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STUDENTS' ATTITUDES TOWARD MATHEMATICS AND MATHEMATICS PERFORMANCE WITHIN THE SPIRAL PROGRESSION CURRICULUM: EVIDENCE FROM GRADE 11 LEARNERS IN BOHOL, PHILIPPINES

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ABSTRACT

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This study examined Grade 11 students' attitudes toward mathematics within the spiral progression curriculum and how these attitudes correlated with mathematics performance. The study used a quantitative correlational design, as guided by Bruner's Spiral Curriculum Theory and Weiner's Attribution Theory—forty-four Grade 11 pupils at Basiao High School, Pres. Carlos P. Garcia from Bohol participated in the study. Data were collected using a modified mathematics attitude questionnaire and summative tests devised by the researcher, which included mathematical competence for grades 7 to 10. The data were analyzed using descriptive statistics and Spearman's rank-order correlations.

The results revealed that the respondents had a moderate motivation attitude towards mathematics (M = 2.43, SD = 0.36), but poor performance in mathematics (M = 14.31, SD = 3.27). The scores were higher for the strategic use of mathematical tools and problem-solving than for communication, reasoning, linkages, representation, and accuracy. All summative examinations continued to demonstrate consistently low performance in math, with all respondents falling into the "Did Not Meet Expectations" group. Similarly, ability levels were grouped into the low and extremely low categories, indicating difficulty with basic arithmetic. There was no significant association between students' attitudes toward mathematics and their performance (r_s = .001, p = .994) in the correlation study. The findings indicate that although youngsters show some interest in mathematics, significant learning gaps persist in several skills. Moreover, the results showed that additional factors beyond attitude variables can affect mathematical success. In the spiral progression curriculum, enhancing conceptual understanding, necessary skills, and instructional support can lead to improved mathematics learning outcomes.

INTRODUCTION

Mathematics plays a vital role in developing learners' critical thinking, problem-solving, and decision-making skills. In the Philippine K–12 curriculum, the spiral progression approach was adopted to promote continuity of learning by revisiting key concepts at increasing levels of complexity across grade levels. This approach is grounded in the idea that learners strengthen understanding when prior knowledge is continuously reinforced and connected to new learning experiences (Bruner, 1960). The spiral progression curriculum was designed to help students improve at math over time by repeatedly exposing them to related ideas and skills. The curriculum does not treat topics as separate units; instead, it pushes students to build their conceptual knowledge over time. This method gives students chances to learn more deeply, but their success may also depend on how they think about and use math.

Research has shown repeatedly that students' feelings about math are linked to how much they participate, stick with it, and do well in it. Researchers have found that students with positive attitudes are more likely to solve math problems, use problem-solving techniques, and persist even when things get hard (Ma & Xu, 2004; Wang & Degol, 2016). On the other hand, bad views of math may make people less confident and limit their chances of learning something useful. Even though spiral development is supposed to help, there are still worries about how well students understand math and how well they do overall. Previous research has shown that the success of spiral progression may rely on several things, such as how it is taught, how well the teacher is prepared, and how ready the students are to make connections between what they already know and what they are learning now (Orale & Uy, 2018).

So, finding out how kids think about math within this curriculum framework might help us understand how they learn and how well they do in school. These worries are reflected in estimates from other countries. Filipino students consistently do worse in math than the OECD average, as shown by the Program for International Student Assessment (PISA) results. Many of these students have trouble bringing math ideas to real-life situations (OECD, 2019; OECD, 2023). These results show that we still need to look into the things that affect how well students learn and perform in math in the Philippine school system.

When it comes to senior high school, it is still important to examine the relationship between students' views and their performance in math. This kind of questioning might help teachers identify where they need to provide more support and guidance in the classroom. As a result, this study examined how Grade 11 students felt about math in a spiral development program and whether those feelings were linked to their math performance. These results could help current efforts to improve secondary school students' learning outcomes and strengthen math lessons.

Theoretical Background. The study is based on Jerome Bruner's Spiral Curriculum Theory and Attribution Theory of Motivation. Bruner (1960) claimed that learning is more meaningful if key concepts are reintroduced and revisited over time at increasing levels of complexity. A spiral curriculum allows learners to reinforce previously learned content and incorporate new knowledge. In math instruction, this method helps students build their conceptual understanding over time by allowing them to connect skills they have already learned to more complex mathematical ideas. The study is also based on Attribution Theory, which examines how people perceive their wins and mistakes and how that shapes their future actions and motivations (Weiner, 1985). Students who are positive about learning are more likely to think that hard work and persistence will help them do well in school. People who think that their failure is due to set traits, on the other hand, might not be as driven or involved. In math class, students' feelings about their own math skills can affect their motivation to do well and to stick with challenging tasks.

These ideas together imply that students' attitudes towards mathematics may be shaped by the curricular structure and students' own perceptions about learning and success. The spiral curriculum provides repeated learning opportunities. Students' motivational beliefs may alter their responses to the possibilities.

Related Literature. It is well known that attitude toward mathematics plays a key role in students' learning experiences. It includes learners' sentiments, beliefs, confidence, and preparedness to engage in mathematical activities. Research has suggested that positive attitudes are associated with increased engagement, perseverance, and success in mathematics (Ma & Xu, 2004). Students who view mathematics as applicable and meaningful are more likely to be motivated to expend effort in studying mathematical ideas.

Motivation affects learners' participation in classroom tasks, problem-solving activities, and autonomous learning behaviors (Middleton & Spanias, 1999). Likewise, confidence in mathematics has been linked to a greater willingness to take on more complex projects and to persist with problems.

Self-efficacy relates to a person's conviction in his/her capability to successfully carry out specific academic activities (Bandura, 1997). Students with strong self-efficacy in mathematics education show greater perseverance, greater interest, and better academic achievement (Pajares & Miller, 1994). Conversely, mathematics anxiety has been shown to adversely affect performance by lowering students' confidence and increasing cognitive interference during problem-solving (Ashcraft, 2002). These features have been reliably related to mathematical achievement and may interact with students' attitudes toward mathematics.

Spiral Progression Curriculum in Mathematics. The Philippine K–12 curriculum uses the spiral progression method to help students learn in a consistent, meaningful way. Using this method, ideas are revisited at different grade levels, but this time they are more in-depth and more difficult. Bruner suggested in 1960 that coming across important ideas more than once helps students understand them better and remember them longer. However, how well spiral progression works depends on several things relating to both the teacher and the student. For execution to go well, people must have a solid grasp of the necessary skills, use the right teaching methods, and keep reviewing what they have already learned. When basic skills are weak, it can be hard for students to make connections between what they already know and what they are learning in math.

Mathematics Performance and Mastery. How well students do in math reflects how well they have learned the skills and information expected of them in the program. Achievement in math is connected to cognitive factors such as prior knowledge and problem-solving ability, as well as to emotional factors such as motivation, self-efficacy, and mood (OECD, 2022). Mastery learning emphasizes the importance of learning basic skills before moving on to more advanced material. Students who have a good grasp of the big ideas are usually better able to apply what they have learned in different math situations and solve challenging tasks. On the other hand, gaps in the information needed before learning can make it harder to learn and succeed later.

Given the above reality, the researcher would like to conduct a study on the Students' Attitudes and Mathematics Performance in the Spiral Progression Curriculum among Grade 11 students, Pres. Carlos P. Garcia, Bohol, during the school year 2022-2023. The study's findings will serve as the basis for proposing an intervention. Specifically, this study seeks to answer the following:

1. What is the level of students' attitudes towards Mathematics in the Spiral Progression Curriculum in the context of the following:

1.1. Problem-Solving;
1.2. Communication;
1.3. Reasoning;
1.4. Connections;
1.5. Representation;
1.6. Use appropriate tools strategically; and
1.7. Precision?

2. What is the Mathematics performance of the Grade 11 students in terms of:
   2.1. Summative scores in the four Grade levels; and
   2.2. Mastery level in the different learning competencies?
3. Is there a significant degree of correlation between students' attitudes and Mathematics performance based on the summative scores?
4. What intervention program can be proposed to address the issue?

RESEARCH METHODOLOGY

Research Design. This study employed a quantitative correlational research design to examine the relationship between students' attitudes toward mathematics in the spiral progression curriculum and their mathematics performance. Correlational research is appropriate when the purpose is to determine the degree and direction of association between variables without manipulating the study conditions (Creswell & Creswell, 2018).

Research Setting and Participants. This study was conducted at Basiao High School in Pres. Carlos P. Garcia, Bohol, Philippines, during the School Year 2022-2023. The participants were the Grade 11 students under the Senior High School Program. A sample of 44 students was selected from the target group using the sample size calculator, with a 95% confidence level and a 5% margin of error. All properly registered students at the time of data collection were eligible to participate. Likewise, transferees and ALS completers who satisfied the inclusion requirements were also examined.

Research Instruments. Two instruments were utilized to gather the necessary data. Students' attitudes toward mathematics in the spiral progression curriculum were measured using an adapted questionnaire based on the Common Core State Standards for Mathematical Practice. The instrument assessed seven dimensions: mathematical problem-solving, communication, reasoning, connections, representation, strategic use of tools, and precision. The questionnaire consisted of 33 items rated on a four-point Likert scale ranging from 1 (Disagree) to 4 (Strongly Agree), with higher scores indicating more positive attitudes toward mathematics. Mathematics performance was measured using four researcher-developed summative tests covering the learning competencies from Grades 7 to 10. The tests were designed based on the competencies prescribed in the K–12 Mathematics Curriculum Guide and consisted of multiple-choice items representing various levels of cognitive

demand. Performance scores were classified according to the performance descriptors prescribed by the Department of Education. Mastery levels were likewise determined using established mastery-level benchmarks. The achievement tests were developed using a Table of Specifications (TOS) based on the Grade 7-10 Mathematics Curriculum Guide. The TOS ensured appropriate representation of content areas and cognitive levels across the assessments.

Validity and Reliability. Before the study, the tools were reviewed by both math education experts and research staff to ensure they were clear and met the study's goals. The pilot test was done with students who were not in the main group. Cronbach's alpha scores for reliability studies ranged from .759 to .994, indicating that internal consistency was good to outstanding (Taber, 2018). Based on these results, it appears the devices worked well at collecting data.

Data Collection Procedure. Permission to perform the study was acquired from the relevant school authorities prior to data collection. The nature and objective of the study were explained to the eligible participants and their parents or guardians. Prior to participation, written informed consent and assent were obtained. The attitude questionnaire was administered first, followed by the mathematical achievement assessments in separate sessions. Data collection was carried out under controlled conditions to ensure uniformity and mitigate potential bias. Completed questionnaires were checked for completeness, encoded, and prepared for statistical analysis.

Ethical Considerations. The study adhered to established ethical standards for educational research. Participation was voluntary, and respondents were informed of their right to withdraw at any stage without penalty. Confidentiality and anonymity were maintained throughout the study by assigning identification codes instead of personal identifiers.

The collected data were used solely for research purposes and were securely stored to protect participants' privacy. Ethical principles of respect for persons, beneficence, and justice guided all phases of the research process.

Data Analysis. Descriptive statistics, including frequency counts, percentages, weighted means, and standard deviations, were used to summarize students' attitudes and mathematics performance. Normality of the data was tested using the Shapiro–Wilk test. Because the data failed to fulfill the assumptions of normality, nonparametric statistical techniques were applied. Spearman's rank-order correlation coefficient (ρ) was utilized to assess the association between students' attitudes towards mathematics and mathematics achievement. Statistical significance was assessed at the.05 level. All analyses were performed using appropriate statistical software.

RESULTS AND DISCUSSIONS

Students' Attitudes Toward Mathematics in the Spiral Progression Curriculum. The findings indicate that the respondents generally demonstrated a slightly motivated attitude toward mathematics within the spiral progression curriculum. Among the dimensions examined, the strategic use of appropriate tools and mathematical problem-solving yielded relatively higher motivation levels, while mathematical communication, reasoning, connections, representation, and precision received comparatively lower ratings.

The fact that students mostly gave positive responses about solving problems suggests they are somewhat comfortable with math tasks that require them to think through solutions and track their progress. Students may know how to use math to solve problems, even if they are still having trouble with other parts of the subject. Researchers have found that students who are interested in tasks that require them to solve problems are more likely to use self-regulated learning strategies and keep working on their math problems (Hidi & Renninger, 2006). On the other hand, the lower scores in mathematical communication, reasoning, connections, representation, and precision suggest that many students may still find it hard to explain mathematical ideas in words, connect ideas from different subjects, and use appropriate mathematical language and representations to explain solutions. These results may show the difficulties students face when they want to learn more about what something means rather than just how to do it. It has been noted that students who are less interested in math participate in fewer math talks and are less likely to recognize how different math concepts are related to one another (Linnenbrink-Garcia et al., 2011; Hiebert & Carpenter, 1992).

Using math tools strategically came in at the top of the list, which I find interesting. It means that children are more likely to be comfortable using computers, digital resources, visual aids, and other tools to help them learn math. It is possible that students had a good look at these tools because more and more learning spaces are using technology to improve them. When technology is used correctly in the classroom, studies have shown that it can help students learn math and be more interested in it (Shaughnessy & Cribbs, 2019).

In general, the data show that students are somewhat interested in math. However, there are still ways to improve higher-order math skills, such as speaking, representing, thinking, and making mental connections. These areas are important for academic success, but they could use more hands-on, student-centered, and inquiry-based lessons. The results also show that students are ready to use math tools and solve problems, but they may need more help to fully grasp the main ideas and feel safe expressing their thinking about math. Attribution Theory (Weiner, 1985) holds that how students perceive their school situations shapes their motivation. The general pattern of

data fits with this theory. Students may be more interested in math questions that require more thought if they have had good learning experiences and have been given the same problems repeatedly.

Mathematics Performance of the Respondents. According to the results, 11th graders performed poorly on all final tests covering math skills from 7th to 10th grade. On top of that, all respondents fell into the "Did Not Meet Expectations" group for all four final tests. The mean scores on the grade-level tests were well below the predicted level of ability. This shows that there are big learning gaps in basic math skills. There were small differences in mean scores across grade levels, but the general pattern shows that many students struggled to demonstrate understanding of what they had already learned. The slightly higher mean score on the Grade 10 test compared to earlier grades may indicate that students are more comfortable with more recent math topics. The numbers were still below the expected level, though, which shows that learning math is still hard. These results show that students may have had trouble remembering and using math ideas they learned in earlier grades. The spiral progression curriculum is designed to build on what students already know. A deficiency in basic abilities may develop over time, making it tougher to do well in more complex courses. Bruner's spiral curriculum theory, developed in 1960, emphasizes repeated exposure to help students truly comprehend material.

However, growth may be limited if students do not fully learn the skills that come before it. Previous research has also shown that math success is influenced by various mental and emotional factors, such as prior knowledge, confidence, drive, and interest in learning tasks (OECD, 2022). Because of this, low achievement may be caused not only by a lack of subject-matter understanding but also by problems with how students learn and think about math.

Mastery Level of the Respondents. Consistent with the performance results, the mastery assessment revealed that most respondents demonstrated either low or very low mastery of the mathematical competencies covered in the study. None of the participants attained the levels categorized as average, moving toward mastery, closely approximating mastery, or mastered. Instead, the majority clustered within the lower mastery categories across all grade-level assessments. The Grade 10 skills across the four exams showed the fewest pupils at the poor competence level. In comparison, the percentage of pupils identified as having very low competence was highest for Grade 8 abilities. There was significant variation across grade levels, but the general pattern shows that pupils struggled to acquire the depth of knowledge needed to master key mathematical concepts. These findings may suggest that learners are still struggling with the basic arithmetic skills required for higher-order learning. Mastery learning theory states that effective learning happens when learners are given sufficient opportunity and assistance to attain mastery before advancing to more complex material (Bloom, 1968). Underdeveloped

core notions can lead to students' difficulties in integrating new information and transferring learning across mathematical settings.

The results also show the need for targeted instructional interventions that strengthen core abilities and provide opportunities for correction. Addressing learning gaps and supporting greater mastery may be aided by strengthening conceptual understanding, fostering active involvement in problem-solving, and using varied instructional styles. The findings shed light on areas of concern and provide opportunities for educators to design interventions that better support students' mathematical growth in the spiral progression curriculum. In sum, the low levels of performance and mastery demonstrated in this study highlight the need to ensure that basic abilities are sufficiently established before moving on to more complicated mathematical topics. Such efforts may lead to greater continuity of learning and increased academic attainment in mathematics.

Correlation Between Students' Attitude Toward Mathematics and Mathematics Performance. Spearman's rank-order correlation indicated no statistically significant association between students' attitudes and mathematics performance, $r_s(42) = .001, p = .994$. This finding suggests that students' attitudes toward mathematics, as measured in this study, were not associated with their performance on the summative assessments. Although the respondents generally exhibited slightly motivated attitudes toward mathematics, these attitudes did not appear to translate into higher achievement scores. Similarly, students with relatively more favorable attitudes did not necessarily perform better than those with less positive attitudes.

Table 1. *Spearman's Rank-Order Correlation Between Students' Attitude Toward Mathematics and Mathematics Performance*

Variables	r_s	p	Interpretation	Decision
Students' Attitude Toward Mathematics and Mathematics Performance	.001	.994	Negligible Positive Correlation; Not Significant	Fail to Reject H_0

Note. $N = 44$. Correlation was tested using Spearman's rank-order correlation. Statistical significance was evaluated at $\alpha = .05$. Interpretation of correlation strength was based on Cohen (1988): .00–.09 = negligible, .10–.29 = weak, .30–.49 = moderate, .50–.69 = strong, and .70–1.00 = very strong.

The lack of a strong association between the two suggests that attitude is not the only factor affecting how well someone does in math. Many cognitive, educational, and external factors interact to influence how well students perform in math. These include prior knowledge, the quality of instruction, self-efficacy, study habits, learning tools, and social conditions (OECD, 2023; Schukajlow et al., 2017). If people around you are not good at basic math, having a good mood might not be enough to make up for learning gaps that happen over time.

Alternatively, it may be that good attitudes are not enough to compensate

for large deficits in the required mathematical abilities. Students may feel good about mathematics and think it is important, yet have trouble in their studies if they have gaps in their basic skills. In a program with spiral growth, these learning gaps could widen as students move up in grade levels, making it less likely that positive views will help students do better in school. These results differ from those of Kaur and Kaur (2021), who found that having a good mood and learning on your own time were associated with better math performance. Similarly, Ma and Xu (2004) found that students with a more positive attitude toward math were more likely to perform better in school. The differences between the current results and those from earlier studies could be due to variations in context, group characteristics, or generally low response rates among participants.

It is also interesting to notice that both attitude and performance levels were quite low in the present research. This trend indicates that students' interest and drive in mathematics could have influenced academic performance to some extent, but difficulties in learning required skills might have limited the extent. In a spiral curriculum, initial competency problems can build and hinder later learning even if students are generally favorable about the subject. Overall, the findings suggest that boosting mathematics success may require a broader range of interventions that target not only students' attitudes but also their conceptual understanding, mastery of core abilities, and access to effective learning support. Improving these areas may have a larger effect on enhancing performance than simply focusing on attitudes.

Limitations of the Study. The relatively small sample size may have limited the study's statistical power to detect subtle relationships between attitudes and mathematics performance.

CONCLUSION

According to the study, 11th-grade students had a somewhat motivated mindset toward math in the spiral progression program. In math, students were more motivated to solve problems and use tools strategically. On the other hand, they were less motivated to communicate, reason, make links, represent, and be precise. These results show that even though students recognize the importance of math and are willing to work on problems, they may still struggle with more complex tasks that require a deeper understanding of underlying concepts.

The data also showed that students in Grades 7 through 10 consistently had low levels of math ability and math mastery. The high number of students at low and very low mastery levels indicates that many have not learned the basic math skills needed to do well in more advanced subjects. In the spiral progression scheme, this pattern illustrates the importance of improving essential skills. Lastly, no significant association was found between students' feelings about math and their math performance. Even though attitude

remains a significant part of learning, the results show that prior knowledge, conceptual understanding, instructional support, and mastery of basic skills may have a greater impact on math success in this setting. Overall, the study shows how important it is to have math learning strategies that focus on both the cognitive and emotional aspects of the subject.

RECOMMENDATIONS

Based on the findings of the study, the following recommendations are offered:

1. Strengthen Foundational Mathematical Competencies. Mathematics teachers should implement remediation and enrichment activities that reinforce prerequisite concepts and skills, particularly those introduced in earlier grade levels. Addressing learning gaps may help improve students' readiness for more advanced mathematical content.
2. Enhance Higher-Order Mathematical Skills. Classroom instruction should provide greater opportunities for students to engage in mathematical communication, reasoning, representation, and conceptual connections through collaborative learning, inquiry-based activities, and authentic problem-solving tasks.
3. Maximize the Use of Educational Technology. Since students demonstrated relatively positive attitudes toward the strategic use of tools, teachers may integrate digital resources, mathematical software, and interactive learning platforms to support engagement and conceptual understanding.
4. Implement Continuous Diagnostic Assessment. Regular formative assessments should be conducted to identify specific areas of difficulty and provide timely instructional interventions before misconceptions become entrenched.
5. Provide Professional Development Opportunities. Schools and educational leaders should support mathematics teachers through training programs focused on differentiated instruction, mastery learning, assessment practices, and the effective implementation of the spiral progression curriculum.
6. Promote Learner Support Mechanisms. Schools may establish tutorial programs, peer-assisted learning activities, and academic support initiatives to help students strengthen their mathematical competencies and confidence.
7. Conduct Further Research. Future studies may examine additional factors associated with mathematics achievement, including self-efficacy, learning strategies, instructional quality, parental support, and socioeconomic influences. Larger samples and multiple school settings may also provide broader insights into mathematics learning within the spiral progression curriculum.

8. Develop a Mathematics Enhancement Program. A structured intervention program focusing on foundational skills, conceptual understanding, and mastery of learning competencies may be designed, implemented, and evaluated to improve mathematics performance among senior high school students.

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