




Multifaceted Structures of Mathematics Education in the Philippines: A Case Analysis

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ABSTRACT

Mathematics education, as a cornerstone of academic curricula globally, varies widely across regions due to diverse cultural, economic, and educational influences. This study considered the Philippines' unique socio-cultural and economic landscape and its localized multifaceted educational structures. This research employed a qualitative case study method in exploring the lived experiences of mathematics educators in the Philippines on the multifaceted structures of mathematics education that influence and shape their professional practices. Findings reported eight (8) emerging themes on the multifaceted structures of mathematics education in the Philippines, namely: (1) Professional Development and Training Needs; (2) Curriculum and Instructional Challenges; (3) Resource Constraints; (4) Support and Collaboration among Educators; (5) Assessment and Evaluation Practices; (6) Student Engagement and Motivation; (7) Influence of Socioeconomic Factors; and (8) Educational Policies and Systemic Issues. Addressing the multifaceted challenges in the Philippines' mathematics education system requires a holistic approach that empowers teachers, enhances instructional quality, and improves educational outcomes through robust training, relevant curricula, equitable resources, collaborative environments, and inclusive policy-making to support and benefit both teachers and students.

RESUMO

A educação matemática, enquanto pedra angular dos currículos acadêmicos a nível mundial, varia muito entre regiões devido a diversas influências culturais, econômicas e educativas. Este estudo teve em conta a paisagem sociocultural e econômica única das Filipinas e as suas estruturas educativas multifacetadas localizadas. Esta investigação utilizou um método de estudo de caso qualitativo para explorar as experiências vividas pelos professores de matemática nas Filipinas sobre as estruturas multifacetadas do ensino da matemática que influenciam e moldam as suas práticas profissionais. Os resultados indicaram oito (8) temas emergentes sobre as estruturas multifacetadas do ensino da matemática nas Filipinas, a saber: (1) Necessidades de desenvolvimento profissional e de formação; (2) Desafios curriculares e pedagógicos; (3) Restrições de recursos; (4) Apoio e colaboração entre educadores; (5) Práticas de avaliação; (6) Envolvimento e motivação dos alunos; (7) Influência dos factores socioeconómicos; e (8) Políticas educativas e questões sistémicas. Para enfrentar os desafios multifacetados do sistema de ensino da matemática nas Filipinas, é necessária uma abordagem holística que capacite os professores, melhore a qualidade do ensino e melhore os resultados educativos através de uma formação sólida, de currículos relevantes, de recursos equitativos, de ambientes de colaboração e da elaboração de políticas inclusivas que apoiem e beneficiem tanto os professores como os alunos.

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Introduction

Mathematics education, as a critical component of academic curricula worldwide, varies significantly across different regions, influenced by diverse cultural, economic, and educational factors (Vasileva, 2019). In the global context, numerous studies have examined the effectiveness of mathematics education systems, highlighting best practices and common challenges. However, despite this extensive body of work, there remains a paucity of research focused on localized educational structures, particularly in developing countries. The Philippines, with its unique socio-cultural and economic landscape, offers a compelling case for exploring the intricacies of mathematics education within a specific national context.

The system of mathematics education in the Philippines is a complex and multifaceted issue that significantly impacts the quality of education and student performance in the country (Bernardo et al., 2022). As the backbone of the educational system, mathematics educators face numerous challenges that stem from both systemic issues and day-to-day classroom realities. These challenges include the need for continuous professional development, effective curriculum implementation, adequate resource availability, and supportive educational policies (Ling & Mahmud, 2023). Understanding and addressing these challenges are crucial for enhancing the teaching and learning of mathematics, a subject that is foundational for many fields and essential for national development.

Mathematics education is recognized for its role in fostering critical thinking and problem-solving skills essential for personal and professional development (Szabo et al., 2020). International assessments such as PISA and TIMSS provide valuable data on student performance and educational quality across countries. These assessments have spurred numerous reforms aimed at improving mathematics education, particularly in developed nations (Nortvedt, 2018). Yet, the transferability of such reforms to the Philippines is uncertain due to contextual differences. This study aims to bridge this gap by contextualizing global best practices within the Philippine education system, examining how global trends in mathematics education are adapted locally.

Mathematics education in the Philippines is currently undergoing significant reforms, particularly with the implementation of the K-12 curriculum and characterized by its multifaceted structure, influenced by historical, cultural, and policy-related factors. This shift aims to align the country's educational standards with global benchmarks, but it has also introduced new challenges for teachers who will adapt to revised content and teaching methods (Barrot, 2021). The preparedness of mathematics educators to navigate these changes is critical for the success of the curriculum. However, there are concerns about whether the existing management systems adequately support teachers in this transition.

Moreover, the effectiveness of mathematics education is heavily influenced by the resources and support available to educators. In many schools, especially those in rural and under-resourced areas, teachers lack basic teaching materials and technological tools (Adam,

Kiazai, & Adam, 2021). These constraints limit their ability to deliver engaging and comprehensive lessons, thereby affecting student outcomes. Additionally, the socio-economic context of students plays a significant role in their academic performance, necessitating a management system that is responsive to diverse student needs and equitable in resource distribution (Rodríguez-Hernández, Cascallar, & Kyndt, 2020).

Another critical aspect of the multifaceted structure is the support and collaboration among educators. Professional development opportunities, administrative support, and peer collaboration are vital components that contribute to the professional growth and effectiveness of teachers. Yet, many educators report insufficient opportunities for professional development and a lack of collaborative platforms to share best practices (Flores, 2019). Addressing these gaps is essential for fostering a supportive teaching environment encouraging innovation and continuous improvement in mathematics education.

This study explored the lived experiences of mathematics educators in the Philippines on the multifaceted structures of mathematics education that influence and shape their professional practices. This research also uncovered the challenges and needs of mathematics teachers that provide insights into crafting policy to develop an effective and supportive structure of mathematics education in the Philippines.

Methods

Research Design

This study employed a qualitative case study method in exploring the lived experiences of mathematics educators in the Philippines on the multifaceted structures of mathematics education that influence and shape their professional practices. A case study is a research method that examines a particular case—be it an individual, situation, organization, or phenomenon—to gain insights applicable to a broader context (Creswell, 2003). Typically, qualitative case studies analyze one to twelve instances to leverage a unique context for informing wider inquiry (Gerring, 2006).

Research Participants

The participants of this study were five (5) mathematics educators with experience in both basic and higher education. The researcher selected these individuals because they have reached the pinnacle of their professional careers in mathematics, ensuring that their experiences would provide rich, meaningful insights. A purposive-expert sampling technique was used to gather knowledge from individuals with specific expertise (Etikan, Musa, & Alkassim, 2016). Participation was voluntary, and informed consent was obtained from each participant as evidence of their willingness to be involved in the study.

Table 1.
Demographic Profile of the Participants

Participants	Academic Ranks	Academic Degrees	Length of Service
P1	University Professor (<i>Emeritus</i>)	PhD in Science Education <i>major</i> in Mathematics Education	59
P2	University Professor	PhD in Mathematical Sciences <i>major</i> in Applied Mathematics	27
P3	University Professor	PhD in Research and Evaluation	41
P4	Professor VI	PhD in Mathematics Education	40
P5	Professor VI	PhD in Mathematics Education	41

Data Collection and Analysis

In this study, the researchers served as the primary research instrument. The study utilized the data source triangulation method in collecting data based on the interview and document analysis. The researcher developed an Interview Guide and used it in conducting a face-to-face and virtual interview.

The gathered data were examined and categorized to find patterns and meanings embedded in the case study. The thematic analysis guided the analysis of participants' accounts, formulation of structural descriptions, and construction of model. This study utilized five stages of data analysis of (Ajjawi & Higgs, 2007) such as: (1) *Immersion tasks* include organizing the data set into texts, iterative reading of texts, and preliminary interpretation of texts to facilitate coding; (2) *Understanding tasks* comprise identifying first-order constructs and coding of data; (3) *Abstraction* emphasizes identifying second-order constructs and grouping second-order constructs into sub-themes; (4) *Synthesis and Theme Development* accentuate cluster of subthemes into themes and further elaboration of ideas; and (5) *Illumination and Illustration of Phenomena* include linking the literature to the items identified, synthesizing the phenomenon, and developing the model.

Delimitations of the Study

This study focused specifically on the mathematics education structures at the tertiary level in the Philippines, excluding primary and secondary education institutions. This considered public HEIs within Region X (Northern Mindanao) to maintain a consistent context for analysis. This study examined curricular frameworks, teaching methodologies, and student performance, including administrative and policy-making perspectives, excluding alternative education systems and international schools.

Results and Discussion

The case analysis of the multifaceted structures of mathematics education in the Philippines explored the given themes.

Table 2.
Summary of Themes Analyzed from Significant Statements

Significant Statements	Themes
<p>"We need more opportunities for continuous training to keep up with new teaching methods and technologies." [P1, P4, P5]</p> <p>"Many of us feel underprepared for the demands of the new curriculum." [P2, P3]</p>	Theme 1: Professional Development and Training Needs
<p>"The current curriculum is overloaded and difficult to cover within the school year." [P2, P5]</p> <p>"Sometimes the examples in the textbooks do not relate to our students' real-life experiences." [P1, P3, P4]</p>	Theme 2: Curriculum and Instructional Challenges
<p>"We often lack basic teaching materials and resources, which makes it challenging to deliver quality education." [P2, P4, P5]</p> <p>"The availability of technology and educational tools is limited, especially in rural areas." [P1, P3]</p>	Theme 3: Resource Constraints
<p>"Collaboration with fellow teachers helps us share best practices and overcome common challenges." [P1, P2]</p> <p>"Support from the administration is crucial, but sometimes it's lacking." [P3, P4, P5]</p>	Theme 4: Support and Collaboration among Educators
<p>"We need more formative assessments to provide timely feedback to students." [P1, P4, P5]</p> <p>"The current evaluation system focuses too much on standardized tests and not enough on holistic development." [P2, P3]</p>	Theme 5: Assessment and Evaluation Practices
<p>"Engaging students in mathematics is challenging, especially with the widespread math anxiety." [P2, P5]</p> <p>"We need more strategies to motivate students and make math interesting." [P1, P3, P4]</p>	Theme 6: Student Engagement and Motivation
<p>"Students from lower socioeconomic backgrounds often struggle more due to lack of support at home." [P1, P3, P5]</p> <p>"Poverty affects students' attendance and overall performance." [P2, P4]</p>	Theme 7: Influence of Socioeconomic Factors
<p>"Frequent changes in educational policies create uncertainty and hinder long-term planning." [P2, P5]</p> <p>"We need a more stable and supportive educational system that values teachers' input." [P1, P3, P4]</p>	Theme 8: Educational Policies and Systemic Issues

Theme 1: Professional Development and Training Needs

Mathematics educators in the Philippines face significant challenges due to insufficient opportunities for professional development and training. Many teachers express the need for continuous learning to stay updated with the latest teaching methods and technological advancements. The rapid evolution of educational strategies necessitates regular training sessions to ensure that educators can effectively incorporate new techniques into their classrooms. Without such opportunities, teachers may feel underprepared, which can negatively impact their teaching efficacy and student outcomes as mentioned:

"We need more opportunities for continuous training to keep up with new teaching methods and technologies." [P1, P4, P5]

"Many of us feel underprepared for the demands of the new curriculum." [P2, P3]

Existing literature supports the critical role of professional development in enhancing teacher competency. Apriliyanti (2020) argues that ongoing professional development is essential for teachers to adapt to curriculum changes and adopt innovative teaching strategies. Professional development programs that focus on practical, classroom-based strategies are particularly effective in improving teachers' instructional skills (Romijn, Slot, & Leseman, 2021). Additionally, these programs can provide a platform for educators to collaborate, share experiences, and learn from each other, further enriching their professional growth.

Furthermore, tailored professional development programs that address the specific needs of mathematics teachers can bridge the gap between theoretical knowledge and practical application (Jacob, Hill, & Corey, 2017). These programs may be designed considering the unique challenges faced by Filipino educators, such as large class sizes and diverse student backgrounds. By investing in comprehensive professional development, the education system can empower teachers, boost their confidence, and ultimately enhance student learning outcomes in mathematics.

Theme 2: Curriculum and Instructional Challenges

The current mathematics curriculum in the Philippines presents significant instructional challenges for educators. Teachers often struggle with an overloaded curriculum, which can be difficult to cover within the allocated school year. This pressure to complete the curriculum can lead to a superficial understanding of topics rather than a deep, conceptual grasp. Moreover, many educators find that the examples and problems provided in textbooks are not always relevant to their students' real-life experiences, making it harder for students to relate to and understand mathematical concepts as stated:

"The current curriculum is overloaded and difficult to cover within the school year." [P2, P5]

"Sometimes the examples in the textbooks do not relate to our students' real-life experiences." [P1, P3, P4]

Research highlights the importance of contextualizing curriculum content to enhance student engagement and comprehension. Kelly (2022) emphasizes that curriculum materials may be aligned with students' cultural and contextual realities to make learning more meaningful and engaging. When students see the relevance of mathematics in their daily lives, their interest and motivation to learn increase. This alignment can also help teachers connect abstract mathematical ideas to practical applications, facilitating better understanding (Kosiol, Rach, & Ufer, 2018).

Addressing these instructional challenges requires a multi-faceted approach. Curriculum developers may involve teachers in the design process to ensure that the content is realistic and manageable within the given timeframe (Fairman, Smith, Pullen, & Lebel, 2020). Additionally, incorporating local examples and culturally relevant materials can make the curriculum more relatable for students (Shih, 2022). Providing teachers with resources and training on how to adapt the curriculum to their specific classroom contexts can also help mitigate these challenges and improve overall instructional quality (Luzano, 2020).

Theme 3: Resource Constraints

A major concern for mathematics educators in the Philippines is the lack of adequate teaching materials and resources. This scarcity hampers their ability to deliver high-quality education, particularly in remote and under-resourced areas. Teachers often have to work with outdated textbooks, limited technological tools, and insufficient instructional materials, making it challenging to engage students and provide a comprehensive learning experience. This issue is exacerbated by large class sizes, where the need for resources is even more pronounced as expressed:

"We often lack basic teaching materials and resources, which makes it challenging to deliver quality education." [P2, P4, P5]

"The availability of technology and educational tools is limited, especially in rural areas." [P1, P3]

The literature underscores the significant impact of resource availability on educational outcomes. Lavy (2020) highlights that sufficient educational resources are crucial for effective teaching and learning. Resources such as modern textbooks, interactive tools, and access to technology enable teachers to create dynamic and interactive lessons. These tools not only

facilitate better understanding of mathematical concepts but also cater to diverse learning styles, making mathematics more accessible to all students (Radović et al., 2018).

To address these constraints, there may be a concerted effort from both government and private sectors to invest in educational resources. Policies aimed at equitable resource distribution can ensure that even the most disadvantaged schools receive the necessary support (Knight, 2019). Additionally, leveraging technology through digital resources and online platforms can provide cost-effective solutions to resource scarcity. By improving resource availability, educators can deliver more effective and engaging mathematics instruction fitted to the needs of the students.

Theme 4: Support and Collaboration among Educators

Support and collaboration among mathematics educators play a crucial role in overcoming the challenges they face. Teachers often find that sharing best practices and collaborating with colleagues helps them develop more effective teaching strategies. Such collaboration can take many forms, including peer observations, co-teaching, and professional learning communities. These interactions provide teachers with valuable feedback and new ideas, fostering a sense of community and mutual support as explained:

"Collaboration with fellow teachers helps us share best practices and overcome common challenges." [P1, P2]

"Support from the administration is crucial, but sometimes it's lacking." [P3, P4, P5]

The importance of support from school administration is also highlighted in the literature. Aldosiry (2020) argues that administrative support is vital for creating an environment where teachers feel valued and motivated. Effective school leadership can facilitate professional development opportunities, provide necessary resources, and create a culture of continuous improvement (MacLeod, 2020). When teachers receive support from their administrators, they are more likely to implement innovative teaching methods and stay committed to their professional growth (Luzano, 2024).

Creating a supportive and collaborative environment requires intentional efforts at multiple levels of the education system (Luzano, 2023). Schools may encourage regular collaboration among teachers through structured time for joint planning and professional development (Middlewood & Abbott, 2018). Also, establishing mentoring programs where experienced teachers guide new educators can enhance teaching practices and reduce feelings of isolation (Camarero-Figuerola et al., 2022). By fostering a culture of support and collaboration, the education system can empower mathematics educators to deliver high-quality instruction and improve student outcomes.

Theme 5: Assessment and Evaluation Practices

Assessment and evaluation practices in mathematics education are critical for monitoring student progress and guiding instructional decisions. However, many educators in the Philippines express concerns about the current evaluation system, which heavily emphasizes standardized testing. This focus on high-stakes testing that can limit teachers' ability to use formative assessments that provide ongoing feedback to students. Formative assessments, such as quizzes, peer reviews, and self-assessments, are essential for identifying learning gaps and adjusting instruction to meet students' needs as elaborated:

"We need more formative assessments to provide timely feedback to students." [P1, P4, P5]
"The current evaluation system focuses too much on standardized tests and not enough on holistic development." [P2, P3]

The literature supports the importance of formative assessments in promoting effective learning. Pinger et al. (2018) highlight that formative assessments help create a feedback loop between teachers and students, fostering a deeper understanding of mathematical concepts. These assessments enable teachers to tailor their instruction based on individual student performance, thereby enhancing learning outcomes. Furthermore, formative assessments encourage students to take an active role in their learning process, improving their self-regulation and motivation.

To improve assessment practices, the education system may adopt a balanced approach that includes both formative and summative assessments. Educators may be trained in designing and implementing various formative assessment techniques to provide timely and constructive feedback (Schildkamp et al., 2020). Additionally, policymakers may consider revising evaluation policies to reduce the over-reliance on standardized tests and recognize the value of holistic assessment methods (Hernández-Colón et al., 2021). By enhancing assessment practices, teachers can better support student learning and development in mathematics.

Theme 6: Student Engagement and Motivation

Engaging students in mathematics is a persistent challenge for educators in the Philippines. Many students experience math anxiety, which can hinder their motivation and ability to learn. Teachers report that traditional teaching methods often fail to capture students' interest, leading to disengagement and poor performance. To address this issue, educators need strategies that make mathematics more appealing and relatable, such as incorporating real-world applications and interactive activities as discussed:

"Engaging students in mathematics is challenging, especially with the widespread math anxiety." [P2, P5]

"We need more strategies to motivate students and make math interesting." [P1, P3, P4]

Atoyebi & Atoyebi (2022) emphasize the importance of student-centered teaching approaches in increasing engagement and reducing math anxiety. Strategies such as project-based learning, collaborative problem-solving, and the use of manipulatives can make mathematics more interactive and enjoyable. These methods help students see the relevance of mathematical concepts in everyday life, which can boost their interest and motivation (Hastuti, 2020). Additionally, creating a supportive classroom environment where mistakes are viewed as learning opportunities can help reduce anxiety and build confidence.

Implementing these strategies requires a shift in teaching practices and classroom dynamics. Educators may receive training on how to design and facilitate engaging and interactive lessons. Schools can also support teachers by providing resources and time for planning innovative activities (Dhamija, A., & Dhamija, D., 2022). Furthermore, involving students in the learning process by soliciting their feedback and interests can help tailor lessons to their needs (Luzano, 2024). By focusing on student engagement and motivation, educators can create a more positive and effective learning experience in mathematics.

Theme 7: Influence of Socioeconomic Factors

Socioeconomic factors significantly impact students' ability to succeed in mathematics. Teachers in the Philippines often observe that students from lower socioeconomic backgrounds face additional challenges, such as lack of support at home, poor nutrition, and limited access to educational resources. These factors can affect students' attendance, concentration, and overall performance in school. Addressing these disparities is crucial for ensuring equitable education for all students as disclosed:

"Students from lower socioeconomic backgrounds often struggle more due to lack of support at home." [P1, P3, P5]

"Poverty affects students' attendance and overall performance." [P2, P4]

Rodríguez-Hernández, Cascallar, & Kyndt (2020) highlight the strong correlation between socioeconomic status and educational outcomes. Students from disadvantaged backgrounds are more likely to struggle academically due to various external factors that hinder their learning (Pang-an et al., 2022; Aranzo et al., 2023). These students may require additional support, such as tutoring, mentorship, and access to nutritious meals, to help them overcome these barriers. Schools in low-income areas often face greater challenges in providing high-quality education due to limited funding and resources (Ghorbani & Golparvar, 2020).

To mitigate the impact of socioeconomic factors, comprehensive support systems may be implemented at both the school and community levels. Schools can establish partnerships with local organizations to provide additional resources and services for students in need (Luzano & Ubalde, 2023). Policies aimed at equitable funding and resource distribution can help ensure that all schools have the necessary tools to support their students (Mampane, 2020). By addressing the broader socioeconomic challenges, the education system can create a more empowering community to support the advocacy of Education for All (EFA).

Theme 8: Educational Policies and Systemic Issues

Frequent changes in educational policies create uncertainty and hinder long-term planning for mathematics educators in the Philippines. Teachers often feel that these policy shifts are implemented without adequate consultation or consideration of their practical implications. This lack of stability can disrupt the continuity of instructional programs implemented by educators, making it difficult to maintain consistent and effective teaching practices as articulated:

"Frequent changes in educational policies create uncertainty and hinder long-term planning." [P2, P5]

"We need a more stable and supportive educational system that values teachers' input." [P1, P3, P4]

Ayllón, Alsina, & Colomer (2019) suggest that consistent and supportive educational policies are essential for sustaining school improvement efforts and teacher morale. Effective policies may be developed with input from educators and grounded in evidence-based practices. When teachers are involved in the policymaking process, they are more likely to feel valued and committed to implementing the changes (Liu, Wang, & Zhao, 2020). Additionally, stable policies provide a framework for long-term planning and continuous improvement, benefiting both teachers and students (Luzano & Ubalde, 2023).

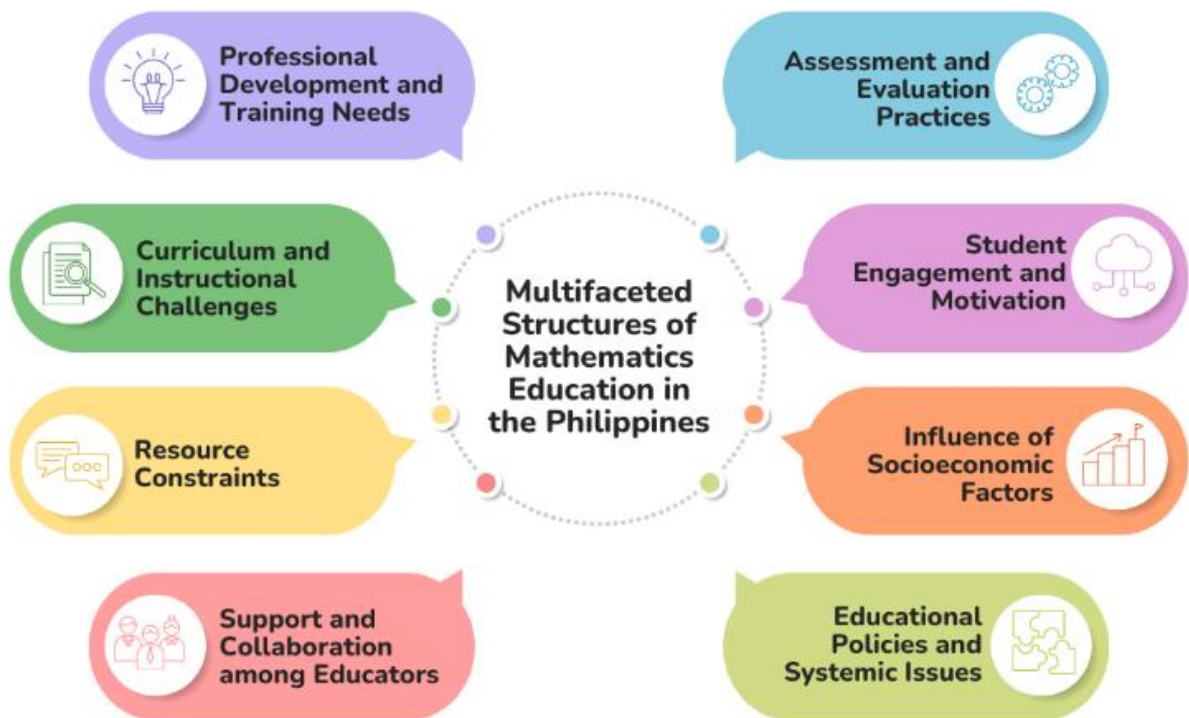
To create a more supportive educational environment, policymakers may prioritize stability and teacher involvement in decision-making processes (Cheon, Reeve, & Vansteenkiste, 2020). Engaging educators in the development and implementation of educational policies ensures that their practical insights and classroom experiences are considered, leading to more effective and feasible policies (Harris & Jones, 2019). When teachers have a voice in these processes, they are more likely to feel valued and motivated, fostering a sense of ownership and commitment to educational reforms.

Emergent Model

The emergent model showed the multifaceted structure of mathematics education in the Philippines through the interconnection of the eight (8) themes that form a complex ecosystem where changes in one area affect others. Inadequate professional development exacerbates instructional challenges and limits student engagement. Resource constraints hinder innovative teaching and assessment methods, especially in underfunded regions. Collaboration among educators is crucial but often impeded by insufficient support and policy instability. Socioeconomic factors add further barriers for disadvantaged students, necessitating targeted interventions. A stable, inclusive policy framework that involves teachers in decision-making is essential for addressing these challenges and creating a resilient, effective mathematics education system.

Figure 1.

Model of the Multifaceted Structures of Mathematics Education in the Philippines



Conclusion and Recommendation

The multifaceted structure of mathematics education in the Philippines reveals a complex interplay of factors that collectively impact teaching and learning outcomes. Key challenges include insufficient professional development, overloaded curricula, resource constraints, and socioeconomic disparities, all exacerbated by frequent policy changes. These issues create a cycle where teachers feel underprepared, leading to ineffective instruction and disengaged students. Addressing these interconnected challenges requires a holistic approach

that includes robust professional development, contextually relevant curricula, equitable resource distribution, and stable, inclusive policies that actively involve educators in the decision-making process. Such a comprehensive strategy is essential to empower teachers, enhance instructional quality, and improve student outcomes in mathematics across the country.

To enhance the effectiveness of mathematics education in the Philippines, it is recommended that the government and educational stakeholders prioritize the establishment of a comprehensive professional development program tailored to the specific needs of mathematics teachers. This program may include regular training on innovative teaching methods and technological integration, with a focus on practical classroom applications. Additionally, the curriculum may be revised to ensure it is manageable within the school year and incorporates real-life examples relevant to students' experiences. To address resource constraints, there may be a concerted effort to provide adequate teaching materials and technological tools, particularly in under-resourced areas. Moreover, fostering a collaborative environment through structured opportunities for peer learning and support is crucial. Policymakers may engage educators in the policy-making process to ensure stability and relevance in educational reforms. Thus, the education system can create a supportive, effective, and resilient framework for mathematics education that benefits both teachers and students.

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