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Research Article

Investigating the Role of Students' Prior Mathematical Knowledge in Conceptual Understanding and Problem-Solving Confidence

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Abstract
Despite ongoing curriculum reforms and teacher training initiatives, many students in Ghana still face challenges in learning mathematics effectively. One factor that may contribute to these difficulties is the level of mathematical knowledge students bring to the classroom before encountering new concepts. This study explored how prior mathematical knowledge influences students' understanding of new mathematical ideas and their confidence in solving problems. A qualitative research approach was employed to gain a deeper understanding of students' experiences. Data were collected through semi-structured interviews with fifteen Form 2 students, allowing them to share their views and learning experiences in their own words. The interview data were analyzed thematically to identify common patterns and recurring themes. The findings showed that students who had a strong foundation in mathematics were generally more confident when learning new topics. They were able to relate new concepts to what they had already learned, making it easier for them to understand lessons and solve mathematical problems. These students also participated more actively in class and were less likely to feel overwhelmed when faced with challenging tasks. In contrast, students with weak prior mathematical knowledge often struggled to connect new ideas to previous learning. As a result, they experienced confusion, found problem-solving more difficult, and reported lower levels of confidence in mathematics. Based on these findings, the study recommends that teachers regularly assess students' existing knowledge before introducing new topics. Lessons should be designed to build on what students already know while addressing gaps in understanding. Strengthening foundational mathematical skills can improve conceptual understanding, increase confidence, and ultimately support better mathematics learning outcomes among students in Ghanaian schools.

Keywords: Conceptual Understanding, Ghana, Mathematics Education, Prior Knowledge, Problem-Solving, Confidence

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1. INTRODUCTION

Many students in Ghana still struggle with mathematics, despite the curriculum being revised and teachers receiving additional training. Reports from the West African Examinations Council (WAEC, 2025) and the National Teaching Council (NTC, 2022) indicate that a significant proportion of senior high school students continue to perform below expected proficiency levels in mathematics. Records from the West African Examinations Council (WAEC, 2025) indicated that, out of 429,076 SHS students who wrote WASSC (SC) 2025, 209,063 students had A1-C6 (48.73%), 52,991 had D7 (11.68%), 52,145 had E8 (12.15%), and 114,872 had F9 (26.77%). Even students who had E9 exceeded the total number of students who had D7 and E8. The Ghana Examination Committee, at its 40th meeting held on Wednesday, November 17, 2025, mentioned that 6,295 candidates brought in foreign materials like prepared notes, textbooks, and printed materials into the examination halls. Moreover, 653 candidates' results were cancelled for possessing a mobile phone in the examination halls. These challenges are often linked to weak foundational understanding developed at the basic and junior high levels, which hinders students' ability to

engage meaningfully with new and more abstract mathematical concepts. Mathematics instruction in many Ghanaian classrooms continues to emphasize procedural fluency and examination preparation, with limited opportunities for learners to connect new ideas to their existing conceptual frameworks (Baah-duodu et al., 2020; Baah-duodu et al., 2022). As a result, many students struggle to transfer prior learning to novel contexts, contributing to a cycle of low achievement, reduced confidence, and growing anxiety toward the subject.

In many mathematics classrooms, students' struggles with new topics can often be traced back to gaps in their prior mathematical knowledge. Mathematics, by its cumulative nature, requires learners to draw upon previously acquired concepts to make sense of new and more complex ideas (Annala, 2022; Barton et al., 2019). When students enter new learning experiences without a firm grasp of foundational principles, they tend to rely on rote memorization rather than conceptual understanding, which limits their ability to make meaningful connections between old and new knowledge. This weak transfer of prior understanding frequently results in misconceptions, fragmented learning, and frustration when faced with problem-solving tasks that demand logical reasoning or abstract thinking (El Fathi et al., 2025). Research and classroom observations consistently reveal that students who possess a well-structured foundation in mathematics are more adept at interpreting new concepts and applying them flexibly across different contexts (Flores et al., 2024; Radmehr & Drake, 2019). Such students exhibit greater persistence and confidence when solving challenging problems because they can relate unfamiliar situations to previously mastered knowledge frameworks. Conversely, those with poor foundational knowledge often experience anxiety and a lack of self-efficacy, perceiving mathematics as difficult or inaccessible (Mamolo, 2022; Terefe et al., 2024). Thus, understanding the role of prior mathematical knowledge becomes critical to addressing learning difficulties, as it underpins students' ability to construct new meanings, overcome cognitive barriers, and develop a confident, problem-solving mindset.

Prior mathematical knowledge, conceptual understanding, and problem-solving confidence are deeply interconnected constructs that together shape the quality of students' mathematical learning experiences. Prior mathematical knowledge serves as the foundation upon which new learning is constructed, providing students with pre-existing mental frameworks that enable them to make sense of unfamiliar ideas (Gorbunova et al., 2025; Tachie, 2019). When learners possess well-developed entry-level knowledge, they can draw meaningful connections between old and new concepts, facilitating the development of conceptual understanding, which goes beyond memorizing procedures to grasping the underlying principles and relationships within mathematics. This conceptual depth allows students to see mathematics as a coherent system rather than isolated rules, empowering them to transfer knowledge across contexts and apply it flexibly in novel situations (Vimbelo & Bayaga, 2024). In turn, a solid conceptual foundation nurtures problem-solving confidence, the belief in one's ability to engage with, analyze, and solve mathematical problems effectively (Margarita et al., 2024; Pajares, 1996). Confident students are more likely to approach challenges with persistence and strategic thinking, rather than anxiety or avoidance (Bandura et al., 1996; Wong & Chiu, 2019). Conversely, when prior understanding is fragmented or shallow, students often struggle to build conceptual understanding, leading to uncertainty and diminished confidence in problem-solving (Lee, 2025; Zhang & Wang, 2025). Thus, the dynamic interplay between these constructs suggests that strengthening students' initial knowledge can enhance their conceptual understanding, which subsequently fosters greater self-assurance and resilience in tackling complex mathematical tasks.

Despite continuous curriculum reforms and efforts to improve mathematics teaching in Ghana, many Form 2 students at Kumasi Senior High Technical School in the Kumasi Metropolis still struggle to perform well in mathematics. Teachers in the General Science, General Arts, and Technical programs often observe that students find it difficult to understand new mathematical concepts, especially when those ideas build on topics they have already been taught. This situation leads to repeated mistakes, low confidence, and a general fear of mathematics among learners. In many cases, the problem does not seem to come only from the difficulty of new topics, but from students' weak or incomplete understanding of earlier mathematical concepts. Because of this, they are unable to connect what they already know to what they are currently learning. For example, when students move into topics like algebra or geometry, they often struggle to recall and apply basic skills they learned in earlier classes. This makes learning slower and affects their ability to solve problems independently.

While previous studies have recognized that prior knowledge is important in learning mathematics, most of them have focused on general factors like teaching methods or motivation (Cleary & Kitsantas,

2017; Zakariya et al., 2023). Less attention has been given to how students themselves experience their prior knowledge, whether they see it as helpful or a barrier, and how it influences their confidence and approach to solving problems. There is also a limited understanding of how past experiences in mathematics shape the way students think and respond to new tasks in the Ghanaian senior high school context. This study, therefore, focuses on Form 2 students at Kumasi Senior High Technical School to better understand how their prior mathematical knowledge affects their learning. It looks at how prior knowledge influences their understanding of new concepts, how they perceive its role in learning, how it affects their confidence in solving problems, and how their past experiences shape their problem-solving approaches. The aim is to gain a clearer picture of students' real learning experiences so that teaching strategies can better support their understanding and confidence in mathematics.

1.1. Research Questions

RQ1. How does prior mathematical knowledge influence students' understanding of new concepts?

RQ2. What perceptions do students hold regarding the influence of prior mathematical knowledge on learning new concepts?

RQ3. How does prior knowledge affect students' problem-solving confidence?

RQ4. How do past mathematical experiences shape students' approaches to problem-solving?

2. METHODOLOGY

2.1. Research Design

This study uses an interpretive descriptive approach because it helps to understand students' experiences with mathematics in a way that is both meaningful and useful for teaching. Instead of focusing on numbers or testing relationships, this approach looks closely at how students make sense of their learning in real classroom situations. In this case, the study is interested in how Form 2 students use what they already know in mathematics when learning new topics and solving problems. While it is already known that prior knowledge can affect understanding and confidence, what matters here is how students themselves experience this influence in their day-to-day learning. Some students may find their prior knowledge helpful, while others may feel it confuses them or holds them back. Using an interpretive descriptive approach makes it possible to understand these different experiences more deeply. It helps to identify patterns in how students think, how they build confidence, and how they approach problem-solving. In the end, the goal is not just to describe what students say, but to draw out useful insights that can help teachers improve how they teach mathematics and support students better.

2.2. Population

The target population for this study consists of Form 2 students at Kumasi Senior High Technical School in the Kumasi Metropolis, specifically those enrolled in the General Science, General Art, and technical programs. This population was chosen because Form 2 students have sufficient academic exposure to understand and engage with the study's subject matter, and including students from diverse academic tracks ensures that the findings reflect a broad range of perspectives and experiences within the school, enhancing the transferability and richness of findings within the context of secondary education in the metropolis.

2.3. Sample Size

In qualitative research, the focus is not on statistical generalization but on gaining a rich and detailed understanding of participants' experiences. For this reason, the sample size was not determined using statistical power analysis, as is common in quantitative studies. Instead, the study followed the principle of data saturation (Guest et al., 2020), meaning data collection continued until additional interviews no longer produced new themes or insights. Participants were selected purposively from Kumasi Senior High

Technical School in the Kumasi Metropolis. To ensure meaningful variation in perspectives, the selection was based on specific criteria. First, only students who were actively enrolled and studying mathematics at the senior high school level were included. In addition, students were chosen to reflect different levels of mathematics performance, based on teacher recommendations and available academic records. Efforts were also made to include both male and female students and students from different classes or streams where applicable, so that a wider range of experiences could be captured. In total, 15 students who met these criteria took part in the study. Data saturation was reached when no new ideas or themes were emerging from the interviews. This approach fits well with the qualitative nature of the study and supports the usefulness of the findings in similar educational settings.

Table 1 shows the demographic information of the 15 students who participated in the study. Slightly more than half of the participants were male (53.3%), while females made up 46.7%, indicating that both genders were well represented. Most of the students were between the ages of 15 and 17 years (46.7%), followed by those aged 18 to 20 years (33.3%), with a smaller number aged 21 years and above (20.0%). In terms of their programme of study, the participants were evenly selected from General Science, General Arts, and Technical programmes, with five students (33.3%) representing each programme.

Table 1. Demographic Characteristics of Respondents

Demographics	Response	Frequency	Percentage
Gender			
	Male	8	53.3
	Female	7	46.7
Age			
	15-17 years	7	46.7
	18-20 years	5	33.3
	21 years or above	3	20
Course of Study			
	General Science	5	33.3
	General Arts	5	33.3
	Technical	5	33.3

2.4. Sampling Technique

A purposive sampling technique was employed to select participants based on their prior mathematical knowledge. This sampling method ensures that the study captures a range of knowledge levels, which is essential for investigating the influence of prior knowledge on learning new concepts and problem-solving confidence. Additionally, purposive sampling allows the researcher to focus on students who meet specific inclusion criteria relevant to the research objectives.

2.5. Instruments

To better understand how students' prior knowledge in mathematics affects their understanding of new topics and their confidence in solving problems, the study used semi-structured interviews to collect data. This approach was chosen because it allows the researcher to guide the discussion with set questions while still giving students the freedom to explain their experiences in their own words. In this way, students were able to share more detailed and personal views about how they learn mathematics. The interview guide had four main questions. These included: "How does what you already know in mathematics help you understand new topics introduced in class?" "Can you describe a time when something you learned earlier in mathematics either helped or confused you when learning a new concept?" "How does your familiarity with previous mathematical topics influence your confidence when solving new or challenging problems?", and "How have your past experiences in mathematics, whether positive or negative, shaped the way you approach difficult problems?" Before the main data collection, the interview questions were tested with three students who were not part of the actual study. This helped to make sure the questions were clear and easy to understand, and it also allowed for small adjustments to improve the flow of the interview.

2.5.1. Validity and Reliability

To ensure the trustworthiness of this qualitative study, several steps were taken throughout the research process. Credibility was strengthened by spending enough time with participants to gain a deeper understanding of their experiences, and by using member checking, where participants reviewed the findings to confirm that their views had been accurately represented. Dependability was maintained by carefully documenting all research procedures so that the process was clear and consistent. Confirmability was then ensured by grounding the findings in the data collected and by reflecting on any possible researcher bias. Lastly, transferability was supported by providing detailed descriptions of the research setting and participants, allowing others to judge whether the findings can apply to similar contexts.

2.6. Data Analysis Procedure

The qualitative data from the semi-structured interviews were analyzed using reflexive thematic analysis following Braun and Clarke (2008), with the aid of NVivo (version 11). The analysis was guided by the study's three research questions (deductive orientation), which helped to structure the coding and theme development process. The analysis began with repeated reading of all transcripts to ensure familiarization with the data. Initial coding was then conducted systematically in NVivo, where meaningful segments of text were assigned concise labels capturing participants' experiences related to prior knowledge, conceptual understanding, and problem-solving in mathematics. Examples of initial codes included *connecting prior and new concepts*, *confidence from familiarity*, *gaps in foundational knowledge*, and *problem-solving strategies*. Coding continued across all transcripts until no new ideas or patterns emerged, indicating data saturation. Following coding, related codes were clustered into broader categories and subsequently refined into two main themes: (1) the foundational role of prior knowledge in conceptual understanding, and (2) prior knowledge as a determinant of problem-solving confidence and self-efficacy. These themes were iteratively reviewed to ensure coherence, distinctiveness, and alignment with the coded data. To strengthen methodological rigor and trustworthiness, a second coder independently reviewed a subset of the transcripts and corresponding codes. Discrepancies between coders were discussed and resolved by consensus, improving the consistency and credibility of the coding process. In addition, an audit trail documenting coding decisions and theme development was maintained to ensure transparency. The interviews were conducted in person and lasted for 30 minutes for each participant. Finally, the refined themes were used to construct a coherent narrative, supported by representative quotations, that links the findings directly to the research questions and relevant literature.

2.6.1. Themes and Corresponding Interview Questions

Table 2 represents the themes and their corresponding interview questions. From Table 2, theme 1 examines how students use the mathematical knowledge they already have to understand new concepts. It seeks to find out whether what students have learned in the past makes it easier or more difficult for them to grasp new ideas. It also explores students' views on the importance of prior knowledge in helping them make connections between familiar and unfamiliar mathematical concepts. Moreover, theme 2 explores how students' previous mathematical knowledge and experiences influence their confidence when solving mathematical problems. It also looks at how these experiences affect the way students approach problem-solving, including the strategies they use, their willingness to persevere when faced with difficulties, and their confidence in finding correct solutions.

Table 2. Themes and Corresponding Interview Questions

Theme	Interview Questions
1. The foundational role of prior knowledge in conceptual understanding	a. How does prior mathematical knowledge influence students' understanding of new concepts? b. What perceptions do students hold regarding the influence of prior mathematical knowledge on learning new concepts?
2. Prior knowledge and mathematical self-efficacy	a. How does prior knowledge affect students' problem-solving confidence? b. How do past mathematical experiences shape students' approaches to problem-solving?

3. RESULTS

3.1. Theme 1: The Foundational Role of Prior Knowledge in Conceptual Understanding

RQ1: How does Prior Mathematical Knowledge Influence Students' Understanding of New Concepts?

Understanding new mathematical concepts often builds directly on what students already know. Prior knowledge serves as a foundation, allowing learners to connect familiar ideas to unfamiliar ones, recognize patterns, and approach problems with greater confidence. In the context of senior high school mathematics, students frequently rely on previously learned skills, whether basic arithmetic, algebraic manipulation, or geometric reasoning, to make sense of new topics introduced in class. To explore this further, we conducted interviews with senior high school students to understand how their existing knowledge in mathematics supports their learning of new concepts. Their responses provide insight into the strategies they use, the connections they make, and the challenges they encounter in bridging prior knowledge with new material.

> "*Whenever I start a new topic, I always try to connect it with what I learned before. For example, when we learned about quadratic equations, I remembered the basic rules of algebra and factorization. This made it easier to follow the steps because I already understood the language of algebra. Without that prior knowledge, I think I would have been confused and slower to grasp the new concepts*." (Student 3)

> "*I think my previous knowledge acts like a map for new topics. When a teacher introduces something like trigonometric identities, I relate them to what I already know about ratios and right-angled triangles. It helps me see patterns and connections, and I don't have to start learning from zero, which makes me more confident in solving problems*." (Student 2)

> "*Sometimes, new topics feel challenging, but recalling what I already know gives me a starting point. For instance, in learning calculus, understanding functions and graphs I learned earlier helped me visualize limits and derivatives. I feel more comfortable experimenting with problems because I can build on that foundation rather than feeling lost.*" (Student7)

> "*I notice that when I remember the concepts from previous lessons, I can predict what the new topic might involve. Like, when we moved from fractions to algebraic fractions, knowing how to add and simplify regular fractions made it easier to handle letters and variables. It saves time and reduces mistakes, and I feel more confident in class discussions*." (Student 4)

> "*My prior knowledge gives me a sense of connection between topics. For example, learning about percentages before learning probability helped me understand probability problems faster because I could relate percentages to likelihoods. I also feel more confident attempting exercises because I can draw on what I already know, which makes learning less intimidating.*" (Student 9)

Students repeatedly explained that what they already knew in mathematics played a major role in helping them understand new topics. Instead of seeing new concepts as completely new, they described prior knowledge as a foundation that helped them make sense of ideas, recognize patterns, and apply what they already knew to solve problems. For example, one student noted that knowing basic algebra made quadratic equations easier to understand (Student 3), while another pointed out that understanding fractions helped with algebraic fractions (Student 7). These responses show that students were not just repeating ideas, but using earlier learning to bridge gaps in new content. Overall, the students' experiences suggest that prior knowledge helps learning become smoother and more connected. It reduces confusion, limits common mistakes, and builds confidence when dealing with difficult topics. Some students also mentioned that linking ideas, such as connecting percentages to probability, made mathematics feel more meaningful and easier to follow. In general, the findings show that when students are able to build on what they already know, they understand mathematics better and learn with greater confidence.

RQ2. What Perceptions do Students Hold Regarding the Influence of Prior Mathematical Knowledge on Learning New Concepts?

When learning mathematics, prior knowledge often plays a crucial role in shaping how new concepts are understood. Sometimes, what students have learned before can serve as a helpful foundation, making new ideas easier to grasp. Other times, earlier learning can lead to confusion if prior understanding conflicts

with new concepts. To explore this dynamic, senior high school students were asked to reflect on instances where previous mathematical knowledge either helped or confused them in learning something new. Their responses provide insight into how students' mathematical experiences influence their learning processes.

> "*When we started learning about geometry, particularly the area of different shapes, I realized that my earlier knowledge of multiplication and division was really useful. I could calculate areas faster because I understood how numbers worked together. However, learning about the Pythagorean theorem was confusing at first because I had never connected squares and square roots in that way before. It took me a while to link the old concepts to the new ones.*" (Student 3)

> "*I remember when we were learning about algebraic equations, I struggled a bit at first. But because I had a strong understanding of fractions and basic operations from earlier grades, I could manipulate the equations without getting lost. It really helped me see patterns in solving for x. On the other hand, when we moved to quadratic equations, some of the negative numbers and squares confused me at first because I hadn't fully mastered exponents before. So, my prior knowledge helped in some ways, but gaps also made some topics tricky.*" (Student 6)

> "*During lessons on probability, I found that my understanding of fractions from previous mathematics classes was very helpful. I could easily figure out the likelihood of different outcomes because I knew how to represent them as fractions. But when we got to permutations and combinations, I was really confused because I didn't have much background on arranging objects systematically. That's when I realized that some prior knowledge is useful, but some gaps can make learning harder.*" (Student 5)

> "*I remember learning about functions in algebra. The concept was confusing at first because it felt abstract. But because I had learned about sequences and patterns before, I could understand how one number led to another in a function. My earlier lessons helped me recognize the rules, but I still had to practice a lot to fully understand them. Without that prior experience, I think it would have been much harder.*" (Student 8)

> "*When we were learning about graphs, especially linear and non-linear ones, my earlier knowledge of plotting points on a coordinate plane really helped. I could quickly identify where to place the points and connect them. But when we got into more complex graphs like exponential functions, I got confused because I didn't understand growth rates from before. So, some past knowledge helped me a lot, but other areas left me struggling until I learned the basics again.*" (Student 7)

Students consistently described prior mathematical knowledge as the foundation that enables them to comprehend and connect new mathematical concepts. Across responses, learners emphasized that previously learned topics, such as algebraic operations, fractions, and geometry, served as *mental anchors* that helped them decode unfamiliar ideas in higher-level mathematics. They viewed prior knowledge as a "map" or "starting point" that guided their understanding of new topics like trigonometry, calculus, and algebraic fractions. This finding reveals that students do not approach new mathematics content as isolated fragments; instead, they engage in *knowledge transfer*, reconstructing earlier understanding to form conceptual bridges with new material.

The responses also show that when prior knowledge is incomplete or fragile, students experience confusion and slower comprehension. This highlights the dual nature of prior knowledge; it can facilitate learning when accurate, but hinder it when misconceptions persist. The evidence aligns with constructivist theories (Bransford, 2000; Ausubel, 2000), which emphasize that meaningful learning occurs when new information is actively linked to existing cognitive structures.

These findings affirm that prior knowledge plays a critical role in shaping conceptual understanding, supporting earlier research by Wang et al. (2020), who found that students with well-structured prior knowledge exhibit greater flexibility and depth of understanding. The results also mirror Rittle-Johnson and Schneider's (2015) model of *bidirectional relations* between conceptual and procedural knowledge, as cited by Borji et al. (2021), suggesting that students who can fluently connect previous procedures to new concepts develop a stronger understanding. For Ghanaian mathematics classrooms, this underscores the importance of diagnostic assessment and scaffolding to ensure that learners build upon firm conceptual foundations rather than rote memory.

3.2. Theme 2: Prior Knowledge and Mathematical Self-Efficacy

RQ3. How does Prior Knowledge Affect Students' Problem-Solving Confidence?

Students explained that how confident they feel in solving new or difficult mathematics problems often depends on how well they remember what they learned before. When they are familiar with earlier topics, they find it easier to connect new ideas to what they already know, which gives them a sense of assurance and motivation to keep trying. On the other hand, when they have forgotten or never fully understood a previous concept, they tend to feel uncertain and less confident in approaching new problems. The following responses show how students' familiarity with past mathematical lessons influenced their confidence and attitude toward solving challenging tasks.

> "*My confidence really depends on whether I remember the basics from previous topics. For example, when we started quadratic equations, I could easily handle the problems because I understood factoring and linear equations. That background made me feel less nervous and more willing to try different methods instead of giving up.*" (Student 6)

> "*I notice that if I struggle with earlier topics, I hesitate more with new ones. Like, I had trouble with fractions last year, so when we moved to ratios and proportions, I wasn't very confident at first. But when I reviewed the older concepts, my confidence grew, and I could solve the problems more smoothly.*" (Student 8)

> "*Knowing previous topics helps me see patterns in new problems. For instance, when learning functions, remembering graphing and algebra rules helped me understand transformations. It gives me confidence because I feel like I already have the tools to approach the questions.*" (Student 5)

> "*Sometimes I get stuck if I forget earlier lessons. But when I am familiar with the foundations, I feel like I can break complex problems into smaller steps, which makes me less anxious and more persistent in trying different solutions.*" (Student 9)

> "*My confidence is higher when I can connect new problems to things I already know. Like, in trigonometry, remembering Pythagoras' theorem and angles from earlier classes made it easier to tackle sine and cosine questions. It's like having a map; I feel prepared and less afraid of making mistakes.*" (Student 1)

The students shared that their confidence in learning new math topics really depends on how well they understand previous concepts. When they had a solid foundation in topics like algebra, fractions, or Pythagoras' theorem, they felt more prepared, less anxious, and more willing to try different ways of solving problems (Student 1, Student 5, Student 6, Student 9). On the other hand, gaps in earlier knowledge made them hesitate or struggle at first, until they revisited the basics (Student 8). Many described prior knowledge as a "map" that helps them see patterns, break down complex problems, and feel ready to tackle challenges. Overall, having a strong foundation not only helps them understand new material but also boosts their confidence, persistence, and willingness to engage in learning.

RQ4: How do past mathematical experiences shape students' approaches to problem-solving?

Understanding how students' past experiences in mathematics influence their problem-solving approaches provides valuable context for interpreting their strategies and attitudes. Whether those experiences were positive, marked by confidence and success, or negative, characterized by frustration or struggle, they play a crucial role in shaping how students tackle challenging problems today. The following focus group responses offer insights into the ways students' prior experiences have informed their approaches, revealing patterns of resilience, hesitation, or innovative thinking in mathematical problem-solving.

> "*My past experiences in mathematics have taught me to be patient. I used to struggle a lot with algebra, and failing some tests made me frustrated. But over time, I learned to break problems into smaller steps and check my work carefully. Now, when I face difficult problems, I try to remain calm and focus on solving them step by step instead of panicking.*" (Student 7)

> "*I think my positive experiences have given me confidence. In junior high, I had a teacher who explained concepts clearly and encouraged us to ask questions. Because of that, I learned to approach hard problems with curiosity*

rather than fear. I try different methods if the first one doesn't work and remind myself that mistakes are part of learning." (Student 3)

"*Honestly, some negative experiences made me more cautious. I remember failing a geometry test even though I studied hard. It taught me to double-check formulas and understand why a method works, not just memorize it. So now, when I encounter challenging problems, I take time to think about the logic before jumping to answers.*" (Student 4)

"*My past successes in mathematics motivate me to keep trying when problems seem difficult. For example, solving a tricky probability question last year boosted my confidence. It made me realize that if I put in effort and don't give up immediately, I can figure out solutions. I approach new problems with persistence and try to recall similar problems I've solved before.*" (Student 8)

"*Both good and bad experiences shaped me. When I get a problem I can't solve immediately, I remember the times I struggled and eventually succeeded after working hard. It reminds me that giving up won't help. I try to stay patient, analyze the problem carefully, and sometimes ask for hints or discuss with friends to understand better before attempting the solution.*" (Student 10)

Findings from this theme reveal that students' confidence in solving mathematical problems is closely tied to how well they remember and apply knowledge from earlier topics. Students frequently reported that confidence increased when they could connect new problems to familiar ideas, such as using algebraic factoring when solving quadratic equations or applying Pythagoras' theorem when studying trigonometric identities. Conversely, gaps in prior knowledge led to hesitation, anxiety, and avoidance, suggesting that mathematical confidence is built not merely on successful experiences, but on perceived continuity of understanding across topics.

Moreover, participants noted that both positive and negative learning experiences shaped their current problem-solving behavior. Students who had supportive teachers or previous successes displayed resilience and curiosity, while those who experienced repeated difficulties adopted cautious or self-doubting attitudes. This illustrates how cognitive and affective factors interact in mathematics learning, where knowledge continuity fosters confidence and self-efficacy (Bandura et al., 1996; Pajares & Miller, 1994).

These insights echo earlier studies emphasizing that mathematical confidence grows when learners perceive a coherent connection between past and present knowledge (Keeffe et al., 2019; Lange et al., 2022; Marcelo & Yot-Domínguez, 2019). The data extend this understanding to a Ghanaian context, showing that students' prior success in foundational concepts directly supports confidence in tackling complex tasks. This supports Bandura's (2006) self-efficacy theory, which posits that mastery experiences are the most powerful source of confidence. Consequently, teachers should design instruction that continually reinforces these mastery links, for example, by revisiting prerequisite skills before introducing advanced topics. Strengthening such continuity could not only improve academic performance but also foster more positive mathematical identities among students.

4. DISCUSSION

The findings of this study reaffirm the important role of students' prior mathematical knowledge in shaping their conceptual understanding and confidence in solving mathematical problems. Consistent with the views of Bransford et al. (2007) and Martín and Bybee (2022), the findings show that mathematics learning is cumulative, meaning that students understand new concepts more effectively when they can build on what they have already learned. Participants explained that recalling earlier topics such as fractions, algebraic manipulation, and geometric reasoning helped them to understand more advanced concepts, including trigonometric identities, quadratic equations, and calculus. These findings also support Kalyuga et al. (2010), who argued that well-developed prior knowledge enables learners to solve problems more flexibly and transfer their understanding to new mathematical situations. While these findings are consistent with previous studies, they also provide insight into why prior knowledge plays such a significant role in the Ghanaian context. In many Ghanaian classrooms, mathematics is taught in a highly sequential manner, where teachers are expected to complete a prescribed syllabus within a limited time. This often leaves little opportunity to revisit concepts that students may not have fully understood in earlier grades. Consequently, students who have strong foundational knowledge are better able to follow classroom instruction and

connect new ideas with existing knowledge, whereas those with weak foundations tend to struggle as mathematical concepts become increasingly abstract. This suggests that the influence of prior knowledge is shaped not only by students' cognitive abilities but also by the way mathematics is taught and organized within the Ghanaian education system. The study therefore extends existing knowledge by showing that the effectiveness of prior knowledge depends on the interaction between students' learning experiences and the instructional context in Ghana. It highlights the need for teachers to regularly assess students' prerequisite knowledge before introducing new topics and to provide timely support for learners with conceptual gaps. Strengthening these foundational concepts is likely to enhance students' conceptual understanding, confidence, and overall achievement in mathematics, particularly in Ghanaian senior high schools.

The results further align with the study by Boaler et al. (2018), which emphasized that mathematics is a connected and meaningful discipline rather than a collection of isolated procedures. Students who successfully related new mathematical ideas to prior knowledge expressed greater persistence, curiosity, and self-confidence, indicating that conceptual connectivity not only supports understanding but also nurtures a positive disposition toward mathematics. Conversely, students who reported gaps in foundational concepts often experienced confusion, hesitation, and lower confidence when tackling complex problems, a pattern also observed by Türkmenoğlu & Yurtal (2019) and Caviola et al. (2022) in their studies on mathematics anxiety and self-efficacy. These findings reinforce the idea that affective factors such as confidence and anxiety are intertwined with cognitive preparedness, and both dimensions must be addressed in effective mathematics instruction.

The Ghanaian context provides valuable insight into how these global trends manifest in local educational systems. Students in this study often traced their learning challenges to fragmented instruction or rapid curricular progression that did not adequately consolidate earlier topics. This suggests that while Ghanaian students' experiences align with global evidence, contextual factors such as curriculum pacing, teacher workload, and resource limitations may amplify the consequences of weak prior knowledge. Similar to observations by Ameyaw et al. (2025) on teacher-centered instruction in Ghanaian classrooms, many students reported limited opportunities to engage in reflective or exploratory learning that could strengthen conceptual linkages between topics. Thus, the current study extends existing research by highlighting how systemic and instructional conditions in Ghana can shape the extent to which students benefit from their prior mathematical experiences.

The implications for curriculum design and instruction are substantial. First, mathematics curricula should be deliberately sequenced to promote vertical alignment and cumulative understanding. Before teaching new topics, teachers should make sure students have mastered the necessary foundational concepts by using quick checks or diagnostic assessments to uncover and fix gaps in understanding. Second, effective teacher scaffolding is essential; educators should model how old and new concepts interrelate through analogies, visual representations, and problem-based discussions. This approach helps learners reconstruct coherent mental models rather than memorizing isolated procedures. Third, there is a need for targeted remediation strategies, including bridging lessons, peer tutoring, and AI-assisted adaptive tools, which can provide personalized support for students with weak foundational skills. These interventions can reduce cognitive load, strengthen self-efficacy, and promote equity in mathematics learning outcomes. Unlike prior studies, this study reveals that curriculum pacing in Ghana intensifies the negative effects of weak prior knowledge in mathematics.

4.1. Practical Implications

The findings of this study have practical implications for researchers, curriculum developers, educational policymakers, and assessment designers. For researchers, the study provides a basis for further examining how students' prior mathematical knowledge influences their understanding, confidence, and problem-solving in different educational contexts. Curriculum developers should ensure that new mathematical concepts are clearly connected to previously learned knowledge and provide opportunities for students to revisit and strengthen important foundational skills. Educational policymakers can support this by encouraging diagnostic and remedial programmes that help schools identify and address students' learning gaps before these gaps affect their progress in more advanced mathematics. Assessment designers should also consider including tasks that assess students' understanding of prerequisite concepts and their

ability to connect previous knowledge with new mathematical problems, rather than focusing mainly on procedural answers. Such approaches can help students develop stronger conceptual understanding, greater confidence, and a more positive approach to mathematical problem-solving.

5. CONCLUSION

The findings of this study show that students' prior math knowledge influences how well they understand new concepts and how confident they feel when solving problems. Students who had a strong foundation were able to grasp new ideas more easily, persist through difficult problems, and feel less anxious. On the other hand, those with gaps in earlier learning often struggled to make connections, which led to confusion and lower confidence. This highlights the importance of teachers deliberately connecting new lessons to what students have already learned. In practice, schools could support this by using strategies like reviewing key concepts, spiraling topics over time, or providing structured scaffolding to help students build and strengthen their foundations. By doing so, students not only understand math better but also feel more capable and confident when facing challenging problems. Strengthening students' prior mathematical knowledge should be considered a foundational instructional priority for improving conceptual understanding, mathematical confidence, and long-term achievement.

5.1. Limitations of the Study

This study has some limitations that should be considered when interpreting the findings. The study was conducted with only 15 students from a single Senior High Technical School in Kumasi using a qualitative research design. Although this allowed for an in-depth exploration of students' experiences, the findings are specific to this context and may not be transferable to other schools or regions with different educational settings. In addition, because qualitative research relies on the researcher's interpretation of participants' responses, there is a possibility of researcher bias during data collection, coding, and analysis, despite efforts to ensure credibility and objectivity throughout the research process. Another limitation is that the findings are based solely on students' self-reported perceptions, which may be influenced by memory lapses, personal opinions, or the desire to provide socially acceptable responses. As a result, the study reflects how students perceived their experiences rather than providing objective evidence of changes in learning outcomes or instructional effectiveness. Future research should involve a larger and more diverse sample from multiple schools and combine students' perspectives with other sources of evidence, such as classroom observations, teacher interviews, and students' academic performance, to enhance the credibility, transferability, and overall strength of the findings.

5.2. Suggestions for Further Studies

Future studies should involve a larger and more diverse group of students from different schools and regions so that the findings can be applied to a wider population. Researchers may also benefit from using a combination of qualitative and quantitative methods, as this would provide a deeper understanding of students' experiences while supporting the results with measurable evidence. In addition, schools and educators could develop teaching strategies that make better use of students' existing mathematical knowledge to improve their understanding of new concepts and strengthen their problem-solving skills. Future research should also explore other factors that may influence learning outcomes, such as teaching methods, the learning environment, and students' motivation. Finally, conducting studies over a longer period would help show how prior mathematical knowledge affects students' learning and problem-solving abilities over time and its overall impact on academic achievement.

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Research Ethics. The authors declare that the study was approved by the Mathematics Education Research Ethics Committee of the University of Skills Training and Entrepreneurial Development (USTED) with reference number USTED/IERC/2026/093. Written informed consent was obtained from students at Kumasi Senior High Technical School.

Data Availability Statement. Corresponding author upon reasonable request. Due to the sensitive nature of the interview responses and to protect participant confidentiality, the full dataset is not publicly available. Access requests will be reviewed and granted in accordance with ethical guidelines and data protection regulations.

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