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Vertical Articulation and Foundational Knowledge Retention in Mathematics (Algebra) of Grade 8 Learners under MATATAG Curriculum

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Abstract. The alignment of competencies plays a vital role in ensuring continuity of learning and sustaining learners' foundational knowledge across grade levels. The curriculum guides of DepEd establish vertical and horizontal articulation as the essential methods that schools must use to create learning pathways which help learners attain the academic objectives. This is a quantitative study that used a descriptive-inferential method with correlational analysis to determine the relationship between vertical articulation and foundational knowledge retention in Mathematics algebra of Grade 8 learners under MATATAG curriculum. The study used purposive sampling as its research method to select respondents. The study selected respondents through specific criteria which relate to the research objectives. The participants of this study were 109 Grade 8 learners at Divine Word College of Calapan, Inc. Basic Education Department who were enrolled in the school year 2025-2026. The researcher used Pearson's r correlation and multiple regression analysis to determine whether independent variables had a significant effect on the dependent variables and to make predictions on the observed data patterns. With all the indicators tested it was found that all the results was not significant and there were only weak correlation and negligible results. Notably, learners may be encourage to actively participate in classroom discussions, participate in problem solving tasks, peer collaboration and review of previously learned concepts and apply into real life situations to easily remember and understand lessons. The findings of the study emphasized the need to strengthen the vertical articulation of Mathematics 8 learning competencies to improve mastery, retention, understanding and develop problem solving ability, higher order and critical thinking skills of the learners.

Keywords: Foundational knowledge retention; MATATAG curriculum; Vertical articulation

Introduction

The alignment of competencies plays a vital role in ensuring continuity of learning and sustaining learners' foundational knowledge across grade levels. Curriculum is commonly defined as what should be taught and learn in an educational system, as well as the activities and experiences that go along with it. Curriculum reform and development is a global trend as governments and states, as well as their education departments strive to provide future focused curricula to meet the challenges and demands of the 21st century, (Brendan & Gordon, 2023). According to (Shimizu & Vithal, 2023), curriculum reform, particularly reform in the Mathematics curriculum has been a phenomenon as long as schooling has existed. Every stakeholder seems to have an opinion on what should be included the curriculum and how it can be improved.

In the Philippines, the MATATAG K-10curriculum represents a big step in improving the K-12 Basic Education Program. The study of (Lagbao, 2024) identifies existing problems which modern society requires all people to understand because assessment data serves as essential evidence for developing educational programs. Moreover, the study conducted by (Jeffry M Saro, 2024) showed that respondents believed the MATATAG Curriculum could enhance learner's ability to think critically and solve problems. The study revealed that professional development needs and resource requirements must be address before successful curriculum implementation. The MATATAG curriculum implementation process needed sufficient resources and institutional backing according to the study.

Furthermore, according to DepEd curriculum guide vertical articulation is the coherent and progressively sequenced alignment of competencies across grade levels is a legal and policy priority in the Philippine basic education. The curriculum guides of DepEd establish vertical and horizontal articulation as the essential methods that schools must use to create learning pathways which help learners attain the academic objectives. The document establishes policy guidelines for MATATAG K-10 Curriculum

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implementation and it also requires educational institutions to develop fundamental skills at all major educational stages according to the educational reform policies which include DepEd Order No. 010, s. 2024.

In the study of (Lindquist et al) mathematical retention is essential for learning because it establishes the capacity of learners to remember and use mathematical knowledge and abilities throughout the education journey. The primary challenge in Mathematics education exists because learners fail to retain essential knowledge as they move from one grade to the next. Vertical articulation deficiencies create challenges for learners who need to recall and use the algebra knowledge from previous studies which results in gaps between the procedural skills and the capacity to tackle advanced tasks (Bauyon, Bathan, Dimaala, & Gutierrez, 2024). Algebra skills experience greater challenges when educational systems demand learners to master advanced skills without providing essential competency development opportunities.

In the conducted pre-survey it shows how learners in Mathematics 7 (4th Quarter, SY 2024-2025) and Mathematics 8 (1st Quarter, SY 2025-2026) earned their grades by showing their grade percentages for five grade ranges which start from below 74 and continue through 75-79, 80-84, 85-89 and 90-100. The results shows how learners between Grade 7 and Grade 8 perform academically while showing how well they maintain their basic algebra knowledge under the MATATAG K to 10 Curriculum. The percentage of learners who received grades between 75-79 proved to be low yet this grade range kept appearing in Grade 7 with a frequency of 4.05 %. The 80-84 grade ranges showed a decrease from 33.11 % to 22.52 % during Quarter 1 of Grade 8 when the learners experienced both identical lessons and advanced lessons which led to many learners moving down from higher proficiency levels. The results show that learners did not fully grasp all essential concepts which they were expected to master.

The first quarter of the school year showed that grades between 85-89 reached their highest point at 47.02% after starting at 27. 70 % in Grade 7 Quarter 4. The results show that most learners achieve proficiency yet their performance varies based on the required skills for different tasks. The proportion of learners who obtained grades within the 90-100 range decreased from 35.14% to 30. 46%. The results show that high-achieving learners struggles to maintain their performance when they faced advanced competencies. Most learners maintained their performance in the 85-89 grade range during both Mathematics 7 and Mathematics 8 across two different quarter. The results show that most learners achieved their expected Mathematics competencies which led to their academic performance failing between satisfactory and above-average levels of achievement.

The Mathematics 7 and 8 grade distribution shows most learners in the 85-89 range but the data results show that learners still need to achieve full academic performance stability. The presence of noticeable shifts across grade brackets particularly between the high (90-100) and middle (80-84) ranges suggest that learning continuity between Grade 7 and 8 remains uneven. The continuous presence of most learners in 85-89 range throughout the quarter serves to create an illusion of stable performance. The majority of the learners demonstrated their ability to achieve the required fundamental competency standards. Knowledge retention shows weak results because learners who stayed at the same level of achievement failed to reach the highest accomplishment level. The 90-100 category shows a drop or stop between Mathematics 7 and Mathematics 8 because learners who reached advanced skills at Grade 7 do not maintain their competencies from the previous grade.

The MATATAG framework needs better curriculum sequencing, pacing and content depth because of this. The ongoing presence of learners in the two grade ranges shows that learners need help applying what they have learned before when they study new Grade 8 math concepts. The learners prefer to use their temporary knowledge instead of developing long-term knowledge. However based on the results of the study of (Garma, 2024) it is being emphasize that MATATAG curriculum is beneficial to revisit some of the suggested topics and activities mapped from the curriculum so the teachers can utilize it in their respective classes without any difficulties. Vertical Articulation is a logical progression of mathematical ideas that allows learners to build on prior knowledge as they advance through successive grades; when this progression is weak or inconsistent, learners often experience gaps in understanding and reduced ability to apply earlier concepts in later learning context (OECD, 2024). In the context of Junior High Algebra learning, this issue is intensify by instructional practices that emphasize procedural routines over conceptual understanding, leading to persistent challenges in mastering essential algebraic concepts such as expression manipulation, equation solving and problem interpretation (Maulina, Sa'diyyah, Rosita, & Hartono, 2024). These gaps in vertical continuity not only hinder learner's ability to transfer skills from Grade 7 to Grade 8 but also contribute to weak long-term retention, where learners easily forgot or misapply previously learned content when faced with new algebraic tasks, thereby undermining overall mathematical proficiency.

The transition of learning competencies in Mathematics from Grade 7 to Grade 8 become uneasy for the learners in Divine Word College of Calapan, Inc. Basic Education. In the self-made learning competencies map, it was found out that most of the learning competencies in Grade 7 is articulated to the competencies in Grade 8 however, problem arise when lesson once again introduced and learners found it difficult to recall

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concepts and ideas which was already have a foundational knowledge during their Grade 7. This scenario happen and eventually lessons and competencies become always new for the learners. The ongoing problems together with insufficient performance results and curriculum alignment problems and the need to improve fundamental concept retention create a strong evidence that researcher must study the vertical articulation and knowledge retention of Grade 8 Mathematics algebra. The study investigates the relationship between vertical articulation and of foundational skills which learners learned in earlier grade through the implementation in the Grade 8 Mathematics under MATATAG K to 10 curriculum.

Research Questions

The study seeks to answer the following specific questions;

1. What is the level of vertical articulation in Mathematics Algebra of Grade 8 learners under the MATATAG Curriculum in terms of:
   1.1. Alignment of learning competencies;
   1.2. Continuity of concepts and skills and;
   1.3. Coherence of content sequence?
2. What is the level of foundational knowledge retention in Mathematics Algebra of Grade 8 learners in terms of:
   2.1. Problem Solving Ability
   2.2. Retention of algebraic concepts and;
   2.3. Academic Performance?
3. Is there a relationship between the level of vertical articulation in Mathematics Algebra and the foundational knowledge retention of Grade 8 learners?
4. Does vertical articulation significantly predict the foundational knowledge retention of Grade 8 learners in Mathematics?
5. Based on the results of the findings, what is the proposed output for the results of vertical articulation and foundational knowledge retention in Mathematics Algebra of Grade 8 learners under MATATAG Curriculum?

Scope and Delimitation of the Study

This study focuses on the relationship between vertical articulation and foundational knowledge retention in Mathematics particularly in Algebra among Grade 8 learners under the MATATAG Curriculum. Specifically, it examines vertical articulation in terms of alignment of competencies, continuity of concepts and skills, and coherence of content sequence. These variables are analyzed in relation to learners' foundational knowledge retention, which includes problem solving ability, retention of algebraic concepts and academic performance. The study aims to determine how well-aligned prior knowledge supports learners' understanding and performance in Grade 8 Algebra. This study is limited to selected one hundred eight (108) Grade 8 learners in Divine Word College of Calapan during the School Year 2025-2026 under the MATATAG Curriculum. The study uses quantitative methods, particularly assessment tools and survey questionnaire to gather data on learners' competencies and performance. Academic performance in Mathematics Grades is measured through grades and self-made test questionnaire focusing on problem solving ability and retention of algebraic concepts. The school was chosen due to its accessibility, availability of respondents and its implementation of the MATATAG Curriculum which makes it suitable for examining vertical articulation and learning progression. This study may be affected by certain limitations beyond the researcher's control. Limitations include its short data collection period and its small research sample size. The study results are affected by three factors which include different teaching methods, learner motivation levels and their previous learning background. The study lacks adequate research in its specific area because there has been too little research done about MATATAG curriculum.

Literature Review

Vertical Articulation

Vertical articulation in Mathematics refers to the systematic organization and sequencing of curriculum content to ensure continuous and connected learning across grade levels, allowing learners to build progressively on prior knowledge while avoiding gaps and unnecessary repetition. It supports the development of conceptual understanding by ensuring that basic skills are taught first before advancing to more complex mathematical concepts, in line with a spiral progression approach. Watermeyer (2026) emphasizes the importance of establishing clear curriculum linkages across educational stages so learners can integrate previous learning with new concepts, while Kimti (2024) defines vertical articulation as the structured progression of content within a subject over time. In the Philippine K to 12 Mathematics

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curriculum, Dio (2020) noted that although content generally increases in complexity, issues such as content overload and improper pacing may weaken curriculum coherence, while Taghap and Toraja (2025) found that inconsistent implementation of vertical progression leads to gaps and repetition in learning. Similarly, Acquah (2021) highlighted that effective curriculum sequencing enhances learner progression and academic achievement across disciplines. In Mathematics, learners are expected to gradually move from foundational arithmetic and number sense to higher-level algebraic reasoning, ensuring that prerequisite skills are mastered before advancing. Sanchez and Ponce (2020) further support this idea by emphasizing logical sequencing of concepts in science education to strengthen understanding and mastery. Overall, vertical articulation is essential in improving curriculum coherence, supporting teacher instructional planning, and ensuring learner readiness, particularly in the MATATAG Curriculum and Grade 8 Mathematics Algebra, where proper sequencing is critical for developing algebraic thinking and preventing learning difficulties due to misaligned competencies.

Alignment of learning competencies

Alignment of learning competencies is a key principle in curriculum development that ensures consistency between intended learning outcomes, teaching strategies, and assessment methods, in line with constructive alignment theory which emphasizes that effective learning occurs when these components are coherently structured. Through vertical articulation, learning competencies are systematically arranged across grade levels, allowing learners to progressively build on prior knowledge and develop higher-level skills. Studies show that curriculum alignment supports logical conceptual understanding, improves retention, and helps learners master new content by connecting it to prior knowledge (IntechOpen, 2025; Taghap & Toraja, 2025). Acquah (2021) further explains that effective curriculum development requires strong alignment between instructional content and vertical progression to ensure learners acquire essential knowledge and practical skills. When competencies are clearly defined and aligned, learners demonstrate better cognitive development and engagement (MDPI, 2024), although differences in instructional time and implementation may still affect learning outcomes. However, gaps in implementation remain a challenge, as misalignment between intended curriculum and actual classroom practice can lead to overlapping competencies, time constraints, and skipped lessons that negatively affect knowledge retention (Respicio & Bauyot, 2026; SEACE, 2020). In Mathematics education, studies show that while many curriculum components are aligned, issues such as limited instructional time and external disruptions may hinder full implementation (Urbano, 2020), although strong alignment generally improves teaching effectiveness and learner performance (Beting, 2024). Furthermore, alignment should not only focus on content but also on cognitive processes and higher-order thinking skills to ensure deeper understanding (Guintu & Fajardo, 2020). International studies also emphasize that well-aligned outcomes, assessments, and instructional activities improve educational efficiency and help identify learning gaps (Derouich, 2025). However, other findings suggest that curriculum alignment alone does not always guarantee high academic performance due to factors such as teacher workload, lack of training, and resource limitations (Balinario, 2021; Ylarde & Cajandig, 2025). Additionally, even when curricula are aligned, students may still struggle with mathematical reasoning, indicating that other variables influence learning outcomes (Incikabi & Erbay, 2025). Overall, literature suggests that while alignment of learning competencies through vertical articulation is essential for improving retention and academic performance, its effectiveness depends on proper implementation, adequate resources, and the development of higher-order thinking skills.

Coherence of content sequence

Coherence of content sequence refers to the logical and systematic arrangement of curriculum topics so that concepts are introduced, developed, and phased out in a structured progression that supports meaningful learning over time (Foster, 2021). In Mathematics education, this means organizing topics from simple to complex in alignment with learners' cognitive development and grade-level expectations. For example, Dio (2020) found that the Philippine K to 10 Mathematics curriculum generally follows an increasing level of difficulty, where foundational concepts are introduced first before advancing to more complex skills, although updates are still needed to fully align competencies with international standards. Similarly, Chinofunga, Chigeza, and Taylor (2023) emphasized that structured planning frameworks improve content sequencing and promote collaboration among teachers across grade levels, strengthening instructional continuity. International studies also highlight that coherent sequencing is a defining feature of effective curricula, as it ensures that mathematical concepts are logically connected across year levels, supporting smooth learning transitions and stronger conceptual understanding (Shimizu & Vithal, 2023). Comparative research by Ocumen and Callaman (2025) further showed that countries with clearer sequencing, such as Singapore, demonstrate stronger learner mastery compared to systems with less coherent progression, including the Philippines, where improvements in sequencing were recommended. In

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addition, Sanchez and Dagondon (2025) found that while some Science concepts are well-sequenced, redundancy and gaps in other areas disrupt learning progression, highlighting the need for stronger vertical articulation. Likewise, Tuzon, Salva, and Fernandez-Gracia (2025) confirmed that coherent sequencing across Mathematics and Physics enhances conceptual connections and improves knowledge retention. However, Koschwitz and Ham (2026) noted that coherent sequencing alone does not always guarantee higher academic performance, as other instructional and contextual factors also influence learning outcomes. Overall, literature consistently shows that coherent content sequencing strengthens continuity, supports conceptual understanding, and improves mastery in Mathematics, although its effectiveness depends on proper implementation and supporting educational conditions.

Foundational Knowledge

Foundational knowledge in Mathematics refers to the essential understanding of basic concepts, procedures, and skills that learners need in order to successfully engage with more complex mathematical ideas. These foundational elements include conceptual understanding, procedural fluency, and the ability to learn through practice and application. Woleński (2022) explains that mathematical foundations define the basic boundaries of mathematical thinking and support the development of logical reasoning and problem-solving skills. Similarly, Jannah et al. (2024) emphasize that learners better understand and retain fundamental concepts when teaching involves interactive tools, cultural contexts, and hands-on learning experiences, which help connect abstract ideas to real-life situations. In the Philippine context, Igarashi and Suryadrama (2023) found that many learners exhibit weak foundational skills in Mathematics, particularly in higher grade levels, highlighting the need to strengthen early mathematical competencies to support long-term learning progression. In contrast, Rach and Ufer (2020) reported that strong foundational knowledge, such as number fluency and algebraic reasoning, significantly predicts higher academic performance in advanced Mathematics topics. Supporting this, Kumar and Behera (2022) noted that supportive home environments and early exposure to numeracy contribute positively to the development of foundational mathematical skills, while Santos et al. (2022) found that learners with strong number sense perform better in solving complex mathematical problems and understanding abstract concepts. Overall, these studies consistently show that strong foundational knowledge is essential for academic success in Mathematics, as it enables learners to build connections between prior learning and more advanced mathematical concepts, thereby improving retention, understanding, and problem-solving ability.

Problem Solving Ability

Problem solving ability in Mathematics refers to learners' capacity to understand a given situation, represent it mathematically, and apply appropriate strategies to arrive at a solution. This skill is influenced by cognitive processes, metacognitive awareness, affective factors, and learning contexts across different educational levels. Sinaga, Sitorus, and Situmeang (2023) found that a deeper understanding of problem-solving processes significantly improves learners' performance in Mathematics, highlighting the importance of strengthening this competency to enhance academic achievement. Similarly, Isnaini, Hafizah, and Fitria (2023) reported that many learners struggle with higher-order thinking skills (HOTS) problems due to difficulties in comprehension and selecting appropriate mathematical concepts, emphasizing the need to develop stronger problem-solving abilities. Cahyaningsih et al. (2022) also found that learners with low mathematical proficiency often struggle in executing step-by-step solutions, showing that foundational skills directly affect problem-solving success. In contrast, Sari and Arliani (2022) revealed that situation-based or contextual learning improves learners' ability to solve mathematical problems by enhancing engagement and understanding, while Harahap (2023) emphasized that regular exposure to problem-solving activities develops learners' critical thinking and logical reasoning skills. Overall, these studies consistently show that problem-solving ability is a crucial component of Mathematics learning, as it is shaped by foundational knowledge, instructional strategies, and learning experiences, all of which contribute to learners' academic performance and higher-order thinking development.

Retention of Algebraic Concepts

Retention of algebraic concepts refers to learners' ability to remember, understand, and apply algebra skills over time, beyond short-term procedural execution. Difficulty in retaining these concepts becomes a major barrier to future success in Mathematics, as learners may forget previously learned procedures and struggle to apply them in advanced topics. Wladis et al. (2026) found that strong retention and understanding of algebraic concepts significantly predict higher achievement in Mathematics and STEM-related fields, emphasizing the importance of long-term conceptual mastery. Similarly, Leong, Zuraida, and Shah (2023) explained that poor retention of algebra leads to reliance on rote memorization, which limits learners' ability to connect and apply concepts in succeeding lessons, while meaningful learning

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experiences enhance understanding and memory retention. Samson, Ramatu, and Abdulrahman (2026) further reported that collaborative instructional strategies improve retention of algebraic concepts compared to traditional lecture-based approaches, as active participation and peer interaction strengthen learning. In addition, Polat and Aydin (2023) found that the use of interactive digital tools enhances long-term retention and engagement in learning algebra. Vea (2026) also highlighted that motivation, learning strategies, and effective teaching methods significantly influence learners' ability to retain mathematical knowledge. Overall, these studies show that retention of algebraic concepts is influenced by instructional approaches, learner engagement, motivation, and the use of technology, all of which are essential in ensuring long-term mastery and successful progression in Mathematics.

Academic Performance

Academic performance refers to learners' overall educational achievement, commonly measured through grades, test results, GPA, and demonstrated competencies, which reflect both individual abilities and environmental influences. Guzman (2023) found that improved conceptual understanding in Mathematics significantly enhances learners' academic performance, while Edulsa (2022) reported that students with higher levels of conceptual understanding achieve better Mathematics outcomes, although many Grade 10 learners still show low performance, indicating the need for targeted interventions. Similarly, Balacuit, Nabua, and Saludares (2025) emphasized that active learner engagement positively influences Mathematics achievement, showing that participation plays a key role in learning success. However, Flores, Robles, and Penero (2026) noted that despite satisfactory performance, many learners still struggle with content difficulty, suggesting the need for blended learning strategies such as formative assessment, guided practice, and feedback. Paz (2026) further highlighted that weak foundational skills and lack of preparation contribute to poor performance in Mathematics, emphasizing the importance of mastering prerequisite knowledge. In addition, Ylarde and Cajandig (2025) explained that factors such as alignment of competencies, content coherence, retention, and problem-solving ability alone are not sufficient to strongly predict academic performance, as it is also influenced by motivation, teaching strategies, learning styles, and available resources. Barrera (2024) found that teacher support, instructional competence, and learner engagement significantly predict Mathematics performance, while Cardino and Dela Cruz (2020) emphasized that cooperative learning and effective teaching strategies improve academic outcomes. Likewise, Cabangisan, Tubo, and Cano (2024) reported that foundational knowledge and prior learning significantly affect performance in advanced Mathematics. Overall, these studies suggest that academic performance in Mathematics is a multifaceted outcome influenced by cognitive, instructional, and contextual factors, with strong emphasis on the importance of vertically aligned competencies and foundational knowledge in improving learner achievement.

Methodology

Research Design

This study employed a quantitative research design using a descriptive–inferential and correlational approach to examine the relationship between vertical articulation and foundational knowledge retention in Grade 8 Mathematics (Algebra) under the MATATAG Curriculum at Divine Word College of Calapan, Inc. Quantitative research involves the systematic collection and statistical analysis of numerical data to identify patterns, relationships, and possible predictive associations between variables (Bhandari, 2023; Sreekumar, 2023). Specifically, the study utilized a researcher-made Likert-scale questionnaire to gather measurable data on key dimensions of vertical articulation alignment of learning competencies, continuity of concepts and skills, and coherence of content sequence and its relationship to learners' problem-solving ability, conceptual retention, and academic performance. A descriptive approach was used to summarize and describe the current status of these variables through frequency, percentage, mean, and standard deviation, providing an overview of learners' responses and learning conditions. In addition, inferential statistics were applied to determine whether significant relationships exist among variables, using Pearson's r correlation to measure the strength and direction of relationships, and regression analysis to identify whether vertical articulation significantly predicts foundational knowledge retention. Correlational analysis was employed since it examines relationships between variables without manipulating them, allowing interpretation of naturally occurring educational patterns (Putri et al., 2025). Overall, the design enables evidence-based generalizations on how structured curriculum articulation relates to learners' mathematical understanding and retention within the MATATAG framework, while maintaining statistical rigor aligned with international quantitative research standards.

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Sampling Design

The study used purposive sampling as its research method to select respondents. The study selected respondents through specific criteria which relate to the research objectives. The research focused on Grade 8 learners who study Mathematics 8, those who are under the MATATAG curriculum and those who are considered pioneering learners of the MATATAG Curriculum in the school. The sampling method is suitable because it selects learners who directly experience the curriculum materials and teaching methods which the research investigates. The respondents in this study were 109 learners from different sections of Grade 8. The researcher used slovin's formula to determine the target sample size of the study given the total population of 149 learners and the margin of error 5%.

Research Locale

The over-all intent of this study is to know the significant relationship between the vertical articulation and foundational knowledge retention in Mathematics Algebra among Grade 8 learners of Divine Word College of Calapan, Inc. Basic Education populated by a number of 149 learners who are enrolled as Grade 8 school year 2025-2026. Divine Word College of Calapan, Inc. Basic Education adopted the MATATAG Curriculum and later became K-10 curriculum, Grade 7 and Grade 8 learners are under K-10 curriculum and the Grade 8 learners was the first batch to undergo the MATATAG curriculum. The researcher examines how foundational Algebra competencies in Grade 7 are aligned and articulated with Grade 8 competencies, emphasizing instructional coherence, curriculum mapping and knowledge retention. The study contributes to the broader discourse on improving instructional continuity, strengthening conceptual understanding in Algebra and enhancing curriculum implementation effectiveness in Junior High School particularly Grade 8 Mathematics.

Research Participants

The participants of this study were Grade 8 learners of Divine Word College of Calapan, Inc. – Basic Education Department enrolled in the School Year 2025–2026. A total of 109 respondents were selected from a population of 149 learners across five sections using purposive sampling based on their availability and willingness to participate. These respondents came from St. John Bosco (15 out of 21 learners), St. Thomas Aquinas (15 out of 20 learners), St. JB De La Salle (27 out of 37 learners), St. Pedro Calungsod (26 out of 36 learners), and St. Jude Thaddeus (26 out of 36 learners), ensuring representation across all sections. The distribution of respondents allowed for a balanced collection of data reflecting different class groups within Grade 8 Mathematics learners, thereby providing sufficient basis for analyzing vertical articulation and foundational knowledge retention under the MATATAG curriculum.

Research Instrument

The research instrument used in this study was a self-made questionnaire designed to measure vertical articulation and foundational knowledge retention in Grade 8 Mathematics (Algebra). It consisted of two main parts: the independent and dependent variables. The independent variable included three indicators—alignment of learning competencies, continuity of concepts and skills, and coherence of content sequence—with seven (7) items per indicator to assess learners' perceptions of how Grade 8 Mathematics connects with Grade 7 learning, how concepts progress across grade levels, and how lessons are logically sequenced. Responses were rated using a four-point Likert scale ranging from 4 (Strongly Agree) to 1 (Strongly Disagree). The dependent variable included two indicators, namely problem-solving ability and retention of mathematical concepts, with five (5) multiple-choice items each, based on real-life and academic mathematical situations to measure learners' ability to recall, understand, and apply algebraic concepts and procedures. The instrument was developed using relevant literature, curriculum guides, and study objectives to ensure validity, relevance, and alignment with the variables under investigation.

Data Gathering Procedure

The data gathering procedure was conducted systematically to ensure accuracy, reliability, and ethical compliance. The researcher first secured permission from Divine Word College of Calapan, Inc. – Basic Education Department, then coordinated with the school principal and Grade 8 subject teachers to schedule the administration of the research instrument at a time that would not disrupt classes. After approval, the purpose of the study was explained to the respondents, along with clear instructions for answering the questionnaire. Participation was voluntary, and confidentiality of responses was strictly observed in accordance with the Data Privacy Act of 2012 (RA 10173). The questionnaires were then distributed to the selected respondents, who were given sufficient time to accomplish them, while the researcher remained present to assist with clarifications and ensure proper administration. After collection, all responses were checked, organized, and encoded into a spreadsheet for statistical analysis using

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appropriate tools such as mean, standard deviation, and Pearson's r correlation. This process ensured that the data gathered were valid, consistent, and suitable for further analysis aligned with the study objectives.

Results and Discussions

Research Question 1: What is the level of vertical articulation in Mathematics Algebra of Grade 8 learners under the MATATAG Curriculum in terms of Alignment of learning competencies, Continuity of concepts and skills and Coherence of content sequence?

Table 1. Level of vertical articulation in Mathematics Algebra of Grade 8 learners under the MATATAG Curriculum in terms of Alignment of learning competencies

Questions	Mean	Rank	SD	Description
1. I feel that the Mathematics Algebra competencies in Grade 8 are clearly aligned with what I learned in Grade 7.	3.367	3	0.648	Strongly Agree
2. I believe that the prerequisite Mathematics Algebra skills I learned in Grade 7 prepared me for Grade 8 topics.	3.376	2	0.691	Strongly Agree
3. I can see a clear progression of Mathematics Algebra competencies from Grade 7 to Grade 8.	3.321	4	0.744	Strongly Agree
4. I notice that Grade 8 Mathematics Algebra lessons assume I have the appropriate prior knowledge from Grade 7.	3.321	4	0.719	Strongly Agree
5. I feel that the learning competencies in Grade 8 build directly on Mathematics Algebra standards I studied in Grade 7.	3.321	4	0.792	Strongly Agree
6. I observe that the Mathematics Algebra competencies in Grade 8 are consistent with the learning competencies I achieved in Grade 7.	3.321	4	0.679	Strongly Agree
7. I notice that the Mathematics Algebra competencies are a continuation of the competencies introduced in Grade 7.	3.413	1	0.748	Strongly Agree
Overall	**3.349**		**0.049**	**Strongly Agree**

The results indicate a generally high level of perceived alignment of learning competencies in Mathematics Algebra from Grade 7 to Grade 8 under the MATATAG Curriculum, with an overall mean of 3.349 (SD = 0.049), verbally interpreted as "Strongly Agree," suggesting that respondents consistently perceive strong continuity, progression, and coherence of competencies across grade levels. Item-level results further show consistently high ratings across all indicators (M = 3.321–3.413), with Question 7 obtaining the highest mean (M = 3.413), indicating that learners strongly recognize Grade 8 competencies as a continuation of Grade 7 learning, while Questions 3 to 6 obtained the lowest but still strongly positive means (M = 3.321), reflecting agreement that competencies are progressive, built on prior knowledge, and systematically structured. Despite the overall positive assessment, slight variations in responses and the presence of a small proportion of disagreement suggest that a minority of learners still experience gaps in perceived continuity or prior knowledge readiness, indicating uneven curriculum transition effects. The low standard deviation values across items further confirm response consistency among participants. Overall, these findings align with curriculum alignment literature emphasizing that coherent sequencing of competencies enhances learning clarity, engagement, and cognitive readiness, although minor implementation gaps may still exist due to differences in learner preparedness and instructional delivery.

Table 2. Level of vertical articulation in Mathematics Algebra of Grade 8 learners under the MATATAG Curriculum in terms of Continuity of concepts and skills

Questions	Mean	Rank	SD	Description
1. I noticed that Mathematics Algebra concepts introduced in Grade 7 are consistently revisited in Grade 8.	3.459	1	0.632	Strongly Agree
2. I can apply the skills I learned in Grade 7 Mathematics Algebra to more complex Grade 8 problems.	3.284	4	0.695	Strongly Agree
3. I feel that there are minimal gaps between Grade 7 and Grade 8 Mathematics Algebra lessons.	3.284	4	0.747	Strongly Agree
4. I can easily connect my previous Mathematics Algebra lessons to new Grade 8 topics.	3.202	7	0.704	Agree
5. I feel that the transition from Grade 7 to Grade 8 Mathematics Algebra is smooth and continuous.	3.229	6	0.715	Agree
6. I notice that important Mathematics Algebra concepts from Grade 7 are reviewed or used again in Grade 8 lessons.	3.312	3	0.742	Strongly Agree
7. I feel that the lessons in Grade 8 continue the ideas and skills I started learning in Grade 7 without interruption.	3.358	2	0.727	Strongly Agree
Overall	**3.304**		**0.039**	**Strongly Agree**

The results reveal a generally high level of perceived continuity of concepts and skills in Mathematics Algebra from Grade 7 to Grade 8 under the MATATAG Curriculum, with an overall mean of 3.304 (SD = 0.039), verbally interpreted as "Strongly Agree,"

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indicating that respondents consistently perceive strong conceptual progression and revisitation of prior learning across grade levels. Item-level results show that all indicators received positive evaluations, with means ranging from 3.202 to 3.459, where Question 1 obtained the highest mean (M = 3.459), reflecting strong agreement that Grade 7 concepts are consistently revisited in Grade 8, while Question 4 recorded the lowest mean (M = 3.202, interpreted as "Agree"), indicating relatively weaker—but still positive—perceived ease in connecting prior lessons to new topics. The low standard deviation values across items further suggest homogeneity in responses, supporting consistency among learners' perceptions. Frequency distribution also confirms this trend, with the majority of respondents agreeing or strongly agreeing that there is continuity between grade levels, although a small proportion reported gaps or difficulty in making conceptual connections. Overall, these findings suggest that while the curriculum is generally perceived as vertically continuous and conceptually progressive, some learners still experience minor challenges in fully integrating prior knowledge with new algebraic concepts, reflecting slight variations in instructional absorption and learning transfer.

Table 3. Level of vertical articulation in Mathematics Algebra of Grade 8 learners under the MATATAG Curriculum in terms of Coherence of content sequence

	Questions	Mean	Rank	SD	Description
1.	I feel that Grade 8 Mathematics Algebra topics are arranged in a logical and meaningful sequence.	3.404	1	0.709	Strongly Agree
2.	I notice that each Mathematics Algebra lesson builds on concepts I have previously learned.	3.358	3	0.701	Strongly Agree
3.	I think the order of topics helps me better understand Mathematics Algebra concepts.	3.294	5	0.749	Strongly Agree
4.	I am able to follow the flow of Mathematics Algebra lessons without confusion.	3.211	7	0.794	Agree
5.	I feel that the sequencing of Mathematics Algebra content helps me reinforce my foundational knowledge.	3.321	4	0.719	Strongly Agree
6.	I notice that the Mathematics Algebra lessons are organized in a way that makes it easier for me to understand each new topic.	3.275	6	0.731	Strongly Agree
7.	I feel that the sequence of Mathematics Algebra topics helps me connect ideas and understand how they are related.	3.367	2	0.648	Strongly Agree
	Overall	**3.319**		**0.045**	**Strongly Agree**

The results indicate a generally high level of perceived coherence of content sequence in Grade 8 Mathematics Algebra under the MATATAG Curriculum, with an overall mean of 3.319 (SD = 0.045), verbally interpreted as "Strongly Agree," suggesting that respondents consistently perceive the lessons as logically structured, systematically organized, and developmentally appropriate. Item-level results show consistently positive ratings across all indicators (M = 3.211–3.404), with Question 1 obtaining the highest mean (M = 3.404), reflecting strong agreement that Algebra topics are arranged in a logical and meaningful sequence, while Question 4 recorded the lowest mean (M = 3.211, "Agree"), indicating that although most learners can follow lesson flow, a small proportion still experiences confusion in the progression of topics. The low standard deviation values further indicate consistency in responses across participants. Frequency distribution supports these findings, showing that the majority of respondents agreed or strongly agreed that lesson sequencing is clear, organized, and supports conceptual understanding, although a minor proportion reported difficulties in following the flow of lessons. Overall, the findings suggest that while the curriculum is generally perceived as well-sequenced and coherent, minor gaps in instructional clarity or cognitive processing may still affect some learners' ability to fully experience smooth conceptual progression.

Research Question 2: What is the level of foundational knowledge retention in Mathematics Algebra of Grade 8 learners in terms of Problem-Solving Ability, Retention of algebraic concepts and Academic Performance?

Table 4. Level of foundational knowledge retention in Mathematics Algebra of Grade 8 learners in terms of Problem-Solving Ability

	Questions	Mean	Rank	SD
1.	A gardener is planting flowers. One row requires $4x^2y$ seeds, and another row needs $2x^2y$ fewer seeds. How many seeds are left for the second row?	0.395	1	0.491
2.	A bacteria culture doubles every day. On day 1, the culture has $(3x^2)$bacteria, and on day 2 it multiplies to $(2x^3)$. If a scientist wants to know how many bacteria are there per unit x on day 2, which calculation will give the correct result?	0.321	5	0.469
3.	A store sells notebooks for $(x+4)$pesos each and pens for$(2x-3)$ pesos each. If a customer buys one of each, which expression represents the total cost?	0.349	2	0.479
4.	A recipe requires $\frac{x}{3}$ liters of milk. If the recipe calls for $\frac{4}{9}$ liters, how much milk is needed in total?	0.330	3	0.473
5.	A factory produces $8x^2-8x$units in a week. If there are $4x$ machines working equally, how many units does each machine produce?	0.330	3	0.473
	Overall	**0.345**		**0.009**

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The results of Table 4 indicate a generally low level of foundational knowledge retention in Mathematics Algebra in terms of problem-solving ability among Grade 8 learners, with an overall mean score of 0.345 (SD = 0.009), reflecting a low proportion of correct responses (34.495%) compared to incorrect responses (65.505%). This suggests that most learners demonstrated limited mastery of algebraic problem-solving competencies, particularly in applying mathematical concepts to contextualized and procedural tasks. Among the indicators, Question 1 obtained the highest mean score (M = 0.395, SD = 0.491), indicating relatively better performance in solving algebraic expressions involving polynomial subtraction; however, incorrect responses still predominated, reflecting partial understanding. Conversely, Question 2 recorded the lowest mean score (M = 0.321, SD = 0.469), indicating significant difficulty in applying algebraic operations in multi-step, higher-order reasoning tasks, particularly those involving interpretation and transformation of expressions. Overall, the findings suggest that while learners exhibit minimal competence in basic algebraic operations, there remains a substantial gap in higher-order problem-solving skills, consistent with literature emphasizing that inadequate conceptual understanding of algebra significantly constrains mathematical performance and cognitive transfer in advanced tasks (e.g., Sinaga et al., 2023; Isnaini et al., 2023; Cahyaningsih et al., 2022). These results highlight the need to strengthen instructional strategies that promote conceptual understanding, procedural fluency, and application-based learning to enhance learners' mathematical problem-solving proficiency.

Table 5. Level of foundational knowledge retention in Mathematics Algebra of Grade 8 learners in terms of Retention of algebraic concepts

	Questions	Mean	Rank	SD
1.	A student is keeping track of temperatures. One day it dropped by 7°C in the morning and 3°C in the afternoon. Which expression correctly represents the total change in temperature?	0.349	4	0.479
2.	A scientist is measuring bacteria growth. If the bacteria count grows like x^3 today and x^5 tomorrow, which rule helps her calculate the total growth?	0.450	2	0.500
3.	A car rental company calculates cost per day using the formula **5/x**, where x is the number of days rented. Which type of algebraic expression is this?	0.532	1	0.501
4.	A shopkeeper notices that her weekly earnings (E) follow the formula **E = 3x + 15,** where x is the number of hours worked. Which statement about this formula is true?	0.257	5	0.439
5.	A student is comparing two bank accounts. One account has Php 8x + 10, and another has −2x + 90. If the balances are equal, what is the value of x?	0.376	3	0.487
	Overall	**0.393**		**0.026**

The results in Table 5 indicate a low level of foundational knowledge retention in Mathematics Algebra among Grade 8 learners in terms of retention of algebraic concepts, with an overall mean score of 0.393 (SD = 0.026), corresponding to 39.266% correct responses and 60.734% incorrect responses. This suggests that most learners have not yet achieved adequate conceptual mastery and retention of key algebraic ideas. Among the indicators, Question 3 obtained the highest mean score (M = 0.532, SD = 0.501), indicating relatively better understanding of rational expressions and classification of algebraic forms, although performance remains moderate given that almost half of the respondents still answered incorrectly. In contrast, Question 4 recorded the lowest mean score (M = 0.257, SD = 0.439), reflecting significant difficulty in interpreting linear equations and translating them into meaningful mathematical statements, with the majority of learners failing to demonstrate correct conceptual understanding. Overall, the findings reveal inconsistent retention of algebraic concepts, where learners show partial understanding in basic classification tasks but struggle with deeper interpretation and application of algebraic representations. These results align with prior studies emphasizing that weak conceptual mastery in algebra limits learners' long-term retention and progression to higher-level mathematical thinking, highlighting the need for strengthened instructional strategies that promote conceptual understanding, meaningful learning experiences, and sustained cognitive retention in Mathematics.

Table 6. Level of foundational knowledge retention in Mathematics Algebra of Grade 8 learners in terms of Academic Performance

Grading Scale	Frequency and Percentage	Descriptor	Remarks
90-100	52 (47.706%)	Outstanding	Passed
85-89	40 (36.697%)	Very Satisfactory	Passed
80-84	17 (15.596%)	Satisfactory	Passed
75-79	0	Fairly Satisfactory	Passed
Below 75	0	Did Not Meet Expectations	Failed

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The results in Table 6 show that the majority of Grade 8 learners demonstrated high academic performance in Mathematics Algebra, with 47.706% (n = 52) classified as Outstanding (90–100), 36.697% (n = 40) as Very Satisfactory (85–89), and 15.596% (n = 17) as Satisfactory (80–84), while no learners fell under Fairly Satisfactory or Did Not Meet Expectations. This distribution indicates that all respondents achieved passing marks, with most performing at high proficiency levels. Overall, the findings suggest that learners exhibit generally strong academic performance in Mathematics despite variations in achievement levels, which may reflect differences in mastery of foundational concepts, learning engagement, and instructional support. These results are consistent with studies emphasizing that improved conceptual understanding and active learner engagement are associated with higher academic achievement in Mathematics (e.g., Guzman, 2023; Balacuit et al., 2025). However, the presence of learners within the satisfactory range also suggests the need for continuous instructional support and remediation strategies to ensure consistent mastery of mathematical competencies across all learners.

Research Question 3: Is there a relationship between the level of vertical articulation in Mathematics Algebra and the foundational knowledge retention of Grade 8 learners?

Table 7. Vertical articulation and Foundational Knowledge Retention in Mathematics Algebra of Grade 8 Learners

Indicators	r- value	r-critical	Interpretation
Alignment of Learning Competencies and Problem Solving Ability	0.056	±0.1882	Negligible Correlation
Alignment of Learning Competencies and Retention of Algebraic Concepts	0.045		
Alignment of Learning Competencies and Academic Performance	0.040		
Continuity of Concepts and Skills and Problem Solving Ability	0.017		
Continuity of Concepts and Skills and Retention of Algebraic Concepts	-0.061		
Continuity of Concepts and Skills and Academic Performance	-0.001		
Coherence of Content Sequence and Problem Solving Ability	0.083		
Coherence of Content Sequence and Retention of Algebraic Concepts	-0.036		
Coherence of Content Sequence and Academic Performance	0.041		

The results in Table 7 indicate that there is no significant relationship between vertical articulation indicators (alignment of learning competencies, continuity of concepts and skills, and coherence of content sequence) and foundational knowledge retention variables (problem-solving ability, retention of algebraic concepts, and academic performance) among Grade 8 learners in Mathematics Algebra. All computed Pearson r-values ranged from 0.083 to -0.061 and were lower than the critical value (±0.1882), indicating negligible to very weak correlations that are not statistically significant. The strongest observed relationship was between coherence of content sequence and problem-solving ability (r = 0.083), while the weakest was between continuity of concepts and skills and academic performance (r = -0.001), both reflecting minimal practical associations. Overall, the findings suggest that improvements in vertical articulation alone do not substantially influence learners' problem-solving performance, conceptual retention, or academic achievement in Mathematics. These results imply that foundational knowledge retention is likely influenced by other pedagogical and learner-related factors such as instructional strategies, cognitive readiness, motivation, and learning environment, rather than curriculum structure alone. Consequently, the null hypothesis is accepted, confirming that no significant relationship exists between vertical articulation and foundational knowledge retention in this study.

Research Question 4: Does vertical articulation significantly predict the foundational knowledge retention of Grade 8 learners in Mathematics?

Table 8. Summary of Regression IVs (Alignment of Learning Competencies, Continuity of Concepts and Skill, and Coherence of Content Sequence) to Problem Solving Ability

Variables	B	t	p-value	Interpretation
Intercept	0.243	1.478	0.142	Not Significant
Alignment of Learning Competencies	0.037	0.452	0.652	
Continuity of Concepts and Skills	-0.087	-0.943	0.348	
Coherence of Content Sequence	0.080	1.002	0.319	
Model Summary	R= 0.124	$R^2 = 0.015$	Adjusted $R^2 = -0.013$	F= 0.549 Significance F= 0.650 Not Significant

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The results of Table 8 show that the multiple regression model examining the predictive influence of alignment of learning competencies, continuity of concepts and skills, and coherence of content sequence on Grade 8 learners' problem-solving ability is not statistically significant, as indicated by the F-value of 0.549 with a significance level of p = 0.650 (p > 0.05). This implies that the combined independent variables do not significantly predict problem-solving ability. The model exhibits a very weak relationship (R = 0.124), while the coefficient of determination (R^2 = 0.015) indicates that only 1.5% of the variance in problem-solving ability is explained by the predictors, with an adjusted R^2 of -0.013 further confirming the model's limited explanatory power. Among the predictors, coherence of content sequence showed the highest positive but non-significant effect (B = 0.080, p = 0.319), followed by alignment of learning competencies (B = 0.037, p = 0.652), while continuity of concepts and skills showed a slight negative but non-significant effect (B = -0.087, p = 0.348). These findings suggest that although minor directional effects are observed, none of the curriculum-related variables significantly influence learners' problem-solving performance. Overall, the results indicate that problem-solving ability is likely shaped by other unmeasured factors such as instructional strategies, learner motivation, cognitive skills, study habits, and learning environment rather than vertical articulation indicators alone.

Table 9. Summary of Regression IVs (Alignment of Learning Competencies, Continuity of Concepts and Skill, and Coherence of Content Sequence) to Retention of Algebraic Concepts

Variables	B	t	P-value	Interpretation
Intercept	0.443	2.470	0.015	Significant
Alignment of Learning Competencies	0.163	1.819	0.072	Not Significant
Continuity of Concepts and Skills	-0.150	-1.498	0.137	
Coherence of Content Sequence	0.030	-0.350	0.727	
Model Summary	R= 0.186	R^2 = 0.034	Adjusted R^2 = 0.007	F= 1.249 Significance F= 0.296 Not Significant

The results presented in Table 9 indicate that the regression model predicting retention of algebraic concepts from alignment of learning competencies, continuity of concepts and skills, and coherence of content sequence is not statistically significant (F = 1.249, p = 0.296). The model demonstrates a negligible relationship between the predictor variables and retention of algebraic concepts (R = 0.186), with an R^2 value of 0.034, indicating that only 3.4% of the variance in retention of algebraic concepts is explained by the model, while 96.6% is attributable to other factors not included in the study. The adjusted R^2 value of 0.007 further confirms the model's limited explanatory power. Among the predictors, alignment of learning competencies exhibited the largest positive regression coefficient (B = 0.163, t = 1.819, p = 0.072), suggesting a weak positive association with retention of algebraic concepts; however, the relationship was not statistically significant. Continuity of concepts and skills showed a weak negative effect (B = -0.150, t = -1.498, p = 0.137), while coherence of content sequence demonstrated a negligible and non-significant contribution (B = 0.030, t = -0.350, p = 0.727). Although the intercept was statistically significant (B = 0.443, t = 2.470, p = 0.015), indicating the presence of a baseline level of algebraic concept retention among learners, the overall findings suggest that the vertical articulation indicators examined in this study do not significantly predict learners' retention of algebraic concepts. These results imply that other factors, such as instructional practices, learner motivation, collaborative learning experiences, use of educational technology, and individual learning strategies, may play a more substantial role in supporting long-term retention of algebraic knowledge.

Table 10. Summary of Regression IVs (Alignment of Learning Competencies, Continuity of Concepts and Skill, and Coherence of Content Sequence) to Academic Performance

Variables	B	t	P-value	Interpretation
Intercept	88.031	35.577	2.137	Not Significant
Alignment of Learning Competencies	0.687	0.554	0.581	
Continuity of Concepts and Skills	-1.072	-0.774	0.441	
Coherence of Content Sequence	0.599	0.502	0.617	
Model Summary	R= 0.087	R^2 = 0.007	Adjusted R^2 = −0.021	F= 0.264 Significance F= 0.851 Not Significant

The regression analysis revealed that the overall model was not statistically significant, as indicated by the F-value of 0.264 and p-value of 0.851, which exceeded the 0.05 significance threshold. This finding suggests that the combined effects of alignment of learning competencies, continuity of concepts and skills, and coherence of content sequence did not significantly predict the academic performance of Grade 8

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learners. The model yielded a negligible correlation (R = 0.087), while the coefficient of determination (R^2 = 0.007) indicated that only 0.7% of the variance in academic performance was explained by the three predictors. The negative adjusted R^2 (-0.021) further demonstrates the limited explanatory and predictive power of the model. Among the predictor variables, alignment of learning competencies showed the highest positive regression coefficient (B = 0.687; t = 0.554; p = 0.581), suggesting a weak positive association with academic performance. However, the relationship was not statistically significant. Similarly, coherence of content sequence yielded a positive coefficient (B = 0.599; t = 0.502; p = 0.617), indicating a minimal positive contribution that was likewise non-significant. In contrast, continuity of concepts and skills produced a negative coefficient (B = -1.072; t = -0.774; p = 0.441), suggesting a weak inverse relationship with academic performance, although this effect was also not statistically significant. These findings indicate that none of the dimensions of vertical articulation independently contributed to variations in learners' academic achievement. The results imply that academic performance in Mathematics may be influenced by factors beyond curriculum articulation, such as instructional quality, learner motivation, study habits, classroom engagement, prior knowledge, and other educational and demographic variables. Consistent with previous research, academic achievement is a multifaceted construct shaped by various learner-related and instructional factors. Therefore, while vertical articulation remains important for curriculum organization and progression, the present findings suggest that it does not serve as a significant predictor of Grade 8 learners' academic performance in Mathematics under the MATATAG Curriculum.

Research Question 5: Based on the results of the findings, what is the proposed output for the results of vertical articulation and foundational knowledge retention in Mathematics Algebra of Grade 8 learners under MATATAG Curriculum?

The results of this study serve as the basis for the development of a proposed output entitled "Strengthened Learning Progression through Vertical Articulation for Mathematics 8 Learning Competencies". This output primarily designed to address the identified learning gaps in the alignment of Learning competencies from Grade 7 to Grade 8 Mathematics. Based on the results and findings of the study presented in this chapter, the proposed output aims to strengthen the alignment of learning competencies, continuity of concepts and skills and coherence of content sequence across Grade levels. It also aims to enhance learners' mathematical skills ensuring understanding, mastery of concepts, retention and problem solving ability in an organized and systematic manner. The proposed output is presented in a structured framework that may guide learners, teachers as well as curriculum developers in refining vertical articulation in teaching Mathematics.

Table 11. Vertical Articulation of Grade 7 and Grade 8 Mathematics Learning Competencies with Identified Learning Gaps and Proposed Interventions

Content Domain	Grade 7 Learning Competencies	Grade 8 Learning Competencies	Learning Gaps	Proposed Remediation/ Interventions
Measurement and Geometry	The learners... 1. explore inductively the volume of square and rectangular pyramids using rectangular prisms, leading to the identification of the formula. 2. estimate volumes of square and rectangular pyramids. 3. solve problems involving volumes of square or rectangular pyramids.	The learners... 1. explore inductively the volume of pyramids other than square and rectangular pyramids. 2. find the volume of pyramids other than square and rectangular pyramids. 3. solve problems involving volume of pyramids.	1. Competencies from Grade 7 to Grade 8 are in increasing complexity order however, the foundational knowledge and skills are not enough. 2. Aside from that for Measurement and Geometry it was congested and learning competencies should be unpack because there are subtopics under one competencies. 3. Learners struggled identifying which formula is appropriate to use especially in	1. Conduct review activities before proceeding with the new lessons. 2. Unpack each learning competencies into smaller learning objectives to strengthen mastery of concepts. 3. Use appropriate visual aids such as 3D models and provide step-by-step demonstrations of solutions. 4. Use and provide contextualized activities for the level of the learners.

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			problem solving.	
Number and Algebra	The learners... 1. solve one variable in terms of the other variables in a formula. 2. write equations in algebraic form. 3. find the value of an unknown in an equation where the unknown is non-negative. 4. solve problems involving algebraic expressions and formulas.	The learners. 1. simplify rational algebraic expressions. 2. perform operations on rational algebraic expressions. 3. solve problems involving simple rational algebraic equations (using cross-multiplication).	1. Learners tend to forgot foundational concepts during Grade 7 that is why basic concepts are being discuss again. 2. Also, concepts are too basic during previous year making it harder to discuss complex ones. 3. It is also seen that there are too much competencies given the limited time for each quarter. 4. Lastly, problem solving skills are weak and one to two competencies took two weeks before they mastered.	1. Provide a scaffolded activities suitable for learners cognitive level. 2. Integrate self-made or contextualized activities to strengthen analytical, reasoning and critical thinking skills. 3. Use of formative assessment, exit tickets, remediation monitoring to master topic for the learning competency.
Data and Probability	The learners... 1. use appropriate graphs to represent organized data: pie graph, bar graph, line graph, and stem-and-leaf plot. 2. interpret statistical graphs.	The learners... 1. investigate, interpret, and analyze graphs from primary data (e.g., examination scores). 2. investigate, interpret, and analyze graphs from secondary data. .	1. In terms of data and probability, learners experienced difficulty in comprehending and interpreting graphs. 2. In addition, the learning competencies are scattered, insufficient and some lessons are not connected with the previous one it cause confusion for the learners.	1. Strengthen continuity of lessons by connecting previous graphs to the new ones. 2. Provide hands-on activities, guided exercises and peer tutoring on interpreting and comparing data. 3. Apply step-by-step data analysis for each activities.

Ethical Considerations

The research conducted according to strict ethical standards to ensure the rights and privacy of the respondents throughout the data collection process. The researcher obtained school administration permission before the use of research instrument at Divine Word College of Calapan, Inc. Basic Education Department. The respondents are informed about the objectives of the study and its importance and the responsibilities as respondents of the study. The research study included voluntary participants who had the right to decline participation in the study's questionnaire whenever they want without academic consequences. The researcher used the collected data for academic purposes only and maintain the confidentiality of respondents. The researcher used secure methods for handling all data collection according to the Data Privacy Act of 2012 (RA 10173).

Conclusion

This study examined the relationship between vertical articulation and foundational knowledge retention in Mathematics Algebra among Grade 8 learners under the MATATAG Curriculum. The findings revealed that learners generally perceived a high level of vertical articulation in terms of alignment of learning competencies, continuity of concepts and skills, and coherence of content sequence. Despite these

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positive perceptions, learners demonstrated relatively low levels of foundational knowledge retention, particularly in problem-solving ability and retention of algebraic concepts. Nevertheless, the majority of learners achieved satisfactory to outstanding academic performance in Mathematics. Furthermore, the results of Pearson's correlation analysis indicated negligible relationships between the dimensions of vertical articulation and the indicators of foundational knowledge retention and academic performance. Similarly, multiple regression analyses showed that alignment of learning competencies, continuity of concepts and skills, and coherence of content sequence did not significantly predict learners' problem-solving ability, retention of algebraic concepts, or academic performance. These findings suggest that while vertical articulation contributes to curriculum organization and learning progression, it is not a significant determinant of learners' foundational knowledge retention and academic achievement in Mathematics. Overall, the study highlights the need to further strengthen curriculum implementation and instructional practices that support conceptual understanding, knowledge retention, problem-solving competence, and higher-order thinking skills. It also suggests that other factors, such as instructional quality, learner engagement, motivation, learning strategies, and classroom experiences, may play a more substantial role in influencing Mathematics learning outcomes among Grade 8 learners.

Recommendations

Based on the findings of the study, it is recommended that curriculum planners and developers continuously review and strengthen the vertical articulation of learning competencies across grade levels to ensure a more coherent progression of mathematical knowledge and skills. While learners perceived a high degree of curriculum alignment, the relatively low levels of problem-solving ability and retention of algebraic concepts suggest the need for further enhancement of curriculum implementation and instructional support. School administrators and educational leaders may consider promoting assessment practices that measure not only academic achievement but also conceptual understanding, knowledge retention, problem-solving competence, and higher-order thinking skills. The integration of formative and performance-based assessments may provide a more comprehensive evaluation of learner outcomes. Mathematics teachers are encouraged to implement learner-centered instructional strategies, including enrichment activities, remediation programs, collaborative learning tasks, and authentic problem-solving experiences that reinforce foundational concepts and facilitate deeper understanding. Such approaches may help improve learners' retention of algebraic concepts and their ability to apply mathematical knowledge in complex situations. Learners should likewise be encouraged to engage actively in classroom discussions, collaborative learning activities, and independent review of previously learned concepts. Consistent practice and the application of mathematical concepts to real-life contexts may contribute to stronger conceptual understanding and long-term retention. Finally, future researchers may replicate the study using larger and more diverse samples from different educational settings to improve the generalizability of the findings. Further investigations may also examine additional variables, such as instructional practices, learner motivation, learning strategies, classroom environment, and parental support, to provide a more comprehensive understanding of the factors influencing foundational knowledge retention and academic performance in Mathematics.

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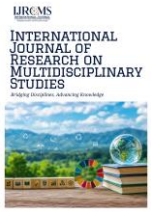

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