (Hong et al., 2022).

This anticipated shift in weather patterns raises significant concerns for construction projects, as heightened rainfall intensity can lead to substantial delays, equipment malfunctions, and safety hazards. Consequently, the construction industry must implement targeted adaptation strategies to mitigate the adverse impact of these changing weather conditions effectively. Tornadoes were similarly infrequent, with a weighted mean of 1.19, reflecting their rarity in the area, as they typically occur less than once every two weeks. Earthquakes were also rare, with a mean of 1.20, showing they occur at similar intervals. A comparable study by Gandhi et al. (2014) reported similar trends in India, identifying high temperatures (4.517), rainfall (4.312), and drought or water restrictions (4.116) as the most frequent extreme weather events. This consistency across studies highlights the commonality of heat waves and rainfall as significant challenges for construction sectors.

3.2 Level of Impact of Extreme Weather on Construction Firms

Table 3 indicates a widespread concern among respondents regarding the significant impact of extreme weather on construction project timelines. With a weighted mean of 3.93, it is clear that extreme weather considerably influences project schedules.

Table 3. Level of impact of extreme weather on construction firms

Situations	Weighted Mean	Description
Project Timelines	3.93	Considerable Impact
Labor Productivity	3.73	Considerable Impact
Budgetary Allocations	3.40	Considerable Impact
Overall Quality and Durability of Construction Projects	3.36	Moderate Impact
Performance or Overall Quality of Construction Equipment	3.32	Moderate Impact

Heat stress represents a significant threat to workers' health, impairing their well-being and productivity, and can lead to substantial economic losses (Zander et al., 2018). The effects of hot and humid weather are particularly pronounced in the construction sector. Research conducted by Al Alawi (2020) in Oman illustrates that extreme temperatures can severely impact labor productivity and extend project timelines. The study found that adverse weather conditions, especially during periods of intense heat, can cause project delays ranging from 3% to 38% beyond the initially planned schedule. Additionally, Alaghbari et al. (2006) confirmed that heat waves significantly contribute to construction delays.

Other studies (Akomah & Jackson, 2016; El-Rayes & Moselhi, 2001; Ronalds, 2023; Pathiranage & Halwatura, 2010) have similarly highlighted the profound impact of extreme weather, particularly heavy rainfall, on road-building projects. Such adverse conditions can lead to delays due to safety concerns, worker discomfort, equipment malfunctions, and interruptions in critical construction activities. This underscores the necessity for the construction industry to factor in potential disruptions from extreme weather in its planning and risk management strategies.

In a similar study by Gandhi et al. (2014), logistics and supply chain disruptions were the most affected, making logistics the most critical concern. Delayed deliveries and transportation issues were crucial challenges, underscoring the widespread impact of weather on the logistics of construction projects. Moreover, this study revealed the impact of extreme weather on budgetary allocations for construction projects. Garnering a mean score of 3.40, placing it within the considerable impact category, it can be concluded that extreme weather substantially influences financial planning within the construction sector in Koronadal City. The results of the study of Gandhi et al. (2014) showed that the financial implications were also significant, particularly in increased marginal cost and revenue losses, highlighting similar concerns about the financial burden imposed by extreme weather.

The findings from this study align closely with the observations made by Alshebani and Wedawatta (2014) regarding the impact of extreme weather on labor productivity. In Koronadal City, the average score of 3.73 highlights that extreme weather considerably hinder labor efficiency among construction workers, echoing the findings of Gandhi et al. (2014), which emphasized severe effects on worker health, productivity, and attendance. According to the Dunne et al. (2013) study, environmental heat stress leads to a 10% reduction in labor productivity, which is projected to decrease to 80% by 2050. The studies of Alshebani and Wedawatta (2014), Gandhi et al. (2014), and Dunne et al. (2013) underscore the challenges faced by workers, including difficulties in reaching construction sites due to adverse weather conditions. These disruptions reduce productivity and reflect a broader trend where high temperatures and humidity levels negatively influence labor outcomes, resulting in decreased productivity and potential economic implications for the construction industry.

The result showed a mean value of 3.32 regarding the impact of extreme weather on construction equipment performance, indicating a moderate impact. Furthermore, the surveyed data illustrated a weighted mean of 3.36 for the impact of extreme weather on the overall quality and durability of construction projects. These projects experience moderate impact from extreme weather, highlighting the need to integrate weather adaptability into both the planning and execution phases of projects. According to Schuldt et al. (2021), weather conditions significantly impact construction materials, including concrete, asphalt, brick, and steel. Both extreme cold and heat can affect the strength and placement of concrete. At the same time, precipitation can impede asphalt application and masonry work—additionally, wind, temperature fluctuations, and rainfall challenge steelwork, particularly in vertical construction. Earthwork operations are also vulnerable; rainfall can lead to soil flooding while freezing temperatures complicate excavation efforts. These weather-related factors ultimately influence the overall quality and durability of construction projects.

Mill (2003) also highlights the effects of undertaking construction projects during extremely hot weather. Hot weather affects construction equipment functionality, concreting processes, workers' conditions, labor productivity, adherence to safety procedures, and financial considerations. Furthermore, extreme weather significantly affect construction projects, causing delays, safety risks, and equipment malfunctions (Pathiranage & Halwatura, 2010). These disruptions can damage worksites, obstruct progress, and affect project timelines. This supports the findings of this study, which highlight the impact of weather on construction sites.

3.3 Potential Health and Safety Hazards that the Workers Encountered in the Construction Industry due to Extreme Weather in Koronadal City

The survey results on health and safety hazards related to extreme weather among construction workers reveal significant concerns (see Figure 1). Physical strain and fatigue were the most reported issues, affecting 90.40% of respondents, which highlights the substantial impact of extreme weather on worker endurance and efficiency. Similarly, heat-related illnesses were noted by 88.14% of participants, with 156 workers emphasizing this concern. These findings are consistent with the broader literature, such as Karthick et al. (2022), which points to outdoor workers being particularly vulnerable to heat strokes and extreme fatigue due to their physically demanding activities in high temperatures. Kiefer et al. (2016) also emphasize that prolonged exposure to high temperatures presents a significant health risk for construction workers engaged in strenuous tasks. Furthermore, high temperatures reduce worker productivity, and prolonged exposure to heat leads to heat-related illnesses (Schuldt et al., 2021).

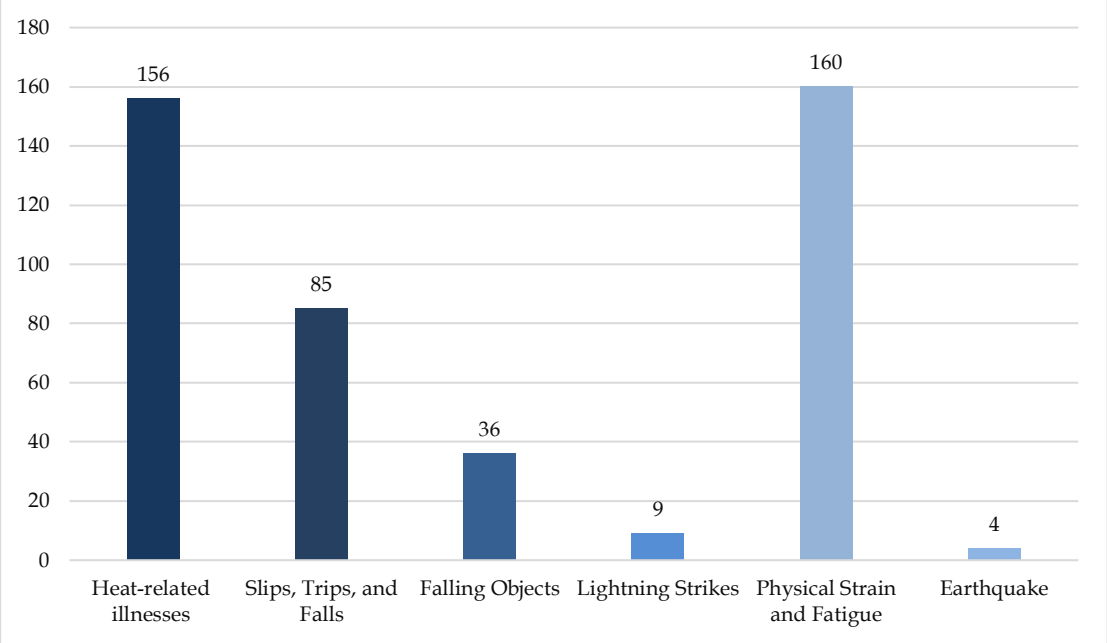

Figure 1. Potential health and safety hazards that the workers encountered in the construction industry due to extreme weather in Koronadal City

Furthermore, Gariazzo et al. (2023) demonstrated a significant correlation between elevated temperatures and increased occupational injuries in the construction industry. This highlights the heightened risks posed by extreme heat, confirmed by the survey's participants, who reported frequent heatwaves and hazards associated with hot weather at their workplaces. The frequent occurrence of heat waves compounds these health risks, as reflected in the high prevalence of heat-related illnesses reported in the survey. These findings underline the pressing need for effective health and safety strategies to mitigate the impact of extreme weather.

Additionally, 48.02% of respondents reported experiencing slips, trips, and falls, exacerbated by adverse weather conditions affecting surface stability and worker balance. In connection, Karthick et al. (2022) revealed that

extreme weather poses accidents, slips, and falls. Also, according to Schuldt et al. (2021), precipitation and wind impact workers' safety, slow productivity, and increase the risk of accidents. Falling objects (20.34%) and lightning strikes (5.08%) were less frequently reported but remained significant hazards, primarily during stormy or windy weather. Lastly, only 2.26% of respondents mentioned earthquakes as a safety concern.

In conclusion, the findings emphasize the significant impact of extreme weather on worker safety and project efficiency. As noted by most respondents, physical strain, fatigue, and heat-related illnesses point to the prevalence of heat waves, consistent with previous studies (Kiefer et al., 2016; Gubernot et al., 2013). Other hazards, such as slips, trips, falls, and falling objects, further underline the need for improved safety measures during adverse weather conditions (Karthuck et al., 2022; Schuldt et al., 2021). While earthquakes were mentioned less frequently, they suggest the need for broader safety preparedness in construction projects, especially in areas with regular seismic activity.

3.4 Perceived Level of Effectiveness of Resilience Measures Implemented on Construction Sites

This study also measured the perceived level of effectiveness of resilience measures currently implemented on the construction firms to mitigate the impact of extreme weather. Table 4 shows the level of effectiveness of resilience as perceived by the respondents.

Table 4. Perceived level of effectiveness of resilience measures implemented on construction sites

Resilience Measures	Weighted Mean	Description
1. Providing adequate hydration and regular breaks in shaded area.	4.33	Highly Effective
2. Utilization of adequate rest breaks, rotating tasks, and employee wellness programs.	4.24	Highly Effective
3. Development and communication of clear emergency response and evacuation plans	3.81	Considerably Effective
4. Incorporating resilient design features and reinforcing structures	3.81	Considerably Effective
5. Securing appropriate insurance coverage and implementing risk management strategies.	3.80	Considerably Effective
6. Diversifying the supply chain to reduce vulnerability to disruptions	3.77	Considerably Effective
7. Implementation of effective water management and drainage systems.	3.71	Considerably Effective
8. Regular monitoring of weather.	3.62	Considerably Effective

The respondents rated Adequate hydration and breaks highly effective, with a mean score of 4.33. This indicates that companies or agencies are proactively managing the risks associated with extreme weather by ensuring worker safety. Similarly, strategies such as rest breaks, task rotation, and wellness programs received a high mean score of 4.24, with 47.24 percent of respondents deeming them highly effective. This is also suggested in the study of Karthik et al. (2022), which suggests that employers should provide cool-down areas, encourage breaks, and offer cool water and electrolyte drinks. Lee et al. (2023) also recommended implementing flexible work hours to avoid peak heat periods. These studies confirm the effectiveness of these measures, as the respondents rated them as highly effective.

Employers should identify hazards, assess worker vulnerability, and develop control strategies. This may involve changes to work schedules, building safety, and communication plans (Levy & Roelofs, 2019). The study of Levy & Roelofs (2019) aligns with the survey's result that respondents considered the following measures effective: development and communication of clear emergency response and evacuation plans and incorporating resilient design features and reinforcing structures, with both having a weighted mean of 3.81. The study respondents also identified the following measures with their respective weighted mean as effective: securing appropriate insurance coverage and implementing risk management strategies (3.80), diversifying the supply chain to reduce vulnerability to disruptions (3.77), implementing effective water management and drainage systems (3.71), and regular monitoring of weather (3.62).

The findings of this study align with previous research emphasizing the importance of preparedness and risk management in mitigating the impacts of extreme weather (Fatima et al., 2023; Levy & Roelofs, 2019). The high ratings for weather forecasting, emergency planning, and resilient design underscore the significance of proactive measures in ensuring project resilience and worker safety. Collectively, these results highlight how important it is to put worker safety and well-being first in construction projects, especially when it comes to minimizing the impact of extreme weather. This shows that Koronadal City has a considerably high level of risk awareness and is implementing risk management strategies.

4.0 Conclusion

This study has demonstrated that construction projects in Koronadal City are subject to a variety of extreme weather, with heat waves and heavy rainfall occurring most frequently. These environmental challenges pose significant risks to both the efficiency and safety of construction activities. The recurrent nature of these conditions underscores the critical necessity for implementing effective strategies to mitigate their adverse impacts. It is imperative that construction companies and policymakers in Koronadal City prioritize the development and adoption of effective mitigation measures. Extreme weather in Koronadal City notably disrupt construction project timelines, budget allocations, labor productivity, construction equipment quality, and the overall quality of the projects. The data shows most construction workers report considerable impacts due to weather-related challenges, emphasizing the need for enhanced project management strategies that include weather adaptability and risk management plans.

The construction sector in Koronadal City faces significant health and safety risks due to extreme weather. Most notably, physical strain and fatigue, heat-related illnesses, slips, trips, and falls are prevalent among workers. These findings highlight the need for comprehensive health and safety protocols and worker training programs to mitigate these risks. The study reveals that extreme weather not only affects the health and safety aspects but also imposes significant economic and operational burdens on construction projects. Increased costs due to delays and damage, as well as the need for budget reallocation, are common, impacting the overall economic viability and efficiency of construction projects. The data gathered indicates that resilient construction practices, including provision of adequate hydration and regular breaks along with the utilization of flexible work schedule, are considered highly effective. Meanwhile, measures such as development and communication of clear emergency response and evacuation plans, incorporating resilient design features and reinforcing structures, securing appropriate insurance coverage ad implementing risk management strategies, diversifying the supply chain to reduce vulnerability to disruptions, implementation of effective water management and drainage systems, and regular monitoring of weather are among the considerably effective measures on resilience. These shows that construction projects in Koronadal City implements effective resilience measures to mitigate the adverse impact of extreme weather.

Future research should focus on the impact of extreme weather on construction projects in Koronadal City compared to other regions, identifying challenges and resilience measures that can be adapted across diverse settings. Emphasis should be placed on developing innovative health and safety protocols, conducting cost-benefit analyses of resilience strategies, and evaluating policies to better manage weather risks. Expanding the study scope to include geological hazards and both public and private sector projects will provide a more comprehensive understanding of these challenges. Policymakers may consider amending existing laws to allow for weather-related suspensions in construction activities, while training programs and seminars for workers should be implemented to enhance preparedness and safety.

5.0 Contributions of Authors

The specific contributions of these authors are as follows:
Lenon V. Namuag: Conceptualization of study, Supervision, Writing and Editing, Checking, Validation
Joshua Marvin A. Noval: Conceptualization of Data Analysis, Writing and Editing, Checking, Validation
El-J A. Flores, Earl Ian T. Delgado, & Czeska Mae B. Pagay : Writing and Encoding, Data Gathering

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7.0 Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this study.

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Toward Sustainable E-Waste Management: Bridging Gaps and Insights from General Santos City, Philippines

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Abstract. Electronic waste (e-waste) management in the Philippines remains underexplored, particularly regarding consumer behaviors, with limited research on the disposal practices of residents in General Santos City. This mixed-method study addresses this gap by exploring the psychosocial factors influencing e-waste management in the city using the Knowledge, Attitudes, and Practices (KAP) model across three segments of electronic and electrical equipment (EEE) consumers. Data were collected from 102 participants across five barangays using stratified proportionate sampling via a self-administered survey. Qualitative insights were gathered through an in-depth interview with a key informant from the Solid Waste Management Office. Commercial users show high knowledge (3.68) and positive attitudes (3.81) but lower sustainable disposal practices (3.29). Residential consumers exhibit moderate knowledge (3.36) and attitudes (3.72), with behaviors like hoarding. Educational institutions have the highest knowledge (3.79) and attitudes (3.62) but face adoption challenges. Thus, awareness of environmental and economic impacts alone does not guarantee responsible e-waste disposal. The study emphasizes the need for systemic solutions, such as adopting Extended Producer Responsibility (EPR) at the local level by leveraging the Local Government Code of 1991. Local governments can pass ordinances requiring stakeholders to manage end-of-life EEEs, such as establishing e-waste collection points in commercial business districts. Establishments can adopt EPR practices, partnering with educational institutions and NGOs for take-back programs. Integrating urban mining into local EPR frameworks supports a circular economy, reduces reliance on virgin materials, creates jobs, and mitigates environmental impacts. Optimizing municipal solid waste management to include e-waste processing, alongside the "Best-of-2-Worlds" approach, bridges technological gaps. A robust institutional mechanism and strong political commitment are essential to address the underutilization of the city's Material Recovery Facilities. Embracing "think globally, plan regionally, act locally" helps cities develop sustainable, tailored e-waste strategies.

Keywords: Electronic Waste (e-waste) Management; General Santos City; Knowledge-Attitude-Practice (KAP); Sytemic Solutions; Urban Mining.

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1.0 Introduction

Scholars have long sought to define and address the gaps in understanding the barriers to pro-environmental behavior. While several established theories in environmental research exist, pinpointing the precise factors that influence environmentally friendly actions remains challenging. No single framework or schematic can fully capture the complex array of elements required to tackle the issues of a "throwaway society" and cultivate an environmentally responsible citizenry (Kollmus & Agyeman, 2002). Achieving this goal demands a fundamental behavior change, which involves developing not only knowledge and competence but also skills, beliefs, emotions, civic responsibility, and a sense of agency among citizens (Goldman, Hansmann, Činčera, Radović, Telešienė, Balžekienė, & Vávra, 2020).

Despite growing awareness of proper waste management, many households and offices in Philippine urban cities still fail to segregate waste at the source, leading to indiscriminate dumping of general solid waste in streets and open spaces (Coracero, Gallego, Frago, & Gonzales, 2021). This exacerbates pollution and health risks, while the common practice of burning garbage worsens the situation. The "throwaway society" (Gregson, Metcalfe, & Crewe, 2007), driven by rapid consumption and disregard for environmental impact, contributes to the growing volume of waste, with inadequate recycling or reuse efforts compounding the environmental burden. A similar challenge is emerging with e-waste, as the rapid obsolescence of electronics adds another strain on waste management systems.

Electronic waste, or "e-waste," is commonly defined as abandoned electrical or electronic devices that are no longer functional, obsolete, or unwanted. Traditionally, e-waste has been associated with two main sources: corporate consumers—including commercial, industrial, and institutional entities—and households (Celestial, 2018). This includes a wide variety of consumer electronics, such as mobile phones, computers, televisions, and household appliances, that have reached the end of their useful life (Widmer, Oswald-Krapf, Sinha-Khetriwal, Schnellmann, & Böni, 2005). E-waste has become a significant environmental and public health issue because of the toxic substances it harbors. Mismanagement of e-waste can release hazardous substances, including lead, mercury, and cadmium, into the environment, contaminating water, soil, and air and directly impacting human health, particularly in vulnerable communities (Robinson, 2009), particularly vulnerable groups such as children and informal waste handlers, who face the potential of enduring health problems, such as neurological damage, respiratory problems, and an increased risk of cancer (Hossain, Al-Hamadani, & Rahman, 2015).

Increases in Gross Domestic Product (GDP) per capita, urbanization, and modernization are major drivers of e-waste production (Tansel, 2017; Chen, Bodirsky, Krueger, Mishra, & Popp, 2020). Based on the latest report, global e-waste production amounted to 53.6 million Metric Tons (Mt) in 2019. It is considered one of the world's fastest-increasing waste streams, with an estimated three to five percent annual growth rate (Forti, Balde, Kuehr, & Bel, 2020). Consistent with these trends, e-waste is inevitable unless there is an undoing of modernity, a reversal of prosperity, and a forestalling of urbanization.

The European Environmental Bureau said e-waste is "the next big environmental challenge in today's digital society—a time bomb waiting to explode" (EEB, 2018). This issue, while considered one of the most urgent and pressing challenges of our time, is often routinely overlooked. Several factors contribute to this neglect, including the lack of a national legal framework, insufficient inventory and collection systems, low public awareness, and inadequate infrastructure. In the Philippines, the challenge is compounded by the lack of reliable e-waste data, which hinders effective planning and policy formulation.

Beyond environmental and health risks, the improper management of e-waste overlooks its economic potential. Through urban mining, valuable materials such as gold, silver, copper, and rare elements can be recovered from discarded electronics, contributing to a circular economy. Responsible recycling of these materials recovers valuable resources and contributes to economic growth while decreasing the need for fresh raw materials (Murthy & Ramakrishna, 2022). As the concern over e-waste grows, the global focus on responsible management has intensified. This aligns with several Sustainable Development Goals (SDGs), including Goal 12 (Responsible Consumption and Production), Goal 3 (Good Health and Well-being), Goal 6 (Clean Water and Sanitation), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action), all of which can be supported through effective e-waste recycling and disposal practices (UN, 2020).

In industrialized countries, while data management systems for e-waste are more advanced, they still struggle with comprehensive tracking, resulting in gaps in monitoring e-waste flows (Heacock, Kelly, Asante, Birnbaum, Bergman, Bruné, & Suk, 2016). This could be evidenced by the increasing reports of transboundary e-waste transactions (Parajuly & Fitzpatrick, 2020). In contrast, developing countries lack the essential technological infrastructure to implement effective data management systems, hindering their ability to track e-waste properly (Osibanjo & Nnorom, 2007; Iqbal, Breivik, Syed, Malik, Li, Zhang, & Jones, 2015). As a result, these regions heavily rely on the informal sector for e-waste processing, where workers often use hazardous methods like open burning and acid leaching to extract valuable materials. Meanwhile, formal recycling facilities, which could offer safer and more regulated processing, are underutilized due to inadequate infrastructure, as well as a lack of public awareness or trust in their services (Laeequddin, Kareem Abdul, Sahay, & Tiwari, 2022).

The increasingly aggressive consumer electronics market, characterized by the planned or "delayed" obsolescence (Lawlor, 2015) of either functionality (Gecit, 2020) or aesthetics (Shevchenko, Laitala, & Danko, 2019), magnifies the global e-waste problem. In the face of conspicuous consumption driven by utilitarian or hedonistic ends, one may argue that the e-waste conundrum is a worldwide problem regardless of a country's socioeconomic context. Nevertheless, emerging and developing economies face more challenges in developing work plans, strategies, and policy responses to the growing amount of e-waste (Gunarathne, de Alwis, & Alahakoon, 2020). E-waste management remains a relatively low priority in many developing countries (Islam, Ahmed, Awual, Rahman, Sultana, Abd Aziz, & Hasan, 2020).

The Brunei Darussalam-Indonesia-Malaysia-Philippines East ASEAN Growth Area (BIMP-EAGA) highlights waste management as a major source of greenhouse gas emissions (GHG), impacting daily urban life through waste generation and disposal. Decomposition and incineration processes release methane (CH4) and nitrous oxide (N2O), potent GHGs. In General Santos City, solid waste is primarily collected by the General Santos City Waste Management Office, which processes materials like food scraps, garden waste, paper, plastics, and glass before disposal in the landfill (BIMP-EAGA, 2018). E-waste, categorized as "special waste," necessitates a heightened focus on guaranteeing proper recycling and disposal as part of the city's waste management plan.

Given this backdrop, how are urban cities in the Philippines addressing the rising challenge of e-waste? In the absence of a specific policy, what measures are being taken to mitigate the social, environmental, and economic impacts of this growing issue? As far as the literature is concerned, the e-waste management system in General Santos City, Philippines, has yet to be determined. As a groundwork study, this research aims to assess consumers' Knowledge, Attitudes, and Practices (KAP) levels across the commercial, educational, and household sectors, evaluating their impact on the current e-waste system. Additionally, the study will examine how contextual variables influence decision-making and disposal practices, aiming to identify key factors that shape consumer behavior and contribute to the overall effectiveness of the e-waste management system.

2.0 Methodology

2.1 Research Design

We employed a mixed-methods approach to assess e-waste management in General Santos City, focusing on the key elements of Knowledge, Attitudes, and Practices (KAP). The quantitative surveys were designed to collect data on residents, businesses, and educational institutions' knowledge of e-waste, such as their awareness of its environmental and health impacts and their understanding of proper disposal methods. The surveys also explored respondents' attitudes toward e-waste recycling, including their concerns and willingness to adopt more sustainable disposal practices. Additionally, the survey examined current practices related to e-waste management, including disposal behaviors and the openness of individuals and organizations to participate in recycling initiatives. Alongside the quantitative surveys, we conducted a qualitative interview with a key informant from General Santos City's Solid Waste Management Office to gain deeper insights into the challenges and gaps in knowledge, attitudes, and practices regarding e-waste management.

2.2 Research Locale

This study concentrated on EEE consumers across various sectors, specifically households, commercial entities, and educational institutions, to assess the state of e-waste management in General Santos City. The research was

carried out in the following barangays: Dadiangas North, Dadiangas East, Dadiangas West, Dadiangas South, and Lagao (NEWS-L), which together comprise the central business district of the city. These barangays were selected due to their diverse socioeconomic profiles, varying population densities, and distinct types of e-waste generation across the household, business, and institutional levels.

2.3 Research Participants

To ensure a representative sample of e-waste generators in General Santos City, 102 participants were carefully allocated across three key subgroups of EEE consumers. This allocation was designed to reflect the diverse sectors contributing to e-waste in the area, ensuring balanced representation across households, commercial establishments, and educational institutions. The sample sizes for each subgroup were established based on the population of each sector and the required margin of error and confidence level. The study achieved a margin of error of 8.14% and a confidence interval (CI) of 88.8%, which indicates a high degree of reliability and statistical significance, ensuring that the findings can be generalized to the broader population of e-waste generators in General Santos City (Raosoft, n.d.). Our sample size was identified using a multi-stage hybrid probability sampling method designed to capture the variability across different e-waste-generating populations while maintaining statistical rigor. This approach is particularly effective for geographically dispersed populations with varying levels of e-waste generation (Rahman, Tabash, Salamzadeh, Abduli, & Rahaman, 2022). It is widely regarded for ensuring the applicability of research findings to the broader target population (Acharya, Prakash, Saxena, & Nigam, 2013).

The first sampling stage involved stratified sampling, which divided the population into subgroups, or strata, based on shared characteristics. The population was stratified into three subgroups: (1) Household-level consumers (HHCs), who are primary consumers of electrical and electronic equipment (EEE) for household use; (2) Commercial-level consumers (CLCs), including commercial establishments like appliance stores and repair shops that generate significant amounts of e-waste; and (3) Consumers at educational institutions (CEIs), who use EEE within educational settings, such as basic education schools, colleges, and universities.

The sample sizes for each subgroup were determined using Raosoft's online sampling calculator and adjusted according to the target margin of error and confidence level. For the HHC stratum, a minimum of 100 participants was recommended, based on a total population of 81,789 in the NEWS-L barangays, with a margin of error of 8.5% and a confidence level of 90%. For the CLC stratum, a business listing from the City Planning and Development Office identified commercial establishments. Applying Slovin's formula, we determined that 100 participants would provide a margin of error of 5.5%. For the CEI stratum, 22 participants were selected based on 29 educational institutions, ensuring a margin of error of 9% and a confidence level of 90%.

In the second stage, proportional allocation was used to determine the number of participants from each stratum. This approach guaranteed that the sample closely mirrored the distribution of e-waste produced by each subgroup, consistent with findings from previous studies (Baldé, Wang, Kuehr, & Huisman, 2015; Ilankoon, Ghorbani, Chong, Herath, Moyo, & Petersen, 2018). Based on the total sample size of 102, the allocation was as follows: 41 participants from CLCs (the largest group due to their higher e-waste generation), 39 participants from HHCs, and 22 from CEIs. Proportional allocation was achieved by dividing the population of each subgroup by the total population and multiplying by the recommended sample size for each subgroup.

The final sampling stage involved purposive sampling for the Key Informant Interview (KII). This approach was chosen to specifically target individuals with specialized solid (or e-waste) management knowledge in General Santos City.

2.4 Research Instrument

To address the scarcity of e-waste management research instruments in the literature, we followed Raykov and Marcoulides' recommendations for establishing domain parameters, ensuring a practical understanding of the issue (Boateng, Neilands, Frongillo, Melgar-Quiñonez, & Young, 2018). In developing the research instrument, we selected a self-administered questionnaire to assess electronic waste disposal practices, carefully designed to align with the study's core objectives. We initially created a pool of items based on existing literature and expert

recommendations to comprehensively evaluate the relevant knowledge, attitudes, and practices (KAP) related to e-waste management.

Considering the linguistic context of General Santos City, we translated the questionnaire items into Bisaya and Tagalog, with English as a supplementary language. This approach ensured content validity and facilitated participant comprehension. To verify the relevance and quality of the items, we sought expert evaluations from environmental science professionals and waste management practitioners. Their feedback on clarity, appropriateness, and comprehensiveness helped refine the instrument, ensuring it captured the dimensions of e-waste disposal practices in the local context.

For reliability testing, we utilized Jamovi, an open-source statistical software, to perform key analyses, including calculating Cronbach's alpha (α) and McDonald's Omega (ω). A Cronbach's alpha value of 0.7 or higher generally indicates acceptable reliability (Cronbach, 1951). McDonald's Omega, a more accurate measure for multi-dimensional scales, confirms reliability when its value exceeds 0.7 (Dunn, Baguley, & Brunsden, 2014). In our study, Cronbach's α coefficient of 0.673 demonstrates moderate to high internal consistency, implying that the items are somewhat correlated but could benefit from further refinement for stronger alignment. McDonald's Omega (ω) coefficient of 0.719 indicates satisfactory reliability, but there is still room to improve the scale's internal consistency.

For the qualitative data collection, we developed a semi-structured questionnaire that allowed us to flexibly explore the complexities of local e-waste management practices.

2.5 Data Gathering Procedure

The present study incorporates a conceptual framework inspired by the KAP model, with the e-waste management system as the dependent variable. We employed the Likert scale to assign numerical values to each point in the participants' responses to the self-administered survey data-gathering. Researchers, most especially in the field of social and behavioral sciences, have primarily relied on Likert-scale questionnaires for years because of their capability to rapidly acquire information in measuring satisfaction, attitudes, perceptions, experiences, and behaviors, among other factors, from a large number of participants (El Refae, Kaba & Eletter, 2021). Upon completing the gathering process of quantitative data, we carried out a rigorous validation procedure to identify and resolve any discrepancies. The data was inputted into a spreadsheet to facilitate subsequent tabulation. To generate descriptive statistics, we imported the pristine datasets into Jamovi, a freely accessible and open-source statistical software.

For the Knowledge (K) variable, we labeled the knowledge construct among household-level participants as "HHK," consisting of seven questions assessing their comprehension of the e-waste issue and their knowledge of national legislation, local regulations, strategies, and interventions. The commercial segment's knowledge construct was labeled "CLK" and consisted of seven knowledge and awareness questions. The knowledge variable for the Educational Institution was coded as "CEK" and consisted of seven questions.

The concept of environmental attitude (A) includes two groups of questions. The initial questions aimed to evaluate participants' views on e-waste and their perspectives on regulations, strategies, and interventions related to e-waste management. We assigned the codes "HHA1" to household-level participants with eight questions, "CLA1" to commercial establishments with five questions, and "CEA1" to educational institutions with eight questions. The Likert scale utilizes a set of numerical values to represent different levels of agreement or disagreement. Specifically, the assigned values are as follows: 5 for Strongly Agree, 4 for Agree, 3 for No Opinion, 2 for Disagree, and 1 for Strongly Disagree. The second set of questions aimed to assess consumers' views on the main factor impacting their decisions about e-waste disposal. We designated the codes "HHA2" for household-level participants with nine questions, "CLA2" for commercial establishments with eight questions, and "CEA2" for educational institutions with eight questions. The Likert scale employs a series of numerical values to denote varying degrees of significance assigned to the factors. The designated values for the given categories are as follows: 5 for the category denoted as Most Important, 4 for the category denoted as Important, 3 for the category denoted as Moderately Important, 2 for the category denoted as Less Important, and 1 for the category denoted as Least Important.

For e-waste disposal practices (P), we adopted the 3R Hierarchy of E-waste Management (Blake, 2018) in designing the questionnaire. It consists of seven inquiries that align with the seven distinct categories of electronic waste, as identified in our extensive literature review. The findings within this conceptual framework unveiled the participants' inclination toward various strategies for managing e-waste, hence, the Disposal Spectrum. Numerical values have been assigned to each point by the 3R Hierarchy of E-Waste Management. 7 symbolizes donation, while 6 symbolizes selling or reselling. When chosen, 5 signifies recycling. 4 indicates repair, three means salvaging usable parts, 2 is hoarding e-waste, and 1 is disposing of electronic waste with regular waste. For the e-waste disposal practice variable, we coded "HHP" to household-level participants, "CLP" to commercial establishments, and "CEP" to educational institutions.

Qualitative data collection involved discussions with the leadership of the Solid Waste Management Office of General Santos City, focusing on the six tenets of Solid Waste Management (Republic Act 9003). The discussions were documented for further analysis. The audio recordings from the in-depth interviews were meticulously transcribed for detailed analysis, translated into English, and then imported into the open-source software Taguette, where they were coded, thematically organized, and analyzed.

2.6 Ethical Considerations

The Mindanao State University (MSU) Institutional Ethics Review Committee (IERC) evaluated the study's protocol and documents, determining the research instrument to be non-sensitive and ensuring participant anonymity. As a result, the study was exempted from review (Approval No: 189-2024-MSUGSC-IERC, MSU-IERC Code: 2024-209-SR). Furthermore, researchers were required to comply with the Data Privacy Act of 2012 and submit a closure report promptly upon completion of the study.

3.0 Results and Discussion

3.1 Knowledge, Attitudes, and Practice Levels for Commercial Segment

Commercial Users' Knowledge, Attitudes, and Practices in E-Waste Management

Table 1 shows that while commercial EEE users have good knowledge (3.68) and positive attitudes (3.81) toward e-waste management, there is a significant gap in actual practices (3.29), with considerable variability (standard deviation of 1.09). This indicates that despite understanding the importance of proper disposal, perceived barriers and unclear options hinder consistent action. The lower standard deviation in attitudes (0.697) suggests most respondents share positive views, while the higher standard deviation in practices highlights challenges in translating these attitudes into action. The standard deviation for knowledge (0.754) shows notable differences in individual understanding of the e-waste issue.

Table 1. K-A-P levels for commercial segment

	K Mean Score	A Mean Score	P Mean Score
N	41	41	41
Missing	0	0	0
Mean	3.68	3.81	3.29
Standard Deviation	0.754	0.697	1.09

Thematic Insights on Commercial E-Waste Management

The awareness-behavior gap observed in the KAP levels among commercial EEE users stems from several factors. A primary challenge is the complexity of e-waste regulations, which involve intricate legal frameworks and compliance requirements. Businesses may know they must dispose of electronic waste responsibly, but specific regulations, such as those governing recycling processes or certified waste transporters, are often unclear. As noted by our key informant, the lack of a formal framework for daily operations contributes to complacency. Businesses may resort to fragmented e-waste disposal methods without visible penalties for non-compliance.

Based on the KAP survey, participants recognize e-waste as a significant concern and express a willingness to pay for effective management strategies attributed to space constraints and impracticality of repair. However, commercial EEE users expressed concerns over the city's lack of dedicated e-waste infrastructure and facilities. Furthermore, their organizations' stringent auditing and inventory systems limit their ability to participate in

formal recycling initiatives. Their perceived lack of value in e-waste hinders effective management practices (Saidan, 2013). Despite these challenges, commercial EEE consumers assign high importance to e-waste management and are willing to invest in solutions.

Echegaray and Hannstein (2017) highlighted that confidence in adopting sustainable behaviors depends on convenient access to efficient government services and facilities. Similarly, Kochan, Pourreza, Tran, and Prybutok (2016) noted that "inconvenience factors," such as the burden of storing e-waste, and "convenience factors," like accessible collection hubs, greatly influence recycling motivation. Distant collection stations hinder proper e-waste disposal, prompting many to either discard e-waste with regular garbage or stockpile it. For effective e-waste management to occur, policies and infrastructure must align with the capacity of businesses to participate in sustainable practices.

While overarching policies such as the Hazardous Waste Act (RA 6969) and the Ecological Solid Waste Management Act (RA 9003) exist, no specific law in the Philippines is dedicated solely to e-waste management. The Administrative Order (DAO) 2013-22, issued by the Department of Environment and Natural Resources (DENR), classifies e-waste under categories M506 and M507 as a "new kind of miscellaneous waste." However, guidelines for the "Environmentally Sound Management" of Waste Electrical and Electronic Equipment (WEEE) remain pending approval (Celestial, 2018). While RA 9003 outlines general solid waste management principles, it does not specifically address e-waste. Similarly, while RA 6969 governs hazardous waste, it lacks provisions for managing e-waste. Additionally, RA 9003's vague definition of "special waste" results in only a small fraction of electronic waste being appropriately categorized.

In response to these gaps, our key informant highlighted that the *Sangguniang Panlungsod* (city council) has already engaged the Solid Waste Management Office to collaborate with research institutions to conduct a waste characterization study, including e-waste. This is part of the city's ongoing efforts to understand better and address the growing issue of electronic waste. Additionally, the city council is in the early stages of drafting an ordinance to establish more comprehensive local policies targeting e-waste management, further emphasizing the city's commitment to tackling this pressing issue.

Moreover, the key informant noted that specialized knowledge is necessary to navigate these complex regulations. While many businesses know e-waste management requirements, they struggle to apply this knowledge in practice. For instance, they may understand the need to recycle e-waste. However, they may not fully grasp the necessity of using certified waste transporters or adhering to local recycling facility standards, leading to improper disposal practices. The key informant emphasized the need for accessible e-waste recycling programs within commercial zones and policies to encourage responsible disposal practices. This lack of institutional support and clear regulations creates a significant barrier to action, even though businesses understand the importance of e-waste recycling.

While there is strong engagement with the business community through annual orientations and regular inspections, awareness of specific e-waste regulations remains insufficient. Most annual orientations and inspections focus on general waste management, neglecting the nuanced challenges of e-waste disposal. Businesses may comply with general waste protocols but lack the necessary knowledge or systems to handle e-waste, which hampers effective enforcement of regulations properly. This gap is further evident in the limited implementation of Extended Producer Responsibility (EPR) for e-waste. While initiatives with some major establishments and non-government organizations (NGOs) promote EPR and consumer recycling, especially for plastics, "*the city government lacks coordination with electronics distributors and manufacturers to establish EPR or take-back mechanisms for e-waste,*" our key informant shared.

Addressing these challenges necessitates significant improvements in program development, data collection, funding mechanisms, collaboration, and capacity-building initiatives. Critical gaps in e-waste management infrastructure and coordination are evident, as current efforts remain largely focused on general waste management. "*Ideally, reports such as the Solid Waste Compliance and Monitoring Report (SCMAR) should be filed. While some data is provided, it is often unreliable, especially regarding electronic waste, which is typically categorized with general waste,*" our informant said.

E-waste management requires an intricate process due to the diverse materials it contains which demands specific methods for safe and efficient recycling. This complexity is further compounded by the need for specialized facilities to properly dismantle, segregate, and process these components. Additionally, the presence of harmful substances like lead, mercury, and cadmium necessitates careful handling to prevent environmental contamination and health risks. Hence, the inadequacy of Material Recovery Facilities (MRFs) and recycling centers severely limits the effective management of e-waste. These facilities are often insufficient in number, unevenly distributed between urban and rural areas, and ill-equipped to handle the growing volumes of e-waste, leaving many communities without access to essential services for sustainable waste management. Additionally, the lack of reliable tracking systems for e-waste volumes and flows undermines local governments' ability to make data-driven decisions, design effective interventions, and assess the success of waste management programs.

Our key informant shared that waste-to-energy (WTE) technology is increasingly on the policy radar, as the city local government recognizes its potential to address the growing solid waste problem, including e-waste. However, integrating WTE into an overall e-waste management strategy remains problematic without the necessary infrastructure and tracking systems. While WTE could help convert non-recyclable e-waste into energy, significant environmental and health concerns persist (Sahajwalla & Gaikwad, 2018). Therefore, the absence of comprehensive tracking systems further hinders effective decision-making and program evaluation.

To move forward, it is crucial that the city invests in acquiring the necessary technical expertise, whether through partnerships with experts, training programs for local staff, or building relationships with organizations that can provide guidance on e-waste handling. "*We haven't yet figured out how to manage it because we admit we lack technical capacity and expertise in e-waste management. Perhaps we need to benchmark first; that's our first step. We need to equip ourselves with the required expertise.*" This acknowledgment emphasizes the importance of addressing knowledge gap. By learning from established best practices, the city can better equip itself to effectively manage e-waste and ensure the success of its future initiatives.

Amid rapid urbanization, the city faces significant waste collection and transportation challenges. To address these, the city government has increasingly relied on private collectors to meet the growing demand for waste management services and enhance efficiency. As the local official notes, "*Our fleet is limited, consisting of three compactors and two dump trucks. Additionally, the barangay operates its haulers. Approximately 80% of the waste collected comes from the informal sector, with the private sector contributing the remaining 20%.*" This underscores the importance of private players in bridging gaps in public waste management infrastructure, particularly by providing resources, expertise, and logistical support for e-waste management. This highlights how logistical challenges and a lack of institutional support exacerbate e-waste management difficulties in the business sector, particularly for small and medium-sized enterprises (SMEs). Despite the city's accreditation of 130 waste transporters, inadequate outreach and education initiatives limit awareness and compliance with sustainable e-waste practices. Many SMEs, constrained by resources, prioritize immediate concerns over proper disposal, often choosing to store, return, or sell IT-related e-waste to scrap dealers rather than engage formal recyclers (Heeks, Subramanian, & Jones, 2015).

3.2 Knowledge, Attitudes, and Practice Levels for Residential Segment

E-Waste Awareness, Mindsets, and Disposal Methods among Residents

Table 2 reveals that the mean scores for knowledge (3.36), attitudes (3.72), and practices (3.60) suggest moderate awareness, positive attitudes, and some effort toward responsible disposal among residential consumers. However, the high standard deviation (1.20) indicates considerable variability, with a significant portion of the population engaging in less sustainable practices, such as hoarding.

Table 2. K-A-P levels for residential consumers

	K Mean Score	A Mean Score	P Mean Score
N	39	39	39
Missing	0	0	0
Mean	3.36	3.72	3.60
Standard Deviation	0.418	0.415	1.20

This behavior is exemplified by individuals who store discarded electronic and electrical equipment (EEE) items at home instead of turning them over to formal or informal recycling sectors, often due to "sentimental attachment." This emotional connection leads some to repair their old devices, such as mobile phones, rather than dispose of them, driven by cost-effectiveness or sustainability values. However, concerns about personal information security (Attia et al., 2021) and the low resale value of old devices may lead individuals to stockpile their end-of-life phones rather than dispose of them, as purchasing new products becomes a more practical and fashionable option. The low standard deviations for knowledge (0.418) and attitudes (0.415) suggest that most individuals have similar awareness and views on e-waste management. However, the higher practice variability indicates a gap between understanding and action. This suggests that systemic barriers may facilitate this dissonance (Bovea et al., 2016).

"I am confident, at about 95%, that overall awareness of solid waste management among the general population is high. Regarding waste recycling (3R), the current practice involves households segregating waste, which is then collected by formal sector garbage collectors paid by the barangay. These collectors further segregate the waste during transportation, separating recyclables before reaching junk shops." In light of the KAP findings, the key informant's statement further contextualizes e-waste disposal challenges. While solid waste management practices benefit from high awareness and a functional infrastructure on the general solid waste stream, e-waste management lacks similar systems. This distinction highlights that while residents demonstrate awareness of waste segregation, the absence of specialized e-waste infrastructure contributes to the disconnect between attitudes and actual disposal behaviors observed in the quantitative analysis.

The city waste management official's insights further illuminate the challenges behind these findings: "*Their (e-waste) arrival here (at the General Santos City Sanitary Landfill Complex) is uncertain, as it somehow gets mixed in with other waste, making isolation or removal challenging. Battery chargers are frequently found, along with smaller items, while larger electronics like computers and TVs often end up in junk shops. The fate of these items post-sale remains unclear.*" This statement explains why consumers, despite having positive attitudes, may still engage in practices that fail to align with sustainable disposal methods. Moreover, the informant added, "*As part of our waste diversion, special waste like e-waste should not come here if possible, but we have a principle that household hazardous waste is better stored here than thrown away or dumped into the sea. So separate them and store them in a containment area within the complex.*" Systemic shortcomings likely contribute to the high variability in disposal practices observed in the survey, further emphasizing the need for improved waste management strategies and infrastructure.

Sytemetic Drivers of Disposal Patterns in Households

In many developing contexts, including the Philippines, the challenge extends beyond establishing disposal systems to addressing behavioral gaps. Previous research has shown that residential consumers often lack adequate understanding of legal requirements and proper disposal methods despite awareness of environmental impacts. Limited access to recycling facilities and insufficient guidance further exacerbated poor disposal behaviors, even among those with positive environmental attitudes (Borthakur & Govind, 2017; Kaza et al., 2018). Studies in Cagayan de Oro (Cultura et al., 2013) and Metro Manila (Alam, 2016) highlight prevalent practices among Filipino households, such as selling e-waste to scrap dealers or stockpiling broken electronics at home. These behaviors result from awareness barriers, inadequate infrastructure, and weak policy enforcement, cascading into broader inefficiencies in e-waste management (Siddiqi et al., 2020).

Our key informant provided insight into these lived realities, emphasizing that infrastructure limitations and a lack of motivation discourage proper disposal practices. The absence of reliable e-waste collection services leaves residents with few options but to hoard obsolete smaller electronics or mix them along with ordinary trash despite awareness of their environmental and economic impact. This practice undermines efforts to reduce pollution, conserve resources, and ensure safe disposal (Wilkinson & Williams, 2020). E-waste's tendency to blend into general household waste compounds these challenges (Forti et al., 2020). The key informant described how small electronic items like cell phones and battery chargers become indistinguishable from other waste: "*Unless e-waste is in bulk, it becomes nearly impossible to separate from other waste types.*" From a more microscopic perspective, the absence of dedicated infrastructure—such as specialized bins or accessible recycling centers—makes it impractical for individual households to segregate small e-waste items like batteries, cables, and old gadgets.

In addition to the convenience of facilities, the cost could also predict behavioral intentions, particularly for properly disposing of e-waste. In Malaysia, government-sponsored e-waste collection schemes, in collaboration with mobile phone manufacturers, showed that free collection efforts positively impacted public intentions to engage in responsible e-waste recycling (Afroz et al., 2020). As Diekmann and Preisendorfer (2003) put forth, environmental concerns will subside if the pro-environmental behavior incurs a cost. Succinctly, an individual's intention to discard his or her e-waste sustainably is likely to be reinforced if behaving sustainably is perceived as cost-free. However, the study of Nguyen et al. (2018) proved otherwise. Their findings revealed that the consumers are willing to participate in recycling e-waste despite the costs they have to pay, owing to their high awareness of the risks associated with the toxic components in e-waste if improperly managed.

"We have plans to tap the malls here in Gensan, set up drop-off points, and encourage people to bring their e-waste to the mall. Then, we will explore how to incentivize people's participation." This plan reflects a practical approach to engaging the local community by leveraging popular public spaces, like malls, to create accessible drop-off points for e-waste. On the other hand, incentivization could involve offering rewards or benefits for those who properly dispose of their old electronics, which could increase awareness and participation in e-waste management programs. However, for these initiatives to be effective, they will require careful planning, including public education, effective outreach, and a streamlined system for processing the collected e-waste (Wath et al., 2010).

Looking into these promising plans, loopholes in local infrastructure and policy-induced limitations may further compound the e-waste management challenges. While efforts are underway to address the growing e-waste problem, inadequate policy frameworks and enforcement mechanisms hinder their effectiveness. RA 9003 mandates the establishment of MRFs to support waste segregation and proper disposal (Domingo & Manejar, 2021). However, many reports highlight the inefficiencies in implementing MRFs, citing issues such as inadequate funding, unclear operational guidelines, and limited community engagement (Asian Development Bank, n.d.). These shortcomings are reflected in the key informant's statement: "*We have a Centralized Material Recovery Facility (CMRF), but it is supposed to have more facilities for plastic and e-waste processing and chemical treatment. It should be within the complex.*" Local governments struggle to manage these materials without the necessary facilities and resources for processing e-waste and other special waste (Sapuay, 2013), resulting in inefficiencies and missed opportunities for sustainable disposal practices.

In 2019, the local government launched the CMRF in Barangay Sinawal under the oversight of the UN Industrial Development Organization (UNIDO) and the DENR-EMB. The project encompasses five Asian countries—Thailand, Vietnam, Cambodia, Laos, Mongolia, and the Philippines, with a focus on General Santos City. The facility has advanced machinery, including waste conveyors, segregators, recyclable waste separators, and plastic shredders, allowing it to process up to five tons of waste per hour (Mindanao Politiko, 2019). However, according to our key informant, e-waste is "*not part of the list of other sorted waste with materials of economic value*" that the CMRF currently manages.

Based on a recent report, the city produces an estimated 300 metric tons of waste daily, a figure derived from the average per capita waste generation rate of 0.289 kilograms per person per day. Despite the large volume of waste generated, only 80 to 90 metric tons are directed to the city's sanitary landfill in Barangay Sinawal. A small fraction of the waste that reaches the landfill, around 20 metric tons, is processed at CMRF situated at the site (BIMP-EAGA, 2018). Per RA 9003, each of the city's barangays has its MRF for localized waste segregation and recycling, but three are non-operational, and the rest often underperform due to resource constraints. Smaller MRFs in schools and puroks aid in waste segregation but struggle to handle growing solid waste volumes, let alone the rising e-waste.

The city government recognizes the need to address its infrastructural barriers, which are reflected in its plans to upgrade and accredit its facilities. "*We already have plans to have our complex accredited, but we need to improve our integrated landfill. We need to complete it and have a bio or hazardous waste treatment facility,*" the informant noted. Accreditation by agencies like the DENR signifies an important step toward compliance with RA 9003, which requires meeting established environmental standards. However, significant challenges persist, including resource allocation and political will. The informant highlighted these critical hurdles: "*One hindrance to achieving our holistic waste management dream is marketing, followed by geographic gaps, and our leaders are not very receptive to*

resource allocation. Sometimes, our leaders significantly hinder making these plans a reality. It is a matter of priority." At this point, one could argue that political and institutional deadlocks impede the city's ability to turn plans into actionable and sustainable solutions.

The sentiment reflects the political dynamics shaping waste management efforts in the city. "*The success of e-waste management depends on the capabilities and manpower of individual barangays,*" our key informant remarked. While the "No Segregation, No Collection" policy empowers barangays to enforce waste segregation, the policy's effectiveness is hampered by inconsistent enforcement. *"Ideally, barangays should manage all waste types, including biodegradable, recyclable, and electronic waste."* However, the lack of consistent enforcement leaves residents without reliable options for sustainable e-waste management, turning the policy's beauty into a beast.

This situation reflects a partial yet evolving level of the city's compliance with RA 9003. If barangay local governments were to compliantly optimize their roles, such as maximizing community-based waste segregation, recycling, and reporting mechanisms, they could significantly enhance waste management systems' overall efficiency and effectiveness, bridging many of these gaps. The lack of prioritization by local leaders and the absence of robust institutional coordination not only delays necessary infrastructural improvements, such as the development of specialized e-waste processing facilities, but also perpetuates reliance on unregulated systems that exacerbate environmental harm. Improper disposal methods, particularly within the informal sector, heighten the risks of toxic substances from e-waste contaminating the environment and harming public health.

3.3 Knowledge, Attitudes, and Practice Levels for Educational Segment

Understanding E-Waste Management in the Education Sector: Awareness, Perceptions, and Behaviors

Gupta (2011) underscored educators' pivotal role in promoting e-waste management and environmental awareness. This is evident in the relatively high levels of knowledge (3.79), positive attitudes (3.62), and highly sustainable disposal methods (4.42) among Consumers from Educational Institutions (CEI), suggesting that educational institutions, as key societal influencers, foster foundational understanding and concern for e-waste issues (see Table 3). While attitudes are generally consistent, with most participating schools holding positive views (0.522) toward e-waste management, the higher variability in knowledge (0.724) indicates differing understanding or awareness of the e-waste issue. The even higher standard deviation for practices (1.24) further underscores the gap between attitudes and actual behaviors, highlighting that despite positive intentions and some awareness, significant variability exists in disposal practices, with some individuals failing to translate their attitudes into consistent behavior.

Table 3. K-A-P levels for educational institutions

	K Mean Score	A Mean Score	P Mean Score
N	22	22	22
Missing	0	0	0
Mean	3.79	3.62	4.42
Standard Deviation	0.724	0.522	1.24

E-Waste Management Barriers in Educational Institutions

Educational institutions, particularly in General Santos City, are significant contributors to the growing e-waste problem, driven by the increasing demand for technology, frequent device breakdowns, and rapid obsolescence (Adejumo & Oluduro, 2021). The shift towards digitalized learning, accelerated by the post-COVID era, has intensified the use of electronic devices, further exacerbating e-waste generation. As educational systems continue to integrate digital tools, the disposal and recycling of outdated technology become critical issues to address for sustainable e-waste management. Although recycling is often the preferred method for managing waste, it remains largely ineffective in many schools, particularly in public institutions. Administrative challenges, including stringent regulations and audit procedures, often prevent schools from exploring alternative disposal methods such as donation, resale, or direct recycling of their abandoned EEEs (Dayaday & Galleto Jr, 2022). This reflects a broader issue where, despite schools generally exhibiting positive attitudes toward sustainable disposal methods, practical challenges consistently hinder the effective implementation of these attitudes into tangible actions.

While educational institutions emphasize the importance of waste disposal and management in their curricula, the lack of proper infrastructure and institutional support makes it difficult for these practices to be consistently applied. Many schools lack designated e-waste storage areas, clear disposal guidelines, and practical training for students, which creates barriers to effective e-waste management. This lack of preparedness is in line with the findings of Licy et al. (2013), who noted that while students may understand the importance of waste segregation and recycling, these practices often fail to be consistently implemented at the household level, demonstrating the same challenges in applying awareness into action.

Moreover, the infrastructure limitations in schools are compounded by unclear disposal options and a lack of specialized knowledge. These issues are particularly pronounced when it comes to the management of e-waste, which often involves devices with valuable materials but hazardous components. Many schools also struggle with inventory management systems that could help track e-waste and ensure it is properly disposed of or recycled. This is further exacerbated by the perception that e-waste has little residual value, diminishing schools' motivation to invest in proper disposal or recycling efforts. Thus, the disconnect between theoretical knowledge and practical action remains a significant challenge in translating positive attitudes into consistent, sustainable school practices.

Our thematic data underscores these challenges, particularly with the inefficiencies in MRFs within educational institutions. A significant barrier is the lack of adequate infrastructure on many school campuses, including specialized bins, secure containment areas, and access to recycling facilities. The challenges are further aggravated by the difficulty in repairing devices due to a lack of technical expertise or equipment, contributing to the accumulation of e-waste. Additionally, schools often lack collaboration with recycling providers and municipal waste systems, which leads to improper disposal practices and increases the risk of environmental harm. Without these key partnerships, schools are left with few viable options for managing e-waste in an environmentally responsible way.

The importance of addressing these challenges is emphasized by insights from our key informant, who pointed out the compounded difficulties arising from a lack of coordinated action. The informant highlighted that despite their best efforts, the local authorities face significant limitations in enforcing effective waste management due to resource constraints. As the informant stated, *"While we can claim to enforce at 100% based on our current capacity, the reality is that our coverage is limited. Ideally, we aspire to cover a broader range of areas, but due to resource constraints, we cannot extend our enforcement efforts to all desired areas."* This observation points to a broader issue of inadequate coordination and resource allocation that hinders the effective implementation of e-waste management systems despite the willingness of local authorities to act.

Given that barangay local governments have direct jurisdiction over the commercial, educational, and residential sectors, they are uniquely positioned to drive meaningful change in the management of e-waste. Barangays can play a pivotal role in bridging the gaps in the current waste management system by strengthening their roles in waste segregation, recycling, and reporting. Empowering barangay leaders to optimize their waste management functions could significantly enhance the effectiveness of e-waste handling, ensuring more sustainable practices in schools and communities. A concerted effort at the barangay level, supported by proper infrastructure, clear guidelines, and partnerships with recycling organizations, could facilitate a more efficient and sustainable approach to managing e-waste, ultimately benefiting educational institutions and the broader community.

Solé et al. (2012) emphasized the crucial role of schools in advancing recycling efforts, noting that schools help raise awareness and encourage student and family involvement. To further tap into this potential, schools can integrate e-waste management into their curriculum, offering hands-on learning about waste segregation and recycling. Additionally, schools can act as e-waste collection points, facilitating recycling efforts within the community. Collaborations with barangay local governments and recycling organizations would further enhance the impact, ensuring a more sustainable approach to e-waste management.

3.4 Reinforcing the KAP Findings

The KAP model's assumption of a causal relationship between knowledge, attitudes, and practices has been critiqued (Launiala, 2009; Wan, Rav-Marathe, & Marathe, 2016), as challenges in accurately categorizing variables can compromise data validity (Hauser, 1993; Schopper & Doussantousse, 1993). Despite these limitations,

combining quantitative surveys with qualitative interviews enhances understanding and addresses biases. In General Santos City, this approach offers comprehensive insights into e-waste management, identifying psychosocial and systemic gaps in sustainable disposal practices.

We also recognize potential challenges regarding the reliability and validity of our research instrument due to the absence of a standard reference for the KAP model. To address these, we assessed the scale reliability using Cronbach's alpha and McDonald's Omega, yielding satisfactory results and ensuring the survey's robustness. Additionally, we conducted an item-rest correlation analysis to evaluate individual items' quality, revealing several key factors influencing e-waste disposal decisions.

The "no facility" factor emerged as the most significant barrier, with the lowest standard deviation (SD = 0.982) and highest item-rest correlation (0.454). This underscores the consensus among participants that the lack of dedicated facilities is a major issue. Other important factors include "space" (0.446) and "no specific policy" (0.446), highlighting the need for adequate storage and clear guidelines. Factors like "lack of information" (0.436) and "e-waste having no value" (0.434) point to the need for more education and recognition of e-waste's value. The "e-waste no ordinary waste" factor (0.382) also plays a role. At the same time, "repair not practical" (0.294) and "inventory and audit" (0.236) were less influential, with the latter being the least concerning for participants, particularly the households segment.

Now, we proceed with the Chi-Squared Test of Independence to help determine whether knowledge, attitudes, and practices are interlinked. The test reveals relationships between these variables by comparing observed and expected frequencies, reinforcing our KAP study.

3.5 Interplay of Knowledge-Attitudes-Practice (KAP)

The initial Chi-square test results indicated that while knowledge significantly influenced attitudes, there was no significant relationship between attitudes and disposal practices or knowledge and practices. The test for attitudes and disposal practices showed a χ^2 value of 628 with 682 degrees of freedom and a p-value of 0.932, indicating no significant relationship. Similarly, the test for knowledge and practices showed a χ^2 value of 657 with 620 degrees of freedom and a p-value of 0.148, suggesting no significant relationship. The result challenges the KAP model's assumption of a straightforward causal link between knowledge, attitudes, and practices. The findings suggest that practical barriers play a significant role in shaping e-waste disposal practices. To further explore this, we decided to rerun the contingency table, this time weighted by the "facility" factor (Table 4), to better capture the influence of infrastructure on disposal behaviors.

Table 4. Contingency Table on Attitudes and Practice Weighted by "Facility" Factor

	Disposal Spectrum							
Attitude Mean Score	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Total**
2	8	8	5	0	3	0	0	24
3	16	55	52	49	29	9	0	210
4	9	10	48	48	19	4	5	143
5	0	0	5	4	3	0	0	12
Total	33	73	110	101	54	13	5	389

Table 4 illustrates the contingency table between Attitude Mean Scores and e-waste disposal practices (Disposal Spectrum levels 1 to 7), weighted by the "Facility" factor. Notably, individuals with an Attitude Mean Score of 3, exhibiting the highest frequency (55) at Disposal Spectrum level 2 (hoarding), suggest that certain attitudes toward e-waste disposal may be strongly linked to specific disposal practices, such as the tendency to hoard old electronics rather than dispose of them responsibly. This pattern implies that individuals with a neutral or moderately positive attitude towards e-waste may not prioritize disposal or recycling due to a lack of urgency or understanding of the consequences of improper disposal.

The Chi-Square test yielded a χ^2 value of 66.6 ($df = 18$, $p < 0.001$), affirming a statistically significant relationship between attitudes and practices. This implies that variations in attitudes are closely linked to differences in e-waste disposal behaviors, emphasizing the importance of addressing attitudinal factors when designing interventions. Similarly, the contingency table between knowledge and disposal spectrum produced a χ^2 value of 78.5 ($df = 24$, $p < 0.001$), further demonstrating a significant association. This suggests that individuals with higher

knowledge levels about e-waste disposal are more likely to adopt specific disposal practices shaped by the accessibility and adequacy of disposal facilities. The findings highlight the potential for knowledge-based interventions to improve e-waste management behaviors. Both Chi-Square tests demonstrate the critical role of contextual factors, particularly facility availability, in shaping the interplay between attitudes, knowledge, and practices. The results indicate that enhancing access to appropriate e-waste disposal options and focused educational initiatives can close the gap between awareness and proactive behavior, fostering more sustainable e-waste management practices.

A related study by Nurcahyo, Wibowo, Gabriel, Sopha, and Ma'aram (2024) introduced the Community-Based Willingness to Recycle (CWTR) model, which integrates attitudes, perceived behavioral control, and subjective norms within the context of community engagement. The CWTR model explained 39.5% of the variance in recycling behaviors, aligning with our findings. Both studies emphasize the multifaceted nature of e-waste management behaviors, highlighting the importance of knowledge, attitudes, social norms, infrastructure, and community involvement.

4.0 Conclusion

Despite some challenges, the KAP model proves valuable and cost-effective when considered. By combining quantitative surveys with key informant interviews, this study offers a comprehensive understanding of e-waste management behaviors in General Santos City. While the survey identified patterns in awareness and behavior, qualitative data uncovered underlying factors such as infrastructure gaps, space constraints, policy enforcement issues, and gaps in public awareness. This analysis was validated through item-correlation statistics and the weighted chi-squared test, with qualitative insights adding greater breadth and depth to the findings. Therefore, this mixed-methods approach effectively overcame the limitations of purely quantitative models by blending broad survey reach with detailed interview insights.

The study contributes to the literature by highlighting context-specific factors influencing e-waste management in General Santos City. It provides unique insights into local challenges and opportunities, contributing to the knowledge of e-waste management in developing cities, where informal practices and infrastructure gaps are common. Additionally, it demonstrates how localized factors—such as space constraints, policy enforcement, and public awareness—affect sustainable e-waste disposal behaviors, offering valuable lessons for other urban contexts. This research paves the way for more context-sensitive strategies to improve e-waste management in regions with similar challenges.

However, the study faced challenges regarding the reliability and validity of the research instrument. The lack of a standardized reference for the KAP model in e-waste management may have affected data consistency. We assessed the scale reliability to address this, which showed satisfactory results. Future improvements to the survey instrument, such as refining item wording and structure, pilot testing, and gathering feedback, could enhance clarity and alignment with measured constructs. Increasing the sample size and ensuring greater diversity would further enhance the reliability and validity of the findings.

Future studies could utilize longitudinal or experimental approaches to gain more insight into causal dynamics. A longitudinal study would track changes, providing insights into how attitudes, knowledge, and practices evolve. Experimental methods, such as randomized controlled trials (RCTs), could assess the impact of targeted interventions, including nudge-driven awareness strategies or improved disposal infrastructure, in influencing e-waste disposal habits.

This study highlights a key challenge in e-waste management: awareness of environmental and economic impacts does not always lead to responsible e-waste disposal behaviors. The discrepancies between knowledge, attitudes, and practices across the three segments of EEE consumers suggest that while individuals generally understand the importance of e-waste management and support sustainable practices, practical challenges, such as unclear options, and lack of awareness prevent them from consistently translating these intentions into action. Solutions must address systemic issues, complementing awareness campaigns with accessible disposal facilities, strong policies, and social norm shifts to encourage responsible behavior. Inadequate and fragmented policies contribute to inconsistent, informal e-waste management practices. Without clear regulations, stakeholders—such as

businesses, educational institutions, and residents—adopt varying approaches, leading to improper disposal and recycling, including unregulated disposal sites and hazardous material mishandling, which increase environmental and health risks.

Extended Producer Responsibility (EPR) can be implemented locally, even without national legislation. Under the Local Government Code (RA 7160) enacted in 1991, local governments may enact ordinances addressing waste management. These local ordinances can require stakeholders to manage the end-of-life of their items, such as establishing e-waste collection points at retail locations or recycling centers. By voluntarily adopting EPR practices as part of their corporate social responsibility (CSR), producers can collaborate with retailers and NGOs to create take-back programs. These partnerships facilitate e-waste collection, recycling, and proper disposal while also bridging critical data gaps on e-waste flows. Collecting data on the types and volumes of e-waste will inform more effective strategies for future e-waste management and help track progress in managing this growing waste stream. Clear product labeling and consumer education campaigns are also essential for promoting responsible disposal. Local pilot programs within commercial business districts can serve as models, offering valuable insights to support the eventual adoption of national EPR policies.

While advanced recycling technologies such as pyrometallurgy and hydrometallurgy are prevalent in industrialized nations, Philippine cities, including General Santos, often lack the infrastructure and expertise to implement them effectively. This has led to relying on informal e-waste handling sectors, which frequently employ unsafe and inefficient practices. Addressing this issue requires a cost-effective and sustainable management system designed specifically for the city's context. E-waste items, such as mobile phones, laptops, and household appliances, are composed of diverse materials, including plastics, metals (e.g., copper, gold, and aluminum), and hazardous substances like lead and mercury. When efficiently recovered, these components hold significant value but can pose serious environmental and health risks if improperly handled. Thus, urban mining offers a promising solution by extracting these valuable resources, supporting EPR initiatives, reducing environmental impact, and lessening reliance on virgin materials.

Formalizing urban mining is both practical and achievable by establishing regulated facilities for e-waste collection, manual disassembly, and material recovery while integrating these facilities into the city's broader waste management system. Partnerships with the private sector can play a crucial role in this effort, particularly through public-private collaborations that provide funding, technical expertise, and operational support for urban mining facilities. Private companies can also contribute by setting up buy-back programs, incentivizing proper e-waste disposal, and sharing advanced technologies for material recovery. These partnerships ensure that urban mining initiatives are sustainable and aligned with industry best practices.

This approach ensures the efficient recovery of valuable materials and addresses the challenges of informal e-waste handling by providing training, fair wages, and safer working conditions for workers. Institutional mechanisms further reinforce urban mining, with key actions including stricter regulations on e-waste management, upgrading materials recovery facilities (MRFs) in communities, schools, and establishments in the barangays and puroks, and capacity-building programs to develop a skilled workforce. Additionally, incentive systems such as buy-back schemes for electronics and public awareness campaigns can encourage proper disposal and increase the volume of e-waste entering formal recycling streams. Optimizing existing municipal solid waste management (MSWM) systems to incorporate e-waste processing, alongside adopting the "Best-of-2-Worlds" approach—where developing regions focus on manual pre-processing while advanced economies handle post-processing with sophisticated facilities—can bridge technological gaps.

"Governance from below" emphasizes empowering barangays through localized decision-making and community-driven actions, as outlined in the Local Government Code of the Philippines. This decentralized approach strengthens e-waste management, ensuring more effective and sustainable solutions. Building on this framework, General Santos City can adopt the principle of "think globally, plan regionally, act locally." This enables the city to develop a unique e-waste strategy, aligning with regional and global best practices while leveraging local resources and partnerships. Such coordination ensures that both local and regional efforts contribute to a sustainable urban mining system, supporting the circular economy.

5.0 Contributions of Authors

[1]Garcia, R. – Conceptualization, Methodology, Data Collection, Data Analysis, Writing - Original Draft
[2]Marcilla, A. – Conceptualization, Validation, Supervision and Guidance, Professional Development
[3]Flores, L. – Methodology, Validation, Critical Evaluation, Feedback, Professional Development
[4]Lapong, E. – Methodology, Validation, Critical Evaluation, Feedback, Professional Development

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Public Safety Challenges Faced by Barangay Officers and Police: Towards a Stronger Policy Framework

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Abstract. This study examines public safety challenges and collaboration between Barangay Public Safety Officers and the National Capital Region Police Office (NCRPO), aiming to enhance police-community partnerships and strengthen public safety measures in the National Capital Region. Using a descriptive-correlational research design, data were collected from 45 barangay public safety officers and 45 NCRPO police officers through questionnaires. The study explored correlations between identified challenges and the effectiveness of public safety measures to propose an improved policy framework. Findings reveal high effectiveness in current public safety measures, supported by excellent police service delivery, strong local executive backing, and robust community partnerships. Respondents, predominantly middle-aged male college graduates, consistently perceived public safety measures positively across demographic categories. However, critical challenges persist in community engagement, organizational support, and policing strategies, reflecting systemic issues common to other regions and departments. A perfect linear correlation was found between these challenges and the effectiveness of public safety measures, underscoring their direct impact on overall performance. The study emphasizes addressing these challenges to enhance public safety outcomes and foster stronger police-community collaborations, providing valuable insights for policy improvements in the NCR.

Keywords: Public safety; Collaboration; Barangay; Police-community partnerships; Policy framework.

1.0 Introduction

Building trust between law enforcement agencies and communities is essential for public safety and effective policing. Strong police-community relationships foster cooperation, encourage crime reporting and improve collective problem-solving. However, these relationships often face challenges, particularly in urban areas where police misconduct or controversial events can erode trust and cooperation. For instance, Kristin et al. (2017) noted that single acts of misconduct might cause lasting damage to police-community interactions, drawing national attention and reducing trust. Efforts to rebuild trust emphasize transparency and active engagement. Transparency, as Gove (2018) suggests, requires law enforcement agencies to share accurate and timely information about incidents and policies. This ensures that communities feel informed and involved. Additionally, cultural competency training and active community presence, as highlighted by Walker and Archbold (2018), are crucial for addressing biases and strengthening ties in diverse populations.

In the Philippines, the Philippine National Police (PNP) has adopted community policing strategies to foster collaborative efforts with residents. The Directorate for Police Community Relations (2015) identified community

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policing as vital for crime prevention, public safety, and peace. However, despite initiatives such as the Integrated Command and Control Centre (iC3) launched by the National Capital Region Police Office (NCRPO) in 2017, challenges persist. High crime rates and low safety indexes suggest a gap between policies and outcomes in cities like Manila.

Previous studies emphasize the importance of police-community partnerships in crime prevention and public satisfaction with police services (Kole, 2016; Hawkins, 2018). These studies agree that mutual trust and collaboration improve law enforcement effectiveness. Similarly, local authors like Duque (2017) and Banaynal-Fernandez (2017) highlight the need for strong partnerships between barangay public safety officers and police to enhance community presence and reduce crime. However, gaps remain in understanding the specific challenges and needs of these partnerships in the Philippine context. This study focuses on assessing public safety challenges and collaborating between barangay public safety officers and the NCRPO. This research aims to strengthen police-community partnerships, improve public safety, and address persistent challenges in the National Capital Region by identifying obstacles and proposing an enhanced policy framework.

2.0 Methodology

2.1 Research Design

This study employed the descriptive correlational research design to determine the assessment and challenges encountered in public safety by barangay public safety officers and the national capital region police office toward an enhanced policy framework. According to Shuttleworth (2016), descriptive design is an appropriate methodology for investigating specific issues and as an initial step before doing more extensive quantitative studies. Moreover, according to Bueno (2019), the descriptive-correlational design involves collecting data to address inquiries about the matter's current state. Correlations examine the magnitude, direction, and strength of relationships or links. Furthermore, according to Sousa (2017), correlational research findings can serve as a basis for formulating hypotheses that can be tested in quasi-experimental and experimental studies. The current study employed a non-interventional methodology to evaluate the correlation between participants' scores on two measures without influencing the examined variables.

2.2 Research Participants

This study employed the simple random sampling technique to draw the samples of this study. There were forty-five (45) police officers in the NCRPO and forty-five (45) barangay police safety officers who answered the research questionnaire.

2.3 Research Instrument

The respondents were tasked to answer the researcher-modified instrument. The instrument contains three (3) parts. The first part contained questions about the respondents' profiles, such as age, sex, and educational qualifications. Part II primarily stipulated the respondents' public safety assessment regarding police service delivery, support of local executives, and community partnership. Lastly, Part III included the challenges encountered by the Barangay Public Safety Officer and National Capital Region Police Officer regarding public safety. The questions were based on research-modified instruments based on the Implementing Guidelines for City/ Municipal Community and Service-Oriented Policing System (CSOP); NAPOLCOM Resolution No. 2015-342.

2.4 Data Gathering Procedure and Analysis

The data gathering started after the colloquium or Pre-Orals and after the researcher-modified instrument had been evaluated by the researcher's mentor and face validated by at least three specialists in the field of investigation. The researcher considered all the necessary revisions on the research instrument. In order to make the administration of the instrument as easy as possible, the researcher sent a letter of request to pertinent departments in the NCRPO and barangays where the respondents are located. After a week of field surveying, the data was tallied and coded with the help of the researcher's statistician so that the researcher could never go wrong when treating the acquired data. The data was analyzed using the International Business Machines (IBM)-developed Statistical Package for Social Sciences (SPSS) version 20.0. (IBM).

3.0 Results and Discussion

3.1 Profile of the Respondents

Table 1 presents the respondents' assessments according to their profiles in terms of age, sex, and educational qualification.

Table 1. Descriptive statistics of the profile of the respondents

	Police Officers	Safety Officers	Frequency	Percentage
Age				
71 years old and above	0	1	1	1.11
61-70 years old	0	3	3	3.33
51-60 years old	0	7	7	7.78
41-50 years old	9	15	24	26.67
31-40 years old	26	12	38	42.22
20-30 years old	10	7	17	18.89
Gender				
Male	33	40	73	81.11
Female	12	5	17	18.99
Education				
Doctorate Graduate	1	0	1	1.11
Masters Graduate	5	1	6	6.67
Masters Units	14	1	15	16.67
College Graduate	25	4	29	32.22
College Level	0	8	8	8.89
Vocational	0	9	9	10.00
High School Graduate	0	7	7	7.78
High School Level	0	3	3	3.33
Elementary Graduate	0	10	10	11.11
Elementary Level	0	2	2	2.22

The data show the distribution of respondents across different age brackets, providing an overview of the age diversity within the sample population. This also affirms the study of Franssen et al. (2020), which investigates the correlation between demographic variables, namely age groups, and different health outcomes, such as chronic illnesses, mental well-being, and healthcare consumption patterns. The study examines the health experiences and management strategies of several age groups within the middle-aged population, such as individuals aged 31-40 and 41-50. Also, the data analysis emphasizes the distribution of genders among the respondents, emphasizes possible gender inequalities, and encourages reflection on the representativeness of the sample and the methodologies used for analysis. Although there is a growing emphasis on incorporating sex-disaggregated statistics into national programs and comprehending the impact of gender-based inequalities on overall health, there is still a dearth of data needed to uncover the root causes of gender disparities and develop successful intervention programs (Weber et al., 2021). Further, the table sheds light on the respondents' educational backgrounds, revealing various educational experiences, with college graduates making up the largest group. Understanding the educational background of the people under study may benefit from knowing this information. The result resonates with the study of Tondo et al. (2020).

3.2 Assessment of the Level of Public Safety

In terms of Police Service Delivery

Table 2 presents the mean and interpretation of the respondents' levels of public safety assessment in terms of police service delivery. As can be seen in the table, the overall assessment concerning public safety in terms of police service delivery" had an overall weighted mean of 3.85, which was verbally interpreted as "Highly Observed. " All items related to police service delivery were rated within the 'Highly Observed' range, indicating a generally favorable perception of police services concerning public safety. The realization of the Filipino people's long-term vision of a matatag, maginhawa, at panatag na buhay para sa lahat rests upon an environment that is safe, secure, and orderly. The government has to ensure that all Filipinos feel secure enough to walk and travel around all places in the country without fear of harming themselves and their property. They can go about their business, economic, and social pursuits. Moreover, as the country pursues greater economic development, the government must safeguard national interests, territory, and sovereignty (PDP 2017-2022). The first steps toward ensuring community safety are the vigorous pursuit of criminal behavior and the equally vigorous defense of each person's rights to privacy, independence, and tranquility (Martinez, 2019).

Table 2. Descriptive statistics of the level of public safety in terms of police service delivery

Indicators	Police Officers		Safety Officers		Composite Mean	
	Mean	Interpretation	Mean	Interpretation	Mean	Interpretation
1) There is initiative and coordination with the local executives and members of the citizenry.	3.88	Highly Observed	3.80	Highly Observed	3.84	Highly Observed
2) The local executives and community members are oriented on the policing system, and their support is solicited.	3.92	Highly Observed	3.88	Highly Observed	3.90	Highly Observed
3) There is a consultation with all stakeholders in identifying problems in the community	3.84	Highly Observed	3.90	Highly Observed	3.87	Highly Observed
4) There are community assemblies for various sectors and marginalized groups.	3.78	Highly Observed	3.85	Highly Observed	3.82	Highly Observed
5) There are strategies to address the identified community problems.	3.75	Highly Observed	3.82	Highly Observed	3.79	Highly Observed
6) There is an opportunity to collaborate to address persistent crime, public safety, and problems related to delivering basic services.	3.87	Highly Observed	3.89	Highly Observed	3.88	Highly Observed
7) Problem-solving is promoted to identify crime and community problems.	3.91	Highly Observed	3.87	Highly Observed	3.89	Highly Observed
8) Specific issues and concerns that most threaten the safety and well-being of residents in the area are identified.	3.83	Highly Observed	3.89	Highly Observed	3.86	Highly Observed
9) There are changes in the police systems and procedures in the precinct.	3.77	Highly Observed	3.84	Highly Observed	3.81	Highly Observed
10) The benefits of change are explained, steps for change to occur are identified, and an organization-wide commitment to change is created.	3.74	Highly Observed	3.81	Highly Observed	3.78	Highly Observed
Overall Composite Mean	**3.83**	**Highly Observed**	**3.86**	**Highly Observed**	**3.85**	**Highly Observed**

Legend: 3.26-4.00 Highly Observed, 2.50-3.25 Observed, 1.76-2.49 Less Observed, 1.00-1.75 Not Observed

In terms of Support of Local Executives

Table 3 presents the mean and interpretation of the respondents' assessment level concerning public safety in terms of support of local executives.

Table 3. Descriptive statistics of the level of public safety in terms of support of local executives

Indicators	Police Officers		Safety Officers		Composite Mean	
	Mean	Interpretation	Mean	Interpretation	Mean	Interpretation
1) There is formulation and adoption of effective coordination, cooperation, and consultation mechanisms.	3.88	Highly Observed	3.80	Highly Observed	3.84	Highly Observed
2) A three-year, term-based Peace and Order and Public Safety Plan exists.	3.92	Highly Observed	3.88	Highly Observed	3.90	Highly Observed
3) There is a Peace and Order Council (POC) quarterly meeting or as often as needed.	3.84	Highly Observed	3.90	Highly Observed	3.87	Highly Observed
4) There is performance and exercise of other functions and duties as may be duly authorized by the NAPOLCOM.	3.78	Highly Observed	3.85	Highly Observed	3.82	Highly Observed
5) There is strategic planning for partnership.	3.75	Highly Observed	3.82	Highly Observed	3.79	Highly Observed
6) There is ensured assistance and support to the Integrated Area/Community Public Safety Plan.	3.87	Highly Observed	3.78	Highly Observed	3.83	Highly Observed
7) All partner agencies/organizations must cooperate fully in meetings, trainings, and seminars.	3.91	Highly Observed	3.87	Highly Observed	3.89	Highly Observed
8) Monitoring and evaluation activities are performed for the policing programs and projects.	3.83	Highly Observed	3.89	Highly Observed	3.86	Highly Observed
9) The necessary personnel are designated, and other resources are mobilized to ensure the successful implementation of community policing.	3.77	Highly Observed	3.84	Highly Observed	3.81	Highly Observed
10) Information, education, and communication activities are implemented.	3.74	Highly Observed	3.81	Highly Observed	3.78	Highly Observed
Overall Composite Mean	**3.83**	**Highly Observed**	**3.84**	**Highly Observed**	**3.84**	**Highly Observed**

Legend: 3.26-4.00 Highly Observed, 2.50-3.25 Observed, 1.76-2.49 Less Observed, 1.00-1.75 Not Observed

All aspects of public safety support from local executives, as assessed by police officers and barangay public safety officers, have been rated in the 'Highly Observed' range (composite mean scores between 3.74 and 3.92). This suggests a strong presence or implementation of the measures detailed in the table. The overall composite mean across all items is 3.84, reflecting consistent support execution across different public safety domains, with no significant deviations into lower observation categories. Despite the overall high ratings, the fact that certain items had slightly lower means than others suggests there are specific areas where police services might still improve, even within the context of generally high performance.

The City and Municipal Mayors, as defined under R.A 8551, shall have the power to direct, superintendent, and oversee the day-to-day functions of police investigations of crime, crime prevention activities, and traffic control by the rules and regulations promulgated by the commission. This also affirms the study of Campoy and Campoy (2022). The results indicated that the local chief executive's legal utilization of automatic deputation positively affected police operations. The mayor's ability to oversee and manage the Philippine National Police is a powerful tool of the government that ensures the provision of skilled and outstanding police services to the public.

In terms of Community Partnership

Table 4 presents the mean and interpretation of the respondents' levels of public safety assessment in terms of community partnership.

Table 4. Descriptive statistics of the level of public safety in terms of community partnership

Indicators	Police Officers		Safety Officers		Composite Mean	
	Mean	Interpretation	Mean	Interpretation	Mean	Interpretation
1) Considering the police's inadequacies in manpower, mobility, communications, and firepower, help is needed to fill the gap in policy deficiencies.	3.88	Highly Observed	3.80	Highly Observed	3.84	Highly Observed
2) Partnerships and alliances exist with all interested groups, NGOs, and civic organizations.	3.92	Highly Observed	3.88	Highly Observed	3.90	Highly Observed
3) There is an explanation of specific tasks, contributing resources, identifying accountabilities, and sharing responsibilities.	3.84	Highly Observed	3.90	Highly Observed	3.87	Highly Observed
4) There is a community policing information and education advocacy program.	3.78	Highly Observed	3.85	Highly Observed	3.82	Highly Observed
5) There is data, information, and input from police and local executives on problems, issues, and concerns.	3.75	Highly Observed	3.82	Highly Observed	3.79	Highly Observed
6) There is mobilization and organization of volunteers as force multipliers who can assist in intelligence information-gathering, incident or crime reporting, neighborhood watch or *Ronda* system; medical and traffic assistance; and emergency and disaster response	3.87	Highly Observed	3.79	Highly Observed	3.83	Highly Observed
7) Resources are shared, and assistance is provided in implementing community policing programs, projects, and activities.	3.91	Highly Observed	3.87	Highly Observed	3.89	Highly Observed
8) There is work within the established and existing local interagency coordinating mechanisms in the locality.	3.83	Highly Observed	3.89	Highly Observed	3.86	Highly Observed
9) There is conduct of regular and structured meetings ("long-long") and public fora or dialogues with the community	3.77	Highly Observed	3.84	Highly Observed	3.81	Highly Observed
10) There is planning and implementation of neighborhood watch or other self-help mechanisms that encourage local community involvement in policing	3.74	Highly Observed	3.81	Highly Observed	3.78	Highly Observed
Overall Composite Mean	**3.81**	**Highly Observed**	**3.85**	**Highly Observed**	**3.83**	**Highly Observed**

Legend: 3.26-4.00 Highly Observed, 2.50-3.25 Observed, 1.76-2.49 Less Observed, 1.00-1.75 Not Observed

The table shows that the respondents' public safety assessment regarding community partnership had an overall composite mean of 3.83, with an interpretation of "Highly Observed." The community partnership aspects related to public safety are overall highly observed, with composite mean scores ranging from 3.74 to 3.92, indicating strong engagement in public safety efforts. The overall composite mean for both Police Officers and Barangay Safety Officers is 3.83, which falls into the 'Highly Observed' category and illustrates a strong overall engagement between the community and the safety officers in terms of partnerships for public safety.

Low legitimacy and lack of trust limit the state's capacity to provide public goods and services. This problem is particularly pertinent to policing, where officers need information about what is happening in the community to provide services effectively and efficiently. Citizens give the police information about the most pressing problems, the location of crime hotspots, concerns about suspicious people or activities, and reports of crimes. The police use this information to allocate their limited resources to prevent crime and ensure public safety.

Summary

Table 5 summarizes the respondents' assessment level concerning public safety regarding police service delivery, support of local executives, and community partnership.

Table 5. Descriptive statistics of the level of public safety

Indicators	Police Officers		Safety Officers		Composite Mean	
	Mean	Interpretation	Mean	Interpretation	Mean	Interpretation
1) police service delivery	3.83	Highly Observed	3.86	Highly Observed	3.85	Highly Observed
2) support of local executives	3.83	Highly Observed	3.84	Highly Observed	3.84	Highly Observed
3) community partnership	3.81	Highly Observed	3.85	Highly Observed	3.83	Highly Observed
Overall Composite Mean	**3.82**	**Highly Observed**	**3.85**	**Highly Observed**	**3.84**	**Highly Observed**

All three categories have all items within the 'Highly Observed' range, which indicates a strong agreement or frequency of observation by the respondents across all safety aspects. The highest composite mean score of 3.85 in this aspect, seen in both Police Officers and barangay public safety officers, reflects that respondents most positively review police service delivery. The overall mean across all the variables (3.84) is within the 'Highly Observed' category, signifying a general perception that all areas reviewed are strongly implemented regarding public safety measures. The close range of scores and the consistently high rating for all categories for both groups indicate a consensus in the perception of these aspects of public safety across both types of respondents. While all items have high observations, specific nuances in their composite scores can identify potential areas for further improvement or highlight existing strengths in public safety efforts.

The results affirm the study of Micah et al. (2023). The findings suggest that effective police service delivery, support from local government officials, and strong community partnerships significantly improve public safety outcomes and increase community satisfaction. The research emphasizes the significance of cooperation among law enforcement organizations, local government authorities, and community stakeholders in advancing efficient community policing strategies.

3.3 Comparison of the Assessment of the Respondents Concerning Public Safety When Grouped According to their Profile

Table 6 shows no significant difference between the police officers and the barangay public safety officers when grouped according to age. This is indicated in the computed chi-square value of 7.7 with a p-value of 0.103, which is at the 0.05 significance level. Since the null hypothesis has been accepted, there is no significant difference in the respondents' ages. The study conducted by Maskály et al. (2021) implies that there is no statistically significant disparity in age between the two groups, indicating that the demographic characteristics of these law enforcement professionals are similar. The study also examines the consequences of hiring, educating, and working together between police and community safety personnel to enhance public safety.

Table 6. Analysis of the difference in the assessment of the respondents concerning public safety when grouped according to their profile

Profile	X^2	p-value	Interpretation	Decision
Age	7.70	0.103	Not significant	Accepted
Sex	9.52	0.072	Not significant	Accepted
Educational Qualification	8.92	0.061	Not significant	Accepted

Also, there is no significant difference when grouped according to sex. The chi-square value is 9.52, with a p-value of 0.07, higher than the 0.05 significance level. The hypothesis that there is no significant difference between the sex of the respondents was accepted. Hence, gender does not seem to be a discerning characteristic among the groups in the sampled population. Harvey's (2017) study examines disparities in communication methods, conflict resolution strategies, and attitudes toward community involvement among male and female officers. The

study also reveals how gender norms and societal expectations influence officers' comprehension and implementation of caring in their policing tactics.

Finally, no significant difference exists when grouped according to their educational qualification. Thus, the hypothesis that there is no significant difference between the respondents' educational attainment was accepted. Mubita et al. (2022) state that higher education often correlates with improved employment chances. However, other characteristics, including field of study, work experience, and socioeconomic background, also play important roles in determining an individual's career trajectory. The study emphasizes the importance of considering various factors when analyzing the connection between employment outcomes and schooling.

3.4 Challenges Encountered

It can be gleaned from Table 7 that the respondents perceived challenges encountered by the Barangay Public Safety Officer and National Capital Region Police Officer in terms of public safety as "Highly observed," with an overall mean of 3.84. indicating that, generally, these public safety challenges are a real and frequent concern for both the Barangay Public Safety Officer and the National Capital Region Police Officer. Helfers and Nhan's (2021) research shows that increased collaboration between barangay public safety officials and the National Capital Region Police Office (NCRPO) is needed to handle complicated public safety issues successfully. The study also covers implications for practice and policy in enhancing law enforcement operations and fostering community safety in the NCR.

Table 7. Descriptive statistics of the challenges encountered

Indicators	Police Officers		Safety Officers		Composite Mean	
	Mean	Interpretation	Mean	Interpretation	Mean	Interpretation
1) The community does not play a more active and coordinated part in enhancing peace and order.	3.88	Highly Observed	3.80	Highly Observed	3.84	Highly Observed
2) The police do not have a new responsibility to devise appropriate ways of associating the community with law enforcement and maintaining order.	3.92	Highly Observed	3.88	Highly Observed	3.90	Highly Observed
3) The police stations do not collaborate with their communities to resolve crime and quality-of-life issues.	3.84	Highly Observed	3.90	Highly Observed	3.87	Highly Observed
4) There are no developed ways to identify community problems and concerns.	3.78	Highly Observed	3.85	Highly Observed	3.82	Highly Observed
5) No resources are available from the police station and the community to provide viable solutions.	3.75	Highly Observed	3.82	Highly Observed	3.79	Highly Observed
6) There are no fundamental changes in the policing strategy.	3.87	Highly Observed	3.79	Highly Observed	3.83	Highly Observed
7) There are no organizational changes that support problem-solving in the communities.	3.92	Highly Observed	3.87	Highly Observed	3.89	Highly Observed
8) There is no stimulation of the policemen, and more satisfaction within the community and the establishment of a contemporary police station are not produced.	3.83	Highly Observed	3.89	Highly Observed	3.86	Highly Observed
9) Community policing is viewed not as a quick remedy but as a long-range effort with specific evolutionary phases.	3.77	Highly Observed	3.84	Highly Observed	3.81	Highly Observed
10) The police officers and private citizens are not working together in creative ways.	3.74	Highly Observed	3.81	Highly Observed	3.78	Highly Observed
Overall Composite Mean	**3.83**	**Highly Observed**	**3.85**	**Highly Observed**	**3.84**	**Highly Observed**

Legend: 3.26-4.00 Highly Observed, 2.50-3.25 Observed, 1.76-2.49 Less Observed, 1.00-1.75 Not Observed

3.5 Policy Framework

This enhanced policy framework for public safety is based on the study's results on challenges encountered by barangay public safety officers and the national capital region police office regarding police service delivery, support of local executives, and community partnership. Public safety is essential in building the foundation for inclusive growth, a high trust and resilient society, and a globally competitive knowledge economy. People feel safe wherever they are in the country and are able to go about their business, economic, or social pursuits as long as they do not violate other people's economic, social, and cultural rights. Such a condition enables the free flow of goods and services.

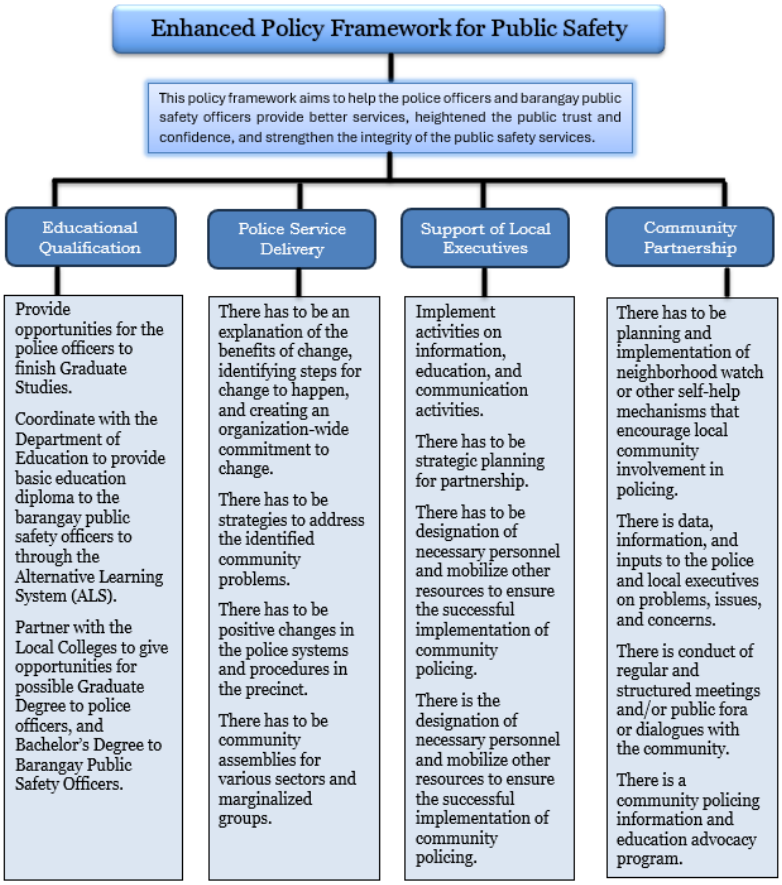

Figure 1. Proposed policy framework

Therefore, along with the current peace, security, public order, and safety of the government, the researcher has proposed additional recommendations for an enhanced policy framework for public safety. This framework aims to help police officers and barangay public safety officers provide better services, heighten public trust and confidence, and strengthen the integrity of the public safety services.

4.0 Conclusion

The study underscores the high effectiveness of public safety measures within the community under investigation, as evidenced by excellent police service delivery, strong local executive support, and robust community partnerships. These elements contribute to a well-received and efficient public safety framework. Demographically, the respondents are predominantly middle-aged males, many of whom hold college degrees, reflecting an educated population actively engaging in public safety assessments. Importantly, perceptions of public safety were consistent across demographic categories such as age, sex, and educational attainment, suggesting a broad agreement on the effectiveness of public safety measures.

Despite this positive assessment, the study identifies critical challenges faced by Barangay Public Safety Officers and National Capital Region Police Officers, particularly in community engagement, organizational support, and policing strategies. These challenges are consistent with those encountered in other regions and police departments, indicating systemic issues within public safety frameworks. The findings further reveal a perfect linear correlation between these challenges and the effectiveness of public safety measures, highlighting their direct impact on the system's overall performance. This correlation emphasizes the urgent need to address these challenges to maintain and enhance public safety outcomes.

5.0 Contribution of Authors

I hereby declare that this submission is my own work and that, to the best of my knowledge and beliefs, it contains material previously published or written by another person nor material which to a substantial extent has been accepted for award or any other degree.

6.0 Funding

Non declared.

7.0 Conflict of Interest

Non declared.

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Development and Validation of a Human Geography Module for Social Studies Instruction

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Abstract. The research's main objective is to create a comprehensive module to enhance students' understanding and appreciation of Human Geography. Utilizing a mixed-method approach within a developmental design framework, the study involves developing and validating the module, supported by feedback from six expert validators. The validation process employs a standard checklist and measures the module's effectiveness through the Content Validity Index (CVI), which shows strong approval from validators. Additional insights are gathered from structured interviews with thirty participants, further affirming the module's positive reception. The abstract suggests that the module significantly improves student engagement and learning outcomes, with the potential for future studies to explore its long-term impact on educational practices in social studies. This streamlined version is concise, focusing on essential information to ensure a complete research summary, aligning with academic standards and contributing to the field's advancement.

Keywords: Content Validity Index (CVI); Curriculum development, Human geography; Mixed methods research; and Social Studies instruction

1.0 Introduction

Education inside the four walls of the classroom is insufficient to create good citizens as it revolves around the students practicing the knowledge they have acquired and applying it to influence others. With that in mind, the Mindanao State University College of Education implemented the new Social Studies curriculum in 2018. This program imparts information on the six disciplines, namely Geography, History, Anthropology, Economics, Political Science, and Sociology, preparing learners to become responsible citizens, critical thinkers, innovators, and more, thus providing the students the means to understand society's functions and acquire the skills to adapt to a culturally diverse world. This, in turn, allows them to establish a connection with the ever-changing world around them.

The Social Studies domain includes Human Geography, an important area of study that examines the dynamic relationships between people, places, and environments and how these evolve and space. Abu Talib, Mohamad, and Wahab's (2015) study states that numerous modules have been developed with various goals in mind, including enhancing motivation, facilitating the teaching and learning process, raising the bar for leadership, and

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more. A module is a collection of ideas related to the topics covered in each unit that aids in mastering one subject before going on to the next subtopic. Despite its importance, no module has yet been developed for SSE103 (Human Geography), leaving practicing teachers and students without a standardized reference for teaching and learning this course. This gap in instructional resources highlights the need for a well-designed module to serve as a comprehensive guide for educators and learners.

2.0 Methodology

2.1 Research Design

Utilizing a mixed-method research design, as Creswell & Creswell (2018) outlined, this approach integrates quantitative and qualitative data to facilitate a comprehensive understanding of the module's effectiveness. The research design involves distributing a modified 24-item checklist adapted from Abdelmohsen (2020) to six validators and conducting interviews with 30 Social Studies students using open-ended questions to assess the perceived usefulness of the module. This study was conducted at the MSU Marawi campus and Al-Khwarizmi International College (AKIC) during the 2022-2023 academic year, capitalizing on their proximity and accessibility to reduce logistical challenges and costs.

2.2 Research Participants

The research participants comprised six validators chosen for their expertise in Social Studies education, including professors from the History Department and a professor from RC-Al Khwarizmi International College Foundation Inc. (RC-AKIC), as well as thirty (30) students who had completed the Human Geography course. This selection aligns with the principles outlined by Auta et al. (2021), emphasizing that involving experts enhances the reliability and credibility of the study.

2.3 Research Instrument

The research instruments used were a modified and content-validated 24-item checklist adapted from Abdelmohsen (2020) for the validators and an interview guide for the students, with questions adapted from Goode (2003) to facilitate in-depth responses.

2.4 Data Gathering Procedure

Data gathering was planned to ensure comprehensive coverage and high validity of the findings. Validators were first asked for feedback on the module draft, followed by a validation checklist to confirm the content's appropriateness. Student interviews were conducted to gauge the module's practical utility and usability, with all responses carefully recorded and documented.

2.4 Data Analysis

The researchers employed both quantitative and qualitative data analysis in their examination and interpretation of the obtained data. The survey data were categorized according to the method of data collection. The content validity of the developed module was assessed by applying the I-CVI and S-CVI, which were developed by Yusoff's (2019) study, to the data collected from the experts. Meanwhile, for the quantitative data analysis, the data acquired started with a series of interview transcripts, which were then analyzed for usefulness. Following transcription, the researchers used theme analysis to narrow the data and draw some findings. The usefulness of the designed module was assessed using a thematic analysis of the student replies. The investigators conducted a theme analysis based on the following, adhering to Braun and Clarke's (2006) stages framework: Familiarization, Coding, Constructing Themes, Review and Modification, Defining Themes, and Writing, Interpretation, and Analysis.

2.5 Ethical Considerations

Ethical considerations were rigorously adhered to, with participant consent obtained and confidentiality maintained as per the guidelines of the ethics committee that approved the study. The specific protocol number and committee name should be included to fulfill academic standards. This structured methodology allows for the replication of the study and provides clear insights into the module's educational impact.

3.0 Results and Discussion

3.1 Feedback and Suggestions of the Validators

The validators' comments on the initial draft of the produced module, along with the recommendations that were required for revision, are presented in the first section. The input and recommendations data collected were helpful in a later iteration of the module. Many comments and suggestions were given throughout the first phase. This section included an overview of the key findings, their interpretation, and a discussion of their importance and study implications. The information allowed the researchers to ascertain the opinions of each validator regarding the module, which was then examined to achieve the goal of having a validated module. Many modifications and additional research were sparked by the recommendations made. Furthermore, the researchers ensured that the validators were part of the validation process. The feedback was essential in raising the overall standard of the results since it offered constructive or critical comments, demonstrated what might be altered, and gave straightforward suggestions about what needed to be improved. Three categories, Learning Activities, Content, Format and Design, and Learning Outcome, were used to group the input.

Learning Objectives

According to the feedback and suggestions of the six (6) validators V1, V2, V3, V4, V5, and V6 on the module's Learning outcomes, the learning outcomes are relevant to the topics of each chapter in the module. It is clearly stated, measurable, and attainable, and the objectives consider the student's needs. While the suggestions are specific to the course objectives/outcomes, it is too summarized; "*Change the word 'demonstrate' in your learning outcomes*," "*specify how many weeks*," or "*write 'At the end of this module…'*" and "*mention that the learning outcomes are from the compendium of CHED*" and that the "*objectives are better if they are outcome-based*." As Abdelmohsen (2020) stated, the learner-centered approach is the module's primary goal. In other words, the module is guided by the learning outcomes, which were established following a thorough examination of the requirements of the Foundation Program students. The curriculum was methodically and meticulously designed to present engaging and valuable writing assignments.

To help create timely and meaningful learning objectives, it was recommended that the learning objectives adhere to the SMART Framework. As a result, the researchers updated the modules' learning objectives (L.O.) by incorporating the SMART Framework, which specifies that learning objectives should be Specific, Measurable, Attainable, Reliable, and Time-Bound under the Validators' recommendations. The researchers have considered the initial capitalization, concision, alignment, and integration of activities into the learning objectives. By addressing these issues, the updated module becomes more logical and easier to use, which makes it simpler for teachers and students to understand and apply. Moreover, the researchers have exhibited a resolute dedication to conforming to the compendium syllabus, conserving the module's significance in the broader curriculum. The researchers have convincingly attempted to address the recommendations and criticisms offered by the validators appropriately.

Learning Content

As to learning content, Table 1 summarizes the key feedback from validators and respondents regarding the Human Geography module, highlighting areas for improvement in language, content, organization, and relevance. Revisions addressed these concerns by simplifying terminology, enhancing depth and accuracy, adding relevant topics, and ensuring systematic organization and proper referencing to improve the module's overall quality and usability.

Learning Activities

It effectively illustrates the valuable contributions of the validators, showcasing the enhancements made to the learning activities based on their insightful input. Their feedback says that the module has creative assignments, is simple and easy to understand, appropriate to the learners' ability, presents clear directions, and assessments are inclined toward the forward learning outcomes. The feedback also says that it is irrelevant to the evaluation that is inclined with the learning outcomes; the module is very relevant, simple, easy to answer, appropriate to the learners' ability, and presents clear directions. The feedback also adds, "*It is all right since we followed the Commission on Higher Education (CHED) Compendium*." Their suggestions for the learning activities are to make them uniform; other suggestions include writing 1 individual activity or writing more group activities and improving assessment.

The module underwent a series of revisions, including the format and design; it was recommended to use high-definition images, straightforward color maps, and larger font sizes for the references and final units. Consequently, the researchers converted the complex maps into simple maps, converted to high-definition images, and increased the font size in the final units and references. It is also advised to rearrange the format, alter the font style, add more context, and put the important words in bold. To make it more formal and make important terms easier, the researchers followed the validators' instructions, rearranged the format, altered the font style, and added more context.

Table 1. Key feedback from validators and respondents regarding the Human Geography module

Aspect	Feedback from Validators and Respondents	Revisions and Improvements Made
Terminology and Language	- Students may struggle with complex terminologies. - 90.7% found language simple and easy to understand.	- Simplified terms and removed technical jargon. - Added more visual content to aid understanding.
Content Clarity and Accuracy	- Content is accurate, but some sources are questionable. - Some passages were grammatically incorrect.	- Corrected grammatical errors and ensured coherence. - Integrated valid references and followed APA format.
Content Depth and Relevance	The module is too summarized and lacks depth. - 87.5% agreed that the content was comprehensive, and 90.6% found them topic-relevant.	- Added detailed explanations, case studies, and contemporary issues. - Introduced a unit on main characteristics.
Organization and Flow	The sequence of topics is good, but units are unevenly treated. - 96.9% agreed that the module was systematic.	- Reorganized units for balance and flow. - Eliminated redundant content for conciseness.
References and Citations	- More references and recommendations are needed for further reading. - Avoid in-text citations.	- Included ample references, books, and films. - Avoided in-text citations but ensured adherence to APA guidelines.
Terminology and Language	- Students may struggle with complex terminologies. - 90.7% found language simple and easy to understand.	- Simplified terms and removed technical jargon. - Added more visual content to aid understanding.
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Content Depth and Relevance	The module is too summarized and lacks depth. - 87.5% agreed that the content was comprehensive, and 90.6% found them topic-relevant.	- Added detailed explanations, case studies, and contemporary issues. - Introduced a unit on main characteristics.
Organization and Flow	The sequence of topics is good, but units are unevenly treated. - 96.9% agreed that the module was systematic.	- Reorganized units for balance and flow. - Eliminated redundant content for conciseness.
References and Citations	- More references and recommendations are needed for further reading. - Avoid in-text citations.	- Included ample references, books, and films. - Avoided in-text citations but ensured adherence to APA guidelines.
Suggested Topics	- Include topics like Universal Humanitarian Law, OFWs, Extrajudicial Killings, Political Asylum, and Global Warming.	- Added these topics with supporting content. - Focused on relatable and contemporary examples.
Spelling and Formatting	- Nearly 85% agreed that contents were free from spelling errors.	- Ensured proofreading to maintain error-free content. - Enhanced presentation and formatting for readability.

Format and Design

For the feedback, the validators said there are too many pictures, which is disarranged; two columns are okay in the module, and the pictures provided a nostalgic feeling. Another validator said it is "*beautiful*" and more contextualized. Maps are better if they can be distinguished by color, the format/layout is not well organized, the language is clear, concise, and motivating, and instructions are not concise and easy to follow. As for the suggestions of the validators 1-6, the researchers should change the font style, include a large clear map, enlarge references for people with poor eyesight, and provide points if the pictures are realistic or formal. Course rationale and descriptions should be on one page, and the course change unit should be on one cover page. Arrange the format, use simple maps with colors, use high-definition images, and enlarge the font size. Furthermore, the validators stated that these changes will make the materials more student-guided.

The format and design modifications significantly improve the developed module's efficacy for teachers and students. Furthermore, by correcting mistakes based on the validators' suggested comments, a more formal and instructional module is given to the students. Adding extra content, like suggested videos, enhances the learning experience, making it more enjoyable. With the Validators' suggestions, the researchers could organize the module properly. Introducing a new format that divides subtopics into discrete lessons allowed students easy accessibility. The researchers have shown that they are dedicated to offering an accessible and interactive learning tool that meets students' needs and preferences and contributes to improving the quality of education. These unique contributions have been crucial in ensuring that the module offers clarity, engages students, and accommodates a variety of learning styles. By incorporating the feedback from the validators, the developed module has been improved and brought closer to the expectations and goals of education. It is now a more thorough, interesting, and student-focused resource.

3.2 Content Validity Index Results

The results from the validators indicate positive findings regarding the content validity of the instructional module. The Content Validity Index (CVI) method was employed to assess content validity, leveraging its strengths in providing both item-level (I-CVI) and scale-level (S-CVI) metrics. The CVI approach is recognized for its simplicity, focus on consensus, and effectiveness in demonstrating content validity (Davis, 1992; Grant & Davis, 1997; Lynn, 1986; Polit & Beck, 2007). The instructional material includes five facets across 24 items, evaluated on a 5-point Likert scale, adapted from Abdelmohsen (2020). Table 2 outlines the constructs and items analyzed.

Table 2. Content Validity Index Result

unit	I-CVI	interpretation
Unit 1	1.00	Accepted
Unit 2	1.00	Accepted
Unit 3	1.00	Accepted
Unit 4	1.00	Accepted
Unit 5	1.00	Accepted
Unit 6	1.00	Accepted
Unit 7	1.00	Accepted
Unit 8	1.00	Accepted
Unit 9	0.87	Accepted
S-CVI= 0.99		

The module underwent a comprehensive review during its refinement, guided by the validators' feedback. Insights highlighted the importance of clarity, alignment with course objectives, engagement, and diverse learning activities to accommodate varied learning styles. The evaluation included I-CVI and S-CVI metrics, using validator responses to assess relevance.

Suggestions from validators emphasized refining learning outcomes, enriching content, improving formatting, and revising learning activities. These inputs informed thorough revisions to ensure the module's effectiveness. The validated and revised Human Geography module is now well-positioned to deliver a valuable and engaging learning experience. Table 3.3 below indicates an exceptionally high agreement among validators, confirming the instructional module's relevance and alignment with its objectives.

3.3 Effectiveness of the Developed Instructional Module

The data gathered from thirty (30) BSEd-Social Studies students who have completed the SSE103 course on the usefulness of the developed module in SSE103 was transcribed and analyzed using thematic analysis.

Clear and Concise Learning Outcomes

In this study, most student participants reported that the developed instructional module is easy to understand because it has clear and concise learning objectives. Sewagegn (2020) believes that learning objectives should be expressed regarding performance or behavior. Teachers and students should be able to understand the same terms. If teachers are going to assess objectives effectively, they need to be specified.

Comprehensive, Detailed, and Organized

Comprehensive, detailed, and organized objectives help the students easily determine what they should learn and focus on every topic. Some of the student participants say that the developed instructional module's contents

could satisfy each topic's objectives. It had pictures that satisfy the learning process. This theme emphasizes the respondents' recognition that the learning outcomes are comprehensive and detailed, as well as the content covered within the module and the assessment methods used to measure the achievement of these outcomes.

Easy to Understand

According to the eleven (11) student participants, the learning outcomes of the module were really easy to understand. It is well-written in precise terms that help the student understand clearly. Overall, the student participants believed that the modules developed by the researchers were very clear, concise, comprehensive, detailed, organized, and easy to understand.

3.4 Accuracy of the Developed Instructional Module

There are three generated themes: the content of the developed instructional module has credible sources, precise and accurate content, and is easily understood.

Credible Sources

In this study, five (5) participants mentioned that our developed instructional module has accurate content because it is from a reliable or credible source. Module creators can guarantee that learners have access to accurate, authentic, and valid material by including reputable sources in their modules. In addition to improving the educational experience, this encourages critical thinking, reasoning supported by evidence, and a greater comprehension of the subject. One of the student respondents says that everything is in there. Everything is precise and accurate because it is written as the information is not made-up but is facts with credible sources that can be seen in its references.

Precise and Accurate Content

This theme suggests that the developed module achieved accuracy through the thorough and rich incorporation of essential information. The information is factual, clearly stated, and organized with a purpose. The subject also highlights how important it is to convey information succinctly to improve overall accuracy. The participants gave several justifications for their evaluations of the accuracy of the module's content. They pointed out that the module's content is thoroughly studied and aligned with the curriculum.

Easily Understood

Out of the thirty (30) student participants, four (4), specifically P8, P10, P23, and P22, stated that the module's content was once again very easy to understand or understandable. All in all, the participants believed that the content was accurate and precise, easily understood, and came from reliable and credible sources.

3.5 Assessments of the Developed Instructional Module

Two generated themes were concluded: assessment-reinforced content and fun and engaging student assessments.

Assessment - Reinforced Content

The respondents pointed out that the module contained assessments that successfully reinforced the information reflected in this theme. It represents the belief that the module's assessments benefit the learning process and closely match the subject matter. The participants greatly appreciate the fact that the evaluation is aligned with the module's content and learning objectives. They also draw attention to the fact that several assessments were employed in creating the module. According to Martin et al. (2021), it is critical to give students a range of assessments at different points in the course so they may track their progress in learning. They discover that the assessment's questions are directly related to the subjects taught in each lesson, strengthening their comprehension of the subject matter.

Assessments are Fun and Engaging for Students

Surprisingly, the developed module has assessments that reinforce the content and are fun and engaging for the students. The major goal of assessment in schools should be to give teachers and school leaders interpretative information about their impact on students so that these educators have the best information possible about what steps to take with instruction and how they need to change and adapt, as stated by Bartlett (2021). We often use

assessments in the classroom to let students know how they are doing and where they stand. This is significant, of course, but more so is the application of this data to educate educators about their influence on learners. It is very effective to use assessments to give teachers feedback. Moreover, this power is enhanced when the tests are accurate, timely, and connected to the material teachers teach.

3.6 Usefulness as a Learning Tool

A generated theme is extracted to address the research question, which is that it is recommended as a teaching tool.

Recommended as a Teaching Tool

The module is highly recommended as a teaching tool since it is well-written. According to Mulyasa (2005), the module's main purpose is to improve the efficiency and effectiveness of learning, including time, funds, facilities, and energy to achieve goals optimally. Most of the student participants in this study indicated that the developed module is very effective and could be used as a teaching tool. They will use it to be an effective teacher in a way that will allow them to turn human geography lessons into engaging and entertaining for students. Some say this is enough for them to understand the lesson, especially when they do not have internet access. Therefore, the comprehensiveness, validation procedure, thorough content, and distinctive features of the module were important aspects that contributed to their favorable inclination.

Overall, the results of the different topics demonstrate how beneficial and effective the designed module is as a teaching tool and for students alike. The participants seemed to have responded positively to the module. First, praise has been given to the learning outcomes for their clarity and conciseness. This shows that the goals of the module are clearly understood by the students, which is important because it helps to direct their learning process. The value of a module is increased when the content is dependable, and students can rely on the information offered. The themes of assessment-reinforced content and self-sufficient learning implied that the module efficiently aligns assessments with the content, fostering a deeper comprehension of the subject matter and giving students the power to take responsibility for their learning.

The acknowledgment of variations in the learning pace underscored the module's adaptability in meeting each learner's unique learning needs. Efficiency through accessibility draws attention to how quickly and effectively the module can support learning, underscoring its value. The module's visual appeal is enhanced by adding images, colors, and pictures, which may increase its effectiveness. There were no clear areas for improvement or confirmation verification, which suggested that the module's quality was highly trusted. The lack of areas of concern reinforces this view. On top of that, the participants saw the module as a useful teaching tool and recommended it as a learning resource. These two themes implied that the program is valuable and practical, able to help educators and students alike.

4.0 Conclusion

This study effectively summarizes its key findings, emphasizing the strong agreement among validators regarding the suitability of the newly developed instructional module for SSE103 for formal classroom use at Mindanao State University-Main Campus. Both validators and student participants recognized the module's potential to enhance understanding, increase interest in social studies, and improve academic performance, which is crucial for preparing future educators. This positive feedback supports the recommendation for the faculty and administration to consider potentially integrating this module into their teaching strategies to enrich the educational experience and outcomes. Additionally, the conclusion could be enhanced by suggesting future research directions, such as exploring the long-term effects of the module on student performance or its adaptability to different educational contexts. Further studies could also investigate the module’s effectiveness in other cultural settings, extending its relevance and application globally in social studies education. By highlighting these points, the conclusion would recap the study's significant contributions and frame the research within a broader context, encouraging ongoing scholarly inquiry and practical application in educational settings.

5.0 Contributions of Authors

The authors indicate equal contribution to each section. The authors reviewed and approved the final work.

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7.0 Conflict of Interests

The authors declare no conflicts of interest about the publication of this paper.

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Evaluating the Impact of AR-Enhanced Virtual Traveling Labs on Physics Teaching and Learning

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Abstract. Augmented Reality (AR) is increasingly being recognized as a transformative technology in education, particularly for enhancing virtual laboratory experiences in physics teaching and learning. This study evaluated the impact of AR-enhanced virtual labs, specifically the Traveling Virtual Lab (TVL), on physics education. A quantitative research design was employed, and (n=18) respondents used a systematic sampling strategy to select teachers across different grade levels. The adapted "Student Acceptance of Virtual Laboratory questionnaire" was used to gather data on teachers' perceptions of the appeal and effectiveness of TVL. The findings revealed a strong agreement among teachers regarding the importance of laboratory equipment and hands-on learning experiences in physics education. The TVL received highly positive perceptions from the teachers regarding its appeal and effectiveness in teaching physics concepts. Although no significant differences were found in the appeal of TVL based on teachers' gender or grade level, male teachers perceived TVL to be more effective than female teachers. A strong positive correlation was found between the appeal and effectiveness of TVL in teaching physics concepts. These findings highlight the potential of AR-enhanced virtual labs, particularly TVL, to address challenges in physics education and provide engaging and interactive learning experiences. The study recommends the integration of AR-enhanced virtual labs into physics curricula, professional development programs for teachers, further research on gender disparities, resource allocation for implementation, and ongoing evaluation and refinement of these innovative educational tools.

Keywords: Augmented Reality; Education; Interactive; Learning; Physics teaching; Virtual labs

1.0 Introduction

Augmented Reality (AR) is increasingly recognized as a transformative technology in education, particularly for enhancing virtual laboratory experience. AR's ability of AR to overlay digital content onto the real world offers unique opportunities for interactive and immersive learning, making it especially valuable in STEM education (Kumar et al., 2024). In the context of virtual laboratories, AR has shown significant potential in bridging the gap between physical and virtual learning environments. A study examining substituting physical lab components with tangible replicas and virtual representations found that AR can reduce experimental setup time without

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compromising knowledge transfer (Knierim et al., 2020). This suggests that AR can streamline laboratory processes while maintaining educational efficacy. AR's application of AR in virtual laboratories extends beyond simulations. This allows students to interact with complex concepts tangibly and engagingly. For instance, AR can create immersive learning experiences that foster interest and aid information retention (Gaikwad & Mulay, 2024).

AR applications in engineering education have been developed to improve students' self-ability and interest in practical experimentation (Sarode et al., 2019). These applications enable students to interact with 3D models and images superimposed on real objects, enhancing their understanding of the specific concepts. However, implementing AR in education is challenging. Developing instructional AR tools and applications requires significant time and effort, which may delay or hinder their adoption in educational settings (Sharma et al. 2023). Additionally, issues such as cost, content development, and accessibility must be addressed to unlock the full potential of AR in education (Selvakumar & Sivakumar, 2023). Despite these challenges, the growing role of AR in education, particularly in enhancing virtual laboratory experiences, is undeniable. AR's ability to create interactive and personalized learning environments aligns well with the principles of Education 5.0, which emphasizes student-centered learning and emerging technologies (Abuzir, 2024; Selvakumar & Sivakumar, 2023). As AR technology continues to evolve, it holds promise in revolutionizing education by providing dynamic, engaging, and effective learning experiences in virtual laboratory settings and beyond.

Physics education in traditional settings encounters numerous obstacles, particularly in offering captivating, practical learning experiences and providing access to laboratory facilities. A study involving 107 high school physics instructors found that only 25% reported having well-equipped physics labs, while 45% operated without dedicated labs but utilized science kits or improvised materials. Notably, 30% lacked access to physics laboratories, science kits, and locally improvised resources (Nzabahimana et al. 2024). This scarcity of resources significantly restricts students' opportunities for hands-on experiential learning, which is vital for understanding intricate concepts in physics. The shortcomings of conventional teaching methods in physics education go beyond the resource limitations. Students often struggle to grasp abstract physical concepts without conducting practical experimentation. Moreover, time constraints in laboratory sessions prevent teachers and students from adequately conducting activities, further impeding the learning process (Nzabahimana et al. 2024). These challenges are especially evident in information security education, where restrictive IT policies can impede hands-on experience in traditional computer laboratories (Konak et al., 2013).

To address these issues, novel approaches, such as virtual laboratories (VLs), digital practical work (DPW), and immersive technologies, such as virtual reality (VR) and augmented reality (AR), are being investigated. These technologies offer promising solutions by delivering immersive, interactive experiences that can replicate complex experiments and render abstract concepts more tangible (Moloi & Matabane, 2024; Prayogi & Verawati, 2024). However, the implementation of these technologies faces several hurdles, including a lack of teacher awareness, limited ICT tools, insufficient supporting resources, and the need for comprehensive professional development programs (Prayogi & Verawati, 2024; Nzabahimana et al., 2024). Surmounting these obstacles is crucial for transforming physics education and ensuring all students have access to engaging, hands-on learning experiences regardless of their physical laboratory resources.

Virtual laboratories have become a valuable resource for providing students with hands-on experiences, particularly when physical laboratories are unavailable or during events such as the COVID-19 pandemic (Racha et al., 2022). These digital environments allow students to engage in interactive learning and develop practical skills. Augmented Reality (AR) has been recognized as a promising technology for enhancing the virtual laboratory experience. AR has the potential to narrow the divide between virtual and real-world settings, fostering more engaging and productive learning opportunities (Iqbal & Campbell, 2021). This technology enables direct manipulation of virtual objects in real-world contexts, which could be particularly beneficial for simulating laboratory equipment and experiments. AR can facilitate learning experiences that would otherwise be unattainable in resource-limited educational systems (Iqbal & Campbell, 2021). Researchers have explored the integration of AR with social robotics in classrooms to improve interpersonal communication and student engagement in learning (Hennerley et al., 2017). This combination can be applied to virtual laboratories, creating a more interactive and collaborative environment that resembles physical laboratory settings. Although the specific concept of Traveling Virtual Labs was not mentioned, the incorporation of AR in virtual laboratory

environments shows promise in addressing challenges related to interactivity and effectiveness in teaching. For example, studies have shown that using AR smart glasses in laboratories can increase student engagement and improve learning outcomes (Racha et al. 2022). As these technologies continue to advance, they have the potential to transform the way students interact and learn from virtual laboratory experiences.

This study is significant because it addresses several gaps in the current research on AR-enhanced virtual laboratories. First, while there is extensive research on using Virtual Reality (VR) and Augmented Reality (AR) in education, there is a notable lack of focus on their specific applications in virtual laboratories. Existing literature primarily covers general educational contexts, gaming, and medical applications (Aliwi et al., 2023; Bajaj, 2023). This study fills this gap by examining AR-enhanced virtual laboratories, which represent a unique intersection between technology and practical scientific education. Interestingly, despite the growing interest in AR and VR technologies, the large-scale demand for these technologies in learning environments is scarce (Dörner et al., 2010). This contradiction highlights the need for research exploring the potential of AR-enhanced virtual labs to bridge this gap and increase their adoption in educational settings. This study is significant because it addresses the lack of comprehensive research on AR-enhanced virtual labs, potentially offering insights into overcoming current technological limitations and integration challenges (Bajaj, 2023; Borgmann et al., 2018). Focusing on this Specific Application. This study aimed to investigate the impact of Augmented Reality (AR)-enhanced Virtual Labs on the teaching and learning of physics, focusing on teachers' perceptions of the appeal and effectiveness of these tools, the relationship between the frequency of laboratory activities and their effectiveness, and the influence of demographic factors such as sex and grade level. By examining the significant differences and relationships among these variables, this study aimed to provide insights into the potential of AR-based Traveling Virtual Labs (TVLs) as innovative, equitable, and effective resources for improving physics education.

2.0 Methodology

2.1 Research Design

This study employed a quantitative research approach to examine and measure the correlation between variables and evaluate the hypotheses using statistical methods (Fischer et al., 2023). The quantitative design offers a methodical and rigorous framework for exploring educators' views on the TVL and its AR components in physics instruction. By utilizing quantitative techniques, this study sought to produce objective and broadly applicable results that enhance existing knowledge in this field. The investigation identifies independent variables (IVs), such as teacher characteristics, and dependent variables (DVs), including attitudes toward the TVL and its AR features. These variables were defined to allow for quantitative measurements, ensuring the study's ability to gather numerical data for analysis.

2.2 Respondents of the Study

This study employed a systematic sampling strategy to select a representative sample of teachers from the target population. The total population consisted of eighteen (18) physics teachers across different grades. To determine the sampling interval (k), we divided the population size by the desired sample size of 18, resulting in a sampling interval of k=1. Starting with a randomly selected teacher from the ordered list, every kth teacher is selected for inclusion in the sample. The interval or sampling interval (k) was calculated by dividing the population by the desired sample size (Voxco, 2021). This systematic approach ensures a balanced representation across grade levels while maintaining randomness in selection. The final sample comprised 18 teachers: 31.2% from senior high school, 25% from primary and tertiary levels, and 18.2% from junior high school.

2.3 Data Gathering Instrument

Quantitative data collection methods were employed to gather numerical data from the participants. Surveys or questionnaires can collect responses related to perceptions, ratings, and demographic information. These instruments were designed using Likert scales or other quantitative measures to facilitate the data analysis. The research instrument utilized for data gathering in this study is the "Student Acceptance of Virtual Laboratory questionnaire," adapted from Park (2009). This questionnaire measured students' acceptance of virtual laboratory activities, particularly in the context of physics education. The instrument consists of 37 items rated on a 5-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree").

The questionnaire was divided into two main sections: Part 1 focused on demographics designed for teachers; the introduction to the questionnaire provided participants with an overview of the research objectives and context, inviting them to share their experiences and opinions on laboratory activities in physics and the Traveling Virtual Lab (TVL), a solar-powered, augmented reality (AR) learning kit designed to enhance physics education. The content of Part 2 is structured into several sections, each containing Likert-scale items related to different aspects of laboratory activities, including access to equipment, effectiveness of current activities, and frequency of hands-on experiences.

The validity and reliability of the instrument have been established using several methods. First, the questionnaire items were adapted from an instrument Park (2009) validated to ensure content validity. Pilot testing was conducted to assess the clarity and validity of the survey items before their full implementation. Furthermore, using Likert-scale responses allows for quantitative analysis of responses, contributing to the instrument's reliability.

2.4 Data Gathering Procedure

The data-gathering procedure for this quantitative research design involved systematically collecting numerical data using well-designed instruments, such as surveys or questionnaires, based on the study's research questions and hypotheses. These instruments were pilot-tested with a small sample to ensure clarity and validity, incorporating revisions as needed. The sampling strategy identified the target population and criteria for inclusion by employing systematic sampling to select participants at regular intervals, ensuring representativeness and minimizing bias. Once participants were selected, the finalized instruments were distributed with clear instructions and assurances of confidentiality to encourage honest responses. Data collection methods included in-person distribution, email dissemination, or online platforms. The completed surveys were recorded and entered into a secure database or a spreadsheet.

Descriptive statistical analysis was used to summarize the sample characteristics and key variables, followed by inferential statistical analysis to test the hypotheses and explore variable relationships. The results concerning the research objectives were interpreted and presented using tables, graphs, and descriptive statistics. The study's findings are discussed, noting limitations and suggesting future research directions. This systematic procedure ensured rigorous data collection, analysis, and interpretation, contributing to advancements in physics education and educational technology.

2.5 Statistical Tools

Table 1 outlines the specific research questions and corresponding statistical analysis techniques to address each question.

Table 1. Statistical tools per research question

Research Question	Statistical Analysis
1. Profile of Teachers	Descriptive statistics (frequencies, percentages)
2. Level of Agreement on TVL Perception	Descriptive statistics (means, standard deviations)
3. Level of Effectiveness of AR Features	Descriptive statistics
4. Relationship between Teacher Profiles and TVL Perception	Chi-square tests or logistic regression analysis
5. Relationship between TVL Perception and AR Features	Pearson correlation analysis or multiple regression analysis

2.6 Ethical Considerations

Ethical considerations for this study of AR-enhanced virtual labs in physics education include ensuring equitable access to technology, protecting student privacy and data, obtaining informed consent, addressing potential psychological impacts, maintaining educational quality, disclosing conflicts of interest, promoting inclusivity, considering long-term effects, providing adequate teacher training, and responsibly reporting results. Researchers should ensure that all participants have equal access to necessary devices and Internet connectivity, implement proper data protection safeguards, obtain informed consent from participants or guardians, offer support to students struggling with the AR interface, minimize disruption to regular learning, accommodate students with disabilities, and transparently disclose any potential conflicts of interest or funding sources. By addressing these ethical considerations, this study can be conducted in a manner that respects participant rights, promotes fairness, and maintains scientific integrity.

3.0 Results and Discussion

3.1 Evaluating the Impact of AR-Enhanced Virtual Labs on Physics Teaching and Learning

Table 2 shows the level of agreement between the teachers' accessibility to equipment and the current effectiveness of laboratory activities.

Table 2. Accessibility to equipment and the current effectiveness of laboratory activities

Variable	Mean	Description	SD
Accessibility of equipment	4.30	Strongly Agree	0.50
Effectiveness of activities	4.40	Strongly Agree	0.50

Studies have affirmed the significance of laboratory equipment and practical experience in physics education with high mean scores (M=4.3, SD=0.5; equipment importance: M=4.4, SD=0.5 for lab helpfulness), indicating a strong consensus on the value of hands-on learning. More than 80% of physics teachers in Aceh require both hands-on and virtual laboratories for effective teaching (Muliandi et al., 2024). Proper use of laboratory equipment correlates with higher student performance (Olufunke, 2012). While traditional lab equipment is essential, virtual and remote laboratories are increasingly recognized for their potential, especially in resource-limited or distance-learning contexts. Remote labs can enhance prospective physics teachers' multiple representation abilities (Fatmaryanti et al., 2024), and virtual labs can boost creativity (Gunawan et al., 2017). High mean scores reflect consensus on the importance of both traditional and innovative lab experiences. However, challenges like equipment inadequacy, lack of maintenance, and time constraints often hinder practical learning (Sunardi et al. 2022). Addressing these issues requires investment in equipment, teacher training, and the development of virtual and remote lab solutions.

Table 3. Appeal and effectiveness of the TVL in learning Physics concepts

Variable	Mean	Description	SD
The appeal of the TVL	4.50	Strongly Agree	0.60
Effectiveness of the TVL	4.50	Strongly Agree	0.60

This passage examines educators' perspectives on the Traveling Virtual Lab (TVL) for physics instruction. As shown in Table 3, instructors strongly endorsed the TVL's attractiveness and efficacy, with identical average ratings of 4.5 and standard deviations of 0.6 for both aspects. These high scores on a 5-point scale indicate a highly favorable view of TVL among teachers. The consistent 0.6 standard deviation suggests uniform agreement among the surveyed educators. These findings imply that teachers consider the TVL an engaging and effective tool for conveying physics concepts, potentially serving as a valuable complement or alternative to the conventional laboratory experience in physics education.

Several studies have underscored the significance of effective teaching methods in TVL and physics education. Pangan (2022) noted that TVL instructors often use diverse teaching approaches, including lecture-laboratory combinations, computer-aided lessons, and modeling demonstrations. Students found these strategies highly satisfactory, particularly regarding teaching quality, attitude, and style (Pangan, 2022). Abdul (2024) revealed that while TVL educators employ traditional teaching techniques, they also show flexibility in adapting their methods to suit resource availability, experience levels, and financial limitations. This adaptability ensures continued student engagement and learning effectiveness, potentially contributing to the appeal and efficacy of the TVL in teaching various subjects, including physics (- and -, 2024). In summary, although the cited literature does not directly support the specific metrics provided (M=4.5, SD=0.6), the research suggests that TVL instructors use diverse and adaptive teaching strategies that are well-received by students. This positive reception could potentially translate into high levels of appeal and effectiveness of physics instruction within the TVL framework. However, additional research on physics education in the TVL context is required to validate these assumptions.

3.2 Appeal of Traveling Virtual Laboratory in Teachers in Learning Physics Concepts According to Sex

As shown in Table 4, while male teachers (M=4.8) demonstrated a slightly higher mean score than their female counterparts (M=4.3), the independent sample t-test revealed that this difference was not statistically significant. The test statistics, $t(14) = -1.99$, $p = .066$, indicate a marginal difference that falls short of the conventional threshold for statistical significance ($p < .05$). This finding suggests that gender may not be a determining factor in teachers' appreciation of TL as an educational physics tool.

Table 4. T-test result of the appeal of TVL in teachers in learning Physics concepts according to sex

Sex	Mean	t-value	df	Sig. (2-tailed)
Male	4.80	1.99	14	.066
Female	4.30			

Although present, the observed difference in mean scores is not substantial enough to conclude that male and female teachers differ significantly in their perception of TL appeal. The p-value of .066, while close to the significance level, still indicates a 6.6% chance that the observed difference occurred by random chance rather than reflecting a true difference in the population. This result underscores the importance of cautious interpretation when examining gender-based differences in educational technology preferences, highlighting the need for further research with larger sample sizes to draw more definitive conclusions about the role of gender in teachers' attitudes towards virtual laboratories in physics education.

3.3 Appeal of Traveling Virtual Laboratory in Teachers in Learning Physics Concepts When Classified According to Grade Level Attended

The results of the one-way Analysis of Variance (ANOVA) indicated that there was no statistically significant difference in the appeal of TVL (Technology-Vocational-Livelihood) among teachers learning physics concepts when classified according to their grade level (see Table 5).

Table 5. One-way ANOVA results of the appeal of TVL in teachers learning Physics concepts according to grade level attended

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	0.54	3	0.180	0.44	.730
Within Groups	4.94	12	0.412		
Total	5.48	15			

The F-statistic, F (3, 12) = 0.44, with a p-value of 0.730, suggests that the observed differences in appeal across grade levels are likely due to random chance rather than a true effect. Based on these results, we conclude that 1. F (3, 12) indicates that there were four groups (three degrees of freedom between groups) and 16 participants (12 degrees of freedom within groups). 2. An F-value of 0.44 is relatively low, indicating that the variance between groups was smaller than within groups. 3. The p-value of 0.730 is much higher than the conventional significance level of 0.05, providing strong evidence to reject the null hypothesis. These findings suggest that the grade level a teacher attends does not significantly influence their perception of the appeal of TVL in learning physics concepts. This implies that the TVL approach may be equally appealing across different grade levels, potentially indicating its versatility and broad applicability to physics education.

3.4 Effectiveness of TVL in Teachers in Learning Physics Concepts When Classified According to Sex

Table 6 revealed a significant gender-based difference in the perceived effectiveness of the TVL (Teaching and Learning) method among teachers (t(14) = 2.41, p = .030). Male teachers reported substantially higher effectiveness ratings (M = 4.77) than their female counterparts (M = 4.15), indicating that male educators found TVL more effective in their teaching practice.

Table 6. T-test for Independent Samples result of the effectiveness of TVL in teachers in learning physics concepts according to sex

Sex	Mean	t-value	Df	Sig. (2-tailed)
Male	4.77	2.41	14	.030
Female	4.15			

This disparity suggests potential variations in how male and female teachers implement, experience, or perceive the TVL method. Several factors contribute to this gender-based difference, including variations in teaching styles, subject areas, classroom dynamics, or personal preferences. Additionally, societal expectations and gender roles in education may influence how male and female teachers approach and evaluate new teaching methodologies. The higher effectiveness ratings from male teachers could indicate that the TVL method aligns more closely with their teaching approaches or that they may have had more positive experiences implementing it in their classrooms. Conversely, the lower ratings of female teachers might suggest that the TVL method may not fully address their specific needs or teaching contexts. This gender disparity highlights the importance of considering

diverse perspectives and experiences when developing and implementing educational strategies, ensuring that teaching methodologies are effective and inclusive for all educators, regardless of gender.

3.5 Effectiveness of TVL in Teachers Learning Physics Concepts According to Grade Level Attended

Table 7 describes the results of two statistical analyses regarding the effectiveness and appeal of a Traveling Virtual Laboratory (TVL) in teaching physics concepts. First, a one-way Analysis of Variance (ANOVA) was conducted to examine whether the effectiveness of TVL differed based on the year teachers taught. The results, $F(3, 12) = .33$, $p = .803$, indicated no significant differences. This suggests that the effectiveness of the TVL in teaching physics concepts is consistent across the different teaching years. Second, an independent samples t-test was performed to compare the appeal of the TVL between the male and female teachers. The results, $t(14) = -1.99$, $p = .066$, showed no statistically significant differences. Male ($M = 4.8$) and female ($M = 4.3$) teachers reported similar levels of appeal for TVL. The p-value of .066, above the conventional significance level of .05, suggests that any observed differences in appeal between genders could be attributed to chance rather than a true population difference. These findings collectively indicate that TVL's effectiveness and appeal of TVL in physics education are not significantly influenced by the year of teaching or the teacher's gender.

Table 7. One-way ANOVA results of the effectiveness of TVL in teachers learning physics concepts according to the grade level attended

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	0.409	3	.136	.33	.803
Within Groups	4.929	12	.411		
Total	5.338	15			

3.6 Correlation Between the Appeal and Effectiveness of TVL in Teaching Physics Concepts

This study investigated the relationship between the appeal and effectiveness of a Traveling Virtual Laboratory (TVL) in teaching physics concepts to educators. Table 8 reveals a strong, positive, and statistically significant correlation between these two variables ($r(14) = .88$, $p = .000$). The correlation coefficient of 0.88 indicates an extremely robust positive link, suggesting that as the attractiveness of TVL increases, so does its efficacy in helping teachers learn physics concepts, or vice versa. A p-value of .000, which falls below the conventional significance level of .05, implies that this correlation is highly unlikely to be due to chance. Fourteen degrees of freedom (14) suggested a sample size of 16 teachers. These results indicate that educators who find the TVL more engaging will likely perceive it as more effective in understanding physics concepts, highlighting the importance of creating engaging and attractive virtual learning environments for successful physics instruction.

Table 8. Correlation between the appeal and effectiveness of TVL in teaching physics concepts

	Pearson Correlation	df	Sig. (2-tailed)
Appeal Effectiveness	.88	14	.000

4.0 Conclusion

This study evaluated the impact of AR-enhanced virtual laboratories, specifically the Traveling Virtual Lab (TVL), on physics education. The findings revealed strong agreement among teachers regarding the importance of laboratory equipment and hands-on learning experiences in physics education. The TVL received highly positive perceptions from teachers regarding its appeal and effectiveness in teaching physics concepts. Although no significant differences were found in the appeal of TVL based on teachers' gender or grade level, male teachers perceived TVL to be more effective than female teachers. A strong positive correlation was found between the appeal and effectiveness of TVL in teaching physics concepts. These findings highlight the potential of AR-enhanced virtual labs, particularly TVL, to address challenges in physics education and provide engaging and interactive learning experiences. However, some limitations should be noted, including the relatively small sample size and the potential bias in self-reported perceptions. Future research should explore implementation in diverse educational settings, examine long-term learning outcomes, and investigate ways to optimize TVL effectiveness across the sexes. Overall, this study provides valuable insights into the potential of AR-enhanced virtual labs for transforming physics education.

This research suggests incorporating AR-enhanced virtual laboratories, specifically the Traveling Virtual Lab (TVL), into physics education curricula to tackle challenges and offer immersive, interactive learning experiences. Additional studies with larger participant pools and varied educational contexts should be undertaken to confirm

these results and examine the long-term effects of the TVL on student achievement. Exploring methods for maximizing TVL efficacy across sexes is essential, addressing the noted disparities in perception between male and female educators. Offering professional training to teachers to successfully integrate AR-enhanced virtual labs into their instructional methods is vital. Moreover, investigating the potential applications of the TVL in other STEM fields could improve hands-on learning across various disciplines. Finally, devising strategies to merge traditional laboratory equipment with AR-enhanced virtual labs may optimize the advantages of both approaches in physics education.

5.0 Contributions of Authors

In this study, Authors 1 and 3 conceptualized and designed the research, including formulating the research questions and hypotheses, contributing significantly to data collection and analysis and ensuring the accuracy and consistency of the data gathered. Played a key role in reviewing the literature and drafting the introduction, providing insights into relevant theories and prior research findings, instrumental in interpreting the results, assisting with statistical analyses, bringing clarity to the findings, focusing on the discussion and implications, linking the findings to practical applications, and suggesting avenues for future research. Authors 3 and 4 Contributed to the final manuscript by reviewing and refining it for coherence, accuracy, and clarity, approved the final version for submission, and lastly oversaw the entire project.

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7.0 Conflict of Interests

No conflict of interest.

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Perceived Effectiveness of Tutorial Program in Improving Mathematics Academic Performance

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Abstract. Tutorial programs are one of the many techniques that educational institutions have been experimenting with to improve students' mathematical skills due to realizing the importance of mathematics in the curriculum. This study assessed the influence and effectiveness of tutoring programs on junior high school pupils' academic performance in Mathematics. The results show that children from various age groups, grade levels, and socioeconomic backgrounds frequently receive individual tutoring, especially in subjects like math and Filipino. Both parents and kids perceive the tutorial program as a highly successful educational intervention that improves learning and gives students more self-assurance when facing mathematical difficulties. Teachers also acknowledge tutorial programs as a beneficial teaching resource that improves students' academic performance. The study demonstrates no substantial correlation between students' academic ability in mathematics and the level of effectiveness of the tutorial program. Although tutoring can provide tailored assistance and promote comprehension, other elements might be more critical in determining academic achievement. Furthermore, a tutorial program is an excellent complement to the educational support structure, offering advantages for various educational backgrounds and demographics.

Keywords: Academic performance; Mathematics; Tutorial Program; Tutoring.

1.0 Introduction

Proficiency in mathematics is a fundamental ability that supports success in the classroom and other spheres of life (Morgan, 2018). For junior high school students, understanding mathematical ideas and problem-solving techniques is essential for their cognitive growth, future educational opportunities, career success, and academic success (National Council of Teachers of Mathematics, 2020). To achieve these, tutorial programs are one of the many techniques that educational institutions have been experimenting with to improve students' mathematical skills due to realizing the importance of mathematics in the curriculum.

As an educational intervention, tutorials have drawn interest as a successful way to raise students' arithmetic proficiency (Baker et al., 2002). Many students struggle to understand and perform well in mathematics, which can negatively affect their academic performance. The school's administration, teachers, and parents have been looking for ways to improve students' mathematics skills and close the achievement gap. Even though mathematics is considered essential for junior high school students' academic growth, there is still a severe worry about their academic progress and mathematical ability.

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Offering tutorial services appears to be a viable way to deal with these issues. Nonetheless, there is a significant knowledge vacuum about the effectiveness and influence of tutorial programs on junior high school students' academic performance and mathematical abilities, particularly at Saint Louis School of Don Bosco. Its junior high school students now have access to tutorial services as part of its dedication to supporting academic performance. The degree to which these programs affect students' academic achievement and mathematical abilities is still debatable.

The study was based on a theoretical framework that suggests tutorials might be an effective, individualized method of providing academic support (Woodward et al., 2016). By analyzing the quantitative data gathered, the research aimed to provide educators and policymakers with a comprehensive understanding of the consequences of tutoring. This would enable them to make educated decisions about integrating tutoring into the educational environment.

This study aimed to determine the level to which junior high school students in one of the private schools in Dumaguete benefit from tutorial programs in terms of their academic performance and mathematical abilities. The study also sought to comprehend junior high school students' opinions regarding the efficacy and advantages of tutorials concerning their mathematics performance. Through an extensive assessment of the role of tutorials in improving math skills, this study would add to the larger conversation on successful teaching methods and student growth. In doing so, this study tackled the crucial issue of how educational establishments may support junior high school students' development of mathematical skills, thus fostering their academic performance and more comprehensive intellectual progress.

2.0 Methodology

2.1 Research Design

The study utilized a quantitative research approach, which is well-suited for assessing the impact of tutoring on mathematics achievement, mediating factors, and demographic variables (Creswell & Creswell, 2017). The study utilized descriptive and correlational research designs to determine and describe the relationships between and among the variables. It used them to develop generalizations and formulate principles or theories based on its findings (Calmorin & Calmorin, 2007).

2.2 Research Participants

The research specifically targeted junior high school students exclusively enrolled in the tutorial program at Saint Louis School of Don Bosco, along with their parents and teachers who are actively engaged in the said program. These students voluntarily participated in tutorial sessions tailored to improve their mathematical skills, showcasing their dedication to academic advancement through private tutoring. By focusing solely on individuals involved in tutorial programs, the study aimed to provide insights into the effectiveness of such programs in enhancing mathematics achievement and performance among junior high school students. This study did not utilize any sampling design. This is because the study's sample size is below 100, specifically 35 students and parents and 18 teachers. Morris (n.d.) posited that the entire population should be studied if this happens.

2.3 Research Instrument

The research instrument was adapted and modified from the instrument developed by Xixi et al. (2003), as utilized in the study by Narzoles and Palermo in 2020. The questionnaire was altered to address key research objectives, including assessing participants' perceived effectiveness of the tutorial program, collecting academic information, obtaining demographic details, and exploring socioeconomic background. The questionnaire incorporated a five-point Likert scale for assessing perceptions and numerical scales for objective academic data, ensuring a well-rounded approach to data collection. In finalizing the questionnaire, some questions from related studies were adapted and modified to align with this investigation's variables and research questions. The development of the questionnaire adhered to ethical guidelines, including informed consent procedures and considerations for participant confidentiality.

2.4 Data Gathering Procedures

The data were collected through the questionnaire method. Questions were adapted and modified to elicit vital information on the students' profiles and their perceived effectiveness of private tutoring and academic achievement in mathematics. This study's data collection commenced with informed consent from the students, parents, teachers, and the principal. Once the principal allowed the administration of questionnaires, the administration was done. After, the intent and purpose of the study were explained to the respondents. They were assured that data were treated with utmost confidentiality. All data and relevant demographics were recorded, reviewed for accuracy, and processed. The study implemented quality control measures. Data analysis determined the impact of tutoring, with validation to ensure accuracy. Data were stored securely, respecting privacy and confidentiality. The research adhered to the predetermined timeline and acknowledged any potential limitations. Participants were recognized for cooperation, and research findings were shared upon conclusion.

2.5 Data Analysis

The study utilized a quantitative approach. The collected data were analyzed using different statistical tools: frequency, percentage, weighted mean, and Spearman correlation.

2.6 Ethical Consideration

Ethical considerations in this research paper encompass several vital principles to ensure the integrity, respect, and protection of all study participants. First and foremost, the study adhered to the principles of informed consent, wherein participants, including students, parents, and teachers, were provided with comprehensive information about the study's objectives, procedures, potential risks, and benefits. This ensured that each participant made a voluntary and informed decision to participate, with the assurance that their participation was entirely voluntary and could be withdrawn at any time without consequence. Confidentiality and anonymity were rigorously maintained throughout the study to safeguard participants' privacy. Measures were implemented to protect personal information and ensure the data collected remained confidential. Participants' identities were anonymized in reporting to prevent potential identification, thereby upholding their confidentiality.

3.0 Results and Discussions

3.1 Profile of the Respondents

Table 1 presents the sex profile of student respondents. The data reveal that out of 35 respondents, 18 (51.43%) are male, while 17 (48.57%) are female.

Table 1. *Profile of the student respondents*

Profile	Frequency	Percentage
Sex		
Male	18	51.4
Female	17	48.5
Age		
12-13	16	45.7
14-15	13	37.1
16-17	6	17.1
Grade Level		
Grade 7	11	31.4
Grade 8	9	25.7
Grade 9	7	20.0
Grade 10	8	22.8
Weekly Allowance		
100-350	26	74.2
351-500	4	11.4
501-850	3	8.57
851-1000	2	5.71
Weekly Tutorial Sessions		
Regularly (3 or more times per week)	14	40.0
Occasionally (1-2 times per week)	8	22.8
Rarely (1-2 times per month)	13	37.1

The data further show that more male students are engaged in the tutorial program of Saint Louis School of Don Bosco, Inc. than female students. The study conducted by Jennings and DiPrete (2018) draws attention to the ongoing disparities between genders in educational choices and outcomes, with men frequently demonstrating more significant levels of intellectual engagement in particular courses or activities. This describes the trend of more male students using private tutoring. Table 1 also presents the age profile of student respondents. The data reveal that out of 35 students, 16 (45.714%) are aged 12 to 13 years old, 13 (37.143%) are aged 14 to 15 years old, and 6 (17.143%) are aged 16 to 17 years old. The data further show that more students ages 12 to 13 are engaged in the tutorial program of Saint Louis School of Don Bosco, Inc. The works by Steinberg and Icenogle (2019) emphasize how critical developmental phases are to how adolescents behave in the classroom and make decisions. The developmental stage of 12 to 13-year-old students is marked by heightened cognitive and socio-emotional development, which may make them more responsive to tutoring programs.

Table 1 presents the grade level profile of student respondents. The data reveal that out of the 35 students, 11 (31.43%) are Grade 7, 9 (25.71%) are Grade 8, 7 (20.00%) are Grade 9, and 8 (22.86%) are Grade 10. The data further show that more Grade 7 students are engaged in the Saint Louis School of Don Bosco, Inc tutorial program. Based on the study conducted by Reardon (2021), academic achievement gaps increase as kids go through the school system, with educational inequality typically being more noticeable at earlier grade levels. This may explain why children in Grade 7 need more tutoring than students from other grades. Table 1 also presents the weekly allowance of student respondents. The data reveal that out of 35 respondents, 26 (74.29%) have an allowance of 100-350 pesos, 4 (11.43%) have an allowance of 351-500 pesos, 3 (8.57%) have an allowance of 501-850 pesos. 2 (5.71%) have an allowance of 851-1000 pesos and none for above 1000. The data further show that more students are engaged in tutorial programs, having a weekly allowance of 100-350 pesos. Research indicates that students' financial resources significantly influence their educational decisions (Chan et al., 2020). A study by Pollard (2019) found that students with moderate allowances are more likely to invest in educational support services than those with very low or high allowances.

Lastly, Table 1 presents the tutorial sessions of student respondents. The data reveal that out of 35 respondents, 14 (40%) are taking tutorials regularly, 8 (22.86%) are taking them occasionally, and 13 (37.14%) are taking them rarely. The data further show that more students are taking tutorial programs regularly, three or more times per week. A study by Hattie and Zierer (2017) on successful educational programs highlights the significance of consistent and ongoing practice for the best possible learning results. Compared to random or occasional sessions, regular tutorial sessions—three or more times a week, as shown by your findings—may promote deeper comprehension and memory of academic knowledge.

Table 2 presents the monthly family income of the parent's respondents.

Table 2. *Profile of the parent respondents*

Profile	Frequency	Percentage
Family Income		
Low Income (Php 9,250 to Php 38,080)	31	88.5
Middle Income (Php 38,080 to Php 66,640)	2	5.71
High Income (Php 66,640 to Php 114,240)	2	5.71
Number of Children Receiving Tutoring Sessions		
Nursery to Grade 2	1	2.33
Grade 3 to 5	5	11.6
Grade 6 to 8	12	27.9
Grade 9 to 12	25	58.1
Parent's Preferred Weekly Tutorial Sessions		
Regularly (3 or more times per week)	15	42.8
Occasionally (1-2 times per week)	9	25.7
Rarely (1-2 times per month)	11	31.4
Regularly (3 or more times per week)	15	42.8
Rate		
150 – 200 per hour	27	77.1
201 – 250 per hour	0	0
251 – 300 per hour	6	17.1
300 above	2	5.71

The data reveal that out of 35 respondents, 31 (88.57%) belong to low-income whose monthly income ranges from Php 9 520 to Php 38, 080, 2 (5.71%) belong to middle-income whose monthly income ranges from Php 38, 080 to Php 66, 640; and 2 (5.71%) belong to high-income whose monthly income ranges from Php 66, 640 to Php 114, 240. The data further show that more students belong to low-income families whose monthly income is Php 9 520 to Php 38 080. The development of Bourdieu's theory by Lamont et al. (2014) highlights how income influences individuals' access to academic resources and educational paths. However, these contradict the results in which higher levels of cultural capital, such as awareness of educational options and the importance of academic enrichment, may be possessed by middle-class families, and this could explain why more of them may enroll in tutoring programs.

Table 2 also presents the number of children in a certain household receiving tutoring sessions from the school. The data reveal that out of 43 students, 1 (2.33%) belongs to the nursery to Grade 2, 5 (11.63%) belong to Grades 3 to 5, 12 (27.91%) belong to Grades 6 to 8, and 25 (58.14%) belong to Grades 9 to 12. The table also shows that the 43 students comprise 35 high school students and eight elementary pupils. The data further show that more students under Grades 9 to 12 receive tutoring sessions from the school. The study by Kraft et al. (2023) looks at how pupils adjust to high school and what kind of help they require during this crucial time. Examining parental choices about tutoring enrollment for Grades 9 through 12 students can reveal the elements that lead to heightened parental involvement in assisting their kids' academic aspirations as they advance through high school.

Table 2 also presents the preferred weekly tutorial sessions of parents. The data reveal that out of 35 respondents, 15 (42.86%) opted for regular sessions (3 or more times per week), 9 (25.71%) opted for occasional tutorial sessions (1-2 times per week), and 11 (31.43%) opted for rarely (1-2 times per month). The data further show that more parents opted for regular tutorial sessions (3 or more times per week). According to Reay (2005), parents of higher socioeconomic backgrounds are more likely to invest in additional educational resources, including regular tutorials, to ensure their children's academic success.

Lastly, Table 2 shows the parent's preferred tutoring rate per hour. The data reveal that out of the 35 respondents, 27 (77.14%) preferred 150 – 200 pesos per hour, 6 (17.14%) preferred 251 – 300 per hour, and 2 (5.71%) preferred 300 above pesos per hour, none opted for 201 – 250 pesos per hour. The data further show that more parents preferred a tutorial rate of 150 – 200 pesos per hour. Akçadağ's synthesis indicates the importance of demand-supply dynamics in determining tuition rates. Approximately 200 pesos per hour may emerge as a competitive pricing point in areas with significant demand for tutoring services but a relatively ample supply—this pricing point balances between meeting parents' affordability expectations and adequately compensating instructors.

Table 3 presents the number of teaching years of the teachers offering tutorial services in the school.

Table 3. *Profile of the teacher respondents*

Profile	Frequency	Percentage
Teacher's Years of Teaching		
less than 2 years	3	16.6
2 to 5 years	5	27.7
6 to 10 years	4	22.2
11 to 15 years	0	0.00
16 to 20 years	1	5.56
21 to 25 years	3	16.6
26 to 30 years	2	11.1
Subjects Tutored		
Mathematics	17	20.9
Science	16	19.7
English	15	18.5
AP	16	19.7
Filipino	17	20.9
Regularly (Tutoring Hours per Session)	15	42.8
1 hour/session	12	66.6
1 hour and 30 minutes/session	0	0.00
2 hours	6	33.3

The data reveal that 3 (16.67%) have served for less than 2 years, 5 (27.78%) have served for 2 to 5 years, 4 (22.22%) have served for 6 to 10 years, 1 (5.56%) has served for 16 to 20 years, 3 (16.67%) have served for 21 to 25 years, and 2 (11.11%) have served for 26 to 30 years. The data further show that more teachers have offered tutorial services in the school for 2 to 5 years. Guo et al. (2020) investigated the factors shaping novice teachers' motivation and professional growth. It may offer insights into how teachers in the 2 to 5-year experience range navigate their career trajectories and seek opportunities for skill development, including tutoring. Table 3 also shows the subjects tutored by the teachers. The data reveal that out of 81 total frequency, 17 (20.99%) have tutored Mathematics, 16 (19.75%) have tutored Science, 15 (18.52%) have tutored English, 16 (19.75%) have tutored AP, and 17 (20.99%) have tutored Filipino. The table shows that the 18 teachers are tutoring more than one subject. The data further show that more teachers are tutoring the subjects Mathematics and Filipino as part of the tutorial services offered by the school.

Table 3 further presents the teachers' preferred number of tutoring hours per session. The data reveal that out of 18 respondents, 12 (66.67%) preferred 1 hour/session, 6 (33.33%) preferred 2 hours/session, and none preferred 1 hour and 30 minutes/session. The data further show that more teachers prefer 1 hour per tutoring session. The findings contradict Hattie and Zierer (2017). Successful educational programs highlight the significance of consistent and ongoing practice for the best possible learning results. Compared to random or occasional sessions, regular tutorial sessions—three or more times a week, as shown by his findings—may promote deeper comprehension and memory of academic knowledge.

3.2 Effectiveness of the Tutorial Program

Table 4. *Level of effectiveness of the tutorial program as perceived by the students*

Indicators	SD	$\bar{x}$	Description
1. The tutorial classes covered key areas linked to the class lectures.	0.73	4.34	Very Effective
2. The tutorial classes were well-planned and structured, similar to the class discussion.	0.76	4.11	Effective
3. The tutorial classes encouraged me to prepare for summative exams properly.	0.74	4.51	Very Effective
4. The tutorial classes' contents were adapted to my needs.	0.71	4.17	Effective
5. The tutorial classes improved my academic performance.	0.87	4.11	Effective
6. I looked forward to my tutorial classes.	0.87	3.69	Effective
7. I am satisfied, and I truly enjoyed the tutoring.	0.87	4.11	Effective
8. I learned a lot from tutorials.	0.81	4.23	Very Effective
9. I would recommend tutorials to my friends and classmates who are at risk or who would like to improve their marks.	0.71	4.46	Very Effective
10. I believe that tutorials help enhance my confidence and mathematical skills.	0.84	4.23	Very Effective
Composite Value	**0.79**	**4.20**	**Effective**
1. My tutor helped me in all the difficulties I have encountered in my academic life.	0.77	4.23	Very Effective
2. My tutor was interested in my academic progress.	0.73	4.34	Very Effective
3. My tutor recognized that students' needs, concerns, and interests differ.	0.69	4.37	Very Effective
4. My tutor gave me the confidence to answer exam questions.	0.83	4.20	Effective
5. My tutor showed concern and greatly tried to help me.	0.83	4.29	Very Effective
Composite Value	**0.77**	**4.29**	**Very Effective**
1. The venue has proper lighting and ventilation.	0.81	3.77	Effective
2. The venue is spacious enough and accommodates the student/s.	0.77	4.00	Effective
3. The venue is conducive to learning.	0.89	3.71	Effective
4. The tutor is always available for tutorials.	0.87	3.80	Effective
5. Time preference is considered.	0.81	4.14	Effective
6. The tutorial time is enough for the tutorial.	0.78	4.09	Effective
Composite Value	**0.82**	**3.92**	**Effective**
Overall Composite Value	**0.79**	**4.14**	**Effective**

Table 4 shows the entire collection of responses on the level of effectiveness of the tutorial program as perceived by students. It is composed of three parts. First, regarding the level of effectiveness of tutorial classes, its composite weighted mean is 4.20, and the composite standard deviation is 0.79, with a verbal description of effectiveness. This means that the tutorial classes are effective, and students find the value of tutorial sessions effective in enhancing their understanding of course materials and improving academic performance. Second, the level of effectiveness regarding the tutors, its composite weighted mean is 4.29, and the composite standard deviation is 0.77 with a verbal description of very effective. This means that the tutors are very effective, and the students'

assessments of the tutor's competence, teaching style, responsiveness to questions, and ability to clarify difficult concepts are relatively very high.

Third, for the level of effectiveness regarding the tutorial venue and time, its composite weighted mean is 3.92, and the composite standard deviation is 0.82 with a verbal description of effectiveness. This implies that student's views on the appropriateness and comfort of the location where tutorial sessions take place – students' feedback on the scheduling and duration of tutorial sessions, including whether the timing is convenient and conducive for learning, are all effective for them. The data further reveal that the overall weighted mean is 4.14 and the overall standard deviation is 0.79, with a verbal description of effectiveness. This means that the tutorial program, as perceived by students, is effective. Students consider it a helpful educational tool that contributes positively to their academic progress. The results further support the study conducted by Seo (2018), which highlights that the tutorial program positively predicted self-study time and academic achievement.

Table 5. *Level of effectiveness of the tutorial program as perceived by the parents*

Indicators	SD	$\bar{x}$	Description
1. The tutorial classes covered key areas linked to the class lectures.	0.76	4.34	Very Effective
2. The tutorial classes were well-planned and structured, similar to the class discussion.	0.84	4.00	Effective
3. The tutorial classes encouraged my child to prepare for summative exams properly.	0.81	4.37	Very Effective
4. The tutorial classes' contents were adapted to my child's needs.	0.82	3.97	Effective
5. The tutorial classes improved my child's academic performance.	0.71	4.29	Very Effective
6. I looked forward to my child's tutorial classes.	0.83	3.71	Effective
7. I am satisfied that my child has truly enjoyed the tutoring.	0.86	4.03	Effective
8. My child learned a lot from tutorials.	0.82	4.17	Effective
9. I would recommend tutorials to other parents whose children are at risk and those who want to improve their marks.	0.73	4.34	Very Effective
10. The tutorials help my child enhance their confidence and mathematical skills.	0.95	4.09	Effective
Composite Value	**0.81**	**4.13**	**Effective**
1. The tutor helped my child with all the difficulties he/she has encountered in their academic life.	0.73	4.23	Very Effective
2. The tutor was interested in my child's academic progress.	0.85	4.14	Effective
3. The tutor recognized that the students differ in their needs, concerns, and interests.	0.93	4.20	Effective
4. The tutor gave my child the confidence to answer exam questions.	0.85	4.14	Effective
5. The tutor showed concern and made a great effort to help my child.	0.83	4.20	Effective
Composite Value	**0.84**	**4.18**	**Effective**
1. The venue has proper lighting and ventilation.	0.85	3.74	Effective
2. The venue is spacious enough and accommodates the student/s.	0.76	3.89	Effective
3. The venue and time are conducive to the students.	0.89	3.71	Effective
4. The time is convenient to the student.	0.87	3.66	Effective
5. The time preference of the tutor is considered.	0.87	4.06	Effective
6. The tutorial time is enough for the tutorial.	0.78	4.09	Effective
Composite Value	**0.83**	**3.86**	**Effective**
Overall Composite Value	**0.83**	**4.06**	**Effective**

Table 5 shows the entire collection of responses on the level of effectiveness of the tutorial program as perceived by parents. It is composed of three parts. First, for the level of effectiveness regarding tutorial classes, its composite weighted mean is 4.13, and the composite standard deviation is 0.81 with a verbal description of effectiveness. This means that the tutorial classes are effective, and parents find the value of tutorial sessions effective in enhancing their understanding of course materials and improving the academic performance of their children. Second, for the level of effectiveness regarding the tutors, its composite weighted mean is 4.18, and the composite standard deviation is 0.84 with a verbal description of effectiveness. This means that the tutors are effective, and parents' assessments of the tutor's competence, teaching style, responsiveness to questions, and ability to clarify complex concepts are relatively high. Third, for the level of effectiveness regarding the tutorial venue and time, its composite weighted mean is 3.86, and the composite standard deviation is 0.83 with a verbal description of effectiveness. This implies that parents' views on the appropriateness and comfort of the location where tutorial sessions take place – parents' feedback on the scheduling and duration of tutorial sessions, including whether the timing is convenient and conducive for learning - are effective for their children.

The data further show that the overall weighted mean is 4.06, and the overall standard deviation is 0.83, with a verbal description of effectiveness. This means that the tutorial program, as perceived by parents, is effective. Parents consider it as a helpful educational tool, contributing positively to their children's academic progress. Moreover, the results support the study of Zheng et al. (2020), which asserts that the tutorial program is significantly and positively associated with student test scores. Furthermore, tutored students tend to report higher levels of self-confidence and parent-child relationships.

Table 6. *Level of effectiveness of the tutorial program as perceived by the tutor/teacher*

`		SD	$\bar{x}$	Description
1.	The tutorial classes covered key areas linked to the class lectures.	0.51	4.44	Very Effective
2.	The tutorial classes were well-planned and structured, similar to the class discussion.	0.69	4.33	Very Effective
3.	The tutorial classes encouraged the students to prepare for summative exams properly.	0.43	4.78	Very Effective
4.	The tutorial classes' contents were adapted to the child's needs.	0.50	4.61	Very Effective
5.	The tutorial classes improved the child's academic performance.	0.57	4.72	Very Effective
6.	I looked forward to my tutorial classes.	0.62	4.44	Very Effective
7.	I am satisfied and I truly enjoyed the tutorial classes.	0.77	4.33	Very Effective
8.	My students learned a lot from tutorials.	0.61	4.61	Very Effective
9.	I would recommend tutorials to other parents/students who are at risk and those who like to improve their marks.	0.32	4.89	Very Effective
10.	I believe that tutorials help the child enhance their confidence and mathematical skills.	0.43	4.78	Very Effective
Composite Value		**0.54**	**4.59**	**Very Effective**
1.	I helped the child in all the difficulties he/she encountered in their academic life.	0.62	4.56	Very Effective
2.	I was interested in my student's academic progress.	0.43	4.78	Very Effective
3.	I recognized that the students differ in their needs, concerns, and interests.	0.43	4.78	Very Effective
4.	I gave the child the confidence to answer exam questions.	0.46	4.72	Very Effective
5.	I showed concern and made a great effort to help the child.	0.46	4.72	Very Effective
Composite Value		**0.48**	**4.71**	**Very Effective**
1.	The venue has proper lighting and ventilation.	0.77	4.00	Effective
2.	The venue is spacious enough and accommodates the student/s.	0.46	4.28	Very Effective
3.	The venue and time is conducive for the students.	0.58	3.89	Effective
4.	The tutor is always available for tutorial.	0.67	4.28	Very Effective
5.	Time preference of the tutor is considered.	0.61	4.39	Very Effective
6.	The tutorial time is enough for tutorial.	0.73	4.06	Effective
Composite Value		**0.64**	**4.15**	**Effective**
Overall Composite Value		**0.55**	**4.48**	**Very Effective**

Table 6 shows the entire collection of responses on the level of effectiveness of the tutorial program as perceived by the tutors or parents. It is composed of three parts. First, for the level of effectiveness regarding tutorial classes, its composite weighted mean is 4.59, and the composite standard deviation is 0.54, with a verbal description of very effective. This means that the tutorial classes are very effective, and tutors/teachers find the value of tutorial sessions effective in enhancing understanding of course materials and improving their children's academic performance. Second, for the level of effectiveness regarding the tutors, its composite weighted mean is 4.71, and the composite standard deviation is 0.48, with a verbal description of very effective. This means that the tutors are very effective, and tutors/teachers' assessments of their competence, teaching style, responsiveness to questions, and ability to clarify complex concepts are very high. Third, for the level of effectiveness regarding the tutorial venue and time, its composite weighted mean is 4.15, and the composite standard deviation is 0.64 with a verbal description of effectiveness. This implies that tutors/teachers' views on the appropriateness and comfort of the location where tutorial sessions take place – teachers' feedback on the scheduling and duration of tutorial sessions, including whether the timing is convenient and conducive for learning - are effective for the students.

The data further show that the overall weighted mean is 4.48 and the overall standard deviation is 0.55, with a verbal description of very effective. This means that the tutorial program, as perceived by tutors/teachers, is very effective. Teachers consider it a helpful educational tool, contributing positively to students' academic progress. Furthermore, the research on youth mentoring programs further underscores that positive mentoring relationships can have many advantages for students' social and emotional well-being (Robinson et al., 2021).

Table 7 indicates the mathematics academic performance profile of the students engaged in the school's tutorial program. This is a collection of their mathematics grades from the first quarter down to the average. The mathematics grades are composed of written works, 40% of their grades, performance tasks, 40%, and quarterly assessments, 20%. Looking at the average grades, 13 (37.14%) students have grades of 90% and above and 85% to 89% belong to advanced and proficient groups, respectively, 7 (20%) of them have the grades 80% - 84% with verbal equivalent as approaching proficiency, 2 (5.71%) of them have the grades 75% - 79% with verbal equivalent as developing, and none belongs to the beginning category.

Table 7. *Mathematics academic performance*

Rating	1st	%	2nd	%	3rd	%	4th	%	$\bar{x}$
90% above (Advanced)	9	25.7%	15	42.8%	13	37.1%	17	48.5%	13
85% - 89% (Proficient)	7	20.0%	9	25.7%	15	42.8%	11	31.4%	13
80% - 84% (Approaching Proficiency)	16	45.7%	9	25.7%	5	14.2%	7	20.0%	7
75% - 79% (Developing)	3	8.57%	2	5.71%	2	5.71%	0	0	2

The data reveal that there are more students who have grades 90% and above and 85% to 89%. This means that the students at this level exceed and have developed the core and fundamental requirements in terms of knowledge, skills, and understanding and can transfer them automatically, flexibly, and independently through authentic performance tasks.

3.3 Difference of Assessment on the Level of Effectiveness of the Tutorial Program

Table 8 illustrates the respondents' perceived level of effectiveness of the tutorial program when grouped according to their sex. The mean for the male student respondents is 4.166, which verbally describes effectiveness. The female respondents have a mean of 4.110, with a verbal effectiveness description. The data exhibit that male and female student respondents have perceived the tutorial program as effective. Students consider tutorial programs as a helpful educational tool, contributing positively to their academic progress. Furthermore, these findings concur with the study of Topping (1996), which explores peer tutoring and its effectiveness across genders. The results reveal that male and female students benefit equally from peer tutoring programs, improving academic performance and engagement.

Table 8. *When grouped according to sex*

Sex	Mean	Description
Male	4.17	Effective
Female	4.11	Effective

Table 9 illustrates the respondents' perceived level of effectiveness of the tutorial program when grouped according to their age. The data indicate that mean value of students ages 12-13 is 4.198 with a verbal description of effective. Their mean value for ages 14-15 is 4.008, with a verbal description of effectiveness. For ages 16-17, their mean value is 4.270, with a verbal description that it is very effective. The data show that ages 16-17 years find the tutorial program very effective. This means that the tutorial program is highly effective and is perceived as a valuable and successful educational support that significantly enhances their learning. Additionally, these findings support the study of Robinsons et al. (2021), which suggests that personalized tutoring programs can significantly improve the academic performance of high school students, particularly those aged 16 to 17. It emphasizes the benefits of individualized attention and tailored instruction in boosting student achievement.

Table 9. *When grouped according to age*

Sex	Mean	Description
12-13	4.20	Effective
14-15	4.01	Effective
16-17	4.27	Very Effective

Table 10 illustrates the respondents' perceived level of effectiveness of the tutorial program when grouped according to their grade level. The data indicate the mean values for each grade level. Grade 7 has a mean of 4.230, which falls under the verbal description of very effective. Grade 8 has a mean of 4.231, which also means it is very effective. Grade 9 has a mean value of 3.674, which is a verbal description of effectiveness. Grade 10 has a mean value of 4.318, with the verbal description of being very effective. The data exhibit that Grades 7, 8, and 10 find the tutorial program of the school very effective, while grade 9 students consider the tutorial program effective.

The findings agree with the study of Shokirova and Rasulov (2024), which highlights the widening achievement gap in middle school and the positive impact of sustained tutoring. The study also reveals the complex dynamics of tutoring in high school, with varying effects on academic performance.

Table 10. *When grouped according to grade level*

Grade Level	Mean	Description
7	4.23	Very Effective
8	4.23	Very Effective
9	3.67	Effective
10	4.32	Very Effective

Table 11 illustrates the respondents' perceived level of effectiveness of the tutorial program when grouped according to their weekly allowance. The data indicate the mean value of the weekly allowance of students. The mean value of 100-350 pesos is 4.096, a verbal description of effectiveness. The mean value of 351-500 pesos is 4.238, which is very effective. For 501-850, the mean value is 4.349, which is very effective. For 851-1000, its mean is 4.190, a verbal effectiveness description. The data further show that the weekly allowances of 100-350 and 851-1000 find the tutorial program effective, while the allowances of 351 to 850 find the tutorial program very effective. The findings are supported by the study of Guyana et al. (2021), which focused on the impact of high-dosage tutoring for adolescents and found that those from low-to-middle-income families benefited significantly.

Table 11. *When grouped according to weekly allowance*

Weekly Allowance	Mean	Description
100-350	4.10	Effective
351-500	4.24	Very Effective
501-850	4.35	Very Effective
851 - 1000	4.20	Effective

Table 12 illustrates the respondents' perceived level of effectiveness of the tutorial program when grouped according to their tutorial sessions. The data show the mean value of the different tutorial sessions. It rarely has a mean value of 4.182, which describes verbal effectiveness. Occasionally, it has a mean value of 4.098, a verbal description of effectiveness. Regularly, it has a mean value of 4.123 and a verbal description of effectiveness. The data exhibit that regardless of tutorial sessions – rarely, occasionally, and regularly, the students find the tutorial program effective. Moreover, the findings concur with the study of Bloom et al. (2008), which explores various educational interventions, including tutoring. It generally finds that more consistent and frequent tutoring yields better outcomes but acknowledges that any tutoring can still provide benefits compared to no tutoring.

Table 12. *When grouped according to the tutorial sessions of student respondents*

Tutorial Sessions	Mean	Description
Rarely	4.18	Effective
Occasionally	4.10	Effective
Regularly	4.12	Effective

Table 13 illustrates the respondents' perceived level of effectiveness of the tutorial program when grouped according to their socioeconomic background. The data reveal that for low-income, its mean is 4.143, which has a verbal description of effectiveness. Middle income has a mean of 4.070, which falls under the effective description. High income has a mean of 3.905, which also has a verbal description of effectiveness. The data further show that regardless of the socioeconomic background of respondents – low income, middle income, or high income- the students consider the school's tutorial program effective. Furthermore, these findings coincide with the study of Guryan et al. (2023), which found that high-dosage tutoring was effective across various socioeconomic groups. It demonstrated that students from low, middle, and high-income families all benefited from intensive tutoring, significantly improving their academic outcomes.

Table 13. *When grouped according to socioeconomic background*

Socioeconomic Background	Mean	Description
Low Income	4.14	Effective
Middle Income	4.07	Effective
High Income	3.91	Effective

Table 14 illustrates the respondents' perceived level of effectiveness of the tutorial program when grouped according to the number of children who received the tutorial program. The data show the mean values of the number of children receiving tutorial programs in the school. For Nursery 2 to Grade 2, the mean value is 3.048, a verbal description of moderate effectiveness. For Grades 3 to 5, the mean value is 3.857, with a description of effectiveness. The mean value for grades 6 to 8 is 4.174, with a verbal description of effectiveness. For Grades 9 to 12, its mean is 4.107 with a verbal description of effective. The data shows that Grades 3 to 12 consider the tutorial program offered by the school effective. Nursery 2 to Grade 2 considers it moderately effective. These findings support the study of Dynarski et al. (2013), asserting that investments in educational programs, including tutoring, can significantly impact students from early childhood through Grade 12. It emphasizes the long-term benefits of such interventions on academic achievement and post-secondary.

Table 14. *When grouped according to the number of children receiving tutorial program*

Number	Mean	Description
Nursery to Grade 2	3.05	Moderately Effective
Grade 3 to 5	3.86	Effective
Grade 6 to 8	4.17	Effective
Grade 9 to 12	4.11	Effective

Table 15 illustrates the respondents' perceived level of effectiveness of the tutorial program when grouped according to their preferred tutorial sessions. The data reveal that for rarely (1-2 times per month), the mean is 4.100 with a verbal description of effective; for occasionally (1-2 times per week), the mean is 3.973 with a verbal description of effective; for regularly (3 or more times per week), the mean is 4.095 with a verbal description of effective. The data further exhibit that parents believed that regardless of the tutorial sessions, all would deliver the same effectiveness. The findings coincide with the work of Dynarski et al. (2013), which evaluates the impact of childhood investments, including tutoring, on postsecondary attainment. While not focusing on parental preferences, it emphasizes the importance of high-quality tutoring programs in achieving positive long-term outcomes.

Table 15. *When grouped according to the preferred tutorial sessions of parent respondents*

Tutorial Sessions	Mean	Description
Rarely	4.10	Effective
Occasionally	3.97	Effective
Regularly	4.10	Effective

Table 16 exhibits the difference in the tutorial program's effectiveness level when grouped according to the preferred rate per hour of parent respondents. The results show that for 150 to 250 pesos per hour, the mean is 4.049; for 251 to 350 pesos per hour, the mean is 4.134; for 351 and above, the mean is 4.071. All have a verbal description of effectiveness. The data further exhibit that regardless of the hourly rate, all will deliver the same effectiveness. They consider it a helpful educational tool, contributing positively to the student's academic progress. Findings support the study of Manning and Marquis (1996). While not directly related to tutoring, this study explores how individuals perceive the quality of services relative to their cost. It suggests that perceptions of quality may influence service satisfaction regardless of the actual payment amount.

Table 16. *When grouped according to the preferred tutorial rate per hour*

Rate/Hour	Mean	Description
150-250	4.05	Effective
251-350	4.13	Effective
351 above	4.07	Effective

Table 17 shows the difference in the level of effectiveness of tutorial programs when grouped according to the years of teaching of teacher respondents. For 5 years and below, it has a mean of 4.468 with a verbal description of very effective; for 6 to 10 years in teaching, the mean is 4.536 with a verbal description of very effective; for 16 to 20 years in teaching, the mean is 4.524 with a verbal description of very effective; for 21 years and above in teaching, it has the mean of 4.505 with a verbal description of very effective. The data further show that regardless of the number of teaching years, the teachers consider the tutorial program highly effective and is perceived as a valuable and successful educational support that significantly enhances student's learning. The study of Rivkin et al. (2005) which investigates the impact of teacher characteristics, including experience, on student outcomes. It

suggests that while experience is one factor, other characteristics such as content knowledge, pedagogical skills, and instructional practices influence teaching effectiveness.

Table 17. *When grouped according to the number of years in teaching of teacher respondents*

Years of Teaching	Mean	Description
5 and below	4.47	Very Effective
6 to 10 years	4.54	Very Effective
16 to 20 years	4.52	Very Effective
21 and above	4.51	Very Effective

Table 18 indicates the difference in the tutorial program's effectiveness level when grouped according to the subjects tutored by the teacher respondents. The data show that Math's mean is only 4.476 – very effective. The combination of the subjects Math AP and Filipino has a mean of 3.905 with a verbal description of effectiveness. For subjects Math, Science, and Filipino, it has a mean value of 4.571 with a verbal description of very effective. Lastly, for all subjects tutored, it has a mean of 4.530 with a verbal description of very effective. The data show that the teachers consider the tutorial very effective regardless of the subjects tutored. The study of Slavin and Lake (2008) reviews effective programs in middle and high school mathematics, including tutoring, and suggests that tutoring programs are beneficial for improving mathematics achievement specifically. However, similar effects may be observed in other subjects.

Table 18. *When grouped according to the subjects tutored by the teacher, respondents*

Subjects Tutored	Mean	Description
Math	4.48	Very Effective
Math AP Fil	3.91	Effective
Math Science Fil	4.57	Very Effective
All	4.53	Very Effective

Table 19 exhibits the difference in the tutorial program's effectiveness level when grouped according to the preferred hour per session of teacher respondents. The data show that teachers who prefer 1 hour per session have a mean of 4.456 with a verbal description of very effective; teachers who prefer 2 hours per session have a mean of 4.571 with a verbal description of very effective. The data show that regardless of the tutoring hour per session, they consider the tutorial program highly effective and is perceived as a valuable and successful educational support that significantly enhances student learning. While there may not be studies directly addressing teachers' preferences for 1-hour versus 2-hour tutoring sessions, subjective evidence and professional recommendations often suggest that shorter, more frequent sessions may be preferable for maintaining student engagement and attention span. However, this preference may vary depending on the subject matter, student needs, and teaching style.

Table 19. *When grouped according to the preferred tutoring hour per session of teacher respondents*

Tutoring Hour/Session	Mean	Description
1 hr/session	4.46	Very Effective
2 hr/session	4.57	Very Effective

Table 20 indicates the difference in the tutorial program's effectiveness level when grouped according to the preferred hourly rate of teacher respondents. For 150 to 200 pesos per hour, it has a mean of 4.537; for 201 to 250 pesos per hour, it has a mean of 4.469. Both categories have a verbal description of very effective. The data conclude that they will deliver the same effectivity to the students regardless of the hourly rate. The study of VanLehn (2011) examines various tutoring systems and their effectiveness. It suggests that the competence and training of the tutor are more important than the cost of the tutoring sessions. High-quality tutoring, whether expensive or affordable, can significantly improve academic performance.

Table 20. *When grouped according to the preferred hourly rate of teacher respondents*

Hourly Rate	Mean	Description
150-200	4.54	Very Effective
201-250	4.47	Very Effective

3.4 Relationship Between Variables

Table 21 indicates the relationship between the level of effectiveness of the tutorial program perceived by the students and their academic performance in mathematics. The perceived level of effectiveness regarding tutorial classes has a value of 0.006, which shows a very weak relationship. The perceived level of effectiveness regarding the tutor has a value of -0.093, which is a very weak relationship. The perceived level of effectiveness regarding time and venue has a value of 0.115, which has a very weak relationship. Overall, they have a mean value of 0.009, which also has a very weak relationship.

Table 21. *Relationship between the level of effectiveness of the tutorial program as perceived by the students and their mathematics academic performance*

Academic Performance	Tutorial Classes	Tutor	Time and Venue
Spearman rho	0.006	-0.093	0.115
Relationship	Very Weak	Very Weak	Very Weak

The data reveal that the effectiveness of the tutorial program, as perceived by the students, and their academic performance in mathematics have a very weak relationship or association. In other words, the students' perception does not have a significant impact on their academic performance in mathematics, and different factors could have caused it. The study of Cohen et al. (1986) examines the effectiveness of various of educational interventions, including tutoring, and finds that students' perceptions of effectiveness do not always correlate strongly with objective academic outcomes. This suggests that students' subjective views on tutorial effectiveness may not always predict actual improvements in mathematics performance.

Table 22 exhibits the relationship between the level of effectiveness of the tutorial program perceived by the parents and the student's mathematics academic performance. The perceived level of effectiveness regarding tutorial classes has a value of 0.060, which shows a very weak relationship. The perceived level of effectiveness regarding the tutor has a value of -0.087, which is a very weak relationship. The perceived level of effectiveness regarding time and venue has a value of 0.115, which has a very weak relationship. Overall, they have a mean value of 0.029, which also has a very weak relationship.

Table 22. *Relationship between the level of effectiveness of the tutorial program as perceived by the parents and the student's mathematics academic performance*

Academic Performance	Tutorial Classes	Tutor	Time and Venue
Spearman rho	0.060	-0.087	0.115
Relationship	Very Weak	Very Weak	Weak

The data show that the relationship between the level of effectiveness of the tutorial program as perceived by the parents and the student's mathematics academic performance is very weak. In other words, the parents' perception does not significantly influence the student's academic performance in mathematics, and different factors could have caused it. The study of Hoover-Dempsey and Sandler (1997) explores the reasons behind parental involvement and their perceptions of educational programs. It suggests that while parents may believe that tutoring programs are effective, their perceptions do not always correlate with their children's academic achievements, including mathematics.

Table 23 shows the relationship between the level of effectiveness of the tutorial program perceived by the teachers and the student's mathematics academic performance. The perceived level of effectiveness regarding tutorial classes has a value of -0.130, which shows a weak relationship. The perceived level of effectiveness regarding the tutor has a value of -0.010, which is a very weak relationship. The perceived level of effectiveness regarding time and venue has a value of 0.026, which has a very weak relationship. Overall, they have a mean value of -0.038, which also has a very weak relationship.

Table 23. *Relationship between the level of effectiveness of the tutorial program as perceived by the teachers and the student's mathematics academic performance*

Academic Performance	Tutorial Classes	Tutor	Time and Venue
Spearman rho	-0.130	-0.010	0.026
Relationship	Weak	Very Weak	Very Weak

The data reveal that the relationship between the level of effectiveness of the tutorial program as perceived by the teachers and the student's mathematics academic performance is very weak. In other words, the teachers'

perception does not significantly impact the student's academic performance in mathematics, and other factors could have caused it. The study of Kane and Staiger (2008) evaluates the impact of teachers on student achievement. It highlights that teachers' perceptions of the effectiveness of various interventions, including tutoring, do not always align with measurable improvements in student performance, including mathematics. This suggests a potentially weak correlation between perceived and actual effectiveness.

4.0 Conclusion

The study conducted at Saint Louis School of Don Bosco, Inc., has provided comprehensive insights into the effectiveness of its tutorial program across various aspects. It reveals that the program predominantly attracts male students, particularly those in Grade 7 and students aged 12 to 13. These findings underscore a demographic skew towards younger male students actively engaging with the tutorial services offered by the school. Furthermore, most students participating in the tutorial program come from low-income families, highlighting the program's accessibility and relevance to economically disadvantaged students.

In terms of engagement and preferences, the study identifies a clear preference for regular tutorial sessions among both students and parents, signaling a perceived value in frequent academic support. Parents typically opt for tutoring rates between 150-200 pesos per hour, indicating a balance between affordability and the perceived quality of the school's tutoring services. Teachers involved in the tutorial program, particularly those with 2 to 5 years of teaching experience, primarily focus on Mathematics and Filipino subjects, conducting 1-hour sessions that align with the student's academic needs and preferences.

Overall, stakeholders—students, parents, and teachers—consistently perceive the tutorial program as effective in enhancing academic progress and supporting student learning outcomes. This positive perception is further substantiated by students achieving high grades and demonstrating mastery of core subjects, indicating the program's tangible impact on educational outcomes. However, it is noteworthy that while the tutorial program is widely regarded as effective, correlations between stakeholders' perceptions and students' mathematics performance appear weak. This suggests that while the program plays a crucial role in supporting academic development, other factors beyond the program's effectiveness may also influence students' overall academic performance and achievement.

5.0 Contributions of Authors

The authors confirm their equal contribution to every part of this research. All authors reviewed and approved the final version of this paper.

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7.0 Conflict of Interests

The authors declare no conflicts of interest.

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The Role of Patient Satisfaction, Technology Usability, and Healthcare Accessibility in Telemedicine Adoption: A Correlational Study

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Abstract. Telemedicine has transformed healthcare delivery, improving patient satisfaction, technology usability, and accessibility. However, gaps remain in understanding patient perspectives on adoption. Most studies emphasize technological and clinical outcomes, with limited focus on how satisfaction, usability, and accessibility interact. Additionally, research on these factors in underserved regions like the Davao Region, where healthcare disparities persist, is scarce. This study investigates the factors influencing telemedicine adoption among patients, specifically focusing on patient satisfaction, technology usability, and healthcare accessibility. Utilizing a quantitative descriptive-correlational design, data were collected from 300 telemedicine users in the Davao Region through validated questionnaires. The analysis revealed significant correlations between telemedicine adoption and the examined variables, with healthcare accessibility exhibiting the strongest correlation (0.820), followed by technology usability (0.749) and patient satisfaction (0.678). Key factors impacting patient satisfaction included the quality of care, perceived similarity to face-to-face interactions, and positive perceptions of healthcare-provider interactions. Furthermore, usability factors such as ease of use, reliability, and interface quality were critical in driving engagement. The findings underscore the importance of enhancing patient satisfaction, improving technology usability, and ensuring healthcare accessibility to facilitate telemedicine adoption. Recommendations include investing in user-friendly platforms, improving service availability and affordability, and increasing awareness among potential users. By addressing these factors, stakeholders can enhance telemedicine's role in healthcare delivery, ultimately improving patient outcomes and access to medical services, particularly in underserved areas.

Keywords: Descriptive-correlation; Healthcare accessibility; Patient satisfaction; Technology usability; Telemedicine adoption

1.0 Introduction

The rapid advancement of technology has transformed the healthcare industry, with telemedicine emerging as a pivotal innovation in improving patient care delivery. Telemedicine, defined as the use of electronic

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communication technologies to provide and support healthcare services remotely, has transitioned from simple phone consultations to sophisticated platforms that enable real-time interaction between patients and healthcare providers (Shirzadfar & Lotfi, 2017; Jagarapu & Savani, 2021). These advancements have addressed the growing demand for accessible healthcare, particularly in underserved and rural areas, while also demonstrating the potential for reducing costs and enhancing the quality of care delivery (Flodgren et al., 2015; Bashshur et al., 2020).

Numerous studies highlight the benefits of telemedicine, including its capacity to improve health outcomes, such as better management of chronic conditions and reduced hospitalization rates, particularly in specialized fields like pediatrics, neonatology, and mental health (McSwain et al., 2017; Monaghesh & Hajizadeh, 2020). Additionally, telemedicine consistently garners high satisfaction levels among patients and healthcare professionals, with factors like ease of use, interaction quality, and service accessibility identified as key determinants of positive experiences (Nguyen et al., 2020; Eldaly et al., 2022). These findings underscore telemedicine's potential to revolutionize healthcare delivery systems by making services more efficient, patient-centered, and inclusive.

However, gaps persist in understanding the full scope of telemedicine adoption, particularly from the patient's perspective. Existing literature primarily focuses on technological and clinical outcomes, with limited attention to the interplay of patient satisfaction, technology usability, and healthcare accessibility as determinants of telemedicine adoption (Kruse et al., 2017). Furthermore, while theoretical models have been proposed to explain telemedicine adoption, these models often lack an integrated approach that holistically examines how these factors interact to influence patients' decisions to adopt telemedicine services (Ahmad et al., 2019). To address these gaps, this study explores the relationships between patient satisfaction, technology usability, and healthcare accessibility in telemedicine adoption. By focusing on the patient experience, the study provides a nuanced understanding of how these factors contribute to telemedicine adoption, offering actionable insights for healthcare providers and policymakers to enhance telemedicine's impact and accessibility globally.

2.0 Methodology

2.1 Research Design

The research design for this study is quantitative, utilizing a descriptive-correlational approach. This method examines the relationships between patient satisfaction, technology usability, and healthcare accessibility without manipulating variables. By focusing on these variables, the descriptive-correlational design aims to provide insights into how they comprehensively influence telemedicine adoption.

2.2 Research Participants

The study's sampling procedure focuses on individuals aged 20 and above in the Davao Region who have used telemedicine services. A two-step approach was utilized: quota sampling to estimate the total population across five provinces and stratified random sampling to select participants. Quota sampling divided the population based on location, estimating the number of telemedicine users, while stratified random sampling ensured representation from various subgroups. The final sample size of 300 was calculated using Raosoft with a 5% margin of error and 95% confidence level, distributed proportionally across the provinces.

2.3 Research Instrument

The study utilized four adapted questionnaires to assess various aspects of telemedicine: the Telemedicine Satisfaction Questionnaire, the Technology Usability Scale, the Healthcare Accessibility Scale, and the Telemedicine Adoption Scale. The Telemedicine Satisfaction Questionnaire, adapted from Yip et al. (2023), consists of 16 items and has a Cronbach's alpha of 0.925, measuring quality of care, similarity to face-to-face encounters, and perceptions of interaction using a 5-point Likert scale to gauge patient satisfaction. The Technology Usability Scale, based on Parmanto et al. (2016), evaluates usability with six indicators—usefulness, ease of use, interface quality, interaction quality, reliability, and future use—and has a Cronbach's alpha of 0.914, indicating high reliability. The Healthcare Accessibility Scale, adapted from the Perceived Access to Health Care Questionnaire by Hoseini-Esfidarjani et al. (2021), includes 30 items with a Cronbach's alpha of 0.918, focusing on access and affordability, also utilizing a 5-point Likert scale. Lastly, the Telemedicine Adoption Scale, based on Okrah (2021), measures the intention to adopt telemedicine through eight indicators, including effort expectancy

and social influence, with a high-reliability score of 0.928. All instruments consistently use a 5-point Likert scale to quantify responses, ensuring robust data collection for the study.

2.4 Data Gathering Procedure

The data gathering procedure for this study was systematically designed to collect high-quality information reflecting the experiences and perceptions of telemedicine users in Region 11, Philippines. It began with validating a comprehensive questionnaire measuring key variables: technology usability, healthcare accessibility, patient satisfaction, and telemedicine adoption. The questionnaire underwent a pilot study, confirming its reliability with high Cronbach's alpha values across various dimensions. Ethical approval was secured from the dean of the College of Nursing and the Liceo Research Ethics Board to protect participants' rights and welfare.

Recruitment involved stratified random sampling, targeting individuals who had used telemedicine services within the past year. Collaborations with healthcare providers and outreach through social media facilitated participant identification. Informed consent was obtained, and participants were assured of confidentiality and their right to withdraw from the study at any time. The electronic questionnaire was distributed via Google Forms to enhance accessibility, with technical support provided to assist participants as needed. After data collection, responses were compiled and checked for completeness and accuracy, preparing the dataset for detailed analysis using appropriate statistical techniques. Strict confidentiality and data security protocols were maintained throughout the process to protect participant information, ensuring reliable and valid findings that contribute meaningful insights into telemedicine adoption in Region 11.

2.5 Ethical Considerations

The study adhered to strict ethical standards outlined by the Liceo de Cagayan Research Ethics Board, ensuring a thorough evaluation of various factors such as inclusion and exclusion criteria, privacy, and data protection. Participants included adults aged 20 and above from Region 11 who had used telemedicine services within the past year. At the same time, those under 20, non-residents, or without internet access were excluded to maintain focus and relevance. The study lasted approximately one month, involving questionnaire completion and possible follow-ups, with strict measures in place to ensure the privacy and confidentiality of participant data, which was stored securely and anonymized. Transparency was prioritized through clear communication of study goals and regular updates, while any potential conflicts of interest were disclosed and managed. Participants were recruited through stratified random sampling, with efforts made to ensure informed consent and community engagement through collaborations with healthcare providers and telemedicine platforms. The study emphasized participant safety, communicated research benefits, and provided small non-monetary incentives. Finally, findings will be shared with stakeholders through presentations and publications, ensuring that the results contribute to improving telemedicine practices.

3.0 Results and Discussion

Table 1 summarizes the level of patient satisfaction in telemedicine, specifically focusing on three key aspects: the quality of care provided, the similarity to a face-to-face encounter, and the perception of the interaction. The mean score for the quality of care provided was 4.41, with a standard deviation of 0.618, indicating that patients were generally satisfied with the care they received through telemedicine. Regarding how similar the experience was to a traditional face-to-face encounter, the mean score was slightly lower at 4.26, with a standard deviation of 0.712. However, it still falls within the “Satisfied” range.

Table 1. *Summary of level of patient satisfaction in telemedicine*

Indicators	Mean	Std. Dev	Interpretation
Quality of Care Provided	4.41	0.618	Satisfied
Similarity to a face-to-face encounter	4.26	0.712	Satisfied
Perception of the interaction	4.50	0.596	Satisfied
Overall Mean	**4.39**	**0.596**	**Satisfied**

The highest level of satisfaction was observed in patient's perception of their interaction with healthcare providers, where the mean score reached 4.50 with a standard deviation of 0.596. The overall mean across all three categories was calculated to be 4.39, with an overall standard deviation of 0.596, consistently reflecting a general satisfaction with telemedicine services. These findings align with previous research on telemedicine conducted by Bashshur

et al. (2016), which found that patient satisfaction with telemedicine encounters highlights the importance of the quality of care delivered remotely. Their findings indicated that patients valued aspects such as effective communication, personalized attention, and thoroughness of assessments, all contributing to overall satisfaction with telemedicine services. Literature has also shown that while telemedicine is well-received, there is often a slight decrease in satisfaction when comparing the experience with traditional face-to-face consultations due to perceived limitations in physical interaction and examination (Fleischhacker, 2020). Replicating the familiar aspects of in-person care to enhance patient satisfaction with telemedicine services (Gondal et al., 2022). Nonetheless, the high ratings across these categories underscore telemedicine's growing acceptance as a viable alternative for healthcare delivery, supported by patient satisfaction metrics across different healthcare environments.

The results in Table 2 highlight the overall usability of technology in telemedicine, as measured across several dimensions. The mean score for "Usefulness" is 4.50, with a standard deviation of 0.569, indicating that respondents found telemedicine highly usable in terms of its usefulness. The dimensions of "Ease of Use and Learnability" and "Interface Quality" scored mean values of 4.44 and 4.39, respectively, with standard deviations of 0.584 and 0.564, both described as usable. Similarly, "Interaction Quality" and "Reliability" both had mean scores of 4.39 and 4.37, with slightly higher standard deviations of 0.605 and 0.620, respectively, yet still within the "usable" category. "Satisfaction and Future Use" recorded a mean of 4.41 and a standard deviation of 0.576, reflecting a generally positive sentiment toward the continued use of telemedicine. The overall mean score for the usability of telemedicine is 4.42, with a standard deviation of 0.529, falling squarely in the "usable" category, demonstrating that respondents find telemedicine technology to be functional and satisfactory. Based on the provided legend, all aspects of telemedicine usability measured fall within the "usable" range (3.51-4.50), with none reaching the "highly usable" classification (4.51-5.0).

Table 2. *Summary of the level of technology usability of telemedicine*

Indicators	Mean	Std. Dev	Interpretation
Usefulness	4.50	0.569	Usable
Ease of Use and Learnability	4.44	0.584	Usable
Interface Quality	4.39	0.564	Usable
Interaction Quality	4.39	0.605	Usable
Reliability	4.3	0.620	Usable
Satisfaction and Future Use	4.41	0.576	Usable
Overall Mean	**4.42**	**0.529**	**Satisfied**

These findings echo current research that emphasizes the importance of communication in telemedicine. Literature suggests that patients' confidence in telemedicine is largely driven by the importance of user-friendly design and intuitive navigation in enhancing patient engagement and satisfaction (Macis et al., 2019). Studies by Haleem et al. (2011) explored the usefulness of telemedicine for managing chronic conditions, highlighting its potential to enhance patient self-management, facilitate timely interventions, and improve health outcomes.

Moreover, Vista and Tamondong-Lachica (2023) compared the characteristics of patients opting for telemedicine consultations versus in-person visits in a Philippine public hospital setting. Their research identified younger, single, or employed individuals as more likely to use telemedicine. Satisfaction with telemedicine was generally high, attributed to its convenience and the perceived quality of care. The findings suggest that telemedicine has the potential to be a permanent component of the healthcare system in the Philippines, provided that issues related to access and equity are addressed (Del Castillo et al., 2022). As telemedicine platforms continue to evolve, enhancing communication tools and ensuring that virtual interactions feel as natural as in-person consultations will likely contribute to even higher satisfaction levels in the future.

Table 3 summarizes healthcare accessibility in telemedicine across six dimensions: availability, accessibility, affordability, accommodation, acceptability, and awareness. The results show that all dimensions are rated as "accessible," with mean scores ranging from 4.23 to 4.43. Specifically, the highest-rated dimension is awareness, with a mean of 4.43 and a standard deviation of 0.611, suggesting that patients are well-informed about telemedicine services. Acceptability follows closely with a mean score of 4.38 (SD = 0.583), indicating that users accept telemedicine well. Accessibility, accommodation, and availability also scored highly, with mean values of 4.37, 4.34, and 4.26, respectively, demonstrating that telemedicine services are easily reachable and available to

patients. Affordability, while still rated as accessible, has the lowest mean of 4.23 (SD = 0.636), suggesting that cost might be a relatively more significant concern than other factors. The overall mean of 4.33 (SD = 0.538) categorizes telemedicine as accessible, based on the criteria outlined in the study, with all factors contributing positively to healthcare accessibility.

Table 3. *Summary of level of healthcare accessibility in telemedicine*

Indicators	Mean	Std. Dev	Interpretation
Availability	4.26	0.609	Accessible
Accessibility	4.37	0.598	Accessible
Affordability	4.23	0.636	Accessible
Accommodation	4.34	0.599	Accessible
Acceptability	4.38	0.583	Accessible
Awareness	4.43	0.611	Accessible
Overall Mean	**4.33**	**0.538**	**Accessible**

These findings align with previous literature that suggests telemedicine is a viable option for improving healthcare access, particularly in underserved and remote areas (Smith & Jones, 2021). However, cost concerns, as reflected in the affordability dimension, are consistent with other studies highlighting that while telemedicine offers convenience, financial barriers may still limit its full accessibility to certain populations (Lee et al., 2020). Additionally, findings by Valencia-Arias et al. (2024) suggest that telemedicine interventions contribute to bridging gaps in healthcare access, especially in areas where traditional healthcare infrastructure is lacking. Moreover, a study by Anawade et al. (2024) underscores how telemedicine enhances healthcare accessibility by providing timely and convenient access to medical consultations, particularly for individuals facing mobility challenges or residing in areas with limited healthcare facilities. These studies collectively emphasize the transformative potential of telemedicine in improving healthcare accessibility and addressing disparities in healthcare delivery. Therefore, these results support the growing body of research advocating for expanding telemedicine to enhance healthcare accessibility while also underscoring the need to address affordability to ensure equity in healthcare delivery.

Table 4 provides a comprehensive summary of telemedicine adoption among patients, highlighting various factors influencing this adoption. The data reveals that most of the assessed factors fall within the "Adoptable" range, with performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, and price value all showing means above 4.0. Specifically, performance expectancy has a mean score of 4.35 (SD = 0.580), effort expectancy is at 4.38 (SD = 0.569), social influence is 4.30 (SD = 0.583), facilitating conditions is 4.32 (SD = 0.581), hedonic motivation is 4.28 (SD = 0.523), and price value stands at 4.27 (SD = 0.594). These factors are rated as "Adoptable," indicating a positive disposition toward telemedicine based on these aspects.

Table 4. *Summary of level of telemedicine adoption among patients*

Indicators	Mean	Std. Dev	Interpretation
Performance Expectancy	4.35	0.580	Adoptable
Effort Expectancy	4.38	0.569	Adoptable
Social Influence	4.30	0.583	Adoptable
Facilitating Conditions	4.32	0.581	Adoptable
Hedonic Motivation	4.28	0.523	Adoptable
Price Value	4.27	0.594	Adoptable
Habit	4.10	0.696	Adoptable
Privacy and Security Concerns	3.43	0.757	Moderately Adoptable
Overall Mean	**4.12**	**0.472**	**Adoptable**

Although slightly lower, Habit falls within the "Adoptable" category with a mean of 4.10 (SD = 0.696). Conversely, privacy and security concerns are rated as "Moderately Adoptable," with a mean score of 3.43 (SD = 0.757), suggesting that these concerns may influence adoption to a moderate extent. The overall mean score for telemedicine adoption is 4.12 (SD = 0.472), reinforcing the general trend of positive adoption among patients. These findings align with the literature on telemedicine adoption, which underscores the importance of performance expectancy, effort expectancy, and social influence in facilitating technology acceptance (Davis et al., 2020; Venkatesh et al., 2012). Moreover, the moderate concern over privacy and security mirrors the concerns

identified in various studies, highlighting the need for robust security measures to enhance user confidence (Kruse et al., 2017).

Moreover, recent studies have emphasized the role of additional factors such as hedonic motivation, price value, habit, and privacy and security concerns in shaping individuals' decisions to adopt telemedicine (Lu et al., 2024; Davis et al., 2020; Hoque & Sorwar, 2017). These factors collectively contribute to the complex landscape of telemedicine adoption, reflecting the interplay between technological capabilities, user perceptions, social influences, and organizational contexts. Furthermore, research has highlighted the importance of addressing barriers to adoption, such as limited access to technology, data security and privacy concerns, and resistance to change among healthcare providers (Abdelhamid et al., 2017; Camara et al., 2015). Overall, the literature underscores the need for a comprehensive understanding of the factors influencing telemedicine adoption to inform policy, practice, and technology development efforts to promote the widespread adoption of remote healthcare services. These insights will be further explored in the subsequent literature review, which will explore how these factors influence telemedicine adoption and the implications for future research and practice.

The correlation analysis presented in Table 5 illustrates significant relationships between telemedicine adoption and three key variables: patient satisfaction, technology usability, and healthcare accessibility, each crucial for the successful implementation of telemedicine. There is a strong positive correlation (0.678) between patient satisfaction and telemedicine adoption, indicating that higher satisfaction levels—driven by the quality of care (0.611), the similarity to face-to-face encounters (0.602), and positive interactions with healthcare providers (0.683)—lead to an increased likelihood of adopting telemedicine. This finding aligns with prior studies that emphasize the importance of patient satisfaction in enhancing telemedicine uptake, particularly regarding convenience and access to care (Bashshur et al., 2016; Kruse et al., 2017).

Table 5. *Correlation analysis for the relationships between telemedicine adoption and three key variables: patient satisfaction, technology usability, and healthcare accessibility*

Variables	Correlation Coefficient	p-value	Interpretation
Patient Satisfaction	.678**	.000	Significant
Quality of care provided	.611**	.000	Significant
Similarity to face-to-face encounter	.602**	.000	Significant
Perception of the interaction	.683**	.000	Significant
Technology Usability	.749**	.000	Significant
Usefulness	.718**	.000	Significant
Ease of use and learnability	.677**	.000	Significant
Interface Quality	.657**	.000	Significant
Interaction Quality	.674**	.000	Significant
Reliability	.645**	.000	Significant
Satisfaction and Future Use	.690**	.000	Significant
Healthcare Accessibility	.820**	.000	Significant
Availability	.724**	.000	Significant
Accessibility	.735**	.000	Significant
Affordability	.687**	.000	Significant
Accommodation	.703**	.000	Significant
Acceptability	.789**	.000	Significant
Awareness	.730**	.000	Significant

**Correlation is significant at the 0.05 level (2-tailed).

Additionally, technology usability shows a high correlation (0.749) with telemedicine adoption, with factors such as usefulness (0.718), ease of use (0.677), interface quality (0.657), and reliability (0.645) contributing to patients' willingness to engage with telemedicine. Previous studies reinforce the idea that user-friendly systems enhance adoption by reducing barriers to engagement (Wade et al., 2019; Pierre, 2024). Improved technology usability encourages patient satisfaction and future use, making it essential to design telemedicine platforms. Moreover, the strongest correlation (0.820) is observed between healthcare accessibility and telemedicine adoption, encompassing availability (0.724), affordability (0.687), accommodation (0.703), acceptability (0.789), and awareness (0.730). These factors are vital for patients to utilize telemedicine services, particularly in underserved areas, as highlighted by studies emphasizing telemedicine's role in improving access to care and reducing travel burdens (Leelavati et al., 2023; Almalki et al., 2023). These findings suggest that enhancing patient satisfaction, ensuring technology usability, and improving healthcare accessibility are key strategies for increasing

telemedicine adoption. Addressing these aspects can support the broader acceptance and integration of telemedicine within healthcare systems, aligning with existing literature on the importance of user experiences and accessibility in successfully implementing telemedicine services.

4.0 Conclusion

The correlation analysis reveals significant relationships between telemedicine adoption and three critical factors: patient satisfaction, technology usability, and healthcare accessibility. A strong positive correlation exists between patient satisfaction and telemedicine adoption, indicating that higher satisfaction levels—driven by quality of care, the similarity of telemedicine to face-to-face interactions, and positive perceptions of healthcare provider interactions—lead to increased adoption rates. Additionally, technology usability is strongly correlated with telemedicine adoption, suggesting that user-friendly systems significantly enhance patient engagement. Furthermore, healthcare accessibility shows the strongest correlation with telemedicine adoption, emphasizing the importance of availability, affordability, accommodation, acceptability, and awareness in encouraging patients to utilize telemedicine services.

To foster greater telemedicine adoption, healthcare providers and policymakers should enhance patient satisfaction by improving the quality of care through effective communication and patient engagement techniques while regularly soliciting feedback for improvements. Additionally, investing in user-friendly telemedicine platforms that prioritize ease of use and reliability is crucial. Strategies to improve the availability and affordability of telemedicine services, particularly in underserved areas, should also be implemented, along with targeted outreach campaigns to raise awareness of these services. Addressing potential concerns and misconceptions about telemedicine is essential for promoting its acceptability. By focusing on these areas, stakeholders can ensure that telemedicine becomes more integral to the healthcare delivery system, ultimately improving patient outcomes and access to care.

5.0 Contributions of Authors

Main Author: As the principal investigator and main author, he conceptualized the study, designed the methodology, collected and analyzed the data, and drafted the manuscript. He also revised the manuscript based on peer-review feedback.

Co-author: As the adviser and co-author, she provided guidance and critical input in the study's conception and design. She reviewed and revised the manuscript, ensuring intellectual rigor and alignment with academic standards.

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7.0 Conflict of Interests

All authors declared that they have no conflicts of interest as far as this study is concerned.

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