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Cracking the Math Code: Challenges and Strategies for Success Among Future Math Educators

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Abstract

Aim: This study looked into the obstacles BSED Mathematics majors at the University of Eastern Philippines experience as they prepare to become math teachers and examines the methods they employ to get beyond such obstacles. It also looked at the methods these children use to learn to build a solid foundation in mathematics.

Methodology: The research method used in this study is qualitative. Focus groups and interviews with twenty-four Bachelor of Secondary Education (BSED) Math students - eight from each year level - were conducted as part of a qualitative study . Thematic analysis was used in the data analysis process to find recurring themes in the student replies.

Results: The results showed that the respondents' typical problems were grasping concepts, solving problems, having trouble remembering things, and having a weak foundation in math. However, the study also identified five crucial learning strategies that were useful in helping the respondents get past the challenges they faced when learning mathematics. These strategies include watching video tutorials, practicing consistently, employing multiple learning methods, focusing on understanding, and seeking help from a variety of sources.

Conclusion: This study will equip future math teachers with valuable tools to unlock the secrets of mathematical success in their students. Aspiring educators who engage with this research will be empowered to develop a solid foundation in mathematics themselves. This, in turn, will allow them to confidently mentor their students by emphasizing deep comprehension over rote memory, adopting a variety of learning strategies, requesting assistance frequently, and practicing regularly.

Keywords: Mathematics education, learning challenges, strategies in mathematics, conceptual understanding, Problem-solving in mathematics

INTRODUCTION

Many kids find mathematics to be difficult, which frequently results in frustration and low self-esteem. Many students either love or despise this subject. Because mathematics has inherent beauty, challenge, and practical applications that may make it an engaging and intellectually stimulating subject for many, it is disliked by students who find it boring and cherished by those who love it. The emphasis on rote memory of formulas and procedures during courses causes many children to struggle with mathematics and develop unfavorable attitudes (Hwang et al., 2022, Russo et al., 2021). It is feasible to overcome these obstacles and succeed in mathematics with the appropriate techniques and mindset (Jaffe, 2020). In this study, we examined some of the difficulties students encounter when studying mathematics and offer practical solutions.

Mathematics, a subject brimming with potential for intellectual curiosity and joy, unfortunately, evokes frustration and discouragement in some students. Research suggests an overemphasis on rote memorization is a key culprit (Hwang et al., 2022; Russo et al., 2021). Fortunately, with the right strategies and mindsets, these obstacles can be overcome (Jaffe, 2020), just like other strategies and innovative ideas in education (Abenojar, 2024; Regala, 2024). This study delves into the challenges faced by learners and explores practical solutions to enhance mathematical engagement and achievement. By exploring the challenges faced by future math educators, the research can highlight systemic issues within mathematics education. Understanding these challenges is crucial for developing targeted interventions and support systems, proposing effective strategies, and ultimately enhancing student learning in mathematics education.

This study delves into the challenges faced by aspiring math educators, to illuminate systemic issues within mathematics education. By understanding the obstacles future math teachers encounter in their learning

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journeys, we can identify areas for improvement in the way mathematics is taught. Ultimately, this research sought to propose effective strategies that will not only equip aspiring educators with the knowledge and skills they need to thrive but also enhance student learning in mathematics education.

The investigation focused on two key areas: the challenges faced by learners and the strategies that can foster deeper understanding and engagement. We explored the factors that contribute to student difficulties, such as a lack of conceptual understanding, anxiety, and a perceived lack of relevance. Additionally, we examined effective teaching practices that can cultivate a love of learning and equip students with the tools they need to navigate the complexities of mathematics.

Since mathematics is stressed just like language, many students find it challenging, as evidenced by research from Ramirez et al. (2020). It appears that several factors, including the home and school environment, students' anxiety, the negative perception of mathematics, the state of the economy, physical facilities, and the teaching-learning process, influence this perception. Without making the necessary improvements to the management of the aforementioned components to support students' learning, we are unable to accomplish the intended outcome.

Lack of conceptual understanding, where students struggle to understand the underlying principles and logic behind mathematical concepts (Md-Ali et al., 2021) and instead rely on memorization of formulas and procedures (Mulenga & Marban, 2020), is one of the main obstacles in learning mathematics. The fear of making mistakes is another barrier to learning mathematics. Pupils frequently experience anxiety and a fear of failing in mathematics because they feel under pressure to perform flawlessly (Abadi, 2020). Many students also struggle with problem-solving abilities, which call for critical thinking and the capacity to apply ideas in unfamiliar contexts (Güleç, 2020).

Furthermore, pupils' lack of enthusiasm and interest in mathematics is a major obstacle (Md-Ali et al., 2021). By incorporating interactive activities, real-world applications, and a nurturing classroom environment, teachers can significantly enhance student engagement in mathematics (Chang et al., 2021). It's also critical to promote gender equality and close the gender gap in mathematics. To advance their practices and the whole mathematics education system, educators must engage in ongoing professional development (Bahriadi et al., 2022).

Individuals having to assume accountability for their education presents another learning problem (Charness et al., 2022). Effective learning thrives when students take ownership of their education and discover personal meaning in the learning journey (Yuen et al., 2020). Teachers must comprehend how each student learns on their own. People engage with their surroundings during the learning process, which means they digest knowledge differently and need a different setting to do so. To help people maximize their learning, it is important to address the difficulty of facilitating learning situations (Robert et al., 2024).

Effective teaching aims to cultivate meaningful and lasting learning within students, fostering a transformation that extends beyond acquiring knowledge (Darling-Hammond & Fullan, 2020). To ensure that students meet specified objectives and competencies, educators should implement the most effective instructional methodologies (Pocaan, 2022). Teachers can successfully assist the process of knowledge transfer and bring about the needed fundamental changes in their pupils by implementing appropriate teaching strategies (Rahim, 2020) that are in line with specified learning objectives and competencies (Pocaan, 2022, Rahim, 2020).

To cultivate meaningful change in learners, teachers must be responsive to the diverse needs, backgrounds, and learning styles within their classrooms (Villegas & Irvine, 2020). This makes it possible to differentiate instruction effectively, allowing students to learn at different rates and in diverse ways (KURŞUNCU et al., 2023). Additionally, this comprehension encourages inclusivity and equity (Chen-Worley, 2021). To establish a classroom that respects all learners and guarantees that everyone has an equal chance to succeed, teachers can challenge prejudices and provide tailored support for individual needs (Simón et al., 2021). (Ho, 2020).

This problem with academic accomplishments is especially evident when it comes to arithmetic performance (Okigbo & Onoshakpokaiye, 2023), as demonstrated by the academic record of certain students attending the University of Eastern Philippines Laoang campus. This study looked for solutions to this important issue. The researchers think that by comprehending the impact of teaching methods and learning styles, educators would be able to identify efficient approaches to raise math proficiency. Additionally, an attempt was made to address the study gap on the precise role these important variables have in how well kids succeed in mathematics.

The purpose of this study was to provide aspiring math teachers with the resources they need to enable their pupils to solve the math puzzle. The study pinpointed difficulties that prospective math teachers themselves had, including understanding ideas, resolving issues, getting beyond memory gaps, and strengthening their mathematical background. The study provides them with useful techniques by emphasizing the value of promoting deep comprehension over rote memory. These tactics include making use of a variety of teaching

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techniques, promoting regular practice, offering assistance when required, and making use of video lessons. Future math teachers can develop a nurturing learning environment where pupils are encouraged to think and reason at a high level by putting these strategies into practice.

Research Questions

This study looked into the obstacles BSED Mathematics majors at the University of Eastern Philippines experience as they prepare to become math teachers and examines the methods they employ to get beyond such obstacles. It also looked at the methods these children use to learn to build a solid foundation in mathematics.

The following research questions would be addressed by the researchers:

1. What typical difficulties did the participants have in their math studies?
2. Which methods of learning do the participants apply when they are studying mathematics?

Theoretical framework

This study-inspiring teacher requires more than just content knowledge. Aspiring math educators face a unique challenge: transforming themselves into "math code crackers" who can unlock the subject's magic for their students. This framework equips them to tackle hurdles like math anxiety (a concern highlighted by Xu et al., 2018), knowledge gaps, and the transition from learner to leader. By confronting their anxieties and building a strong foundation in math, future educators can foster a positive learning environment. Furthermore, Cognitive Load Theory (CLT) empowers them to optimize learning. Research by Yuksel et al. (2018) demonstrates that instruction aligned with working memory limitations leads to improved student achievement. CLT equips educators with tools like breaking down complex concepts, utilizing visuals, and promoting deliberate practice – all strategies that align with the "Cracking the Math Code" framework's emphasis on a growth mindset. Ultimately, this framework empowers future educators to become "math code crackers," igniting a lifelong passion for math in their students by fostering a love of learning and problem-solving.

METHODS

Research Design

To delve into the concept of "cracking the math code" for aspiring math teachers, this study adopted interpretive phenomenology, a qualitative research design. This approach is particularly valuable because it excels at uncovering the "how" and "why" behind participants' experiences. The research aimed to shed light on the specific difficulties encountered by Bachelor of Secondary Education (BSED) Mathematics majors at the University of Eastern Philippines. Through in-depth exploration, the study sought to understand the methods these aspiring educators employ to overcome these challenges and ultimately achieve success in mastering mathematics.

Population and Sampling

The study's target population was future math teachers, namely those specializing in mathematics for their Bachelor of Secondary Education (BSED) at the University of Eastern Philippines Laoang Campus in the 2023–2024 school year. Eight participants from each of the three-year levels—first, second, and third—for a total of twenty-four (24) BSED Math students were included in the study to obtain a variety of viewpoints.

Purposive sampling was utilized in this study to learn about the difficulties and coping mechanisms faced by aspiring math educators. This indicates that participants who may offer the most pertinent insights were hand-picked by the researchers. The participants in this instance were mathematics majors pursuing a Bachelor of Secondary Education (BSED). In qualitative research, purposeful sampling is frequently used because it enables researchers to concentrate on a particular group with distinctive experiences—for example, aspiring math educators—and acquire comprehensive data from them (Silvia, 2020).

Instrument

The researchers developed a unique interview guide to collect the necessary data. This guide consisted of a designed list of questions that addressed common issues and strategies used by students to excel in arithmetic rather than merely a series of random questions. With the students, the researchers could engage in in-depth discussions by posing these particular topics. In addition to ensuring that all pertinent questions were answered, the guide allowed students to discuss their personal experiences and the methods that worked best for them when learning math. Thus, a great deal about the needs of pupils was discovered by the researchers. Better teaching strategies can then be developed using this knowledge, enabling all upcoming pupils to lay a solid mathematical foundation.

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Data Collection

This study aimed to help future math teachers understand the challenges their students face and the strategies they use to succeed in math. The researchers called this process "cracking the math code" for future educators. They obtained consent from the students to conduct individual interviews, small-group discussions, and in-depth talks to obtain information. Since the group discussions gave students a chance to share their personal experiences and the methods that worked best for them when learning math, they were especially beneficial. The researchers were able to find recurring patterns regarding the difficulties students encounter and the methods they employ to get over them by listening to these discussions and going over all the data they gathered. Better teaching strategies can be developed using this knowledge, enabling all upcoming students to lay a solid mathematical foundation.

Data Analysis

Following in-depth interviews and focus groups with aspiring math teachers, the researchers began a procedure known as "Thematic Analysis" (Maguire & Delahunt, 2017) to decipher the secret to math student success. This approach entailed going through the gathered data and looking for recurrent themes or patterns. The researchers used thematic analysis to find the most prevalent and perceptive themes in the students' comments, much like they would sift through a pile of seashells. These themes provided a better insight into the difficulties students had and the methods they used to succeed in arithmetic, rather than just being recaps of what they said. The researchers were able to gain a better understanding of the nature and significance of students' challenges and achievements in learning mathematics by examining these themes. This material gives aspiring math teachers the tools they need to develop engaging lesson plans that enable every student to have a solid foundation in math.

Ethical Consideration

Fairness was highly valued throughout the research procedure in this study. The investigator adhered to certain protocols to ensure that the data gathered was reliable and correct. First, they obtained approval from key figures such as the dean of the BSED program, research-engaged professors, and the thesis advisor. Most significantly, the students who took part in the study gave their consent. The researchers set up group talks and one-on-one interviews with the pupils after everyone gave their approval. To ensure that the interviews were performed uniformly and with respect, the investigator personally conducted each one. They re-asked the students for permission and emphasized how their privacy would be maintained before filming each interview. This is significant since the information shared by the students in the interviews should remain confidential. Lastly, the data was safely erased following its usage in the study.

RESULTS AND DISCUSSION

This section delves into the details that students provide regarding the challenges they encounter and the strategies they employ when studying mathematics. After identifying trends in the students' comments, the researchers organized these patterns into major themes. These themes draw attention to the most typical difficulties faced by pupils as well as the useful techniques they employ. Teachers can improve their teaching approaches by gaining useful insights from knowing these issues.

Common challenges

Themes

Understanding concepts
Problem-solving
Memory Limitation
Weak Foundation

Based on the data, learners identified several common challenges they encountered while studying mathematics and were categorized into four themes namely: understanding concepts, problem-solving, memory, and foundation.

Understanding Concepts

The majority of participants' responses categorized the Understanding Concept as the foremost common challenge that the respondents encountered while studying Mathematics. The following are the samples of the transcription showing the challenges of understanding concepts:

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Respondent 1: I face many challenges while studying math, such as solving problems, memorizing formulas, and understanding complex equations, especially when they're more difficult than the initial examples provided.
Respondent 3: Sometimes, I encounter topics or problems that are difficult for me to understand, even after putting in a lot of effort
Respondent 16: Confusion regarding signs (+, -), doubting my answers/solutions, and encountering numerous word problems are some of the challenges I face.
Respondent 15: Solving word problems, particularly complex ones, and a lack of learning materials to support my studies are some of the challenges I encounter.
Respondent 18: Analyzing word problems, identifying the appropriate formulas to use, determining the relevant concepts to apply for a specific problem, and understanding how to begin solving the problem are all challenges I face.
Respondent 3: I struggle to remember different formulas, and my overall math skills are not strong.
Respondent 10: I find it difficult to grasp the more intricate parts, hindering my overall learning effectiveness.
Respondent 11: I have difficulty visualizing and understanding mathematical ideas.
Respondent 3: Sometimes there's a topic or problem that is difficult for me to understand and even if I tried harder I was not able to come up with a correct solution or answer.
Respondent 10: Since I have a weak foundation in the said subject. I find it hard to learn the complex part.
Respondents 11 & 22: My foundational concepts are crucial for understanding new topics discussed.
Respondent 21: I have a lack of knowledge in some fundamental concepts that hinder our ability to understand topics discussed by the professor.
Respondent 22: The process of solving a problem itself is challenging.

Educators like Boaler (2016) acknowledge the inherent difficulty students face in grasping mathematical concepts. Mastering core skills presents a significant challenge. Similar to how a weak vocabulary hinders science comprehension, a shaky foundation in arithmetic creates gaps that impede learning (Andriyani, 2015). Math, with its unique symbolic language, can become a barrier if equations, functions, or geometric shapes lack clear meaning (Andriyani, 2015). This parallels students' struggles with applying newly learned scientific terms in diverse contexts. These points highlight the importance of clear explanations, a solid foundation in mathematical principles, and consistent practice applying those principles across various scenarios.

Problem-solving

Another relevant challenge that emerged in the response of the respondents in the interview is Problem-solving as one of the common challenges that the respondents encountered while studying Mathematics. The following are the samples of transcription:

Respondent 1: I face many challenges while studying math, such as solving problems, memorizing formulas, and understanding complex equations, especially when they're more difficult than the initial examples provided.
Respondent 3: Sometimes, I encounter topics or problems that are difficult for me to understand, even after putting in a lot of effort
Respondent 16: Confusion regarding signs (+, -), doubting my answers/solutions, and encountering numerous word problems are some of the challenges I face.
Respondent 15: Solving word problems, particularly complex ones, and a lack of learning materials to support my studies are some of the challenges I encounter.
Respondent 18: Analyzing word problems, identifying the appropriate formulas to use, determining the relevant concepts to apply for a specific problem, and understanding how to begin solving the problem are all challenges I face.

While rote memorization of formulas holds a place in math education, true comprehension hinges on applying that knowledge to solve novel problems. This transition can be a significant hurdle for students, much like learning a new language requires more than just memorizing vocabulary terms (Jackson et al., 2020; Andriyani, 2015). Similarly, students may struggle to translate their theoretical understanding of math into real-world problem-solving. Just as a strong vocabulary is crucial for fluency in a new language, a solid foundation in arithmetic is essential in math (Andriyani, 2015). Without this foundation, students encountering unfamiliar problems may feel lost.

Memory Limitation

One challenge that highlights the common challenges that the respondents encountered while studying Mathematics is memory limitation. Below are some data from the investigation:

Respondent 3: I struggle to remember different formulas, and my overall math skills are not strong.

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Respondent 10: I find it difficult to grasp the more intricate parts, hindering my overall learning effectiveness.
Respondent 11: I have difficulty visualizing and understanding mathematical ideas.
Respondent 21: I have a lack of knowledge in some fundamental concepts that hinder our ability to understand topics discussed by the professor.
Respondent 22: The process of solving a problem itself is challenging.

While memory plays a vital role in arithmetic success, it can also be a double-edged sword. Complex problems can overload short-term memory, making it difficult to remember formulas or track multiple steps (Xu et al., 2018). This is why simply memorizing formulas without understanding the principles behind them leads to "formula amnesia" and hinders their application in new situations (Sweller et al., 2018). Students struggle to retrieve memorized formulas during tests or when solving problems, highlighting the drawbacks of rote memorization without comprehension (Sweller et al., 2018; McCrory et al., 2023).

Weak Foundation

Another crucial challenge encountered by respondents in learning mathematics is a weak foundation. Here are the experiences of the students:

Respondent 3: Sometimes there's a topic or problem that is difficult for me to understand and even if I tried harder I was not able to come up with a correct solution or answer.
Respondent 10: Since I have a weak foundation in the said subject. I find it hard to learn the complex part.
Respondents 11 & 22: My foundational concepts are crucial for understanding new topics discussed.
Respondent 21: My foundation in mathematics is very poor

Building a solid foundation in math can be a significant challenge for students. Wu (2018) argues that these early learning deficits can snowball over time, creating underlying weaknesses like hidden cracks. Just like a facade built without a strong foundation collapses eventually, focusing solely on memorizing procedures without understanding the underlying principles leads to similar instability (Boaler, 2016; Adoro et al 2024: Hwang et al., 2022).

To address this, prioritizing a strong foundation should be a top priority for teachers. This can be achieved through various methods, such as emphasizing conceptual understanding over rote memorization (Boaler, 2016). Further emphasizing the importance of a solid foundation, a recent study by Han et al. (2020) highlights the positive impact of early arithmetic interventions on later academic achievement.

Learning Strategies

Five themes emerged when the participants were asked about the learning strategies used by respondents to learn mathematics. The following themes are focused on understanding, multiple learning methods, practice and perseverance, seeking help, and watching video tutorials.

Themes

Watch video tutorial
Focus on understanding
Seeking help
Multiple learning methods
Practice and perseverance

Watch video tutorials

Watching video tutorials is one of the themes revealed by the participants during the investigation. The following are samples of the transcription:

Respondent 20: Eventually the strategy that I have used in solving mathematics or to learn mathematics. I watched on YouTube some tutorials in solving mathematics which will be my solution to solve my problems.
Respondent 17: I watch tutorials and I scan my notes so as I'll be able to recall our previous discussion I ask some of my seniors to have classification if I'm confused on the topic and I make a try and error to measure my learning.
Respondent 16: Mostly, searched and watched videos on YouTube to understand each problem and formula that was being tackled.
Respondent 14: Watching some tutorial videos on YouTube so that I can better understand the topic that we've been tackling.
Respondent 15: Watch a video tutorial on YouTube about that specific topic.

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Respondent 7: I watch videos to learn the lesson that I don't understand.
Respondent 8: Watching online video tutorials after class or in my free time.
Respondent 9: Study and master the lesson. Take notes and watch video tutorials on YouTube.
Respondent 10: Watching lessons on YouTube that my help for the problems I encountered in math. I begin with the single solution which understanding the concept of math.
Respondent 4: I watched video tutorials and discussions on how to solve word problems in different areas of mathematics.
Respondent 2: To be honest, the learning strategies that I used when learning math lessons are being at least all the time and being a good listener and a good reader. And watching videos online or on YouTube.
Respondent 5: Video tutorial, scanning my notes, peer collaboration, using all the strategies we learned from our teachers, and understanding the basic concepts first.

Study participants highlighted the advantages of video tutorials for math learning, particularly the flexibility of self-paced instruction (Means et al., 2019). However, the study emphasized that optimal results come from combining video lessons with other strategies. This includes seeking help from teachers or peers, engaging in practice exercises, and actively participating in classroom instruction (Means et al., 2019). While acknowledging potential drawbacks like overreliance or distractions (Nobis, 2021), participants generally agreed that video tutorials can be valuable tools for learning arithmetic when used effectively. Cabugwason et al (2024) advised to strategically integrate math applications while taking into account varied learning styles.

Focus on understanding

Focus on understanding is one of the themes revealed by the participants during the investigation. The following are samples of the transcription:

Respondent 1: Build a strong foundation in number sense and basic skills.
Respondent 2: To be honest, the learning strategies that I used when learning math lessons are being at least all the time and being a good listener and a good reader. And watching videos online or on YouTube.
Respondent 3: Well to cope with the struggles I have encountered in learning mathematics. I put myself studying on my own during my free time. Although there are instances that I cannot understand on my own but doesn't matter because I believe that hard work will somehow pay off.
Respondent 4: I watched video tutorials and discussions on how to solve word problems in different areas of mathematics.
Respondent 6: Practice regularly regarding solving math problems to reinforce understanding and improve problem skills. Seek help from teachers, classmates, and online resources when I encounter difficulties.
Respondent 9: Study and master the lesson. Take notes and watch video tutorials on YouTube.
Respondent 11: The strategy that I used is after the discussion if it
s not enough for me to learn the teacher's discussion go to YouTube and watch the lesson, for short using an online video about trials on how to easily learn to solve problems.
Respondent 18: Don't think negatively keep trying and don't give up easily. If I found that it was difficult I studied hard to master the lesson or topic. I watch on YouTube and any website for me the easily understand mathematics. I work hard to improve my capabilities in answering solutions in mathematics.
Respondent 19: The strategies I typically do to learn mathematics lessons is that every time my class in major and our professor discuss the lesson I finish my profession and when the class ends and go home, every night I recall the lesson that my professor has discussed and do any math problem that is related to the lesson and solve it so that I make familiar with the topic.
Respondent 21: Prepare to have group collaboration or to do it with my classmates so that I can ask them whatever I am not able to understand also self-study or watching educational videos about mathematics lessons could help me improve and learn about mathematics lessons.
Respondent 23: The strategies I typically use in learning and putting those learning into practice to first what concept I learned and how far I've gone in practicing what I learned. Take notes and video tutorials.

This study aimed to equip aspiring math teachers with the tools to foster a deeper understanding of math in their students, moving beyond rote memorization. Students themselves emphasized the effectiveness of various learning tactics, including visual aids and methodical techniques, aligning with Schuklenk's (2024) research on catering to individual student needs. Additionally, Slavin's (2023) findings on the benefits of cooperative learning in mathematics supported the notion that collaboration and communication are valuable strategies. Ultimately, students advocated for a comprehensive approach that fosters a lifelong love of learning alongside a solid foundation in mathematical knowledge.

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Seeking help

One of the helpful strategies encountered by respondents in learning mathematics is seeking help. Here are the experiences of the students:

> ***Respondent 6: Practice regularly regarding solving math problems to reinforce understanding and improve problem skills. Seek help from teachers, classmates, and online resources when I encounter difficulties.***
> ***Respondent 21: Prepare to have group collaboration or to do it with my classmates so that I can ask them whatever I am not able to understand also self-study or watching educational videos about mathematics lessons could help me improve and learn about mathematics lessons.***
> ***Respondent 18: Don't think negatively keep trying and don't give up easily. If I found that it was difficult I studied hard to master the lesson or topic. I watch on YouTube and any website for me the easily understand mathematics. I work hard to improve my capabilities in answering solutions in mathematics.***
> ***Respondent 25: I typically use strategies such as practice, repetition, and seeking help when needed. Watching some video tutorials on YouTube and other sites to practice my problem-solving skills.***
> ***Respondent 13: Collaboration with my peers is also helpful to me especially if they know the topic and process of how to solve that particular problem.***

Students also recognized seeking help as a critical strategy for success in math. Knowing when to ask for assistance is crucial, whether they're struggling with a concept, feeling lost in class, or needing further explanation (Siegle & Banihashemi, 2023). They identified various resources, including forming study groups and teaching peers (CARVALHO & SANTOS, 2022), utilizing online resources for practice problems and explanations (Erdener, 2021), and seeking one-on-one tutoring (Pascarella & Terenzini, 2019). Caparroso and Nobis indicate that targeted parental involvement strategies can significantly enhance completion rates, with effective methods including accessible support, designated study spaces, breaking down assignments, fostering student autonomy, and leveraging technology (2024).

Multiple learning methods

One of the identified strategies in learning mathematics is multiple learning methods. Sample transcription is as follows:

> ***Respondent 13: Collaboration with my peers is also helpful to me especially if they know the topic and process of how to solve that particular problem.***
> ***Respondent 17: I watch tutorials and I scan my notes so as I'll be able to recall our previous discussion I ask some of my seniors to have classification if I'm confused on the topic and I make a try and error to measure my learning.***
> ***Respondent 5: Video tutorial, scanning my notes, peer collaboration, using all the strategies we learned from our teachers, and understanding the basic concepts first.***

This study identified a variety of teaching strategies future math educators can utilize to cater to diverse learning styles and enhance student achievement. Participants highlighted the effectiveness of visual aids, manipulatives, and class discussions, emphasizing the importance of tailoring instruction to individual needs (Schuklenk, 2022). Developing metacognition, or "thinking about thinking," was identified as crucial for students to effectively adjust their learning strategies (OECD, 2023). Further supporting the value of collaboration and communication, Slavin's research (2023) demonstrated the benefits of cooperative learning in mathematics. While acknowledging the potential for technology to be an engaging learning tool, some participants cautioned against overreliance and advocated for a balanced approach.

Practice and Perseverance

Another relevant strategy that emerged in the response of the respondents in the interview is practice and perseverance as one of the learning strategies that the respondents encountered while studying Mathematics. The following are the samples of transcription:

> ***Respondent 3: Well to cope with the struggles I have encountered in learning mathematics. I put myself studying on my own during my free time. Although there are instances that I cannot understand on my own but doesn't matter because I believe that hard work will somehow pay off.***
> ***Respondent 18: Don't think negatively keep trying and don't give up easily. If I found that it was difficult I studied hard to master the lesson or topic. I watch on YouTube and any website for me the easily understand mathematics. I work hard to improve my capabilities in answering solutions in mathematics.***

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Respondent 25: I typically use strategies such as practice, repetition, and seeking help when needed. Watching some video tutorials on YouTube and other sites to practice my problem-solving skills.

This study identified practice and perseverance as the two key ingredients for mastering math concepts. While regular, focused practice is essential for solidifying understanding (Boaler, 2019; Hwang et al., 2022), participants emphasized the importance of "grit" (Duckworth, 2016) – persisting through challenges – given the inherent difficulty of math. To enhance the effectiveness of practice sessions, students suggested strategies like focusing on comprehension (National Council of Teachers of Mathematics, 2020), employing diverse approaches (Siegle & Banihashemi, 2023), seeking help when needed (Pascarella & Terenzini, 2019), and celebrating achievements (Black & Wiliam, 2019). These techniques foster a growth mindset (Dweck, 2006), where students believe their abilities can develop with effort.

Conclusion

This study explored the challenges students face in mastering mathematics. A key obstacle identified was rote memorization, which hinders understanding and application of concepts. Students struggle to convert word problems into equations and retain formulas without truly grasping the underlying principles. This highlights the importance of a strong foundation built on deep conceptual understanding.

The study offers promising solutions. Students themselves emphasize the need for diverse teaching methods to cater to individual learning styles. The research supports this, highlighting the effectiveness of varied approaches in fostering comprehension. Furthermore, overcoming difficulties requires fostering perseverance and a growth mindset. Developing "grit" and the belief that abilities improve with effort are crucial for navigating challenges in math.

Seeking help is another key takeaway. The study encourages a collaborative learning environment, with support available from peers, online resources, and tutors. Instructional videos can be a valuable supplement, but focused practice prioritizing comprehension remains essential.

Overall, by understanding these challenges and implementing the recommended strategies building deep understanding, utilizing diverse teaching methods, fostering perseverance, seeking help, and employing technology strategically we can empower students to conquer the complexities of mathematics.

Recommendations

To address the challenge of rote memorization hindering understanding, the study suggests a shift towards building deep conceptual comprehension. Students themselves emphasized this, along with the importance of diverse teaching approaches. The research highlights that catering to individual needs through varied methods can enhance learning. Furthermore, overcoming difficulties requires fostering perseverance and a growth mindset. The study emphasizes the importance of "grit" and the belief that abilities can improve with effort.

Seeking help is another key takeaway. The study recommends utilizing collaborative learning with peers, along with strategic use of online resources and tutors. This highlights the value of a supportive learning environment and diverse learning tools.

Overall, the study suggests instructional videos as a supplement but emphasizes the importance of focused, regular practice that prioritizes comprehension over memorization.

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