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Spiral Progression Approach, Digital Literacy and Competency of Teachers: Basis for Learning Activity Guides

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Abstract. The K–12 curriculum adopted spiral progression and rapid digitalization of education, which exposed essential gaps in how science teachers integrated technology into their teaching framework. The study addressed the absence of empirical evidence about spiral progression implementation, digital literacy, and teacher competence to develop Learning Activity Guides. A descriptive-correlational research design included surveys of 23 junior high school science teachers and 45 Grade 10 students at Esperanza National High School to examine spiral progression implementation, digital practices, and teaching competencies through Likert-scale questionnaires, classroom observations, and self-evaluations. The mean and standard deviation results demonstrated that teachers strongly followed vertical and horizontal curriculum articulation principles and showed high confidence in their digital tool usage. Pearson's r analysis showed that spiral progression implementation had a significant positive relationship with teacher competence (r=.54, p=.001) and digital literacy had a significant positive relationship with competence (r=.66, p=.022). The research results directly shaped the development of Learning Activity Guides, which linked spiral progression principles to technology-enhanced teaching methods. At the same time, administrators received proof to support professional development programs that connect digital skills to curriculum implementation methods. Future research may investigate student achievement outcomes while studying the qualitative aspects of teachers' technology integration experiences.

Keywords: Competency of teachers; Digital literacy; Learning activity guide; Spiral progression.

1.0 Introduction

The global education landscape faces challenges like implementing progressive curricular models like spiral progression and the fast-paced digital transformation. The Philippines needs immediate evaluation of how teachers handle curriculum delivery and digital demands because the K–12 curriculum implements spiral progression. The current research lacks clear connections between these elements, especially within science education, which demands hands-on learning and technological integration. Digital literacy is an essential requirement for teaching in the 21st century, according to Jones et al. (2021), yet knowledge gaps exist. Ballano et al. (2022) demonstrate through their study that spiral progression remains poorly studied in educational environments that utilize technology. International studies show that Japan demonstrates a strong technological infrastructure. Still, its students demonstrate weak digital abilities (Taylor, 2018) which reflects the Philippine situation where rural teachers lack sufficient resources (Yu & Wang, 2024). Research shows a significant knowledge deficiency regarding how curriculum structures function with digital teaching approaches across different resource availability scenarios.

The Philippine educational environment brings distinctive obstacles to the table. The adoption of digital tools by urban teachers continues to grow but rural educators face ongoing challenges with unstable internet access and insufficient training according to Yu and Wang (2024). The gap between urban and rural education systems hinders teachers from using spiral progression effectively, especially in science education, which needs continuous access to high-quality resources for iterative concept development. Current research investigates curriculum models or digital skills independently without exploring their combined effects. The research fills these knowledge gaps by studying three essential components: spiral progression implementation in science education alongside teachers' digital literacy and abilities to articulate curriculum and integrate technology. The research analyzes these factors simultaneously to create practical Learning Activity Guides that connect curriculum needs with actual classroom situations.

2.0 Methodology

2.1 Research Design

The study utilized the descriptive-correlational research design to investigate the relationship between the implementation of the spiral progression approach and digital literacy and teaching competence of science teachers. The independent variable, implementation of the spiral progression approach, comprises two specific indicators: vertical articulation and horizontal articulation. The dependent variable, digital literacy, is measured through four indicators: understanding digital practices, finding information, using information, and creating information, while the competence of teachers comprises four specific indicators: subject mastery, classroom management, instructional delivery, and assessment. The study examined how the indicators of implementation of the spiral progression approach potentially correlate with digital literacy and teaching competence among science teachers. The research objectively analyzed the natural relationships between these variables without attempting to manipulate or establish direct causation. Miksza and Elpus (2018) define descriptive research as observing behavior to describe attributes objectively and systematically, and describe correlational research as a method that predicts how variables are naturally related in the real world.

2.2 Research Participants

The respondents of this study were the 23 junior high school (JHS) science teachers and 45 grade 10 students at Esperanza National High School. The teachers were selected because they are responsible for implementing the spiral progression approach and using digital technologies in their science classes. The students were chosen because they are directly impacted by the teachers' instructional practices and provided valuable feedback on the developed learning activity guides (Dexter, 2019). To ensure the respondents are qualified and appropriate for the study, they should adhere to the following criteria: firstly, Science teachers should currently teach science subjects in grades 7-10 at Esperanza National High School. Secondly, they should have at least 3 years of teaching experience using the spiral progression approach. Lastly, they should be digitally literate and use technology in their lessons. Fourthly, they must be willing to participate in the study and provide honest feedback. Students must be currently enrolled in grade 10 at Esperanza National High School. And they must be willing to participate in the research and provide feedback on the learning activity guides.

Complete enumeration was used to select all junior high school (JHS) Science teachers at Esperanza National High School, while purposive sampling was employed to select 45 Grade 10 students as respondents. Complete enumeration, also known as census sampling, involves every member of the population in the study. In this case, all 23 JHS science teachers were included. Literature supports complete enumeration in educational research, as it thoroughly explains the population's characteristics and experiences. According to Taherdoost (2016), complete enumeration is beneficial when the population is small and manageable, allowing researchers to obtain accurate and detailed information.

On the other hand, a non-probability sampling technique was employed to select respondents based on specific characteristics or criteria pertinent to the research. In this study, 45 Grade 10 students were chosen purposively because they had had direct experience with the Spiral Progression Approach in their science classes. The use of purposive sampling is supported by literature, which emphasizes its effectiveness in qualitative research, where researchers seek to understand specific phenomena or experiences. According to McAuliffe and McGann (2016), purposive sampling allows researchers to focus on individuals with knowledge or experience related to the study, leading to more prosperous and relevant data.

2.3 Research Instrument
This study employed four (4) sets of research instruments with reliability established through pilot testing and previous validation studies. The first set is an adopted research survey questionnaire from Garay and Kim (2023). It determined the level of the implementation of the spiral progression approach in terms of vertical and horizontal articulation, with Cronbach's $\alpha \geq 0.85$ for both subscales. The second set is an adopted standardized Digital Literacy Checklist from (Ferrari et al., 2012). It determined the teachers' digital literacy level in understanding digital practices, finding information, using information, and creating information. After expert review, it was validated in 12 EU countries and modified terminology for the Philippine context. The third set is a questionnaire adopted and verified through pilot testing with $\alpha = 0.89$. It comprises nine indicators that have been devised and nationally validated and are derived from the Philippine Professional Standards for Teachers (PPST). The indicators were derived from the DepEd's widely used classroom observation tool (COT), which was developed by the Philippine National Research Center (PNRC) to assess teacher quality. This tool was included in the Department of Education's policy through DepEd Order No. 42, s. 2017. Included in the survey questionnaire were the nine indicators from the COT.

The level of teaching competence of the science teachers, particularly subject mastery, was determined by indicators 1 and 7. Indicators 4, 5, and 6 were used to evaluate classroom management, indicators 2, 3, and 8 were used to assess instructional delivery, and indicator 9 was used to evaluate assessment. The nine indicators were grouped into four domains. A rubric incorporated from the Department of Education (DepEd) was implemented to assess teaching competence. The rubric includes a performance continuum for each career period. DepEd Order No. 42, s. 2017 was the foundation for the Philippine Professional Standards for Teachers (PPST) for Teachers I-III (Levels 3–7). Through well-defined domains, strands, and indicators, the PPST defines the qualities of a teacher, including professional learning, competent practices, and effective engagement throughout the various phases of a teacher's career. Deri, Janer, and Marbella (2021) were the sources of the fourth set of survey questionnaires, with test-retest reliability confirmed ($r = 0.82$) during the pilot phase. It assessed the student's level of acceptance of the learning activity guides regarding technical aspects, assessment, learning plan, and objective competency.

2.4 Data Gathering Procedure
The researcher employed survey questionnaires to inventory the teachers' perceptions of the Spiral Progression Approach. This was followed by tracing back the Classroom Observation Tool (COT) results for the past three years of the Science Teachers. This process helped identify teachers' lowest ratings or weak points, which served as one of the bases for developing learning activity guides. The researcher secured all necessary communication letters from the Graduate School of Sultan Kudarat State University to initiate this process, as stated in Ang Karugasik (2016). Following this, the researcher requested approval from the Schools Division Superintendent (SDS) of the Division of Sultan Kudarat to administer the survey questionnaire to the science teachers and conduct the study with the grade 10 students of Esperanza National High School. An approval letter from the SDS was attached to seek permission from the School Principal of Esperanza National High School. Once all survey questionnaires had been gathered, the results were consolidated for data analysis. The findings served as a basis for developing learning activity guides in science, which were implemented in the school during the second grading period of the school year 2024–2025. The results were consolidated for data analysis.

2.5 Ethical Considerations
This research study followed ethical guidelines, ensuring voluntary participation where respondents could leave anytime if uncomfortable. The dignity and well-being of teachers and students were rigorously protected, with no physical, social, psychological, or other harm incurred. All research information remained confidential through secure data storage protocols, with personally identifiable information anonymized to protect participant identities. Respondent rights were upheld to maintain scientific integrity, and the study adhered to plagiarism-free, misconduct-free standards throughout its execution.

3.0 Results and Discussion
3.1 Implementation of Spiral Progression Approach
The level of implementation of the spiral progression approach by science teachers was measured through two indicators: vertical articulation and horizontal articulation (see Table 1). It yielded an overall mean of 4.33, which

is very high. This indicates that secondary school teachers effectively implement the Spiral Progression Approach in their teaching practices. The high score reflects a robust alignment with the core principles of the spiral progression approach, which emphasize iterative revisiting of concepts and skills across grade levels to deepen understanding and mastery. Moreover, the overall standard deviation is 0.53, less than 1, indicative of a minimal range of dispersion.

Table 1. *Consolidated Findings of the Level of Implementation of the Spiral Progression Approach*

Indicators/Items	Mean	SD	Verbal Description
A. Vertical Articulation			
1. The topics discussed in the previous years are needed in the present year.	4.77	0.43	Very High
2. There is continuity of lessons in the same concept of science in all grade levels.	4.18	0.59	High
3. The topics are reviewed from the previous grade level before introducing new topics.	4.23	0.43	Very High
4. The progressions of learning competencies of science are discussed in all grade levels.	4.41	0.50	Very High
5. The presentations of the lessons are broadened and deepened each time a concept is revisited.	4.18	0.66	High
6. The lessons are easy to understand since the same topics are offered in all grade levels at varying level of complexities.	3.95	0.58	High
Section Mean	**4.29**	**0.53**	**Very High**
B. Horizontal Articulation			
1. The concepts and skills in Life Science, Chemistry, Physics and Earth Science are presented with increasing levels of complexity from one grade level to another.	4.36	0.49	Very High
2. There is an integration of knowledge and skills across different disciplines.	4.32	0.48	Very High
3. The presentations of the lessons are broadened and deepen each time a concept is revisited.	4.23	0.53	Very High
4. There is more integration of various concepts on each topic encountered.	4.45	0.51	Very High
5. The lessons are extended in more elaborate and comprehensive teaching style.	4.45	0.60	Very High
Section Mean	**4.37**	**0.52**	**Very High**
Overall Mean	**4.33**	**0.53**	**High**

Vertical Articulation of Science Teachers

The section mean of 4.29 is interpreted as Very High with a standard deviation of 0.53. This vertical articulation of teachers was confirmed by three indicators interpreted as very high and three with a high interpretation. It indicates that science teachers had a well-structured science curriculum with strong continuity, regular review of previous material, and progressive complexity across grade levels. It also suggests effective implementation of curriculum design principles that support student learning and understanding in science education. In particular, the highest mean of 4.77, interpreted as Very High, shows that the topics discussed by the teachers in the previous years are needed in the present year. Moreover, the teachers' lessons are easy to understand since the same issues are offered in all grade levels at varying complexities, manifested by 3.95, the lowest mean acquired, interpreted as High. This result aligns with the spiral progression approach introduced in the K to 12 curriculum, which Giray and Kim (2023) and Tirol (2022) described as crucial for national progress and addressing academic disadvantages. The finding that topics discussed by the teachers in the previous years are needed in the present year (mean of 4.77, interpreted as "Very High") strongly supports the spiral progression approach. Saeidmehr et al. (2023) explain that this approach involves revisiting topics throughout a student's education, increasing complexity with each revisit and using prior knowledge as a foundation for new learning. De Ramos-Samala (2018) noted that this aligns with Bruner's spiral curriculum model, which the K to 12 curricula in the Philippines has adopted. This finding is consistent with the new curriculum approach described by Batidor and Casinillo (2021), where Integrated Science, Biology, Chemistry, and Physics are taught simultaneously rather than as separate subjects over four years.

Horizontal Articulation of Science Teachers

This indicator reveals a section mean of 4.37, described as Very High with a standard deviation of 0.52. This level of horizontal articulation was established by five indicators interpreted as Very High. It connotes that the spiral progression approach was effectively implemented, with concepts presented in increasing complexity across grade levels and integration of knowledge across disciplines. It also implies that the instructional approach emphasizes comprehensive coverage of topics, with lessons consistently extended in a more elaborate teaching style and increased integration of various concepts within each topic encountered. Specifically, the highest mean of 4.45, interpreted as Very High, illustrates that there is more integration of multiple concepts on each topic encountered and that the lessons are extended in a more elaborate and comprehensive teaching style. These findings strongly emphasize the interconnected learning and in-depth exploration of topics within the science curriculum. Notably, while still interpreted as Very High, the presentations of lessons being broadened and deepened each time a concept is revisited received a slightly lower yet still high mean of 4.23. This result supports the objective stated by Mariano and Mina-Roguel (2025) that strengthened science teaching following a spiral progression is a key feature of the K-12 Enhanced Basic Education Program. The finding that lessons are extended in a more elaborate and comprehensive teaching style supports the goal of enhancing scientific literacy, as Vidergor (2018) outlined.

3.2 Digital Literacy of Science Teachers

The level of research digital literacy of science teachers was measured in terms of understanding digital practices, finding, using, and creating information (see Table 2). It yielded an overall mean of 4.33, with a standard deviation of 0.53, which is described as very confident. This indicates that secondary school teachers possess high confidence in their digital literacy skills. The results reflect the growing emphasis on integrating digital tools into teaching practices, especially in response to the demands of modern education systems and technological advancements. Moreover, the overall standard deviation is 0.53, less than 1, indicative of a minimal range of dispersion in respondents' responses.

Table 2. *Consolidated Findings of the Level of Digital Literacy*

Indicators/Items	Mean	SD	Verbal Description
A. Understanding Digital Practices			
1. Using online tools and websites to find and record information online.	4.14	0.35	Confident
2. Knowing what categories of users, you can expect to find online.	4.04	0.58	Confident
3. Explaining what happens to information you put online: your digital footprint.	4.45	0.60	Very Confident
4. Choosing the right tool to find, use, or create information.	4.41	0.59	Very Confident
5. Establishing who owns information and ideas you find online.	4.23	0.53	Very Confident
6. Establishing what online information you can legally re-use.	4.41	0.67	Very Confident
7. Presenting yourself online: your digital identity.	4.32	0.65	Very Confident
8. Finding a person online, for example an expert in your discipline, and establishing their contact details.	4.05	0.49	Confident
Section Mean	**4.26**	**0.52**	**Very Confident**
B. Finding Information			
1. Knowing what information you can find in the web.	4.18	0.50	Confident
2. Using social networks as source of information.	4.32	0.57	Very Confident
3. Using keywords commonly used in your discipline to search for information online.	4.45	0.51	Very Confident
4. Knowing what information you can find in an online Library.	4.32	0.65	Very Confident
5. Knowing when to change your search strategy or stop searching.	4.27	0.63	Very Confident
6. Scanning / skimming a web page to get to the key relevant information quickly.	4.27	0.55	Very Confident
7. Using advanced search options to limit and refine your search.	4.27	0.55	Very Confident
8. Filtering large numbers of search results quickly.	4.27	0.55	Very Confident
9. Keeping up to date with information from authoritative people or organizations by subscribing to Really Simple Syndication (RSS) feeds.	4.45	0.51	Very Confident
Section Mean	**4.31**	**0.56**	**Very Confident**
C. Using Information			
1. Keeping a record of the relevant details of information you find online.	4.27	0.53	Very Confident
2. Using information in different media, for example, podcasts or videos.	4.45	0.51	Very Confident
3. Citing a reference to an online resource (e.g. in an assignment) using the correct format.	4.27	0.63	Very Confident
4. Assessing whether an online resource (e.g. web page, blog, wiki, video, podcast, academic journal article) or person is credible and trustworthy.	4.18	0.50	Confident
5. Sharing files legally with others.	4.55	0.51	Very Confident
6. Using other people's work (found online) without committing plagiarism.	4.32	0.48	Very Confident
7. Using social bookmarking to organize and share information.	4.27	0.46	Very Confident
Section Mean	**4.33**	**0.52**	**Very Confident**
D. Creating Information			
1. Adding comments to blogs, forums or web pages, observing netiquette and appropriate	4.00	0.31	Confident
social conventions for online communications.	4.41	0.50	Very Confident
2. Working with others online to create a shared document or presentation.	4.05	0.49	Confident
3. Writing online for different audiences, e.g. a web page or blog entry for private use, for reading by your fellow students, for reading by your tutor, or for reading by anyone in the world.	4.14	0.64	Confident
4. Using media-capture devices, e.g. recording and editing a podcast or video.	4.14	0.47	Confident
5. Writing in different media for people to read on-screen.	4.32	0.47	Confident
6. Communicating with others online (forums, blogs, social networking sites, audio, video, etc.).	4.32	0.48	Very Confident
Section Mean	**4.17**	**0.48**	**Confident**
Overall Mean	**4.33**	**0.53**	**Very Confident**

Understanding Digital Practices of Science Teachers
As shown, the section mean of 4.26 is interpreted as Very Confident, with a standard deviation of 0.52. This understanding of teachers' digital practices was confirmed by five indicators interpreted as very confident and three with an interpretation of confident. It indicates that science teachers had a well-structured science curriculum with strong continuity, regular review of previous material, and progressive complexity across grade levels. It also suggests effective implementation of curriculum design principles that support student learning and understanding in science education. In particular, the highest mean of 4.45, interpreted as Very Confident, shows that the topics discussed by the teachers in the previous years are needed in the present year. Moreover, the teachers' lessons are easy to understand since the same issues are offered in all grade levels at varying complexities, manifested by 3.95, the lowest mean acquired, interpreted as Often.

Finding Information of Science Teachers
This indicator reveals a section mean of 4.31 interpreted as Very Confident, with a standard deviation of 0.56. Nine indicators confirmed teachers' digital literacy level in finding information with a very confident interpretation. It indicates that science teachers are confident in obtaining online information. In particular, the highest mean of 4.45, interpreted as very confident, shows that they are very competent in using keywords commonly used in their discipline to search for information online and keeping up to date with information from authoritative people or organizations by subscribing to Really Simple Syndication (RSS) feeds. Moreover, they know what information they can find on the web, which is manifested by 4.18, the lowest mean acquired and is interpreted as very confident. This result aligns with the findings of Masrukhin (2025), who stated that digital literacy is a dynamic concept: as information and communication technology (ICT) advances, the notion of digital literacy must also evolve to ensure that students acquire and use skills in pertinent new technologies for information retrieval, transfer, analysis, evaluation, and communication.

Using Information of Science Teachers
The section mean of 4.33 is described as Very Confident with a standard deviation of 0.52. Six indicators confirmed this with an interpretation of very confident, and one indicator with an understanding of confident. This indicates that educators maintain an online record of essential information. They have less experience in organizing and disseminating content through social bookmarking. Moreover, they may plagiarize by utilizing others' work through inadequate citation practices. Notably, the highest mean of 4.55, with a description of very confident, indicates that teachers share files legally with their colleagues and friends. Moreover, they can also assess whether an online resource or person is credible and trustworthy. It is demonstrated by a mean of 4.18, which is described as confident and is the lowest mean score they have. This is consistent with a study by Giray and Kim (2023), which showed that scientific educators possess confidence in data collection via digital technologies and exhibit a high degree of digital literacy, especially in locating, comprehending, utilizing, and generating digital information. Nevertheless, according to Silvhiany et al. (2021), digital literacy involves complex skills essential for full participation in a knowledge society. It includes the ability to evaluate online information sources critically.

Creating Information on Science Teachers
This indicator reveals a section mean of 4.17 with a standard deviation of 0.48 and is interpreted as Confident. Two indicators were described as very confident, and four with a confident description confirmed this. The result indicates a robust ability to interact, create, and communicate effectively in online environments, spanning writing, multimedia production, and interactive engagement. Teachers' capacity to collaborate with others online to generate a shared document or presentation is demonstrated by the highest mean of 4.41, which is accompanied by a description of "very confident." In addition, the mean gain score of 4.00 indicates that instructors are proficient in adding comments to blogs, forums, or web pages and observance of netiquette and appropriate social conventions for online communications. In their study, Ballano et al. (2022) supported this finding by emphasizing the importance of digital literacy in enabling educators to articulate themselves and engage effectively in digital communication. In addition, Al-Khatib (2023) stresses the role of netiquette in fostering respectful and effective online communication. They noted that adhering to netiquette principles enhances collaboration and builds positive relationships in digital learning environments.

3.3 Competence of Teachers
Teachers' competence level was measured in terms of subject mastery, classroom management, instructional

delivery, and assessment (see Table 3). The overall mean score of 4.55 and a standard deviation of 0.59 indicate that teachers demonstrate exceptional skills across all aspects of teaching science. The high scores reflect a strong foundation in pedagogical practices and subject-specific knowledge.

Table 3. *Level of Competence of Science Teachers*

Indicators/Items	Mean	SD	Verbal Description
A. Subject Mastery			
1. Applied knowledge of content within and across curriculum teaching areas.	4.67	0.53	Outstanding
2. Established a learner-centered culture by using teaching strategies that respond to their linguistic, cultural, socio-economic and religious backgrounds.	4.58	0.62	Outstanding
Section Mean	**4.62**	**0.58**	**Outstanding**
B. Classroom Management			
1. Displayed proficient use of Mother Tongue, Filipino and English to facilitate teaching and learning.	4.71	0.46	Outstanding
2. Established safe and secure learning environments to enhance learning through the consistent implementation of policies, guidelines and procedures.	4.69	0.48	Outstanding
3. Maintained learning environments that promote fairness, respect and care to encourage learning.	4.59	0.50	Outstanding
Section Mean	**4.66**	**0.48**	**Outstanding**
C. Instructional Delivery			
1. Used a range of teaching strategies that enhance learner achievement in literacy and numeracy skills.	4.41	0.57	Outstanding
2. Applied a range of teaching strategies to develop critical and creative thinking, as well as other higher-order thinking skills.	4.31	0.64	Outstanding
3. Adapted and used culturally appropriate teaching strategies to address the needs of learners from indigenous groups.	4.47	0.64	Outstanding
Section Mean	**4.40**	**0.62**	**Outstanding**
D. Assessment			
1. Used strategies for providing timely, accurate and constructive feedback to improve learner performance.	4.53	0.67	Outstanding
Section Mean	**4.53**	**0.67**	**Outstanding**
Overall Mean	**4.55**	**0.59**	**Outstanding**

Subject Mastery of Science Teachers

The section means of 4.62 is presented, described as Outstanding, with a standard deviation of 0.58. Teachers' competence level in teaching science in terms of subject matter was established by two indicators described as outstanding. It connotes that teachers demonstrate high professional adaptability and pedagogical expertise, effectively integrating content knowledge with responsive teaching strategies that acknowledge and respect diverse student backgrounds. It is supported by the study of Schneider (2019), who emphasized the importance of science teachers' competencies, particularly their Subject Matter Knowledge and Pedagogical Content Knowledge, that effective science teaching requires integrating content knowledge with teaching strategies that address diverse learners' needs. Further, Sorge et al. (2019), cited in the European Journal of Humanities and Educational Advancements, confirm that competent science teachers possess strong subject matter knowledge and adapt their teaching methods to meet diverse student needs.

Classroom Management of Science Teachers

The section means of 4.66 is interpreted as outstanding, with a standard deviation of 0.48. This level of competence of teachers in teaching science in classroom management was confirmed by three indicators described as excellent. This implies that teachers demonstrate exceptional professional skills in creating inclusive, safe, and linguistically diverse learning environments, prioritizing student well-being, respect, and effective communication across multiple languages. This aligns with research by Zajda (2021), which emphasizes the importance of teachers' skills in creating inclusive and effective learning environments. Their study found that competent teachers demonstrate the ability to plan appropriate classroom physical environments, accommodate and adjust learning environments, counsel special needs students, provide conducive classroom environments, rearrange classroom seating positions, and set up comfortable environments.

Instructional Delivery of Science Teachers

The result indicates a section mean of 4.40, which is described as outstanding, with a standard deviation of 0.62. It was established by three indicators with a description of outstanding. It suggests that teachers demonstrate exceptional pedagogical expertise, employing diverse, culturally responsive, and intellectually stimulating teaching strategies that effectively enhance student learning, critical thinking, and skill development across different learning contexts and student backgrounds. Pertinent to this study, Mamlok-Naaman (2024) states that effective science teaching requires integrating content knowledge with teaching strategies that address diverse learners' needs.

Assessment of Science Teachers

The section means of 4.53 was presented, which was described as outstanding. This level of competence of teachers in teaching science in terms of assessment connotes that teachers demonstrated exceptional skill in implementing strategic, timely, and constructive feedback mechanisms crucial for enhancing student learning, performance improvement, and academic growth. Ahmad (2021) supported the result and found that constructive feedback significantly improves students' academic performance and self-efficacy. He emphasizes that timely and specific feedback helps students identify areas for improvement and motivates them to achieve higher academic success.

3.4 Implementation of Spiral Progression Approach and Competence of Science Teachers

Table 4 shows that Pearson's Product-Moment correlation was run to examine the relationship between the implementation of the spiral progression approach and science teachers' competence.

Table 4. *Correlational Analysis between the Implementation of the Spiral Progression Approach and Competence of Science Teachers*

Variables	r	t	p	Interpretation
Implementation of Spiral Progression Approach and Competence of Science Teachers	.54	3.49	0.001	Significant

The results indicate a statistically significant positive correlation between these two variables ($r = 0.546$, $t = 3.49$, $p = 0.00149$). The Pearson correlation coefficient (r) of 0.546 suggests a moderate positive relationship. This indicates that as the implementation of the spiral progression approach increases, the competence of teachers in teaching science also tends to increase. The computed t-value of 3.49 is statistically significant, with a p-value of 0.00149. Since the p-value is less than the alpha level of 0.05, the null hypothesis (that there is no relationship between the two variables) is rejected. This provides evidence that the observed correlation is not due to chance. The findings suggest that utilizing a spiral progression approach in teaching science is associated with enhanced teacher competence. This approach, which revisits topics at increasing levels of complexity throughout the curriculum, may enable teachers to deepen their understanding of the subject matter and develop more effective pedagogical strategies. It aligns with Bruner's spiral curriculum model, where students build on what they have learned, reinforcing the teacher's knowledge and skill (de Ramos-Samala, 2018). In the Philippines, the K to 12 curricula, implemented to enhance the overall quality of education, incorporates the spiral progression approach in science, aiming to strengthen science teaching and improve students' scientific literacy (Giray & Kim, 2023). Competent teachers are pivotal in bridging academic gaps and elevating student achievement (Earley, 2024), and the spiral progression approach may contribute to this competence. Teachers implementing this approach may demonstrate enhanced teacher noticing, a perception, interpretation, and decision-making process that shapes their instructional practice (Astatike, 2024). Furthermore, a good teacher is also a good motivator for achieving the best academic results for their students (Zokir qizi, 2023).

3.5 Digital Literacy and Competence of Science Teachers

The correlational analysis, which aims to determine the relationship between digital literacy and science teachers' competence, indicates that they are significantly positively correlated ($r = 0.699$, $p = 0.0225$).

Table 5. *Correlational Analysis between Digital Literacy and Competence of Science Teachers*

Variables	r	t	p	Interpretation
Digital Literacy and Competence of Science Teachers	.69	3.35	.022	Significant

Note: ns - not significant at .05 level

The Pearson correlation coefficient (r) of 0.6991 suggests a strong positive relationship. This indicates that as digital literacy increases, the competence of teachers in teaching science also tends to increase. The computed t-value of 3.35 is statistically significant, with a p-value of 0.0225. Since the p-value is less than the alpha level of 0.05, the null hypothesis (that there is no relationship between the two variables) is rejected. The findings suggest that digital literacy is positively associated with teacher competence in science education. The integration of technologies in teaching-learning processes is complex and multi-dimensional (Wanyama & Baetz, 2023). In today's world, it is impossible to think about education without technologies that support teaching-learning processes (Roushan et al., 2024). Teachers who are more digitally literate are likely better equipped to use technology effectively in their teaching, enhancing their overall competence. The significant positive relationship between digital literacy and teacher competence is crucial because effective technology integration requires teachers to demonstrate sufficient competence in choosing the right technologies (Ballano et al., 2022).

3.6 Performance of the Students

Table 6 presents the level of the students' performance in terms of their second-grading grade in science.

Table 6. *Performance of Students*

Grading Scale	Frequency	Percentage	Description
90 – 100	29	64	Outstanding
85 – 89	16	36	Very Satisfactory
80 – 84	0	0	Satisfactory
75 – 79	0	0	Fairly Satisfactory
Below 75	0	0	Did Not Meet Expectations
Overall	**45**	**100**	**Outstanding**

The data reveal that most students demonstrated high levels of achievement, with 64% (29 students) achieving an Outstanding rating (90-100) and 36% (16 students) achieving a Very Satisfactory rating (85-89). No students received a rating below 85, indicating a generally high level of performance in the subject.

3.7 Acceptability of the Developed Learning Activity Guides

The level of acceptability of the developed Learning Activity Guides (LAGs) was measured in terms of competency, learning plan, assessment, and technical aspect (see Table 7). The data reveal that the LAGs were generally very acceptable across all indicators, with an overall mean score of 4.68 (SD = 0.15), indicating a high overall acceptance level. Among the specific indicators, the Learning Plan received the highest mean score of 3.93 (SD = 0.70), suggesting that students particularly appreciated the structure, organization, and sequencing of the learning activities within the guides. The Technical Aspect also received a high rating, with a mean of 3.87 (SD = 0.73), indicating that students found the guides' layout, language, and error-free nature highly satisfactory.

Table 7. *Consolidated Findings of the Level of Acceptability of the Developed Learning Activity Guides*

Indicators/Items	Mean	SD	Verbal Description
A. Target Competency			
1. The Learning Activity Guides are very much aligned with the target competencies in science.	3.71	0.69	High
2. The Learning Activity Guides are very much appropriate for my grade level in science.	3.87	0.79	High
3. The Learning Activity Guides cover all the necessary target competencies in science.	3.76	0.77	High
Section Mean	**3.78**	**0.75**	**High**
B. Learning Plan			
1. The learning activities in the guides are very much suitable for the target competencies in science.	3.96	0.67	High
2. The learning activities are much well-sequenced and organized.	3.91	0.73	High
3. The Learning Activity Guides provide acceptable instructions for the learning activities.	3.93	0.69	High
Section Mean	**3.93**	**0.70**	**High**
C. Assessment			
1. The Learning Activity Guides include very much appropriate assessment tools to measure my understanding of science concepts.	3.82	0.83	High
2. The assessment tools are much well-designed and easy to use.	3.67	0.71	High
3. The assessment tools provide acceptable meaningful feedback to help me learn science better.	3.91	0.79	High
Section Mean	**3.80**	**0.78**	**High**
D. Technical Aspect			
1. The layout and format of the Learning Activity Guides are very much visually appealing and easy to navigate.	3.69	0.70	High
2. The language used in the guides is much clear and easy to understand.	3.98	0.84	High
3. The Learning Activity Guides are free from grammatical and typographical errors.	3.93	0.65	High
Section Mean	**3.87**	**0.73**	**High**
Overall Mean	**3.85**	**0.74**	**High**

The consistently high level of acceptance across all indicators suggests that the developed LAGs are a well-received and effective learning resource for students. This positive evaluation aligns with research highlighting the importance of considering various factors, such as instructional design, assessment strategies, and technical aspects, in developing effective learning materials. Research by Leppink (2018) highlights the significance of incorporating user-friendly design principles and clear communication strategies to enhance the usability and effectiveness of instructional materials.

Target Competency

The evaluation of the Learning Activity Guides (LAGs) regarding their alignment with target competencies in science indicates a generally positive perception. The section means of 3.78, described as High, suggests that the LAGs are largely well-aligned with the intended learning objectives. The result reveals that the learning activity guides successfully addressed the key scientific parameters. The mean of 3.71 for the statement The Learning Activity Guides are very much aligned with the target competencies in science, along with the means of 3.87 and 3.76 for the remaining two statements (The Learning Activity Guides are very much appropriate for my grade level in science, and The Learning Activity Guides cover all the necessary target competencies in science) reinforce the notion that educators find the LAGs to be a valuable resource. These findings are consistent with the framework that promotes critical thinking, strategies, and new teaching practices that assist students in achieving the desired curriculum objectives (Deri et al., 2021).

Learning Plan

The section mean score of 3.93 with a standard deviation of 0.70 indicates that the students generally find the learning plan incorporated within the LAGs acceptable. Specifically, item 1, The learning activities in the guides are suitable for the target competencies in science, garnered the highest mean of 3.96 (SD = 0.67), suggesting that students perceive the activities as highly relevant and aligned with the intended learning outcomes in science. Item 2, the learning activities are much more well-sequenced and organized, obtained a mean of 3.91 (SD = 0.73), indicating that students find the structure and flow of the learning activities logical and easy to follow. Item 3, The Learning Activity Guides provide acceptable instructions for the learning activities, received a mean score of 3.93 (SD = 0.69), highlighting the students' understanding and ease of use with the instructions provided for each learning activity. The well-sequenced and organized nature of the activities aligns with the activation principle, which emphasizes the importance of activating prior knowledge and building upon it in a logical progression (Shamsitdinova, 2023).

Assessment

The section means 4.53 is interpreted as High, with a standard deviation of 0.78. This indicates that the students generally find the assessment methods incorporated within the LAGs acceptable. Specifically, item 1, The Learning Activity Guides, includes very appropriate assessment tools to measure my understanding of science concepts, garnering a mean of 3.82 (SD = 0.83), suggesting that students perceive the assessment tools as aligned with the learning objectives. Similarly, in item 2, the assessment tools are well-designed and easy to use, and a mean of 3.67 (SD = 0.71) was obtained, indicating that students find the assessment tools user-friendly and well-structured. The highest mean score of 3.91 (SD = 0.79) was observed for item 3. The assessment tools provided acceptable and meaningful feedback to help me learn science better. This is consistent with the principles of constructive alignment, where assessment tasks are designed to measure the intended learning outcomes and provide students with opportunities to demonstrate their understanding (Munikwa, 2024).

Technical Aspect

The result indicates a section mean of 3.87 with a standard deviation of 0.73, which suggests that the students generally find the technical aspects of the LAGs Much Acceptable. Specifically, item 1, the layout and format of the Learning Activity Guides, is very visually appealing and easy to navigate, receiving a mean of 3.69 (SD = 0.70), suggesting that students generally find the visual presentation and organization of the LAGs pleasing and user-friendly. Item 2, the language used in the guides is straightforward to understand, garnered the highest mean of 3.98 (SD = 0.84), indicating that students perceive the language used in the LAGs as highly accessible and comprehensible. Item 3, The Learning Activity Guides are free from grammatical and typographical errors, obtained a mean of 3.93 (SD = 0.65). This highlights the students' appreciation for the attention to detail and the absence of errors in the LAGs. According to research in cognitive load theory (Leahy & Sweller, 2019), the visual layout, clarity of language, and absence of errors can significantly impact a learner's cognitive load, which affects their ability to process and retain information. A visually appealing and easy-to-navigate layout reduces extraneous cognitive load, allowing students to focus on the essential content (Wu et al., 2022). Clear and understandable language and the absence of grammatical errors further minimize unnecessary cognitive demands, promoting more effective learning. This is supported by White and Newby (2025), who emphasize the importance of usability and clarity in instructional design to ensure learners can easily access and understand the presented information.

3.8 Academic Performance of Students and the Acceptability of the Developed Learning Activity Guide

Table 8 presents the correlation coefficients (r) and corresponding p-values to determine if there is a significant association between learners' academic performance and their acceptance of the developed Learning Activity Guides (LAGs), as measured across four key indicators: Target Competency, Learning Plan, Assessment, and Technical Aspect.

Table 8. *Correlation between Learners' Academic Performance and their Acceptance of the Developed Learning Activity Guides*

Acceptability	Academic Performance	
	r	p
Target Competency	.00	.517
Learning Plan	.09	.145
Assessment	.05	.737
Technical Aspect	.00	.475

The correlational analysis results indicate no statistically significant association between student acceptance of the LAGs and their academic performance for any measured indicators. Specifically, the correlation between acceptance of the Target Competency aspect of the LAGs and academic performance was weak and non-significant (r = 0.005, p = 0.517). The correlation between acceptance of the Learning Plan aspect of the LAGs and academic performance was also weak and non-significant (r = 0.091, p = 0.145). Similarly, there was no significant correlation between acceptance of the Assessment aspect of the LAGs and academic performance (r = 0.058, p = 0.737). Finally, the correlation between acceptance of the Technical Aspect of the LAGs and academic performance was weak and non-significant (r = 0.006, p = 0.475). Since all p-values are much higher than the significance level of 0.05, it fails to reject the alternative hypothesis of no association. Therefore, based on this data, the student's acceptance of the Learning Activity Guides, as measured by the four indicators, is not significantly associated with their academic performance. This suggests that while students may perceive the LAGs as acceptable, this perception does not directly translate into a statistically significant improvement in their academic outcomes.

4.0 Conclusion

This study investigated the effectiveness of integrated learning activity guides in Grade 10 Science, focusing on the spiral progression approach. In this curriculum design, topics are revisited with increasing complexity across grade levels, teacher digital literacy, and competence. Key findings revealed that consistent implementation of the spiral progression approach strengthens teacher competence, while strong digital literacy further enhances teaching proficiency. Notably, student acceptance of the learning guides did not correlate with academic performance, emphasizing the greater influence of teacher expertise and curriculum design. These results highlight the critical role of interdisciplinary strategies in improving science education and emphasize the need for targeted teacher training in curriculum articulation and digital tools. Future research may explore how specific digital resources and curriculum adaptations can maximize learning outcomes, particularly in contexts where teacher competence and student engagement intersect.

5.0 Contributions of Authors

The principal author contributes to the study's writing and implementation. The co-author edits and supervises the data.

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7.0 Conflict of Interests

The authors assert no conflicts of interest regarding the publication of this paper.

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