

The Spiral Progression Approach in Learning Mathematics: Advantages and Disadvantages

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Abstract. This study aimed to identify students' perspectives on the advantages and disadvantages of the Spiral Progression Approach (SPA) in learning mathematics. This topic interests the researchers due to the lack of current literature focusing on it. The study utilized a descriptive and explanatory survey and employed a systematic sampling technique to identify the 277 Senior High School students who served as respondents. A validated questionnaire was used, with the following Cronbach's Alpha coefficients: 0.701 for repetition, 0.702 for improved prior knowledge, 0.713 for age-appropriate learning, 0.704 for limited time, 0.723 for prior knowledge dependence, and 0.720 for broad curriculum. The study revealed that students have "high" perceptions of the advantages of the SPA in terms of repetition, prior knowledge, and age-appropriate learning. However, students also have "high" perceptions of the disadvantages of the SPA in terms of limited time, prior knowledge dependence, and broad curriculum. Moreover, the results indicate that students' academic performance in General Mathematics is "very satisfactory" and significantly correlated with their perceptions of the advantages of the SPA.

Keywords: Age-appropriate learning; Broad curriculum; Concept repetition; Prior knowledge dependence; Spiral progression approach.

1.0 Introduction

Jerome Bruner, a well-known psychologist who made significant contributions to the field of education, developed the concept of a spiral curriculum (Borkala, 2022), a type of curriculum that emphasizes revisiting and building upon previously taught content in a cyclical manner. The SPA allows for a deeper understanding and mastery of the content over time (Davis, cited in Bartolome, 2023). However, the education system has been facing many issues, one of which is curriculum adaptation, according to Lynch (2023). That is why Van Werven et al. (2021) believe in the need for a greater focus on education since many of the competencies taught show a significant overlap with global teaching competencies at all educational levels. Moreover, a discrepancy has been observed between what is taught and what is deemed important in basic schools.

The Philippine educational system has undergone developmental stages, along with government efforts to revise the curriculum for quality education (De Ramos-Samala, 2018). The country's curriculum follows a Spiral Progression Approach (SPA) to guarantee mastery of information and skills at each grade or year level (Republic Act No. 10533 | GOVPH, 2013). However, if the spiral is broken or if students are unable to gain mastery of the prior lessons and are introduced to new and more complex lessons, they will encounter difficulty in learning the subject (Orale & Uy, 2018). Igcasama (2021) pointed out that teachers, students, and schools were not ready for the change as it caused a high level of adjustment. Yap (2019) found that it is uncertain whether the basic principles of mathematics are adequately conveyed by teachers and thoroughly absorbed by students during the primary years. Moreover, Futralan and Mamhot (2018) revealed in their study that some topics at the higher year level are not adequately pre-spiralled at the prior-year level, resulting in students developing mathematical anxiety.

Yap (2019) and Alvarez (2022) both tackled the gaps in learning Patterns and Algebra. However, the former considered the teachers as respondents while the latter covered the students. Both researchers claimed that teachers and students experienced problems at the higher year level because some topics are not covered in the discussion during their lower years. The studies of Bueno (2023) and Igcasama (2021) identified how mathematics teachers and students perceive the implementation of SPA. Although numerous studies have already explored SPA, there is still a lack of current literature focusing on the advantages and disadvantages of the implementation of the K-12 curriculum.

Given this scenario, the author believes that this study could provide enlightenment, insights, and awareness to people in the education sector, especially teachers who implement the SPA. Knowing the students' perception of the advantages and disadvantages of SPA in learning mathematics would enable the authorities to proactively address issues, maintain instructional effectiveness, accommodate individual student needs, and contribute to continuous improvement in education. Students would also be driven to actively participate in the learning process and become less dependent on their teachers' input. With these, gaps in learning would be addressed along with careful planning and ongoing assessment to ensure that all students are effectively learning and progressing.

This study aimed to examine how students perceived the advantages and disadvantages of the SPA in mathematics education. Specifically, the study sought to answer how much students valued the advantages of repetition, improved prior knowledge, and age-appropriate learning, as well as the disadvantages of time limitations, dependence on prior knowledge, and a broad curriculum. It also aimed to assess students' general mathematics skills academically and explore any connections between their performance and their perceptions of the benefits and drawbacks of SPA.

2.0 Methodology

2.1 Research Design

The study is a descriptive and explanatory type of survey that describes how students feel about using SPA in math class and how well they perform academically. It is explanatory because it examines the link between these variables and descriptive since it describes perceptions and performance.

2.2 Research Participants

The respondents of the study are the Senior High School students enrolled in Siquijor State College for the school year 2023-2024. They were selected using the systematic sampling technique, where every 2nd student in the list is a respondent. This means that the researchers chose students from the lists given by the teachers at regular intervals and it was done with a random start. If the random start is 1, all odd-numbered students in the lists are selected as respondents.

2.3 Research Instrument

The self-made questionnaire has four parts. Part I includes a consent statement. Part II asks for the students' self-disclosed General Mathematics grades, chosen because it's taught every first semester and integrates previously learned math concepts. Parts III and IV cover indicators for the advantages and disadvantages of SPA in math learning. The indicators were collected from various sources and validated by three experienced master's degree math teachers. A trial with 30 students ensured reliability using the Cronbach's Alpha Test, showing good results: 0.701 for repetition, 0.702 for prior knowledge improvement, 0.713 for age-appropriate learning, 0.704 for limited time, 0.723 for prior knowledge dependence, and 0.720 for broad curriculum. Below is the legend used for the result per table.

2.4 Data Gathering Procedure

With the endorsement of the Dean of the Graduate School of Foundation University, submitted a formal request letter to the President of Siquijor State College. The signed and approved request was presented to the school principals and respective advisers of the students. With the permission of the respective advisers, the researchers clarified to the students the objectives of the research and that their participation could help in attaining the objectives of the study. The data were gathered through a validated questionnaire which was distributed to

randomly selected students applying the systematic sampling technique. The researchers waited and collected the answered survey questionnaires after the respondents were done. Throughout the process, the students were assured that any information would be treated with strict confidentiality.

The responses of the students were then tallied using MS Excel, analyzed using JAMOWI software and interpreted. Weighted mean was used in presenting the extent of students' perceived advantages and disadvantages of SPA. The percent and mean were utilized to show the academic performance of the students while the Multiple Regression Analysis was employed to identify the explanatory variables that may predict the academic performance of the students.

2.5 Ethical Considerations

Research ethics were upheld and adhered to consistently throughout the entirety of the study. The researchers did not ask for the names of the respondents to protect their privacy. They were assured that their identity would be held anonymous. The respondents were also not forced to participate in the study and were given the freedom to withdraw from the study anytime they felt uncomfortable.

3.0 Results and Discussion

3.1 The Extent to Which Students Perceived the Advantages of the SPA in Learning Mathematics

In terms of Repetition

Table 1 indicates the extent to which students perceived the advantages of the SPA in learning Mathematics in terms of repetition. Generally, the student's perception is "high," as shown by the composite $w\bar{x}$ of 3.59. Specifically, the students have "high" perceptions that (a) the discussions are fun because they learn the lessons gradually, from easy to hard topics ($w\bar{x} = 3.82$), and (b) they feel comfortable learning new things because they already learned a little bit about every mathematical concept ($w\bar{x} = 3.64$). Moreover, the students have "moderate" perceptions that the lessons are easier to understand because teachers teach the same concepts in every grade level ($w\bar{x} = 3.30$). These findings suggest that students highly value a gradual learning approach and feel comfortable with prior knowledge when it comes to discussions in the SPA.

Table 1. The extent to which students perceived the advantages of the SPA in learning mathematics in terms of repetition (n =277)

Indicators	$w\bar{x}$	VD	EoA
1. The discussions are more fun because I learn things in the right order, starting with the easier lessons and gradually getting harder.	3.82	A	H
2. I feel more comfortable learning new things because I have already learned a little bit about every mathematical concept.	3.64	A	H
3. The lessons are easier to understand because teachers teach the same concepts at every grade level.	3.30	MA	M
Composite	3.59	A	H

The above findings are affirmed in the study of Cabansag (2014), as cited in De Ramos-Samala (2018), that students find the subject matter easy at first and eventually grow difficult. However, they learn the concepts because they are taught at an individual pace and over a longer period. This is also attested by Martin (cited in Amirul, 2021) that the same topics are offered again throughout the curriculum, but with increasing complexities. Hence, repetition of the concepts would result in mastery and adequate learning, which is a very sustainable method of surviving and conquering educational problems (Boladola, 2018). However, according to Maed (n.d.), the "one size fits all" method of instruction is faulty because it assumes that every student learns differently. Differentiation in the curriculum is necessary to meet the demands of every single student. Students will not be able to get the best education and be ready for success in the future until then.

In terms of Prior Knowledge Improvement

Table 2 stipulates the extent to which students perceived the advantages of the SPA in learning mathematics in terms of prior knowledge improvement. The results expose that, generally, students have a "high" perception as shown in the composite weighted mean of 3.84. To specify, the students have "high" perceptions that: (a) when they go over what they learned, it helps them understand the new lessons better ($w\bar{x} = 3.94$); (b) starting easy math and moving to hard math problems helps them become a better thinker ($w\bar{x} = 3.89$); (c) they use concepts or ideas they learned in the past to help them in the current learning ($w\bar{x} = 3.83$); and (d) re-learning the same Math ideas made the subject easier to understand ($w\bar{x} = 3.69$).

Table 2. The extent to which students perceived the advantages of the SPA in learning mathematics in terms of prior knowledge improvement

Indicators	$w\bar{x}$	VD	EoA
1. When we go over what we learned before, it helps us understand new lessons better.	3.94	A	H
2. Starting with easy math and moving to hard math problems helps me become a better thinker.	3.89	A	H
3. I use concepts or ideas I learned in the past to help me with what I am learning now.	3.83	A	H
4. Learning about the same math ideas in one grade and then learning more about them in the next grade, made the subject easier to understand.	3.69	A	H
Composite	3.84	A	H

The findings connote that students highly prefer reinforcement and progression in their learning experiences. They particularly appreciate the effectiveness of revisiting previously learned material, transitioning from easy to difficult concepts, and applying past knowledge to current learning tasks. This emphasis on continuity and building upon existing foundations can inform teaching strategies aimed at enhancing student understanding and critical thinking skills.

The construction of new ideas that are based upon previously learned knowledge is mentioned not only in Gagne's Hierarchical Theory but also in Bruner's Constructivists Theory. In teaching new concepts, it is necessary to activate one's prior knowledge. According to Panggabean and Tamba (2020), to come up with new knowledge or respond to new information, students will draw on previous knowledge. Lack of knowledge will cause problems because there is a conflict between prior knowledge and new knowledge. Furthermore, Boladola (2018) stated that teachers should ensure that students can explore previously encountered topics when planning classes. This serves to connect the students' existing knowledge to their current learning, resulting in more meaningful and integrated learning for the students. Thus, the majority of teachers expressed frustration upon finding that students were not prepared to tackle written difficulties because they had not mastered the material from earlier lessons (Yap, 2019).

In terms of Age-Appropriate Learning

Reflected in Table 3 is the extent to which students perceived the advantages of the SPA in learning mathematics in terms of age-appropriate learning. The table reveals that the students generally have a "high" perception on this area as indicated in the composite weighted mean of 3.90. It is specifically presented in the table that the students have "high" perceptions that: (a) learning the concepts of math is tailored to one's age levels ($w\bar{x} = 4.05$); (b) math can be easy or hard depending on the grade level they are in ($w\bar{x} = 3.95$); and (c) they learn math that matches how their brains grow ($w\bar{x} = 3.70$). The students "highly" consider these as advantageous in learning math. These findings indicate that students highly recognize the alignment of math learning with their age and developmental stage. Additionally, the recognition that math learning matches their brain's growth suggests an understanding and appreciation of developmental appropriateness in the learning process.

Table 3. The extent to which students perceived the advantages of the SPA in learning mathematics in terms of age-appropriate learning

Indicators	$w\bar{x}$	VD	EoA
1. Learning the concepts of Math is tailored to one's age level.	4.05	A	H
2. Math can be easy or hard depending on what grade we are in.	3.95	A	H
3. We learn math that matches how our brains grow.	3.70	A	H
Composite	3.90	A	H

The lessons and tasks that are crafted to match students' abilities and readiness benefit them as different age groups have varying levels of cognitive development. Writer (2022) and Borkala (2022) believed that during the child's formative years in school, the spiral curriculum assists in teaching children new topics at their age-appropriate understanding while also improving what they previously learned.

In terms of Limited Time

Table 4 shows the extent to which students perceived the disadvantages of the SPA in learning mathematics in terms of limited time. It presents that the students have generally "high" perceptions of its disadvantages as reflected in the composite weighted mean of 3.65. To point out, the students have a "high" belief that: (a) reviewing old lessons hinders them from covering new topics ($w\bar{x} = 4.18$); and (b) they spend the same amount of time in learning easy and difficult math topics ($w\bar{x} = 3.41$). Moreover, the students "moderately" acknowledge that not all concepts are discussed due to limited time ($w\bar{x} = 3.35$).

Table 4. The extent to which students perceived the disadvantages of the SPA in learning mathematics in terms of limited time

Indicators	w $\bar{x}$	VD	EoD
1. Reviewing old lessons hinders us from covering new topics in a particular grading period.	4.18	A	H
2. We spend the same amount of time learning easy and difficult Math topics.	3.41	A	H
3. Not all new concepts are discussed due to limited time.	3.35	M	M
Composite	3.65	A	H

These findings imply that students perceive certain factors as potentially hindering their learning experiences. Specifically, the belief that reviewing old lessons may impede progress in covering new topics highlights a concern about time management and efficiency in the learning process. Additionally, the perception that equal time is spent on both easy and difficult math topics may indicate a need for strategies to optimize learning time and prioritize areas that require more attention. Furthermore, the acknowledgment of limited time for discussing all concepts underscores the importance of curriculum planning and instructional strategies that effectively address key learning objectives within constrained timeframes.

The same issues are seen in the study of Yap (2019) on time allocation. Consequently, in situations where there is little time, teachers choose to exclude some competencies or limit their discussion to easy or fundamental concepts. This was confirmed throughout the interview in Yap's study when the participants mentioned how difficult it was to allocate time. In addition, the respondents stressed that there were a lot of competencies in the first part of the grading period alone and they had difficulty in budgeting their time to dwell on each competency.

In terms of Prior Knowledge Dependence

Reflected in Table 5 is the extent to which students perceive the disadvantages of the SPA in terms of prior knowledge dependence. It shows that the students have "high" perceptions of its disadvantages as manifested in the composite weighted mean of 3.62. It is indicated in the table that the students have "high" perceptions that: (a) learning new things and remembering old lessons are overwhelming ($w\bar{x} = 3.95$); and (b) unable to recall concepts needed for the new lessons is frustrating and leads to a loss of interest in learning ($w\bar{x} = 3.78$). Furthermore, the students "moderately" perceived that re-teaching the lessons that they do not have enough foundation disinterest them ($w\bar{x} = 3.20$).

Table 5. The extent to which students perceived the disadvantages of the spa in learning mathematics in terms of prior knowledge dependence

Indicators	w $\bar{x}$	VD	EoD
1. When I keep learning new things and have to remember old lessons too, it overwhelms me.	3.95	A	H
2. When I can't recall the concepts needed for a new math lesson, it makes me feel frustrated and not interested.	3.78	A	H
3. I feel that re-teaching the lessons that I do not have enough foundation disinterest me.	3.20	MA	M
Composite	3.62	A	H

These findings highlight significant challenges that students face in managing their learning experiences. The perception of feeling overwhelmed by the simultaneous demands of learning new material while remembering old lessons proposes a need for strategies to support memory retention and cognitive load management. The frustration stemming from the inability to recall necessary concepts emphasizes the importance of reinforcement and review practices to strengthen foundational knowledge and maintain engagement.

It is apparent that if the foundational concepts are not mastered, there will be difficulty in building advanced knowledge. The current K-12 curriculum supposedly helps students learn more by building on what they already know. However, if the basic concepts are not thoroughly understood, it creates confusion on the part of the students. In the study of Batidor and Casinillo (2021), they found that SPA is ineffective, as teachers tend to proceed to more advanced mathematical concepts without ensuring the necessary mastery. Orale and Uy (2018) also stated that about 71% of students who are about to move to Grade 11 are still beginners in Grade 10 Math. With this scenario, Boladola (2018) believed that if teachers attentively facilitate learning by eliciting past knowledge and allowing the students to repeat some basic concepts, they will maximize their learning. This will be further strengthened if the students also actively participate in the learning process.

3.2 The extent to which Students Perceived the Disadvantages of the SPA in Learning Mathematics

In terms of a Broad Curriculum

Table 6 reveals that a broad curriculum is an issue in the SPA for learning mathematics. Students have generally “high” perceptions of its disadvantages, as made evident in the composite weighted mean of 3.60. As presented, the students “highly” perceived that: (a) it is tough when lessons keep changing every grading period ($w\bar{x} = 3.70$); (b) there is less mastery of the subject since it is taught again on the next year's level ($w\bar{x} = 3.65$); and (c) there is so much to learn that students do not master the concepts ($w\bar{x} = 3.45$). These findings signify that students perceive challenges related to continuity and mastery in their learning experiences. The difficulty arising from frequent changes in lessons across grading periods hinders the students from maximizing their learning.

Table 6. The extent to which students perceived the disadvantages of the spa in learning mathematics in terms of broad curriculum

Indicators	$w\bar{x}$	VD	EoD
1. It is tough when lessons keep changing every grading period.	3.70	A	H
2. There is less mastery of the subject since it is taught again at the next year level.	3.65	A	H
3. There is so much to learn that students do not master the concepts.	3.45	MA	M
Composite	3.60	A	H

According to Borkala (2022), for students to master the lesson, the teachers will have to teach and re-teach the concepts, which may be too demanding and time-consuming. Thus, teachers may only briefly touch on the subject, anticipating that they will return to it later. Yap (2019) also found that some topics in the higher year level are affected when concepts in the lower year level are not fully discussed. It then leads to a domino effect, and later learning will be jeopardized if prerequisite knowledge is not fully gained.

3.3 Students' Academic Performance in General Mathematics

Table 7 exposes the students' academic performance in General Mathematics. The data show that 55.23% of them are in the “fairly satisfactory” classification. It also presents that 41.16% of them have “very satisfactory” ratings and better. Generally, their overall performance is 88.64%, which is labeled as “very satisfactory.” Based on DepEd Order No. 73, s. 2012, this classification indicates that the students can develop the fundamental knowledge and skills in performing problems in General Mathematics.

Table 7. Student's academic performance in general mathematics (n = 277)

Rating	Verbal Description	Frequency	Percent
90% - 100%	Outstanding	66	23.83
85% - 89%	Very Satisfactory	48	17.33
80% - 84%	Satisfactory	10	3.61
75% - 79%	Fairly Satisfactory	153	55.23
Mean = 88.64% (very satisfactory)			
sd = 4.60			

This is in line with the findings of Bueno (2023) that the student's performance in the spiral progression curriculum was computed to be 85.17% (very satisfactory) with a standard deviation of 2.44. However, Orale and Uy (2018) have opposing findings wherein they exposed that the majority of the students entering Grade 11 lack the necessary knowledge in the fundamentals of mathematics.

3.4 Relationship between the Students' Academic Performance and Their Extent of Perception on the Advantages and Disadvantages of the SPA

Table 8 discloses the data in identifying the relationship between the student's academic performance and the extent of their perception of the advantages and disadvantages of the SPA. Employing the Multiple Linear Regression Analysis, the data show that the F-test significance or overall p-value (0.000) is less than the level of significance (0.05). This finding will guarantee the rejection of the null hypothesis. This means that one of the explanatory or independent variables is a significant determinant of the student's academic performance. Evaluating the regression output, it was revealed that the student's perception of the advantages of SPA ($p = 0.000$) is the only predictor of their academic performance in Mathematics. On the other hand, the students' perceptions of the disadvantages of the SPA cannot be considered as a determinant of their academic performance ($p = 0.899 > \alpha = 0.05$).

Table 8. Multiple Linear regression analysis

Variables	Coefficients	SE	t Stat	P-value
Intercept	81.607	1.807	45.153	0.000
Advantages of SPA	1.828	0.472	3.872	0.000
Disadvantages of SPA	0.068	0.533	0.127	0.899
R = 0.268				
R ² = 0.072				
adjusted R ² = 0.065				
F-ratio = 10.62				
p-value = 0.000 (significant)				
Level of significance = 0.05				

The adjusted coefficient of determination (R^2) means that 6.5% of the variations in the performances of the students can be explained by their perceptions on the advantages and disadvantages of the SPA. Removing the variable that is not a significant predictor of the students' academic performance, the regression equation is given by the equation: $Y = 81.731 + 1.860 \cdot \text{Rating on Advantages of SPA}$.

The findings can be related to the attribution theory, wherein an individual's perception or attribution of situations significantly affects their behavior or performance (Sanders, 2024). In other words, how the students perceive the advantages of the SPA has something to do with how they embrace the approach, which is later manifested in their behavior, as they choose whether to exert efforts to learn or leave the situation as is.

4.0 Conclusion

The Spiral Progression Approach, if implemented or used, helps in the reinforcement of learning since repetitive exposure to the concepts can solidify foundational knowledge and facilitate deeper understanding over time. The success of the SPA depends on its proper execution. When implemented correctly, it enables students' strong understanding of mathematical ideas. Meanwhile, when the implementation of the approach is half-baked, it results to gaps in students' conceptual understanding, which later affects their overall learning and performance in mathematics. Thus, to optimize the benefits and minimize any potential drawbacks of the SPA, educators must make sure that it is well integrated and applied.

5.0 Contributions of Authors

The authors prepared, reviewed and submitted this paper.

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7.0 Conflict of Interests

The authors declared no conflicts of interest as far as this study is concerned.

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