



**IMPLEMENTATION OF SPIRAL PROGRESSION APPROACH (SPA)
IN MATHEMATICS TEACHING AND THE ACADEMIC PERFORMANCE
OF THE JUNIOR HIGH SCHOOL STUDENTS: INPUT FOR
INSTRUCTIONAL ENHANCEMENT**

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ABSTRACT

This study aims to assess the implementation of the different domains in Mathematics teaching through the SPA and the academic performance of the junior high school students. Findings of the study served as input for instructional enhancement in Mathematics. The study also determined relationship between the student- respondents' academic performance and the level of implementation of SPA in Mathematics education. Moreover, the study revealed that there is a significant relationship between the student- respondents' Academic Performance and the Level of Implementation of SPA in Mathematics Education. The extent of student participation in the spiral progression approach in mathematics and the academic performance of the students. Thus, students were motivated to learn when the teacher presents the process well and they were interested to participate during the discussion.

This study used the descriptive-correlation method employing the survey and correlation techniques. The qualitative analysis of the study was based on the data gathered from the questionnaire answered by both the teachers and the students. This included the level of implementation of SPA in Mathematics education. Also, the academic performance of the Grade

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10 students was described based on the result of the achievement test which was administered to them.

Meanwhile, comparison in the perceived level of implementation of the SPA was done when the respondents were grouped according to profile. Finally, the study had tested if there exists a relationship between the academic performance of students and the level of implementation of SPA in Mathematics education. From the results of the study, an Instructional Enhancement Projects was conceptualized and suggested.

The perceived level of implementation of SPA in Mathematics education among teachers is significantly different. Male teacher respondents are more likely than female teacher respondents to use a spiral progression technique while teaching math.

Comparison in the level of implementation of SPA in Mathematics education as perceived by the student-respondents when grouped according to profile When students are categorized by profile factors, there is no significant variation in their perceptions of the level of implementation of SPA in Mathematics education. Relationship between the student- respondents' academic performance and the level of implementation of SPA in Mathematics education

There is a strong correlation between student-respondent academic performance and the level of SPA implementation in mathematics education. The spiral progression strategy to teaching in Mathematics was found to have a favorable impact on students' academic achievement.

Students have common perception as regards the implementation of SPA in mathematics education. They perceive that the different areas which include knowledge of the subject matter, teaching strategies, instructional materials, and assessment in student learning were all considered in mathematics education following the SPA.

There is no established relationship between the student- respondents' academic performance in mathematics and the relatively extensive implementation of SPA in Mathematics education.

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Keywords: Spiral Progression, Academic Performance, Instructional Enhancement

INTRODUCTION

The rising environment of innovations in areas such as space technologies, technological and scientific development, quality production, and inventions has raised interest of countries in science, engineering, and innovative technologies, urging them to focus on the fields of education and investment. Along with this, modernization with the digitalization process had changed the labor markets and individual competencies. Report of the Organization for Economic Cooperation and Development (2017) suggests that in those industries where digitalization is higher, competencies focused on literacy, problem-solving skills, information and communications skills, management and communication, STEM (Technology, Engineering and Mathematics) skills, and self-organization and learning readiness skills are indispensable. In this context, skills that play a key role in teaching students' deep understanding of knowledge and facilitating the transfer of knowledge to new environments gained more importance.

As the education milieu continues to respond to the demand of modernization and innovation, Philippines for example, took the initiative to become globally attuned. The implementation of RA 10533, otherwise known as Enhanced Basic Education Act of 2013 in the Philippines was intended to produce graduates that are prepared for college with the help of a well-developed and well-designed curriculum. Specifically, the goals of K-12 curriculum were to (a) provide a set of specific competencies through the provision of an appropriate track and strand to every student, (b) ensure that the student is ready for further studies towards a baccalaureate degree, and (c) to ensure that the basic K-12 education that the student receives conforms with the international standards (Wenceslao, 2022). In the context of Mathematics, which is

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recognized to be one subject that permeates life at any age and in any circumstance, its value goes beyond the classroom and the school. Hence, it must be learned comprehensively and with much depth.

Considering the efforts to improve the performance of students in Mathematics especially in basic education, dismal results in international assessment are revealed. Trends in International Mathematics and Science (TIMSS) and the Programme for International Student Assessment (PISA) showed that there is a problem plaguing the basic education program of the country. The latest PISA assessment results are consistent with the results in TIMSS, where the Philippines performed poorly across the years of its participation in the study (OECD, 2022). In the mathematics domain (Mathematics Literacy) of PISA, Filipino students achieved an average score of only 355 points. Such score is significantly lower than the Organization for the Economic Co-operation and Development (OECD) international average of 472 points. This is the second in the bottom among the six ASEAN countries and ranked 75 among 80 participating countries (OECD, 2022). Meanwhile, the participation of the grade 8 learners in the TIMSS revealed that in mathematics, only 19% of Filipino students were on the Low benchmark, which means that they had "some basic mathematical knowledge," while 81% did not even reach this level. Overall, the Philippines scored 297 in mathematics and 249 in science, which are "significantly lower" than any other participating country. In fact, the country scored the lowest among all 58 participating countries for both tests. The above presentation is followed up by the recent PISA result which revealed that students in the Philippines scored less than the OECD average in mathematics (PISA 2022).

The Philippine Institute for Development Studies reported in 2020 that some senior high school students struggled with numeracy skills and basic English language proficiency. The recent Department of Education's Basic Education Exit Assessment (BEEA) results indicated poor scores for high school students in mathematics and science, marking the lowest national assessment performance (Albano, 2020). Locally, research found that K-12 graduates were not adequately

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prepared for college, particularly in mathematics and science, with the lowest scores of 16% and 14.5% respectively in the College Readiness Test (Tamayao et al., 2019). This aligns with the 2019 National Achievement Test, where learners demonstrated low proficiency in mathematics and science (DepEd, 2020).

In Region 02, result of 2018 National Achievement Test (NAT) for grade 6, 10 and 12 indicated that overall, the learners' Mastery Level Index falls under "Average Mastery" with a Mean Percentage Score (MPS) of 45.74. The region was not able to surpass 75% level of proficiency and accuracy in all subject areas for Grades 6, 10 and 12 as exhibited in the result of 21st Century Skills and learning areas tested. In fact, Mathematics posted the lowest with the MPS of 35.34 which shows that learners performed way below the acceptable MPS. The DepEd Memo suggested that most of the divisions in Region 02 need technical assistance to somehow address the need to increase students' NAT performance.

Results of summative assessment in high school mathematics reveal the students' least mastered competencies. Following the spiral progression approach, students consistently fail to master the concepts related to Probability and Statistics. The least mastered competencies conducted by the Math Coordinator of the district for the school year 2021-2022 were the following, in all grade levels, pose real-life problems that can be solved by Statistics, formulate simple statistical instruments, gather statistical data, find the mean, median and mode of ungrouped data, find the mean, median and mode of grouped data, solve problems involving mean, median and mode of ungrouped and grouped data, find the range, standard deviation, and variance of the given data, illustrate the following measures of position: quartile, decile, and percentile, calculate a specified measure of position of a set of data, interpret measures of position, illustrate an experiment, outcome, sample space and event, organize the number of occurrences of an outcome in an experiment using (a) table, (b) tree diagram, (c) systematic listing, and (d) fundamental principle of counting, calculate the probability of simple event, and

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illustrate an experimental probability and a theoretical probability solve problems involving probabilities of simple events.

Since the implementation of the spiral progression in Mathematics basic education curriculum, limited local research has been conducted regarding teachers' assessment about the approach and how this may have influenced the mathematics performance of the learners. Also, knowledge of teachers on the subject matter as well as teaching strategies, instructional materials, and assessment methods used by teachers in teaching Mathematics through the spiral progression approach have not been explored. Hence, the purpose of this study is to determine the extent by which Mathematics teaching and learning is implemented through the Spiral Progression Approach (SPA) and how the SPA may be associated to the academic performance of students in Mathematics.

MATERIALS AND METHODS

This chapter presents the research design used in the study, research locale, respondents and sampling procedure, research instrument, data gathering procedure and statistical treatment of data.

Research Design

This study used the descriptive-correlation method employing the survey and correlation techniques. The qualitative analysis of the study was based on the data gathered from the questionnaire answered by both the teachers and the students. This included the level of implementation of SPA in Mathematics education. Also, the academic performance of the Grade 10 students was described based on the result of the achievement test which was administered to them.

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Meanwhile, comparison in the perceived level of implementation of the SPA was done when the respondents were grouped according to profile. Finally, the study had tested if there exists a relationship between the academic performance of students and the level of implementation of SPA in Mathematics education.

Locale of the Study

This research was conducted in Baggao North District. It consists of three secondary schools namely, Baggao National Agricultural School (Main) Tallang, Baggao National Agricultural School (Annex)-Sta Margarita and Agaman National High School. These three schools found in the Northern part of Baggao.

Respondents and Sampling Technique

The respondents of this study were the teachers in Mathematics and the Grade 10 students in Baggao North District. The research had included all the thirteen (13) mathematics teachers in the 3 secondary schools in Baggao North District, Baggao, Cagayan. The following inclusion-exclusion criteria, however, were considered. First, their status is permanent. Second, they have been teaching Mathematics subjects for at least two (2) years. Finally, they have the consent to be included as respondents of the study. Also, Raosoft calculator was used to determine the sample size of the Grade 10 students who were considered as student- respondents of the study. The population size of 494 brought about a sample size of 344 student- respondents considering the 5% margin of error. The distribution of the respondents is presented in the table below:

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Figure 1. The Distribution of the Respondents

Secondary Schools	Number of Teacher-Respondents	Student Population	Sample Size
Agaman National High School	4	109	86
Baggao National Agricultural School- Tallang Main Campus	5	185	126
Baggao National Agricultural School - Sta Margarita Annex	4	200	132
TOTAL	13	494	344

The 344 student- respondents were selected proportionally from all the sections in Grade 10 of the three (3) schools using the simple random sampling.

Data Gathering Instruments

To gather the needed data in this study, a survey questionnaire was prepared and utilized for teachers and students. The first part of the questionnaire for student and teacher respondents was used to ascertain the profile variables and the second part was their perceptions regarding the extent by which the different Mathematics teaching and learning domains are implemented through the spiral progression approach. The domains include knowledge of the subject matter, teaching strategies, instructional materials, and assessment in student learning. The instrument is a 4- Likert scale in which the student and the teacher respondents will respond to the questionnaire as follows: 4 = Strongly Agree, 3 = Agree, 2 = Disagree and 1= Strongly Disagree. The following steps were done in the development of the survey questionnaire: (a) The draft consists of 10 items in each of the four (4) domains. (b)The developed survey questionnaire had undergone content validation by the experts which comprised of 1 supervisor, 1 principal, 1 master teacher, and 3 mathematics teachers. The Content Validation Index (CVI) derived indicated which items in the draft are included and which are to be deleted or improved. (d) Pilot

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test before the utilization in the study was done. The questionnaire was conducted in the three (3) selected schools. There were 50 students who answered the questionnaire at Baggao National School of Arts and Trades (Baggao South District). This schools was selected for pilot testing because it has approximately the same characteristics as the respondents of the study. (e) Finally, the result of the pilot test was used to establish the reliability of the questionnaire. The reported Cronbach's alpha of the scale instrument is $\alpha=0.890$ which is interpreted as very good and acceptable. Hence, the instrument is valid and accurate for data gathering. Cronbach's alpha is a measure to assess the reliability, and internal consistency, of a set of scale or test items, that is, how the items are closely related as a group (Goforth, 2015).

Meanwhile, an achievement test was developed and administered to determine the academic performance of the students in Mathematics. The following steps were done in the construction of the achievement test prior to its administration: (a) The test was constructed based on the Most Essential Learning Competencies (MELCs) in Mathematics Grade 7-10 particularly the last component of Mathematics Curriculum which is Probability and Statistics. (b) It was a multiple- choice test and was constructed based on the Table of Specifications (TOS). The initial draft consists of 80 items considering the identified competencies in Probability and Statistics. (c) The test had undergone content validation by the experts which comprised of 1 supervisor, 1 principal, 1 master teacher, and 3 mathematics teachers. The Content Validation Index (CVI) derived suggested which items in the draft are included and which are to be deleted or improved. (d) Pilot test before the utilization in the study was done. The test was conducted in Baggao National School of Arts and Trades at Baggao South District. This school was selected for pilot testing because the students have approximately the same characteristics as the respondents of the study. Item analysis on the result of the test was used as a basis for coming up with the final draft of the achievement test to be used in data gathering. From the initial draft consisting of 80 items, the final draft that was used for data gathering has a total of 60 items. (e) Finally, the result of the achievement test was used to establish the reliability of the test.

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Data Collection Procedure

A request letter to conduct this study was forwarded to the Supervisor of Baggao North District as well as to the different principals of the three secondary schools. Likewise, to ensure maximum participation of the respondents, a letter was forwarded to the Grade 10 teachers of the different schools involved in the study.

Upon the approval of the requests, the researcher asked permission from the concerned authorities for the floating of the questionnaires. In addition to this, permission was sought regarding the document analysis, ocular inspection, and classroom visits to validate the responses of the respondents. To facilitate the floating of the questionnaire to the respondents, a schedule of visit was made. To ensure a 100% retrieval, the researcher personally had done the data gathering. Also, the conduct of the achievement test to the respondents was done by the researcher. Finally, ethical standards were observed in all the parts of the study. Particularly, data gathered were treated with confidentiality and were used only for the purpose of the study.

Data Analysis

The data gathered were tabulated, analyzed, and interpreted using the following tools:

Frequency count and percentage were utilized to describe the profile of the teacher and student- respondents.

Mean was used to describe the level of implementation of SPA in Mathematics education relative to the domains such as knowledge of the subject matter, teaching strategies, instructional materials and assessment of student learning. Result was interpreted using the scale intervals below:

Figure 2.0 Descriptive value on the Implementation of SPA

<i>Point</i>	<i>Descriptive Value</i>	<i>Mean Range</i>	<i>Interpretation</i>
4	Strongly Agree	3.25 – 4.00	Highly Implemented
3	Agree	2.50 – 3.24	Moderately Implemented

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2	Disagree	1.75– 2.49	Partially Implemented
1	Strongly Disagree	1.00 – 1.74	Minimally Implemented

On the other hand, the academic performance of the students based on the result of their 60- item achievement test was interpreted based on DepEd Order No. 8, s. 2015. The scale below was used:

Figure 3.0 Numerical Value of their scores in the Achievement Test

Numerical Value	Descriptive Value
90 – 100	Outstanding
89 – 85	Very Satisfactory
84 – 80	Satisfactory
79 – 75	Fairly Satisfactory
74- below	Did not Meet Expectations

Independent samples t-test and One-way Analysis of Variance (ANOVA) were used to compare the level of implementation of SPA in Mathematics education as perceived by the student-respondents when grouped according to profile. Post- hoc test was done for variables tested to have significant differences using Tukey HSD. On the other hand, Kruskal Wallis test and Mann-Witney U Test were used to test the significant difference in the level of implementation SPA when teacher- respondents are grouped according to profile.

Finally, Pearson- r was applied to test the relationship between the level of implementation of SPA and the academic performance of the student-respondents. The hypotheses in the study were tested using the 5% significance.

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RESULTS AND DISCUSSION

This chapter presents the data gathered which were analyzed and treated with the appropriate statistical tools. These were presented according to the problems stated in the study.

Profile of the Teacher- Respondents

Personal Profile

Table 1 shows the personal profile of the teacher- respondents when grouped according to age, sex, civil status, and number of training and seminars attended. It is revealed in the table that out of 13 respondents, majority were 35 years or younger with a frequency of 6 or 46.15 percent while 2 or 15.38 percent are 46 years or older. The teacher- respondents have an average age of 37 years. In terms of sex, it reflects that out of 13 respondents, there are more females than males with a frequency of 7 or 53.85 percent and 6 or 46.15 percent, respectively. It can also be gleaned from the table that 10 are married which comprised 76.92 percent, and only 3 or 23.08 percent were single.

The result corroborates the findings of Wylie (2000) which pointed out that there is a rapidly growing number of young teachers as might be expected from the large numbers participating in the Teacher Induction Program. More female teachers also conform with the study of Alcera (2020) which revealed that majority of the teachers are female. Besides, Philippine census findings disclosed that teaching is a woman-dominated profession disclosing that there are more female than male teachers in secondary schools. Lastly, considering the age range of the respondents, it is reasonable to assume that a significant number of them were already married in as much as women typically get married between the ages of 25 and 35 years (Hassen (2020).

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Table 1.1 Profile of the Teacher- Respondents in terms of Age, Sex and Civil Status

Variables	Categories	Frequency (n= 13)	Percent
Age	35 years or younger	6	46.15
	36- 45 years	5	38.46
	46 years or older	2	15.38
	Mean = 37. 4 years SD= 5.2 years		
Sex	Female	7	53.85
	Male	6	46.15
Civil Status	Single	3	23.08
	Married	10	76.92

Professional Profile

Table 2 illustrates the professional profile of the teacher-respondents in terms of educational attainment, position, number of years in service, and trainings/ seminars attended. Result shows that majority of the teachers were master’s degree graduates with a frequency of 6 or 46.15 percent of the total respondents while 3 or 23.08 percent had earned units in a doctorate degree. In terms of position/ rank, the majority (8 or 61.54%) of the teachers occupy Teacher III while only 3 or 23.07 % occupied the position of Head Teacher or higher. Two (2) teachers or 15.38 occupied Teacher I and Master Teacher I, respectively. Moreover, in terms of years in service, teachers have an average of 12.2 years of teaching. Specifically, 6 or 46.15 percent has been teaching for 9 years or less while 3 or 23. 08 percent have been teaching for already 16 years or more. Interestingly, all the 13 teacher- respondents have attended trainings and seminars related to Mathematics teaching for the past 5 years. These included Mathematical investigation, Graphing Calculator Webinar, In- Service Trainings, and Mathematical Investigation.

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The above- results revealing that only a few are Master Teachers or Head Teacher is because of the Department of Budget Management (DBM) guidelines which mandate that the total Master Teacher positions shall not exceed 10% of the total authorized teacher positions in the school. Meanwhile, attendance to seminars/ trainings shows that teachers recognize the importance of technology in teaching as it promotes effective learning especially in the field of Mathematics (Shih-Chih, et al., 2020).

Table 1.2. Professional Profile of the Teacher Respondents in terms of Educational Attainment, Position/ Rank, Number of Years in Teaching and Trainings/ Seminar Attended

Variables	Categories	Frequency (n= 13)	Percent
Educational Attainment	With Master’s Degree Units	4	30.77
	Master’s Degree Graduate	6	46.15
	With Doctorate Degree Units	3	23.08
Position/ Rank	Teacher I	2	15.38
	Teacher III	8	61.54
	Master Teacher I or Higher	3	23.07
Number of Years of Teaching	9 or less	6	46.15
	10-15	4	30.77
	16 or more	3	23.08
	Mean=12.2years	SD= 7.6 years	
Trainings/ Seminars Attended	Mathematical Investigation	13	100
	Graphing Calculator Webinar	13	100
	In- Service Trainings	13	100
	Mathematical Investigation	13	100

Table 3 shows the frequency and percent distribution of the student- respondents profile when grouped according to age, sex, parent’s highest educational attainment, and income. Based

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on the result, most of the students' age lie within the bracket of 16-17 years with a total of 229 comprising 66.57 percent. On the other hand, 26 or 7.56 percent are in the age bracket of 18 years and above while 89 or 25.87 percent are 15 years and below. It can be noted that the mean age of 16 years represents the ideal age for the Grade 10 students who are the respondents of the study. Furthermore, result shows that there is a slight difference in the number of male and female respondents. There are more female respondents with a frequency of 175 or 50.87 percent compared to the male respondents with 169 or 49.13 percent. In terms of the educational attainment of the student- respondents' fathers, data revealed that 108 or 31.40 percent of them are high school graduates while around 40 percent are high school undergraduates. Meanwhile, about 23 percent have reached college with 10 or 2.91 who finished graduate degrees. Educational attainment of mothers also showed that most of them are high school graduates while around 22 percent did not reach high school. Similarly, around 35 percent of the mothers have reached college with some of them who are graduates of vocational courses. Fewer mothers have finished graduate degrees registering 7 of them. Both results indicate that the educational attainment of the majority of the respondents' parents does not permit them to be employed as professionals. This may consequently bring limitations on their capability to assist their children in their studies.

In terms of their parent's income, 138 or 40.12 percent had a monthly income of below Php 5,000 while 12 or 3.49 percent of the income of parents was Php 30,000-34,999. This contradicts the Preliminary Results of the Family Income and Expenditure Survey (FIES) in 2021, poverty incidence among the population, defined as the proportion of Filipinos whose per capita income cannot sufficiently meet the individual basic food and non-food needs, was recorded at 18.1 percent. This translates to around 19.99 million Filipinos who live below the poverty threshold of about Php 12,030 per month for a family of five. Comparing these values with the poverty threshold as per survey of Philippine Statistics Authority (2017), indicates that the family

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income shows that their families could hardly afford to provide the basic needs of their family. However, it can be noted that the average income of Php 26, 420.06 shows a large disparity on the monthly income of the parents of the respondents. While most of them have very low income, around 12 percent of the other parents have monthly income that is as high as above Php 35,000.

Table 1.3. Personal Profile of the Student- Respondents

Variables	Categories	Frequency (n= 344)	Percent
Age	15 years and below	89	25.87
	16-17 years	229	66.57
	18 years and above	26	7.56
	Mean=16.0 years ; SD= 0.85year		
Sex	Female	175	50.87
	Male	169	49.13
Father's Educational Attainment	Elementary Undergraduate	33	9.59
	Elementary Graduate	69	20.06
	High School Undergraduate	39	11.34
	High School Graduate	108	31.40
	College undergraduate	28	8.14
	College graduate	43	12.50
	Post graduate	10	2.91
	Vocational	10	2.91
	Did not attend School	4	1.16
Mother's Educational Attainment	Elementary Undergraduate	15	4.36
	Elementary Graduate	61	17.73
	High School Undergraduate	41	11.92
	High School Graduate	104	30.23
	College Undergraduate	45	13.08
	College Graduate	53	15.41
	Postgraduate	7	2.03
	Vocational	14	4.07

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	Did not attend School	4	1.16
Monthly Income of Parents	Below Php 5,000	138	40.12
	Php 5, 000-Php 9,999	69	20.06
	Php 10,000-14,999	30	8.72
	Php 20,000-Php 24, 999	38	11.05
	Php 25,000-Php 29,999	17	4.94
	Php 30,000-34, 999	12	3.49
	Php 35,000-above	40	11.63
Mean = Php 26, 420.06		SD = 2, 324.00	

Table 4 presents the available mathematics references and resources and assistant in mathematics learning. It is gleaned from the table that the mathematics books ranked first with a frequency of 210 while math videos is ranked last with a frequency of 44 in terms of the available Mathematics references and resources. Also, other references used by the students are Youtube channels, dictionaries and modules. The result is consistent with UNESCO's (2019) report that textbooks are the most visible aspects of a curriculum and are often considered the main script that shapes the teaching and learning processes. Thus, the use of e-books to facilitate Mathematics learning is not evident among the students.

Also, the table shows that most of them were guided by their parents in learning Mathematics while other assistants were their siblings and classmates. There were few students though who were helped by their grandparents. This result is consistent with the study by Rosie Thornton (2019) stating that parents of the students are intently involved in their children's academic activities. Consequently, it is assumed that parents who are actively involved in their child's education are more likely to encourage the child's social, emotional, and academic growth (Green et al. 2019).

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Table 1.4. School-related Profile of the Student-Respondents

Variables	Categories	Frequency (n= 344)	Rank
Available Mathematics references and resources	Mathematics books	210	1st
	You tube Channels	120	2nd
	Math Dictionaries	59	3rd
	Math Modules	56	4th
	Videos	44	5th
Assistant in Math learning	Parents	161	1st
	Siblings	142	2nd
	Classmates	104	3rd
	Relatives	51	4th
	Tutorials	44	5th
	Grandparents	17	6th

II. Level of Implementation of Spiral Progression Approach in Mathematics Education

This section presents the level of implementation of SPA in Mathematics education as perceived by the student and teacher respondents. As reflected in Table 2.1, the indicator, “The topics are reviewed from the previous grade level before introducing new topics” has the highest mean with 3.69 while the indicator “The lessons are easier to understand since the same topics are offered in all grade levels at varying levels of complexity” has the lowest mean which is 3.08. The teacher- respondents *strongly agree* to all the indicators and the overall mean is 3.39 (*Highly Implemented*) which denotes that teaching Mathematics is executed in such a way that using the SPA, all the indicators along knowledge of the subject matter are broadly considered.

On the other hand, the indicator “There is continuity of lessons in the same concept of Mathematics in all grade levels” has the highest mean of 3.15. The student- respondents generally

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agree to all the indicators and overall, the category mean is 2.94 (*Moderately Implemented*). This signifies that although the student- respondents perceived that the indicators are commonly practiced, it appears to be of a lower level compared to the perception of the teacher-respondents. Put into context, it shows that the implementation was wide and interconnected understanding of core content was done, allowing students to revisit and reinforce foundational concepts multiple times over the course of their learning journey to guarantee the depth and accuracy of knowledge of the subject matter among the learners.

This result does not conform to the finding of Tundun (2019) claiming that teachers’ and students’ perception on the extent of implementation of the SPA in teaching Mathematics in terms of a subject matter is ‘fair’. The study further suggested that for teaching Mathematics to be effective through SPA, administrators should require teachers to provide differentiated instruction. Also, content knowledge of teachers must be supported with tangible, practical, and tailored professional development (Meadows, 2019).

Table 2.1. Level of implementation of SPA in Mathematics education in terms of the knowledge of the subject matter

Indicators	Teacher-respondents		Student-respondents	
	Mean	Interpretation	Mean	Interpretation
1. There is continuity of lessons in the same concept of Mathematics in all grade levels.	3.62	Strongly Agree	3.15	Agree
2. The topics discussed in the previous years are required in the present year.	3.54	Strongly Agree	3.01	Agree
3. The progressions of learning competencies in Mathematics are discussed in all grade levels.	3.31	Strongly Agree	2.93	Agree
4. The lessons are easier to understand since the same topics	3.08	Agree	2.85	Agree

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are offered in all grade levels at varying levels of complexity.				
5. The topics are reviewed from the previous grade level before introducing new topics.	3.69	Strongly Agree	2.88	Agree
6. The concepts and skills specifically in Probability and Statistics are presented with increasing levels of complexity from one grade level to another.	3.54	Strongly Agree	2.89	Agree
7. There is more integration of various concepts on each topic encountered.	3.38	Strongly Agree	2.96	Agree
8. The lessons are extended in a more elaborate and comprehensive manner each time they are discussed.	3.31	Strongly Agree	2.92	Agree
9. There is an integration of knowledge and skills across different disciplines.	3.38	Strongly Agree	2.95	Agree
10. The presentations of the lessons are broadened and deepened each time a concept is revisited.	3.31	Strongly Agree	2.89	Agree
Categorical Mean	3.39	Highly Implemented	2.94	Moderately Implemented

Table 2.2 shows the level of implementation of SPA in terms of teaching strategies in Mathematics education. It can be gleaned from the table that the highest indicator among the teachers- respondents is that the “Active participation from learners is encouraged during math lessons by asking thought-provoking questions, facilitating discussions, and promoting peer collaboration” with a mean of 3.62 (*Strongly Agree*). On the other hand, “Independent study is encouraged through homework, projects, and reports.” with a mean of 3.31 (*Strongly Agree*)

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.The teacher- respondents *Strongly Agree* to all the indicators with a categorical mean of 3.46 (*Highly Implemented*).

Meanwhile, the student- respondents identified the indicator "Direct instruction is used in teaching the topics such as lecture, board work, drills, and exercises" to have the highest mean which is 3.27 (*Strongly agree*). The indicators "Problem-solving strategies and the ability to apply concepts in various mathematical situations is introduced in the presentation of the topics" and "Spiral progression is ensured through meaningful tasks and portfolios that help learners to revisit and build upon previously learned concepts" were considered to have the lowest mean of 2.94 (*Agree*). Overall, the category mean is 3.03 which means that the student- respondents perceive that the indicators related to teaching strategies are *Moderately Implemented*.

This result connotes that both the teacher and student respondents acknowledge that various teaching strategies have been applied in the teaching of Mathematics. Through SPA, teachers provided adequate learning opportunities that are anchored on constructivism which catered to the diverse nature of the learners. Also, students were allowed to work independently and collaboratively during the discussion and problem-solving activities. Specifically, problem-solving activities were presented such that students are given the opportunity to revisit and build upon previously learned concepts at an increasing difficulty level. This corroborates the study of Chariss (2021) which described the students to have different learning styles; thus, they need varied instructional strategies and activities. Findings of the study also emphasized the role of the teachers in the students' Mathematics performance through the SPA that can be enhanced through discussion, peer collaboration, problem-solving activities, and other teaching approaches.

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Table 2.2. Level of implementation of SPA in Mathematics education in terms of the teaching strategies

Indicators	Teacher-respondents		Student-respondents	
	Mean	Interpretation	Mean	Interpretation
1. Direct instruction is used in teaching the topics such as lecture, board work, drills, and exercises.	3.54	Strongly Agree	3.27	Strongly Agree
2. Indirect instruction such as problem-solving, investigation, inquiry-based and concept formulation is utilized in the teaching of math concepts.	3.46	Strongly Agree	3.19	Agree
3. Interactive strategies are introduced in teaching the topics through group or class discussion, cooperative learning, and brainstorming.	3.38	Strongly Agree	3.10	Agree
4. Experiential instruction is promoted by using games, simulation, model building, and other related strategies in Mathematics classes.	3.38	Strongly Agree	3.00	Agree
5. Independent study is encouraged through homework, projects, and reports.	3.31	Strongly Agree	3.00	Agree
6. Differentiated instruction is promoted to meet the diverse needs of learners with varying proficiency levels.	3.54	Strongly Agree	2.97	Agree
7. Active participation from learners is encouraged during math lessons by asking thought-provoking questions, facilitating discussions, and promoting peer collaboration.	3.62	Strongly Agree	2.95	Agree
8. Problem-solving strategies and the ability to apply concepts in various mathematical situations is introduced in the presentation of the topics.	3.54	Strongly Agree	2.94	Agree

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9. Connections between mathematical concepts and real-world applications to help learners understand the relevance of math in their lives is emphasized.	3.46	Strongly Agree	2.99	Agree
10. Spiral progression is ensured through meaningful tasks and portfolios that help learners to revisit and build upon previously learned concepts.	3.38	Strongly Agree	2.94	Agree
Categorical Mean	3.46	Highly Implemented	3.03	Moderately Implemented

Table 2.3 presents the level of implementation of SPA in terms of instructional materials in Mathematics education. The indicators “Print materials such as handouts and books that are used in teaching the topics allow students to practice and consolidate their understanding”, “Resources offer opportunities for differentiation based on learners' readiness, interests, and learning styles by providing additional support or challenges as needed” and “Technology tools and resources, such as graphing calculators, interactive apps, and computer software, to enhance concepts are used in teaching” have the highest mean which is 3.54 (*Strongly agree*). However, “Digital media such as TV Clips and YouTube are incorporated in the lesson presentations to facilitate the teaching-learning process” as an indicator obtained the lowest mean of 3.31(*Strongly agree*). The category mean of 3.43 shows that the use of instructional materials were *highly implemented* in the teaching of Mathematics through SPA.

The student- respondents considered the criterion “Presentation materials are provided such that the instructional sequence builds upon previously learned skills, gradually increasing the complexity and depth of understanding” to have the highest mean of 3.13 (*Agree*) though the indicator “Visual representations like visual aids, diagrams, charts, and graphs supports concepts are incorporated to make abstract ideas more tangible and to assist with problem-

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solving and reasoning” to have the lowest mean of 3.03 (*Agree*). All indicators were, by average, agreed by the student- respondents and the overall mean of 3.07 suggests that instructional materials were perceived to have been utilized to a *moderate level*.

This result shows that despite the innovative trends in terms of the instructional materials in teaching, teachers mostly rely on learners’ module/reference books as their main instructional materials. It is still one of the most important teaching materials despite the presence of the technology which is being used by most of the students nowadays. De Dios (2019) stressed that in high school, the spiral curriculum not only requires good teachers who could handle multiple disciplines, but also different types of textbook. In addition, instructional materials such as models / pictures / illustration / drawing should be introduced since these help to enhance the imagination of the students to understand better concepts in Mathematics and enable real world application. Moreover, models are one of the very powerful instructional materials that bridge and make unfamiliar phenomena seem more relevant in mathematics education. Consistently, both the teacher and student respondents consider the digital and advanced instructional materials to have been less prioritized compared to the other learning materials. It should be reiterated that there is a need to augment teachers’ need in a more advanced instructional material to cater the millennial learners.

Table 2.3. Level of implementation of SPA in Mathematics education in terms of the instructional materials

Indicators	Teacher-respondents		Student-respondents	
	Mean	Interpretation	Mean	Interpretation
1. Explicit references to prior knowledge and connections between different mathematical ideas are considered in	3.38	Strongly Agree	3.12	Agree

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integrating previously learned and concepts into new lessons.				
2. Presentation materials are provided such that the instructional sequence builds upon previously learned skills, gradually increasing the complexity and depth of understanding.	3.38	Strongly Agree	3.13	Agree
3. Instructional materials make connections between mathematics and other disciplines such that the topics discussed are applied to real-world contexts or linked to other subjects such as science, technology, engineering, or art.	3.38	Strongly Agree	3.10	Agree
4. Digital media such as TV Clips and YouTube are incorporated in the lesson presentations to facilitate the teaching-learning process.	3.31	Strongly Agree	3.04	Agree
5. Print materials such as handouts and books that are used in teaching the topics allow students to practice and consolidate their understanding.	3.54	Strongly Agree	3.05	Agree
6. Instructional materials guide students through a coherent and logical progression of mathematical concepts.	3.46	Strongly Agree	3.05	Agree
7. Resources offer opportunities for differentiation based on learners' readiness, interests, and learning styles by providing additional support or challenges as needed.	3.54	Strongly Agree	3.04	Agree
8. Technology tools and resources, such as graphing calculators, interactive apps, and computer software, to enhance concepts are used in teaching.	3.54	Strongly Agree	3.06	Agree

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9. Hands-on manipulatives such as cubes, geoboards, or measuring devices are used to help students develop a concrete understanding of mathematical concepts are used before moving to abstract representations.	3.38	Strongly Agree	3.04	Agree
10. Visual representations like visual aids, diagrams, charts, and graphs supports concepts are incorporated to make abstract ideas more tangible and to assist with problem-solving and reasoning.	3.38	Strongly Agree	3.03	Agree
Categorical Mean	3.43	Highly Implemented	3.07	Moderately Implemented

As presented in Table 2.4, both the indicators “Assessment methods are valid to accurately measure learners' understanding of the desired learning goals” and “Various assessment methods such as written tests, quizzes, projects, and problem-solving tasks are used for more comprehensive view of students' abilities and to allow for multiple ways to demonstrate mastery” were recognized by the teacher- respondents to have the highest mean of 3.54 (*Strongly Agree*). However, the indicator “Formative assessment techniques are used throughout the teaching process to monitor learners' progress and provide timely feedback”, “Authentic assessments are provided as opportunities for learners to apply mathematical concepts and skills to solve relevant problems” and “Technology tools and software for math assessments are utilized to provide immediate feedback and data tracking for instructional decisions” were registered to have the lowest mean of 3.23 (*Agree*). Remarkably, this result reveals that despite the emphasis of the K-12 Basic Education Curriculum as stipulated in DepEd Order No. 8, s. 2015 that formative assessment, authentic assessment, and other alternative forms of assessment should be used in

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the classroom, teachers commonly subscribe to the traditional forms in assessing the students learning in Mathematics. The category mean of 3.37 displays, though, that the different criteria were *Highly Implemented* which shows their adeptness along assessment in student learning.

Considering the student- respondents, the highest mean is 3.09 (*Agree*) on the indicator "Assessment methods are valid to accurately measure learners' understanding of the desired learning goals" while the lowest mean is 2.97 (*Agree*) on the indicator "Technology tools and software for math assessments are utilized to provide immediate feedback and data tracking for instructional decisions". Thus, as perceived by the students, the teachers are using assessment methods that are valid and accurate to the learners but few of them used technology tools and software for assessment. As 21st century learners, teachers are expected to be imbued with knowledge and skills that foster students' active learning process. Using the SPA, the technology-based assessment methods are expected to be explored by the teachers to ease monitoring, tracking, and feedbacking of student assessment and learning. Overall, the category mean of 3.05 would show that students still perceive that their teachers fulfill the different expectations along assessment in student learning such that the practices were *moderately implemented*.

This proves that despite some limitations on the use of more progressive methods of assessment, teachers still ensure that students are validly assessed to accurately measure the desired outcomes.

Table 2.4. Level of implementation of SPA in Mathematics education in terms of the Assessment in Student Learning

Indicators	Teacher- respondents		Student- respondents	
	Mean	Interpretation	Mean	Interpretation
1. Assessment methods are valid to accurately measure learners'	3.54	Strongly Agree	3.09	Agree

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understanding of the desired learning goals.				
2. Various assessment methods such as written tests, quizzes, projects, and problem-solving tasks are used for more comprehensive view of students' abilities and to allow for multiple ways to demonstrate mastery.	3.54	Strongly Agree	3.01	Agree
3. Assessment strategies are employed to ensure that learners at different skill levels can appropriately demonstrate their understanding.	3.38	Strongly Agree	3.06	Agree
4. Formative assessment techniques are used throughout the teaching process to monitor learners' progress and provide timely feedback.	3.23	Agree	3.05	Agree
5. Authentic assessments are provided as opportunities for learners to apply mathematical concepts and skills to solve relevant problems.	3.23	Agree	3.06	Agree
6. Summative assessment methods, either written or performance-based, that consider the progression of learning competencies in Mathematics are administered.	3.38	Strongly Agree	3.05	Agree
7. Assessment methods such as differentiated tasks, tiered assignments, or alternative assessment are tailored to meet the diverse needs of learners.	3.38	Strongly Agree	3.03	Agree
8. Technology tools and software for math assessments are utilized to provide immediate feedback and data tracking for instructional decisions.	3.23	Agree	2.97	Agree
9. Assessment methods are fair and equitable for all learners such that the	3.31	Strongly Agree	3.05	Agree

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diverse backgrounds, experiences, and learning styles of the students are considered.				
10. Constructive feedback on the result of assessment is provided to learners to encourage them to reflect on their learning and progress and to guide them towards self-assessment and self-improvement.	3.46	Strongly Agree	3.08	Agree
Categorical Mean	3.37	Highly Implemented	3.05	Moderately Implemented

As revealed in Table 2.5, all the four dimensions, namely knowledge of the subject matter, teaching strategies, instructional materials, and assessment in student learning were generally realized in the teaching of Mathematics through the SPA. Although the teachers seemingly had revealed higher self- assessment on the implementation, both the students and the teachers themselves acknowledged to a wide range that these different areas have been accorded in the teaching of Mathematics through the SPA

Table 2.5. Summary Table on the Level of implementation of SPA in Mathematics education

Dimensions	Teacher- respondents		Student- respondents	
	Mean	Interpretation	Mean	Interpretation
Knowledge of the Subject Matter	3.39	Highly Implemented	2.94	Moderately Implemented
Teaching Strategies	3.46	Highly Implemented	3.03	Moderately Implemented
Instructional Materials	3.43	Highly Implemented	3.07	Moderately Implemented
Assessment in Student Learning	3.37	Highly Implemented	3.05	Moderately Implemented

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Overall Mean	3.41	Highly Implemented	3.02	Moderately Implemented
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III. Level of Academic Performance of the Student- Respondents

Table 3 reveals the frequency and percent distribution of respondents in terms of the level of academic performance in Mathematics 10 as revealed in the result of the achievement test. It can be observed that out of 344 respondents, 304 or 88.37 percent of the students *did not meet expectations* while 5 or 1.45 percent have very satisfactory level performance. Moreover, the overall mean of respondents' proficiency level is 46.24 which indicates that they *did not meet expectations*. This signifies that the students, in terms of their performance in Probability and Statistics, failed to achieve the required competencies as reflected in the K- 12 Curriculum Guide in Mathematics.

This finding mirrors the performance of the Filipino learners in the results of the comparative international assessments such as Trend in International Mathematics and Science (TIMSS) and the Programme for International Student Assessment (PISA). The PISA 2022 assessment results are consistent with the results in TIMSS (2022) where the Philippines performed poorly across the years of its participation in the study (OECD, 2022). Specifically, in the mathematics domain (Mathematics Literacy) of PISA, Filipino students achieved an average score of 355 that is significantly lower than the average OECD of 472. Moreover, PISA test result shows that only 16% of the 13 year old Filipino students attained at least the basic or baseline level of proficiency in mathematics (labeled in the report as "level 2 proficiency"). It can be noted that Statistics and Probability is one of the five content areas of Mathematics in the K- 12 Basic Education Curriculum. The TIMSS 2022 also revealed that The most recent TIMSS 2019 results indicate that Filipino students in the Philippines scored 297 in mathematics and 249 in science,

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which are significantly lower than other participating countries. These scores placed the Philippines at the lowest position among 58 participating countries for both subjects. In comparison, Singapore achieved the highest scores in both grade 4 mathematics (625) and science (595), as well as in grade 8 mathematics (616) and science (608). The TIMSS study highlighted that only 19% of Filipino students reached the Low International Benchmark in mathematics, indicating basic mathematical knowledge, while 81% did not reach this level. Similarly, in science, 13% of Filipino students were on the Low benchmark, signifying limited understanding of scientific concepts. The Department of Education (DepEd) expressed its commitment to using the TIMSS results to enhance curriculum and educational quality, aiming to recover and improve student performance in math and science.

Table 3. Level of academic performance of the student-respondents as revealed in the result of the achievement test

Descriptors	Grading Scale	Frequency (n= 344)	Percent
Outstanding	90-100	11	3.20
Very Satisfactory	85-89	5	1.45
Satisfactory	80-84	18	5.23
Fairly Satisfactory	75-79	6	1.74
Did not meet expectations	Below 75	304	88.37
Mean =46. 34, SD=18.07; Did not meet expectations			

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IV. Comparison on the Level of Implementation of SPA in Mathematics Education as Perceived by the Teacher – Respondents when Grouped according to Profile

Table 4 presents the test of significant difference in the level of implementation of SPA in Mathematics education as perceived by the teacher – respondents when grouped according to profile. As gleaned from the table, data reveal that irrespective of ages, civil status, educational attainment, and number of years in teaching Mathematics, teachers have common perception in so far as the different domains in the teaching of Mathematics are being implemented through the SPA. The derived probability- values are greater than 0.05 level of significance showing that the extent of implementation of the spiral progression approach in teaching Mathematics as perceived by the teacher-respondents is comparable. This suffice, to the study of Dr. Geronimo B. Zaldivar, on his research was conducted to determine the perceptions of the Teachers and Students on the implementation of the K-12 Spiral Progression approach in teaching Secondary Mathematics , it was found out that the Spiral curriculum had greatly influenced the curriculum, particularly the content and transitions of subjects, the secondary schools, the learners, and especially the teachers. Based on the findings, teachers were still adapting to the new curriculum. They needed more time and training to master all the fields and learn new teaching strategies because it is challenging to teach something that does not have the necessary mastery. They can teach other branches of their significant subjects without an in-depth discussion because it is not their specialization. Also, it was found out that the derived probability- values are greater than 0.05 level of significance showing that the extent of implementation of the spiral progression approach in teaching Mathematics as perceived by the teacher-respondents is also comparable.

On the other hand, sex presented a significant difference in the domains that include teaching strategies, instructional materials, assessment in student learning, and overall. Result shows that male teachers are more likely to implement at a higher extent the practices related to the above- mentioned areas when they teach Mathematics through the SPA. This finding confirm

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Results showed that both genders, male and female teachers, have a high level of formulation of mathematics; the mean was (2.4840). Moreover, their teaching practices level of employing mathematics was high and reached the mean (2.3976). Meanwhile their level of teaching practices of the process of mathematics explanation was at the mean (2.2130). Results also showed that there is a statistical significant difference in the level ($[\alpha]$ [less than or equal to] 0.05). The previous result is related to the gender variable in which females outperformed the males, and to the teaching experience in which the more experienced respondents outperformed the inexperienced ones. Finally, results showed that there was no statistical significant difference in the level ($[\alpha]$ [less than or equal to] 0.05) for the level of education variable.

Moreover, in terms of the teachers' position, there exists a significant difference in the perception of teachers only on the knowledge of the subject matter. Result shows that Teacher III position displayed a wide and interconnected understanding of core content in Mathematics, allowing the students to revisit and reinforce foundational concepts multiple times over the course of their learning journey. Such practice is done to ensure the depth and accuracy of understanding by the students regarding the mathematical content when taught through the SPA. This result suffice the study of of Wong Angela (2018) that both Teacher I and Teacher III teachers perceived a significantly higher level of pedagogical knowledge and skills. However, the increase in the levels of pedagogical knowledge and skills perceived by Teacher I were significantly greater than that shown by the Teacher III teachers. In the area of pedagogical knowledge, the Teacher I group perceived a significantly higher level of the following factors: facilitation, preparation, management, and care and concern. For pedagogical skills, the significant differences were found in the facilitation and management factors.

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Table 4. Comparison on the Level of Implementation of SPA in Mathematics Education as Perceived by the Teacher – Respondents when Grouped according to Profile

Variables	Domains in Mathematics Teaching									
	Knowledge of the subject matter		Teaching strategies		Instructional materials		Assessment in student learning		Overall	
	P-Value	Interpretation	P-Value	Interpretation	P-Value	Interpretation	P-Value	Interpretation	P-Value	Interpretation
Age	0.072	NS	0.310	NS	0.624	NS	0.796	NS	0.498	NS
Sex	0.406	NS	0.047*	S	0.019*	S	0.004*	S	0.005*	S
Civil Status	0.806	NS	0.609	NS	0.173	NS	0.160	NS	0.541	NS
Educational Attainment	0.301	NS	0.277	NS	0.870	NS	0.559	NS	0.255	NS
Position	0.030*	S	0.292	NS	0.753	NS	0.833	NS	0.240	NS
Number of Years in	0.599						0.369			

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Teaching Mathematics		NS	0.366	NS	0.383	NS		NS	0.277	NS
Trainings/seminars attended related to Mathematics teaching	0.076	NS	0.068	NS	0.103	NS	0.200	NS	0.234	NS

*Hypothesis is tested at $\alpha = 0.05$.

NS is Not Significant.

S is Significant.

V. Comparison on the Level of Implementation of SPA in Mathematics Education as Perceived by the Student – Respondents when Grouped according to Profile.

Table 5 reveals the test of significant difference in the level of implementation of SPA in Mathematics education as perceived by the student– respondents when grouped according to profile. As seen from the table, data reveal that regardless of sex, age, parents’ educational attainment and monthly income, available Mathematics references/ resources, and assistant in learning mathematics, students have shared perception in so far as the different domains in the teaching of Mathematics are being implemented through the SPA. The resulting probability-values are greater than 0.05 level of significance indicating that the extent of implementation of the spiral progression approach in teaching Mathematics as perceived by the student-respondents is similar to the study of Rico o. Charis (2021) Level of Implementation of Spiral Progression Approach in Relation to Students’ Performance in Algebra that level of implementation of the Spiral Progression Approach in teaching Mathematics, as perceived by student-respondents when

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grouped according to profile, indicates positive outcomes and effective teaching practices. Research findings show that teachers highly implemented the Spiral Progression Approach, with students experiencing collaborative activities and problem-solving under this approach. Despite the high implementation level by teachers, study revealed that students' performance in Algebra was poor, highlighting a significant relationship between the use of the Spiral Progression Approach and students' academic performance. Additionally, it emphasized that there is a significant relationship between teachers' understanding and the implementation of the Spiral Progression Approach, leading to positive curriculum outcomes.

Also, according to Judy B. Dunton (2018) on his "Spiral Progression Approach in Teaching Mathematics and the Performance of Learners in District I, Capiz" Results reveal that respondents are 21-30 years old, females, specializing in integrated Math, with Bachelor's Degree, 1-10 years' service, and holding Teacher I positions; their SPA implementation in teaching science is 'fair'; no difference existed in their SPA implementation by dimensions; the students' performance from grades 7, 8, 9, and 10 in the different schools is very satisfactory; differences existed in the students' performance from grades 7, 9, and 10 in different schools; but none in Grade 8; no relationship existed on the SPA implementation and different grade levels, and in different schools; the top five (5) problems in the SPA implementation included teaching guides and learning modules as have not yet been massively distributed; the SPA implementation is not well-planned; lack of qualified teachers; incompetency of teachers; and time spent for teachers' training is not enough; and a Training Program is proposed to better prepare and equip the teachers in the SPA implementation in teaching Math.

Additionally, the only variable that obtained a significant difference based on the students' perception was the available mathematics references and resources specifically under the domain knowledge of the subject matter. Result shows that students who use mathematical books have the higher chances to gain a wide and interconnected understanding of core content in

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Mathematics. This is because the available learning references and resources help them to revisit and reinforce foundational concepts multiple times over the course of their learning journey and this is to ensure the depth and accuracy of their understanding on the mathematical content covered through the SPA. This finding proves the study of Heliyon (2022) result showed that overall using mathematics e-books has a high effect ($g = 0.82$) on students' mathematics achievement. Furthermore, using e-Books does not affect students' mathematics achievement in year publication and significantly affects the pre-school level, who are more proficient in using technology. Mathematics e-books are more effective when used for less than 4 weeks and also effective when the sample is less than 30 students. There is no significant difference between non-interactive and interactive mathematics e-books. Moreover, this research provided a detailed description of the findings and implications as well as highlighted some suggestions for future studies.

Table 5. Comparison on the Level of Implementation of SPA in Mathematics Education as Perceived by the Student – Respondents when Grouped according to Profile

Variables	Domains in Mathematics Teaching									
	Knowledge of the subject matter		Teaching strategies		Instructional materials		Assessment in student learning		Overall	
	P-Value	Inter pre-tation	P-Value	Inter pre-tation	P-Value	Inter pre-tation	P-Value	Inter pre-tation	P-Value	Inter pre-tation

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Age	0.683	NS	0.683	NS	0.958	NS	0.131	NS	0.646	NS
Sex	0.844	NS	0.917	NS	0.111	NS	0.523	NS	0.555	NS
Father's Educational Attainment	0.655	NS	0.210	NS	0.889	NS	0.150	NS	0.300	NS
Mother's Educational Attainment	0.779	NS	0.105	NS	0.655	NS	0.310	NS	0.330	NS
Monthly Income of Parents	0.300	NS	0.648	NS	0.228	NS	0.601	NS	0.411	NS
Available mathema	0.020*						0.122			

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tics reference s and resources		NS	0.598	NS	0.661	NS		NS	0.201	NS
Assistant in mathema tics learning	0.577	NS	0.489	NS	0.309	NS	0.062	NS	0.242	NS

*Hypothesis is tested at $\alpha = 0.05$.

NS is Not Significant.

S is Significant.

VI. Relationship between the Student- respondents' Academic Performance and the Level of Implementation of SPA in Mathematics Education

Table 6 displays the test of significant relationship between the student- respondents' academic performance and the level of implementation of SPA in Mathematics education. As to the knowledge of the subject matter and teaching strategies, there is a low positive significant relationship between academic performance and those domains since the p-values are less than 0.05 level of significance. Overall, a low positive significant association was also displayed. This means that through the SPA, the students are provided with a wide and interconnected understanding of core content to revisit and reinforce their basic concepts and they gained a deeper understanding on the mathematical content that allowed them to perform better in the subject. Likewise, result indicates that the specific methods, techniques, and approaches

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employed by teachers to deliver mathematical content effectively under the SPA that reinforced active and independent learning and developed the students' higher order cognitive skills directly and significantly explained their better performance in the achievement test. In fact, overall result shows that better performance in mathematics is explicated by these different facets of Mathematics teaching through the SPA.

Teaching Algebra through SPA was found to have a positive effect on students' academic performance. The study found that when teachers explicitly discussed the topics such that they are built upon the previously learned concepts, there was a significant increase in students' performance (Rico & Baluyos, 2021). A similar study on quadratics also proved that the repetitive process of spiral teaching increased students' confidence level and mastery of concepts (Dhunny & Angateeah, 2019). Because of the continuous relationship between new learning and existing knowledge, the spiral progression technique helps students recall math concepts better than the mastery approach. Spiraling leads to improved long-term retention of facts, skills, and concepts. The approach is effective with all learners, including struggling learners, and promotes the retention of skills in later grades. (Urquhart, 2021).

Through the SPA in teaching mathematics, the students are engaged that directly translated to their academic performance. When students become active learners through the strategies used by the teacher, they become motivated to learn. Hence, the students' increased interest and participation had brought a positive effect on their achievement (Alegre, 2019).

On the contrary, study have shown that the Spiral Progression Approach (SPA) in teaching mathematics has been perceived positively by students and has led to improved academic performance. However, there is contrasting study (Santos 2021) on the effectiveness of the Spiral Progression Approach in mathematics education. His study conducted in the Philippines examined the effectiveness of the Spiral Progression Approach in teaching junior high school mathematics and found that while students perceived the approach as effective, there were challenges faced

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by educators due to the exposure of learners to a wide variety of concepts, regardless of difficulty level. This study highlighted a significant relationship between the effectiveness of the Spiral Progression Approach and academic performance among different grade levels. Also, it was revealed that any BEC is better than Spiral Progression Approach.

Table 6. Relationship between the Student- respondents' Academic Performance and the Level of Implementation of SPA in Mathematics Education

Relationship between academic performance and ...	Pearson Correlation	Probability Value-value	Interpretation
Knowledge of the subject Matter	0.323	0.006*	Significant
Teaching Strategies	0.272	0.018*	Significant
Instructional Materials	-0.031	0.569	Not Significant
Assessment of Student Learning	0.025	0.642	Not Significant
Overall	0.343	0.043*	Significant

Significant at 0.005 level of significance

A. Instructional Enhancement Plan

AREAS OF CONCERN	OBJECTIVES	ACTIVITIES	RESOURCES			EXPECTED OUTPUTS	TIME FRAME
			Human	Physical	Financial		
	Develop the topics in a spiral progressive approach across the	Title: A refresher course for JHS Mathematics	Resource Speakers,	K- 12 Curriculum Guide in	Maintenance and Other Operating	Accomplish daily assignments, problems	School Year 2024-2025

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<p>Knowledge of the subject Matter</p>	<p>grade levels 7- 10 to foster mastery and understanding since the same topics are offered in all grade levels at varying levels of complexity</p>	<p>Teachers. Description: Lectures to be included in this training are the mathematics competencies in Statistics and Probability. LAC Sessions among teachers teaching Mathematics from Grade 7-10</p>	<p>School Heads, Master Teachers, and Teachers</p>	<p>Mathematics</p>	<p>Expenses (MOOE)</p>	<p>sets and summative examination. Designed and developed curriculum that ensures the gradual progression of topics across different grade levels.</p>	
	<p>Improve the students' performance</p>	<p>Intensive and comprehensive</p>	<p>School Divisions</p>	<p>Educational Materials</p>	<p>Maintenance and Other</p>	<p>Mathematics curriculum</p>	<p>School Year</p>

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	in Mathematics across all grade levels	ensive Mathematics teaching Math Olympiads, Math Quiz Bowl, Mathematics Day	n Superintendent, Schools District Supervisors, School Heads and Teachers, Students	als, Facilities, and Equipment	Operating Expenses (MOOE)/ School Education Fund (SEF)/ Donations	that is aligned with the latest educational standards and pedagogical best practices. Thus, an improved performance of the students	2024-2025
Teaching Strategies	Promote problem-solving strategies in teaching the concepts in the various mathematical topics	•Conduct of seminar workshops on Innovative Teaching Strategies in Mathematics.	Resource Speaker, School Heads, Research Enthusiasts, Teachers	Educational Materials, Facilities, and Equipment	Maintenance and Other Operating Expenses (MOOE)/ School Education Fund (SEF)/ Donations	Implemented problem-solving strategies in teaching and training programs for teachers to enhance their ability to problem-solving strategies in their DLL and DLP.	School Year 2024-2025

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		LAC Sessions , attendance to Seminar , Training , Workshops, Conferences,					
	Design meaningful tasks and portfolios that help learners to revisit and build upon previously learned concepts.	Focused and directed Math Teaching, Mathematics Day	School Heads and Teachers, Students	Educational Materials, Facilities, and Equipment	Maintenance and Other Operating Expenses (MOOE)	Established portfolio system where students can compile evidence of their learning over time.	School Year 2024-2025
Instructional Materials	Incorporate digital media such as TV Clips and YouTube in the lesson presentations to facilitate the teaching-	Seminar , Training , Workshops, Conferences,	Research Enthusiasts, School Heads and Teachers	Educational Materials, Facilities, and Equipment	Maintenance and Other Operating Expenses (MOOE)/School Education Fund	Motivated and engaged learners due to the integration of TV clips and YouTube videos	School Year 2024-2025

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	learning process	LAC Session			(SEF)/Donations		
	Design visual representations like visual aids, diagrams, charts, and graphs supports concepts are incorporated to make abstract ideas more tangible and to assist with problem-solving and reasoning.	Seminar , Training , Workshops, LAC Session	District and School Heads and Teachers, Students	Educational Materials, Facilities, and Equipment	Maintenance and Other Operating Expenses (MOOE)/ School Education Fund (SEF)/ Donations	Established interactive visual materials that allow students to actively engage with the content.	School Year 2024-2025
Assessment of Student Learning	Design formative assessment techniques that are used throughout the teaching process to monitor learners' progress and provide timely feedback	LAC Sessions	Master Teachers, Mathematics Teachers	Educational Materials, Facilities, and Equipment	Maintenance and Other Operating Expenses (MOOE)/ School Education Fund/ Donations	Developed a comprehensive assessment plan that outlines the formative assessment techniques to be used in the different phases of	School Year 2025-2026

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						the teaching process.	
	Include authentic assessments for learners to apply mathematical concepts and skills to solve relevant problems.	LAC Sessions , Classroom meetings	Teachers, Students	Educational Materials, Facilities, and Equipment	Maintenance and Other Operating Expenses (MOOE)/ School Education Fund (SEF)/ Donations	Designed authentic assessment tools that can validly measure students' performances	School Year 2024-2025
	Develop technology tools and software for math assessments are utilized to provide immediate feedback and data tracking for instructional decisions.	Seminar / Workshop, LAC Sessions , Classroom meetings	School Heads and Teachers, Students	Educational Materials, Facilities, and Equipment	Maintenance and Other Operating Expenses (MOOE)/ School Education Fund (SEF)/ Donations	Effectively functioning technology tools and software specifically designed for math assessments.	School Year 2026-2027

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Conclusion

The implementation of SPA in mathematics education elicits a nearly similar perception from both teachers and students. Teachers perceive that in the implementation of SPA, there is a consistent application and practice of the indicators related to the domains in Mathematics education. Meanwhile, students perceive that through SPA, domains in Mathematics teaching have been adequately practiced but may require further improvement. Remarkably, the optimum implementation of SPA did not translate to the academic performance of the students. While some variables were identified to have influenced the perceived level of implementation of SPA in Mathematics education, it can be noted that considerable implementation of SPA was linked to the satisfactory performance of the students in the subject. Based on the results of the study, it can be concluded that age, sex, civil status, educational attainment, position, number of years in teaching Mathematics and trainings/ seminars attended related to Mathematics teaching (for the past 5 years) have greatly extent in the different domains of Mathematics through the spiral progression approach. The domains in Mathematics among the teachers: knowledge of the subject matter, teaching strategies, instructional materials and assessment in student learning are greatly extent in implementing in Mathematics teaching through the spiral progression approach. The extent of student participation in the spiral progression approach in mathematics and the academic performance of the students. Thus, students were motivated to learn when the teacher presents the process well and they were interested to participate during the discussion.

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