

Relationship Between Grade 7 Students' Interest and Their Performance in Acid-Base Lessons Using LoLiPap and CIS

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Date received: September 21, 2024

Date revised: October 6, 2024

Date accepted: October 18, 2024

Originality: 94%

Grammarly Score: 99%

Similarity: 6%

Recommended citation:

Benong, C.B., Benong, S., Piñero, B., Futralan, M.C. (2024). Relationship between grade 7 students' interest and their performance in acid-base lessons using LoLiPap and CIS. *Journal of Interdisciplinary Perspectives*, 2(11), 389-394. <https://doi.org/10.69569/jip.2024.0513>

Abstract. This study utilized descriptive, correlational, and cluster-randomized controlled trial (CRT) methods to explore the relationship between the Grade 7 students' interest and their performance in learning acid-base lessons using localized litmus paper (LoLiPap) and a computer interactive simulator (CIS) at a private school in Dumaguete City (SY 2023-2024). Validated questionnaires were used to assess the students' interests and performance. As indicated by the results, the two groups of students exhibited a "very high" interest in using the LoLiPap and CIS methods and attained "fairly satisfactory" performances. It was further unveiled that the interest levels of both groups, with p-values of 0.243 and 0.064, respectively, were not significantly related to their performance. This finding suggests that, besides interest, other factors affect students' learning outcomes. It is advised that the two methods should be combined with effective classroom dynamics, positive teacher behavior, better study habits, and a supportive environment to improve student performance.

Keywords: Localized apparatus; Educational outcomes; Computer interactive simulator; Acids and bases; Level of interest.

1.0 Introduction

Chemistry knowledge is highly crucial for shaping today's world. However, student disinterest and poor performance in the subject have remained persistent issues in chemistry education (Musengimana et al., 2021). Espinosa (2014) and Mangubat and Picardal (2023) noted that chemistry is one of the most feared subjects in science. This fear causes students to struggle often to complete the necessary tasks, resulting in them receiving low grades. Siddique et al. (2022) also revealed that despite their curiosity, secondary school students experienced learning difficulties and disengagement in chemistry. This was attributed to the perceived complexity of the subject, leading to poor attitudes toward learning chemistry.

Like many other countries, the Philippines faces a decline in students' science knowledge, as reflected in the 2018 and 2022 Programme for International Student Assessment (PISA) results, where Filipino students scored very low in science (Bernardo et al., 2023), which showed that their performance has not had considerable improvement since the evaluation in 2018 (Acido & Caballes, 2024). Filipino fourth graders also ranked last internationally in science concepts and principles based on the results of the 2019 Trends in International Mathematics and Science Study (TIMSS) (Martin et al., 2020). Several factors have been found to cause this decline in science knowledge

among Filipino learners. These include negative attitudes toward the subject, scarce learning materials, and ineffective teaching methods (Cheung, 2009; Khan & Ali, 2012; Morabe, 2004; Musengimana et al., 2021). Moreover, the weakening of students' science learning came as a result of the lack of laboratory facilities and equipment, particularly for chemistry, in Philippine schools, according to several scholars such as Estipular and Roleda (2018), Villar (2018), Jin et al. (2018), and Balbinot-Alfaro et al. (2019). Chemistry lab exercises are essential for raising students' comprehension and interest in the subject (Tuysuz, 2010; Orbe et al., 2018). Hence, educators must develop active learning strategies that emphasize the importance of science in a dynamic learning environment to solve the shortage of chemistry labs and boost students' motivation and performance in chemistry (Albarico et al., 2023).

Moreover, in response to this issue, studies like that of Patron and Despojo (2020), and Ayasrah et al. (2024) focused on utilizing inexpensive demonstrations and experiments, such as localized apparatuses, simulations, and augmented reality, to aid in teaching science and mathematics. Several studies also assessed students' post-test performance and interest in using computer interactive simulations in science (Ouahi et al., 2022), specifically in physics (Estipular & Roleda, 2018; Marces & Caballes, 2019; Dionson, 2020; Acabal et al., 2022; Candido et al., 2022), mathematics (Wong & Wong, 2019), and chemistry (Barocio et al., 2021). Other researchers explored students' performance and interest in using localized apparatuses in physics (Onasanya & Omosewo, 2011; Acabal & Mari, 2019; Gainsan, 2021; Balbon, 2019; Duya, 2021; Acabal et al., 2022), and biology (Cabuyoc, 2020). However, no studies have specifically examined the combined use of localized litmus paper (LoLiPap) and computer interactive simulation (CIS) in teaching chemistry. Thus, this study aims to determine the relationship between students' interest in the acid-base lesson using LoLiPap and CIS and their post-test performance after utilizing these two methods.

2.0 Methodology

2.1 Research Design

The study employed descriptive, correlational, and CRT methods. It is descriptive because it describes the level of students' interest in using LoLiPap and CIS. It is correlational because it examines the relationship between students' interest and their post-test performance in acids and bases using LoLiPap and CIS. Additionally, it applied the CRT method because students were not individually randomized; instead, groups were created based on their previous science grades (grade six overall science grade) and were each randomly assigned a method of instruction.

2.2 Research Locale

This study was conducted at a private school situated in Dumaguete City, Negros Oriental.

2.3 Research Participants

A total of 32 Grade 7 students were considered as the participants of the study. These students were enrolled in a private school in Dumaguete City, Negros Oriental. They were grouped based on their prior knowledge of the subject and split into two groups or clusters. The researchers ensured fairness in grouping the participants, and to verify that the two groups had equal knowledge, a t-test for independent data was used. The researchers randomly assigned each group a method of instruction using a one-stage cluster sampling procedure, which led to the formation of the LoliPap Group and the CIS Group. Students in each group participated in the experiment using their assigned method of instruction. Furthermore, both groups of participants gave their consent to participate, with the permission also granted by the school administrators and their respective parents.

2.4 Research Instrument

The study utilized LoLiPap, a CIS, an activity guide, and questionnaires as research instruments. The computer simulator pH Scale Simulation Software, obtained from Phet Colorado (phetcolorado.edu), was employed in conjunction with an activity guide created by the researchers. Additionally, a questionnaire was developed to assess students' posttest performance in acid-base lessons, with test questions formulated using a Table of Specifications (TOS). Questionnaires for measuring students' interest were adapted from Piñero et al. (2023) and validated by four experts in the field, followed by a dry run for item reliability identification.

Indicators for assessing student performance underwent item analysis, while indicators for gauging student interest were evaluated using Cronbach's Alpha Coefficient before the final experiment. The obtained coefficients were 0.874 for LoLiPap and 0.834 for CIS, indicating high reliability (both > 0.70). Statistical tools such as standard deviation, mean, and Spearman's rho were also applied in the analysis.

2.5 Data Gathering Procedure

With the approval of the dean of the Foundation University Graduate School, a request letter to conduct the research was submitted to the University Chancellor for Academic Affairs. Once the request was signed and approved, it was presented to the school principal and the relevant advisers of the grade seven students at the targeted school. During the data collection process, the researchers ensured that the disclosure statement was included with the questionnaires just before the participants began to answer them. Before beginning the research and distributing the test questionnaires, the researchers provided the students with a clear explanation of the study's purpose and significance to facilitate a smooth experiment. The researchers also adhered strictly to the established protocols.

Throughout the three-day experiment, a schedule was followed, allocating one hour for each day. On the first day, the researchers thoroughly covered the lessons on acids and bases. The second day involved explaining the activity's procedure, allowing students to experiment with the localized litmus paper and computer interactive simulator, guided by the activity instructions. On the third day, the post-test questionnaire and Questionnaires for measuring students' interest were distributed to the students, after which the results were analyzed and interpreted.

2.6 Ethical Considerations

The participants in the study were thoroughly informed about its purpose and were allowed to choose whether or not to take part on the research. The confidentiality of information, including the participants' grades and personal details, was rigorously maintained. If a participant decided to withdraw from the study, they were given a month to do so. After this period, all information would remain private and anonymous. Moreover, the researchers guaranteed that no respondent would face any harm while participating in the study.

3.0 Results and Discussion

3.1 Level of Students' Interest

Table 1 shows the level of students' level interest in using both methods of learning acids and bases. The data reveal a composite weighted mean of 4.23 for students who have utilized LoLiPap and 4.22 for students who have used the CIS.

Table 1. Level of students' interest in learning acids and bases with the use of LoLiPap and CIS

Indicators	LoLiPap Group			CIS Group		
	w $\bar{x}$	VD	LoI	w $\bar{x}$	VD	LoI
1. The use of LoLiPap/CIS in science discussion is interesting.	4.56	SA	VH	4.69	SA	VH
2. I enjoyed using the LoLiPap/CIS.	4.50	SA	VH	4.63	SA	VH
3. The concepts of acids and bases are very fascinating to me because of the use of LoLiPap/ CIS.	4.31	SA	VH	4.31	SA	VH
4. It made me realize that with the use of LoLiPap/ CIS, science concepts would be a lot more fun.	4.31	SA	VH	4.25	SA	VH
5. The LoLiPap/c CIS helps me focus on the discussion on the concepts of acids and bases.	4.25	SA	VH	4.13	A	H
6. The use of LoLiPap/ CIS makes me excited about what I'm going to find out, especially in the lesson about acids and bases.	4.25	SA	VH	4.06	A	H
7. The activity in the acids and bases made me realize that science would be more interesting with the use of LoLiPap/ CIS.	4.19	A	H	3.94	A	H
8. Using LoLiPap/ CIS makes me curious about the nature of science.	4.13	A	H	4.13	A	H
9. The activity encouraged me to use my skills in manipulating objects.	4.13	A	H	4.31	SA	VH
10. The activity made me realize that Chemistry is not merely a set of chemical formulas that needs to be memorized.	4.13	A	H	3.75	A	H
11. Using LoLiPap/ CIS makes me listen attentively to the teacher.	4.06	A	H	4.06	A	H
12. I want to use this LoLiPap/ CIS in other concepts of Science.	4.00	A	H	4.44	SA	VH
Composite	4.23	SA	VH	4.22	SA	VH

Note: 4.21 – 5.00 Strongly Agree (SA), Very High (VH) 3.41 – 4.20 Agree (A), High (H), 2.61 – 3.40 Moderately Agree (MA) Moderate (M), 1.81 – 2.60 Disagree (D), Low (L), 1.00 – 1.80 Strongly Disagree (SD), Very Low (VL)

The results further indicate that students using LoLiPap experience positive emotions such as enjoyment, fun, and excitement, which enhance the lesson's appeal and help them concentrate on the discussion and activities, resulting in a "very high" level of interest. These findings align with Piñero et al. (2023), and Acabal et al. (2022), who observed that students displayed excitement and interest, facilitating focused engagement in discussions and experiments.

The data in Table 1 also indicate that using the computer simulator enables the students to manipulate it actively. This experience promotes positive emotions like satisfaction and amusement among the students. Moreover, the level of students' interest became "very high" due to the engaging discussions during the activity. This finding validates the statements of Wong and Wong (2019), Acabal et al. (2022), and Mahawan and Celedonio (2023) that students find it interesting and fun when technology-enhanced learning, such as interactive simulation and computer-aided learning, is applied in Mathematics, Physics, and Chemistry lessons.

Furthermore, in the brief interviews conducted by the researchers, students expressed enjoyment in using the localized apparatus and interactive simulation, describing the activities as highly interesting. They also indicated a willingness to recommend these methods for lesson supplementation. These positive responses correlate with their "very high" level of interest. Moreover, the students said they had developed a better appreciation for and understanding of the acid-base lessons because of their first-hand encounters with LoliPap and CIS.

3.2 Students' Posttest Performance

Table 2 displays the post-test outcomes for CIS and LoLiPap groups. The mean percentages of 77.58% (for the LoLiPap group) and 76.50% (for the CIS group) imply that both groups' post-test performance is "fairly satisfactory." This finding implies that students at this level have met the necessary knowledge, abilities, and comprehension of acids and bases. However, they will still need assistance completing real-world tasks (DepEd Order No. 8, s 2015). Additionally, the standard deviations (SD) for both the LoLiPap (SD = 6.18) and CIS (SD = 5.26) groups indicate that the students' scores deviate significantly from the mean.

Table 2. Posttest performance of the two groups of students

Rating (%)	LoLiPap Group (n=16)		CIS Group (n=16)	
	f	%	f	%
85 - 89	1	6.25	2	12.50
80 - 84	5	31.25	1	6.25
75 - 79	6	37.50	9	56.25
≤ 74	4	25.00	4	25.00
Mean	77.58% (Fairly Satisfactory)		76.50% (Fairly Satisfactory)	
SD	6.18		5.26	

Dionson (2020) and Duya (2021) also observed in their respective studies that the students' performance in grasping difficult scientific concepts improved after the intervention. Likewise, Cabuyoc (2020), Patron and Despojo (2020), and Acabal et al. (2022) emphasize the methods' positive impact on student learning. This is also stated by Siddique et al. (2022), where secondary school students may encounter inherent difficulties in understanding chemistry concepts. That is why strong pedagogical knowledge and skills (Nkundabakura et al., 2023)—along with factors such as classroom dynamics, a supportive learning environment, improved student study habits, and positive teacher behavior (Mangubat, 2023)—should be combined with the implementation of LoLiPap and CIS methods.

3.3 Relationship of Students' Level of Interest and their Posttest Performance

Table 3 illustrates the data regarding the correlation between students' interest levels and their post-test performances. Spearman's Rank Order Correlation found that the p-values for both groups ($p = 0.243$ and $p = 0.064$) are greater than the significance level (0.05). This indicates that no significant relationship exists between (a) students' interest in using LoLiPap and their post-test performance and (b) students' interest in using CIS and their post-test performance. These findings suggest that changes in the independent variable (interest level) do not correspond to changes in the dependent variable (performance).

Table 3. Relationship between the level of students' interest and their post-test performance

Level of Interest and Posttest Performance using:	n	r_s	p-value	Remark
LoLiPap	16	0.311	0.243	Not significant
CIS	16	0.472	0.064	Not significant

Level of significance = 0.05; n = 16 in each group

The results can be further supported by the data presented in Table 1, which show that the level of students' interest does not vary much and that their performances are within the "very high" and "high" classifications. In other words, the students have the same performances regardless of their level of interest. This result affirms the findings of Acabal et al. (2022) that no significant relationship exists between the level of students' interest in using localized apparatus or interactive simulation and their post-test performance, which connotes that the students' interest is not a determinant of their performance. Piñero et al. (2023) also asserted that students' interest in the teacher's use of localized apparatus is unrelated to their performance. Moreover, Viljaranta et al. (2014) and Kaskens et al. (2020) found no evidence proving that a person's interest predicts his or her academic achievement, while Wong and Wong (2019) claimed in their study that students' interest does not correlate with their performance in mathematics. These findings further coincide with those of Macalisang and Bonghawan (2024), suggesting that other factors contributing to students' academic performance, such as motivation, self-efficacy beliefs, and effective learning methods, must be aligned with students' interests when designing effective instructional strategies.

4.0 Conclusion

Students' high level of interest when employing both instructional methods (LoLiPap and CIS) indicates that they found these instructional materials engaging and stimulating. This engagement can create a vibrant learning environment where students are actively involved and motivated to participate. The results also demonstrated the potential value of LoLiPap and CIS as instructional materials that the Department of Education (DepEd) and private basic education teachers could use in teaching acid-base lessons. However, the fact that the student's academic performance remains fairly satisfactory despite their keen interest in the lessons raises questions about the effectiveness of these strategies in translating enthusiasm into academic outcomes. This implies a need for further exploration into the alignment between instructional methods and learning objectives and the identification of potential barriers hindering the translation of interest into academic achievement. Additionally, the lack of a significant relationship between students' interests and academic performance emphasizes the complexity of factors influencing educational outcomes. While interest is undoubtedly important for fostering engagement and motivation, it may not be the sole determinant of academic success. This suggests that educators should adopt a holistic approach to optimal learning and performance of students that encompasses various aspects, including their interests and cognitive abilities, study habits, and external factors such as socioeconomic background. Moreover, future studies should utilize a longitudinal approach to examine students' interest and performance over time with a larger sample size to understand the impact of performance interest better.

5.0 Contributions of Authors

The authors declare that they all contributed equally to this study, and all have reviewed and approved the final paper. Specifically, Mr. Christopher Bernard S. Benong and Mrs. Shery-Ann T. Benong formulated the research framework, methodology, and data collection, ensuring that the study's objectives were clearly defined and were attainable. Mr. Brando A. Piñero was involved in assessing the manuscript drafts and data collection, and Dr. Maria Chona Z. Futralan was responsible for the statistical analysis and data interpretation in this study.

6.0 Funding

No grants or funding were provided for this research.

7.0 Conflict of Interests

The authors clearly state that they have no known competing financial or personal interests that might affect the research reported in this publication.

8.0 Acknowledgment

The authors thank Foundation University and Saint Louis School of Don Bosco for allowing them to conduct this research.

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