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Senior High School Mathematics Teachers' Epistemological Knowledge and Mathematical Discourse Practices: Basis for Professional Development

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ABSTRACT

This study investigated the relationship between Senior High School mathematics teachers' epistemological knowledge and mathematical discourse practices, examined differences based on selected profile variables, and determined the predictive influence of epistemological knowledge on discourse practices. Employing a descriptive-correlational research design, the study involved 43 Senior High School mathematics teachers from 13 public secondary schools in the Schools Division of Lipa City, selected through total population sampling. Data were gathered using two researcher-developed instruments: the Epistemological Knowledge in Mathematics Questionnaire (EKMQ) and the Mathematical Discourse Practices Questionnaire (MDPQ), both subjected to expert validation and reliability testing. Following ethical research protocols, questionnaires were administered online. Data were analyzed using descriptive statistics, independent samples t-test, one-way analysis of variance (ANOVA), Pearson product-moment correlation, and simple linear regression. Findings revealed that teachers demonstrated a high extent of epistemological knowledge and highly practiced mathematical discourse in classroom instruction. No significant differences in epistemological knowledge were observed based on ancillary roles, while mathematical discourse practices differed significantly according to the number of mathematics-related trainings and seminars attended. Furthermore, a strong positive relationship existed between epistemological knowledge and mathematical discourse practices, with epistemological knowledge significantly predicting discourse practices. These findings emphasized the importance of strengthening teachers' understanding of mathematical knowledge and promoting meaningful classroom communication. Consequently, the Mathematical Discourse Enhancement Program (MDEP) was developed as a research-based professional development initiative designed to enhance teachers' epistemological knowledge, improve mathematical discourse practices, and support effective mathematics instruction through targeted professional learning opportunities and continuous instructional improvement.

Keywords: *epistemological knowledge, mathematical discourse, senior high school teachers, descriptive-correlational design, professional development*

INTRODUCTION

Mathematics education has shifted its focus from a predominantly procedural, teacher-centered approach to one that emphasizes conceptual understanding, learner engagement, and meaning-making. Before, teaching and learning were expected to focus on transmitting fixed rules. Students are expected to memorize and replicate solutions. Newer perspectives view mathematics as a dynamic discipline. Learners

construct knowledge through reasoning, problem-solving, and communication. This transformation progressed in consonance with reforms in education and assessments. This includes higher-order thinking skills and the ability to apply knowledge in varied contexts. Learning mathematics is now recognized as involving explanation, justification, and critical evaluation of ideas.

Through these transformations and developments, classroom discourse has emerged as an element for effective instruction. This requires teachers to facilitate interactive and meaningful learning environments. Thus, it is important now to understand teachers' epistemological beliefs about mathematics. These orientations influence instructional design and enactment. This focus aligns with the United Nations Sustainable Development Goals, specifically SDG 4 on quality education and SDG 10 on reduced inequalities, as well as broader institutional strengthening, including SDGs 11 and 16.

Beyond these instructional shifts, the core of effective classroom discourse lies in teachers' epistemological knowledge. Teachers' epistemological knowledge refers to the beliefs about the nature of mathematical knowledge: how it is acquired and justified. Utilizing and investigating this could affect interpretations of curriculum goals, the selection of instructional strategies, and student engagement. Teachers who view mathematics as conceptual and constructed emphasize understanding, exploration, and student participation. On the other hand, rule-based instruction and correctness are prioritized by those with procedural or authoritative beliefs about mathematics. This shapes both what is taught and how it is communicated, making it central to classroom practice.

Closely linked is classroom mathematical discourse. It is defined as patterns of interaction through which understanding is constructed and communicated. It includes questioning, explaining, justifying, and negotiating meaning. In these classrooms, students are allowed to articulate reasoning, evaluate alternative solutions, and collaborate on problem-solving. This fosters conceptual understanding. Conversely, procedural, teacher-led classrooms limit meaningful interaction. The quality of discourse thus reflects the effectiveness of teaching, indicating how teacher beliefs translate into practice.

This conceptual framework naturally extends to classroom mathematical discourse, which serves as the physical manifestation of how these beliefs are enacted through patterns of interaction. Studies suggest a meaningful connection between teachers' epistemological knowledge and classroom discourse. Teachers with sophisticated, inquiry-driven beliefs promote dialogic instruction, reasoning, and the exchange of ideas. On the other hand, procedural-oriented teachers rely on authoritative patterns. The enactment of beliefs, however, is often constrained by contextual factors. These are time, curricular demands, class size, and workload. It highlights the need to study how epistemological knowledge interacts with real classroom conditions.

However, the ideal alignment between belief and discourse is rarely achieved in practice, as few studies simultaneously examine epistemological knowledge and discourse practices within the unique landscape of Philippine Senior High Schools. Despite the constructivist orientation of contemporary mathematics curricula, teachers still tend to rely on conventional, teacher-centered instructional practices rather than fully implementing learner-centered, constructivist approaches (Balanlay, 2021; Jabagat, 2025). This instructional misalignment likely reinforces the student difficulties identified by Bautista et al. (2023), who found that epistemological barriers and psychological factors like anxiety remain major hurdles to mathematical success. Predictive relationships between epistemological knowledge and classroom discourse remain underexplored. These issues include the following: teacher competence, persistent procedural instruction, gaps in student performance, and limited alignment between training and classroom practice, all of which call for an integrated, context-responsive analysis.

Translating theory into the Philippine classroom requires an understanding of local pressures, specifically within the Schools Division of Lipa City, where diverse professional and administrative burdens challenge even the most sophisticated epistemological beliefs. SHS mathematics teachers in the Schools Division of Lipa City face diverse realities. Among these are varied professional training experiences, having high instructional demands, including large class sizes, heavy teaching loads, and

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multiple preparations. Additional ancillary assignments, such as coordinatorships, non-academic tasks, and clerical work, among others, burden teachers. These conditions challenge epistemological knowledge and meaningful discourse. This shows that a systematic investigation is needed.

To address these multifaceted challenges, this study is constructed to investigate the epistemological knowledge of SHS mathematics teachers in the Schools Division of Lipa City. Moreover, this aims to determine its relationship to classroom discourse practices, identify differences across teacher profiles, assess the predictive influence of epistemological knowledge on discourse, and inform evidence-based interventions to enhance instructional quality and student outcomes. The study also accounts for the influence of profile variables, including teaching experience, educational attainment, instructional demand, subjects taught, and professional training, which serve as moderating and grouping factors. These variables are examined to determine if the relationship between a teacher's epistemological knowledge and their discourse practices differ across various professional contexts, acknowledging that personal and environmental factors can either facilitate or constrain the enactment of one's beliefs in the classroom. Results will contribute to mathematics education research, policy development, and local teaching practice.

This comprehensive investigation is further justified by its alignment with broader socioeconomic and educational frameworks. The research demonstrates relevance to both international scholarship and the Philippine educational context by situating the study within global SDGs, national development plans such as AmBisyon Natin 2040, and EDCOM II priorities.

Statement of the Problem

This study aims to examine the relationship between teachers' epistemological knowledge and their mathematical discourse practices, specifically exploring how the former influences and predicts the latter to craft a professional development program. Furthermore, it investigates the role of profile variables as moderating and grouping factors to determine how professional background and instructional context may influence or differentiate these constructs and their predictive relationship. More so, this study will seek answer for the following questions:

1. What is the profile of the respondents in terms of:
   1.1. Bachelor's Degree;
   1.2. Years of teaching experience;
   1.3. Highest educational attainment;
   1.4. Number of ancillary roles;
   1.5. Number of Mathematics-related trainings/seminars attended?
2. What is the extent of Senior High School teachers' epistemological knowledge about mathematics as measured by the Epistemological Knowledge in Mathematics Questionnaire (EKMQ)?
3. What is the level of Senior High School teachers' mathematical discourse practices as measured by the Mathematical Discourse Practices Questionnaire (MDPQ)?
4. Are there significant differences in Senior High School teachers' epistemological knowledge about mathematics when respondents are grouped according to their profile variables?
5. Are there significant differences in Senior High School teachers' mathematical discourse practices when respondents are grouped according to their profile variables?
6. Is there a significant relationship between Senior High School teachers' epistemological knowledge about mathematics and their mathematical discourse practices?
7. To what extent does Senior High School teachers' epistemological knowledge about mathematics predict or influence their mathematical discourse practices?
8. What professional development program may be designed based on the findings of the study?

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Purpose of the Study

The primary purpose of this study is to examine the relationship between the epistemological knowledge and mathematical discourse practices of Senior High School mathematics teachers in the Schools Division of Lipa City. Specifically, it seeks to assess the levels of teachers' epistemological knowledge and the Extent of their discourse practices to determine if a significant association exists between these two constructs. Furthermore, the study aims to identify significant differences in these areas when teachers are grouped by profile variables, such as years of teaching experience, educational attainment, instructional demand, subjects taught, and professional training. Crucially, the study employs regression analysis to determine the Extent to which epistemological knowledge influences and predicts classroom discourse. The findings will serve as the empirical basis for crafting a professional development program designed to strengthen teacher competence and facilitate discourse-rich mathematics instruction. This initiative supports global and national mandates, including the Sustainable Development Goals (SDG 4) for quality education, AmBisyon Natin 2040 for human capital development, and EDCOM II priorities regarding teacher quality and curriculum coherence.

Literature Review

Thematic Review of Related Literature

Epistemological Knowledge in Mathematics Teaching

Epistemological knowledge in mathematics refers to teachers' beliefs about the nature of mathematical knowledge. It refers to how it is constructed, and how it should be taught and learned. Literature presents this knowledge as a dimension of teacher cognition. It shapes instructional decision-making and classroom interaction. Teachers who view mathematics as dynamic, constructed, and reasoning-oriented are more likely to foster inquiry-based learning environments. More so, those who perceive it as fixed and procedural tend to emphasize transmission-oriented instruction (Nordgren, 2024; Marshman, 2021).

Discussions emphasize that epistemic beliefs are not isolated constructs. They are embedded within broader professional knowledge systems. For instance, the characterization of teacher knowledge includes not only content and pedagogy. It also sees underlying beliefs about knowledge itself (Leikin, 2021; Hudson, 2021). These epistemological orientations influence how teachers interpret mathematical tasks. More so to respond to student reasoning and structured discourse. Evolving perspectives situate epistemological knowledge within collaborative and collegial contexts. Beliefs are negotiated and reshaped through professional interaction (Nordgren, 2024).

Scholars argue that epistemological knowledge is implicit and underdeveloped in teacher education. It led to inconsistencies between intended and enacted practices (Goldenberg et al., 2021). This suggests a persistent tension between formal knowledge acquisition. More so is the internalization of epistemic perspectives. It shows the need for more explicit integration of epistemological reflection in teacher preparation and development programs (Fatima, 2023).

Teacher Knowledge Frameworks and Professional Competence.

Teacher knowledge has been widely seen as a multidimensional construct. It encompasses content knowledge, pedagogical knowledge, and professional judgment. Conceptualizations extend this framework to include adaptive expertise, contextual responsiveness, and the ability to mediate learning through discourse (Hamar, 2023; Chapman, 2021). Professional knowledge is increasingly viewed as practice-based and situated, emerging through engagement with real classroom contexts in mathematics education (Horn & Garner, 2022).

Teacher competence is not merely the accumulation of knowledge. It is the capacity to mobilize this knowledge in dynamic instructional situations. The ability to interpret students' mathematical reasoning and respond productively is considered a hallmark of effective teaching (Ribeiro et al., 2021).

Frameworks focusing on knowledge in action emphasize that teachers' understanding of mathematical concepts must be flexible and connected to pedagogical purposes (Orrill & Brown, 2023).

The role of teacher educators in shaping professional knowledge has gained attention. Teacher educators are expected to possess specialized knowledge that enables them to support teachers' learning. It is particularly in linking theory and practice (Escudero-Ávila et al., 2021; Chapman, 2021). This presents viewing teacher learning as a continuous, collaborative process rather than a one-time acquisition of competencies.

Debates persist regarding the Extent to which formal frameworks adequately capture the complexity of teacher knowledge. Some argue that existing models may oversimplify the interplay between knowledge, beliefs, and practice. It calls for more integrative and context-sensitive approaches (Leikin, 2021; Hamar, 2023).

Mathematical Discourse Practices and Classroom Interaction

Conceptual literature emphasizes discourse as a central mechanism for learning, positioning it as both a cognitive and social process (Smith, 2023; Mesiti et al., 2021). Mathematical discourse practices are ways in which teachers and students communicate mathematical ideas. This includes questioning, explaining, arguing, and justifying.

Moreover, discourse is linked to the development of mathematical reasoning. It provides opportunities for students to articulate and refine their thinking (Ribeiro et al., 2021). Dialogic teaching approaches include the importance of creating spaces. It is where students actively participate in meaning-making through discussion and reasoning. Particularly in how they facilitate or constrain student contributions, teachers' orientations toward discourse significantly influence the quality of these interactions. (Smith, 2023).

The role of cultural and contextual factors in shaping discourse practices is being underscored. Classroom norms, linguistic diversity, and sociocultural expectations can, for example, influence how students engage in mathematical communication (Ding et al., 2023), underscoring the need for culturally responsive teaching approaches that recognize and leverage diverse forms of participation.

The integration of digital technologies, at the same time, has introduced new dimensions to mathematical discourse. Digital tools can mediate interaction, support visualization, and expand opportunities for collaboration. But, they also require teachers to adapt their practices and develop new forms of pedagogical knowledge (Remillard et al., 2024; Bozkurt et al., 2024).

Interplay Between Epistemological Knowledge and Discourse Practices

Several conceptual works suggest that teachers' epistemological knowledge is linked to their discourse practices. Teachers who hold constructivist views of mathematics are more likely to engage students in exploratory and dialogic interactions. Those with more traditional beliefs may prioritize procedural explanation and authoritative communication (Marshman, 2021; Nordgren, 2024).

The relationship is often mediated by teachers' ability to interpret and/or respond to student thinking. Promoting meaningful discourse requires not only valuing student contributions. It might also be possessing the knowledge and skills to build on them effectively (Ribeiro et al., 2021). Epistemological beliefs and professional knowledge interact to shape instructional practices in complex ways.

Discussions have also highlighted the role of collaborative professional contexts in aligning beliefs and practices. For teachers to reflect on their epistemological orientations and experiment with new discourse strategies, collegial planning, lesson study, and professional learning communities provide the foundation (Hagemeyer, 2022; Nordgren, 2024). Having these contexts can facilitate the transformation of beliefs into practice, although such changes are often gradual and context-dependent.

Tensions remain between beliefs and enacted practices. Teachers may endorse student-centered approaches. On one side, they struggle to implement them due to constraints such as curriculum demands, assessment pressures, or limited support (Horn & Garner, 2022). The need for professional development that addresses both knowledge and beliefs has been seen in this context.

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Professional Development and Teacher Learning.

Professional development is recognized as a key mechanism for enhancing teachers' knowledge and teaching practices. Contemporary models emphasize job-embedded, collaborative, and practice-oriented approaches. These approaches support sustained learning (Ghousseini & Kazemi, 2023; Quadros & Carreira, 2024). More so, these models align with the view that teacher learning is situated and continuous. It also occurs through engagement with authentic teaching challenges (Horn & Garner, 2022).

Lesson study, for example, has been identified as an effective approach for fostering reflective practice and improving instructional quality (Hagemeyer, 2022). Similarly, professional learning tasks that focus on real classroom scenarios can help teachers to develop a deeper understanding and more adaptive practices (Quadros & Carreira, 2024). The importance of integrating theory and practice in professional development has been highlighted.

Recent literature also suggests the need to reimagine professional growth in response to changing educational demands. This includes integrating digital technologies, addressing diverse learner needs, and promoting 21st-century competencies. This includes further communication and critical thinking (Law, 2023; Powell, 2021). Teachers' epistemological knowledge becomes increasingly important as it shapes how they interpret and respond to these challenges in this context.

Scholars note that professional development initiatives face limitations. These limitations could include insufficient alignment with teachers' needs, lack of sustained support, and limited attention to epistemological dimensions (Fatima, 2023; Sanders et al., 2024). More comprehensive and context-sensitive approaches that consider the interplay between knowledge, beliefs, and practice are now required.

Emerging Perspectives and Future Directions. The importance of integrating digital, cultural, and critical perspectives into teaching and learning is increasingly evident, especially in recent research. For instance, the use of digital resources. It is transforming instructional practices and creating new opportunities for interaction and engagement (Remillard et al., 2024; Bozkurt et al., 2024). To address social and equity issues, challenging traditional views of mathematics as neutral and value-free, critical mathematics education emphasizes the role of teaching in this context (Critical Mathematics Education in Action, 2022).

Future-oriented discussions led to a rethinking of the goals and practices of mathematics education to prepare students for complex, real-world contexts (Karthika, 2024), including fostering reasoning, modeling, and problem-solving skills, which are closely linked to discourse practices and epistemological understanding (Kularajan & Czocher, 2024).

Significant gaps remain in the literature, despite the developments discussed and highlighted in this section, especially regarding technology and technological advancements in mathematics teaching and learning. What we have seen is a limited integration of epistemological knowledge and discourse practices within a unified framework. There is little literature that explicitly discusses their predictive relationships. Additionally, the role of contextual factors, such as policy environments and institutional constraints, requires further discussion.

Synthesis and Research Gap

Based on the foregoing discussions of the literature, this shows the centrality of teachers' epistemological knowledge and discourse practices in shaping mathematics instruction. Gaps remain in understanding their interrelationship and practical implications, while substantial progress has been made in conceptualizing these constructs. There is a need for more integrative approaches that examine how epistemological knowledge influences discourse practices and how this relationship can inform professional development.

These gaps clearly pave the way towards the relevance of the present study, which seeks to examine the relationship between teachers' epistemological knowledge and their mathematical discourse practices, and to use these insights as a basis for designing targeted professional development programs.

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Review of Empirical Studies

Epistemological Knowledge of Mathematics

Contemporary empirical literature converges on the view that teachers' epistemological knowledge of mathematics is multifaceted, encompassing beliefs about the nature, certainty, justification, acquisition, and teachability of mathematical knowledge. Recent studies further affirm that mathematics teachers' epistemological beliefs range from absolutist and procedural orientations to more dynamic and constructivist perspectives, influencing how mathematical knowledge is conceptualized and enacted in classroom practices (Rott, 2021; Thurm & Barzel, 2022). More recent empirical investigations emphasize how such epistemological orientations are dynamically shaped by contextual teaching experiences and professional learning trajectories, although these foundational works provide theoretical anchoring.

Empirical studies suggest that teachers' epistemological knowledge is not static. It evolves through interaction with curricular reforms, instructional demands, and collaborative professional environments. Research highlights that teachers with more sophisticated epistemological beliefs tend to view mathematics as a connected, reasoning-driven discipline rather than a set of procedures to be transmitted (Campbell, 2022; Fowler, 2022). This orientation is associated with deeper cognitive structuring of mathematical knowledge. It is where teachers integrate conceptual understanding with procedural fluency in ways that support learner meaning-making.

Studies in this domain frequently employ mixed-methods designs that combine belief surveys, epistemological belief scales, and reflective interviews. It allows triangulation of cognitive and affective dimensions of teacher knowledge (Johnson Sprague, 2024; Kim & Lim, 2025). Several studies also indicate that epistemological knowledge is significantly associated with teachers' prior educational background, specialization in mathematics, and exposure to inquiry-oriented pedagogies, although these foundational works provide theoretical anchoring (Aguilar, 2024; Alderton & Pratt, 2025). Inconsistencies remain regarding the strength of these associations across different educational contexts. It thus suggests that institutional and cultural variables mediate epistemological development.

Though gaps persist in explaining how such knowledge translates into observable classroom discourse practices, the literature indicates convergence on the notion that epistemological knowledge of mathematics is a critical determinant of instructional orientation.

Mathematical Discourse Practices

Recent empirical studies on mathematics education emphasize mathematical discourse practices as interactional and communicative processes shaped by teacher questioning strategies, student participation structures, collaborative reasoning, and meaning negotiation within classroom communities. Contemporary literature conceptualizes mathematical discourse as the social process through which mathematical ideas are communicated, justified, negotiated, and refined through classroom interaction and collective sense-making (Kooloos et al., 2022; Shinno & Fujita, 2021). Contemporary studies focus on how discourse is shaped by teacher facilitation strategies and institutional expectations for mathematical reasoning.

Findings indicate that teachers who employ dialogic and inquiry-oriented discourse patterns are associated with higher levels of student reasoning and conceptual articulation (Castro Superfine et al., 2024; Boran Yu & Cao, 2025). These studies show that discourse-rich classrooms are communicative, characterized by open-ended questioning, uptake of student responses, and an emphasis on justification rather than on answer correctness alone. Planas et al. (2024) and Howell et al. (2025) highlight that discourse quality is strongly influenced by teachers' ability to scaffold mathematical argumentation and sustain reflective dialogue.

Discourse studies utilize classroom observations, video analysis, and discourse coding schemes. It is often complemented by stimulated recall interviews to capture teacher decision-making processes (Dorwu et al., 2025; Spitzer & Phelps-Gregory, 2024). Variability in analytical frameworks remains a challenge. It is particularly in defining what constitutes productive mathematical discourse across different cultural and curricular contexts. Teacher-centered instructional traditions continue to constrain discourse

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practices in some settings. It thus limits student participation in higher-order mathematical reasoning (Flores-Medrano et al., 2022; Ochoviet & Molfino, 2022).

Though the depth of implementation varies widely across classrooms and educational systems, this section presented a shift toward discourse-oriented mathematics instruction.

Relationship Between Epistemology and Teaching Practice

Recent research on mathematics education increasingly examines the relationship between teachers' epistemological knowledge of mathematics and their enacted discourse practices in the classroom. Contemporary evidence suggests a strong conceptual and pedagogical linkage between sophisticated epistemological beliefs and the implementation of reform-oriented, student-centered instructional approaches. Studies indicate that teachers who perceive mathematical knowledge as dynamic, constructed, and open to justification are more likely to facilitate exploratory discussions, collaborative reasoning, and dialogic discourse. practices. Conversely, teachers holding more absolutist and procedural views of mathematics tend to rely on teacher-dominated instruction, procedural exposition, and closed-ended questioning patterns (Rott, 2021; Thurm & Barzel, 2022; Kooloos et al., 2022).

These recent empirical studies reinforce this relationship by demonstrating that epistemological beliefs significantly predict classroom interaction patterns. Findings from the studies by Aguilar-Valdés and Montenegro (2025) and Bakir and Turgut (2023) suggest that teachers with constructivist epistemological orientations are more likely to facilitate exploratory discourse and encourage multiple solution pathways. Similarly, Kim and Lim (2025) report that the relationship between exposure to professional development and instructional change is mediated by epistemological sophistication. It highlights its role as a cognitive filter through which pedagogical knowledge is enacted.

The literature also reveals inconsistencies: some studies indicate that contextual constraints such as curriculum demands, assessment pressures, and institutional culture may override individual belief systems, while others report strong predictive relationships between epistemological beliefs and discourse practices (Wilkerson & Shelton, 2023; Schmidt et al., 2024). Epistemology is a necessary but not sufficient condition for instructional transformation.

Regression analyses, structural equation modeling, and multilevel modeling dominate this research strand, allowing for examination of both direct and mediated effects (Howell et al., 2025; Lee & Vongkulluksn, 2022). A recurring gap is the limited longitudinal evidence tracing how epistemological change translates into sustained discourse reform over time, despite methodological sophistication. While the relationship between epistemology and practice is well-supported, its developmental trajectory remains underexplored.

Professional Development and Teacher Learning

Professional development (PD) remains a critical mechanism for strengthening teachers' epistemological knowledge and enhancing mathematical discourse practices in classroom instruction. Contemporary research characterizes effective PD as sustained, collaborative, practice-oriented, and reflective, with strong alignment to teachers' instructional contexts and classroom realities. Recent empirical studies further emphasize that meaningful professional development promotes reflective inquiry, pedagogical transformation, and improved facilitation of student-centered mathematical discourse and reasoning practices (Borko et al., 2022; Darling-Hammond et al., 2023). PD models that integrate lesson study, coaching cycles, and video-based reflection to promote epistemological and pedagogical shifts are emphasized as effective (Rocha, 2025; Piñero Charlo & Canto López, 2025).

Findings in several studies suggest that PD programs that explicitly target teachers' beliefs about mathematics are more likely to produce meaningful changes in instructional discourse. Studies by Suh et al. (2023) and Hatısaru et al. (2025) indicate that when teachers engage in reflective analysis of mathematical tasks and student thinking, their epistemological perspectives become more constructivist. It

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leads to richer classroom discourse practices. Similarly, Bendalian (2025) and Marfuah and Khikmawati (2023) report that sustained PD interventions improve teachers' ability to orchestrate mathematical discussions. More so, it facilitates argumentation-based learning environments.

Literature also highlights persistent challenges. Short-term PD programs fail to produce lasting epistemological or instructional change, particularly when not supported by institutional follow-up or collaborative professional communities (Aguilar, 2024; Johnson Sprague, 2024). Moreover, cultural and systemic constraints may limit the transfer of PD learning into actual classroom practice, especially in high-stakes accountability environments (Castro Superfine et al., 2024; Pansell, 2023).

PD studies commonly employ quasi-experimental designs, pre-test/post-test measures, and qualitative case studies to assess changes in teacher cognition and practice. There is a notable lack of large-scale longitudinal studies examining sustained impacts on epistemology and discourse over extended periods.

In synthesis, professional development is consistently identified as a key driver of change. Yet its effectiveness depends on depth, duration, and alignment with teachers' epistemological orientations and contextual teaching conditions.

Theoretical Framework

This study is anchored on complementary theoretical perspectives that collectively explain how teachers' knowledge systems shape instructional practice and inform professional development. These perspectives include the Epistemological Beliefs Theory of Hofer and Pintrich (1997) and Schommer (1990), as discussed in recent studies on mathematics teachers' epistemic beliefs and instructional orientations (Trakulphadetkrai, 2022; Thurm & Barzel, 2022), and Sociocultural Theory of Vygotsky (1978), which continues to inform contemporary views of socially mediated learning, discourse, and classroom interaction (Kooloos et al., 2022).

These frameworks provide a lens for identifying variables, explaining their relationships, supporting predictive analysis, and crafting a professional development program.

Epistemological Beliefs Theory, Schommer (1990) and Hofer and Pintrich (1997) as cited in Trakulphadetkrai (2022) and Thurm and Barzel (2022), conceptualized epistemological beliefs. They refer to these as individuals' views about the nature of knowledge and knowing, encompassing dimensions such as certainty, simplicity, source, and justification. These outlined the independent variable of this study, teachers' epistemological knowledge of mathematics.

Meanwhile, Sociocultural Theory (Vygotsky, 1978, in Kooloos et al., 2022) provides a foundation for understanding the role of discourse in learning. In this theory, cognitive development is mediated through social interaction and language. It means discourse is positioned as a primary tool for meaning-making. Learning occurs through dialogue: explanation and collaborative engagement in mathematics education. Mathematical discourse is not merely a communicative activity but a mechanism through which learners construct and refine understanding.

Teachers' epistemological knowledge, grounded in Epistemological Beliefs Theory and situated within Teacher Cognition Theory, influences their instructional practices. This is particularly mathematical discourse, as explained by Sociocultural Theory and perspectives on mathematical discourse. All of these will provide a theoretical foundation for examining relationships, conducting predictive analysis, and generating practical implications for improving mathematics instruction.

The Epistemological Beliefs Theory is fundamental to this study as it provides the structural framework for the independent variable, defining mathematical knowledge not as a static trait but as a multidimensional system of beliefs regarding the nature and justification of truth. By categorizing these beliefs, ranging from the simplicity and certainty of knowledge to its source and justification, the theory allows for a systematic assessment of how teachers perceive mathematics. This internal cognitive framework serves as the primary predictor in the study's regression analysis, providing a theoretical basis

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for explaining why teachers hold specific instructional orientations that ultimately dictate their classroom behavior.

Complementing this, Sociocultural Theory justifies the focus on the dependent variable by positioning mathematical discourse as the essential social mediator for cognitive development. This perspective shifts the view of mathematics from a solitary, rote activity to a collaborative process of meaning-making, where language serves as the tool for constructing understanding. By anchoring the study in this theory, the research can evaluate the quality of classroom interactions, such as questioning and justification, as measurable manifestations of learning. Together, these theories bridge the gap between a teacher's internal belief system and their external communicative practices, providing the necessary foundation to design a professional development program that addresses both the mindset and the method of instruction.

Conceptual Framework

This study was guided by a conceptual framework that translates theoretical perspectives into a structured model to examine how teachers' epistemological knowledge of mathematics influences their mathematical discourse practices. Through the framework, key variables, relationships, and predictive effects could be described. These will generate a professional development program.

The study identifies three categories of variables: the independent variable (IV) refers to the teachers' epistemological knowledge of mathematics, the dependent variable (DV) refers to the teachers' mathematical discourse practices, and the profile variables that include years of teaching experience, educational attainment with specialization, instructional demand, subjects currently taught, and mathematics-related trainings or seminars attended. These variables function primarily as grouping variables for comparative analysis. They also serve as potential moderators that may influence the strength or direction of the relationship between the IV and DV.

The framework presents a direct and predictive relationship between epistemological knowledge and mathematical discourse practices. Grounded in Epistemological Beliefs Theory, teachers' conceptions of knowledge shape their instructional orientations. Teacher Cognition Theory explains that internal belief systems influence observable teaching practices, thereby supporting the assumption that epistemological knowledge predicts variations in discourse practices. Teachers with more sophisticated epistemological beliefs are more likely to promote discourse-rich, student-centered instruction, while those with more traditional beliefs may rely on procedural and teacher-dominated approaches.

Across teacher profiles, variations are expected in both epistemological knowledge and discourse practices. Meanwhile, differences in experience, specialization, instructional demand, and professional training may contribute to differences in how teachers conceptualize mathematics and enact instruction. These profile variables provide a basis for examining group differences and contextualizing the relationship between the main variables. While they are not treated as primary causal variables, their inclusion would allow differences in the interpretation of patterns observed in the data.

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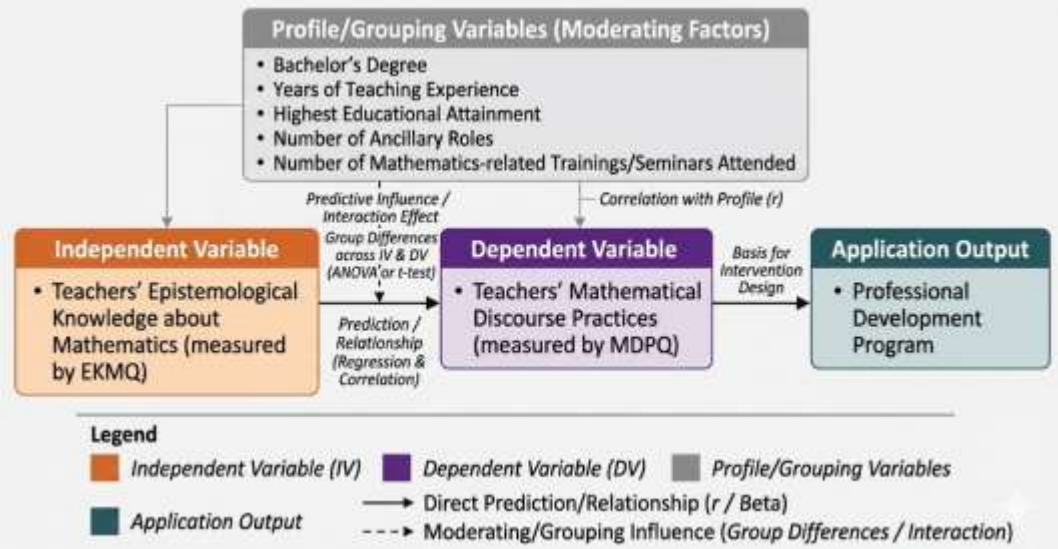


Figure 1. *The Conceptual Framework*

Figure 1 presents the study's conceptual framework as a predictive and relational model. The model illustrates a pathway from the independent variable (teachers' epistemological knowledge of mathematics) to the dependent variable (teachers' mathematical discourse practices). This represents the primary causal and predictive relationship. Profile variables are positioned above this pathway.

This indicates their role as moderating and grouping factors, and may influence both the independent and dependent variables. Their interaction could also be described. The model includes a pathway from the dependent variable to the development of a professional development program. This illustrates that the study's findings will serve as a basis for designing interventions to enhance instructional practice.

The conceptual framework aligns with the study's research questions. It supports the descriptive analysis of epistemological knowledge and discourse practices. It examines their relationship. Moreover, it analyzes group differences based on profile variables and investigates their predictive influence. Lastly, the output provides the basis for developing a professional development program.

The framework is firmly grounded in the study's theoretical foundations: Epistemological Beliefs Theory, Teacher Cognition Theory, Sociocultural Theory (Vygotsky, 1978 in Kooloos et al., 2022), and mathematical discourse perspectives (Cobb et al., 1993; Sfard, 2008 in Trakulphadetkrai, 2022; Thurm & Barzel, 2022). The theories support the framework that teachers' epistemological knowledge influences their mathematical discourse practices, as observed across teacher profiles. These relationships inform the design of a targeted professional development program.

Research Gap and Justification

Prior research on this topic focuses on teachers' epistemological perspectives and mathematical discourse, but these have often been examined separately. Existing research sometimes focuses either on teachers' beliefs about knowledge and learning or on classroom discourse practices without investigating how these two domains relate to one another, particularly through quantitative approaches.

Additionally, there is limited localized evidence examining how teachers' epistemological knowledge is evident in observable pedagogical practices within actual secondary mathematics classrooms. The professional development that was designed was done generically. These were created without being

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grounded in data that diagnose how teachers' underlying views of mathematics may enable or constrain their use of discourse-oriented strategies.

Having said all of these, there is a need to quantitatively study the relationship between epistemological knowledge about Mathematics and their Senior High School teachers' mathematical discourse practices. Moreover, these findings should serve as an empirical basis for designing a targeted professional development program that responds to identified instructional needs.

Relevance to the Current Study

According to the existing literature, teachers' epistemological beliefs significantly influence their instructional practices. This relationship is mediated by contextual constraints, including workload, training, and institutional conditions. Mathematical discourse is important to promote reasoning, conceptual understanding, and meaningful learning, but remains underutilized in many classrooms.

Professional development aligns teachers' beliefs with effective instructional practices. It informs the present study by integrating Epistemological Beliefs Theory (the independent variable) and Teacher Cognition Theory (the belief-practice relationship). The quantitative study will utilize the EKMQ and MDPQ to measure key constructs, as guided by the theoretical and conceptual frameworks. It incorporates descriptive analysis, correlation, group comparison, and regression to examine relationships, differences, and predictive influence. The study will investigate the epistemological knowledge and discourse practices within the Senior High School. The findings aim to enhance instructional practice and support evidence-based professional development.

METHODS

Research Design

This study utilized a descriptive-correlational design. It is well-suited to investigating the respondents' epistemological knowledge of mathematics and their mathematical discourse practices, as well as the relationships and predictive influences between these variables.

Descriptive-correlational research design, on the other hand, is a quantitative method that examines the degree of relationship between two or more variables as they naturally occur without experimental manipulation or causal inference (Creswell & Creswell, 2022).

The design is chosen for its ability to address the study's objectives. The study measured teachers' epistemological knowledge and discourse practices, providing descriptive insights (mean, standard deviation, ranking) into their current levels through validated instruments (EKMQ and MDPQ). Examination of the strength and direction of relationships between epistemological knowledge and discourse practices will be done through inferential analyses, including Pearson correlation and predictive modeling. Identification of significant differences across teacher subgroups, to support targeted interventions, was conducted through group comparisons based on profile variables, such as teaching experience, educational attainment, instructional load, subjects taught, and professional training attended.

The operationalization of variables aligns with the research objectives, with teachers' epistemological knowledge as the independent variable (IV) and mathematical discourse practices as the dependent variable (DV). Profile variables serve as a grouping or moderating factors in the analysis that would allow the study to look for contextual influences on teacher practices.

The total enumeration approach was used to collect data within the Division of Lipa City. This is to ensure comprehensive coverage of the population. Respondents completed the validated questionnaires, and the data will be screened for completeness and accuracy. Descriptive statistics summarized variable levels, while inferential statistics tested relationships, differences, and predictive models.

Additionally, the design reflected the relational and predictive model in which epistemological knowledge influences discourse practices. Findings from descriptive, relational, and predictive analyses

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informed the development of a data-driven professional development program, making the proposed interventions empirically grounded.

Variables and Operational Definitions

The following variables are conceptually and operationally defined to ensure accurate measurement and alignment with the research objectives.

1. ***Epistemological Knowledge of Mathematics*.** This refers to the independent variable (IV) and is conceptually defined as teachers' understanding of the nature, justification, and development of mathematical knowledge. Operationally, it uses the same definition and is measured using the Epistemological Knowledge in Mathematics Questionnaire (EKMQ).
2. ***Teachers' Mathematical Discourse Practices*.** This refers to the dependent variable (DV) and is defined as the frequency and quality of teachers' engagement in classroom discussions involving reasoning, argumentation, and conceptual understanding among students. It uses the same definition for operational sense. It is measured by the Mathematical Discourse Practices Questionnaire (MDPQ.
3. ***Profile Variables*.** This refers to the grouping or moderating factors, including years of teaching experience, highest educational attainment with specialization, instructional demand (class size, teaching load, number of preparations), subjects currently taught, and mathematics-related training/seminars attended. These will be gathered through a survey questionnaire.

Population and Sampling Techniques

All 43 Senior High School teachers in the Division of Lipa City who are teaching mathematics or mathematics-related subjects were the population of this study. They represent the professionals who possess the following, as aligned with the study: responsibility for delivering mathematical content, facilitation of classroom discourse, and implementation of instructional strategies that reflect their epistemological knowledge. They were also characterized by the following: teaching experience, educational attainment with specialization, instructional load, subjects taught, and participation in mathematics-related professional development programs. These attributes are important to make sure participants are relevant to the study's focus on epistemological knowledge and classroom discourse practices.

The population comprises 43 Senior High School mathematics teachers who are available and willing to participate in the Division of Lipa City during the study period. The study targeted teachers across public Senior High Schools where data collection is feasible; hence, the following considerations apply: institutional schedules, geographic location, and administrative permissions.

Total enumeration was employed to include all accessible Senior High School mathematics teachers in the sample, given the descriptive-correlational quantitative design. Coverage of the accessible population and the provision of data for descriptive, relational, group-comparison, and predictive analyses were ensured through a non-probability sampling approach. The complete inclusion of available teachers, which enhances the validity of the correlation and regression analyses, as well as the examination of differences across profile variables, is justified by the total number of respondents.

The participants' epistemological knowledge and discourse practices directly inform the development of a data-driven professional development program; selecting this population aligns with the study's objectives. Supporting both scholarly inquiry and practical program design, the inclusion of the participants ensures that findings reflect the instructional realities and professional needs of mathematics teachers in the Division.

A letter was sent to the Schools Division Superintendent (SDS) requesting permission to conduct the study and inviting Senior High School (SHS) Mathematics teachers to participate by answering the research questionnaire. With assistance from the Public Schools District Supervisor (PSDS) for SHS, the

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questionnaire was distributed to the identified respondents. All 43 invited SHS Mathematics teachers participated in the study and completed the questionnaire, resulting in a 100% response rate.

Research Locale

The study was conducted in the Schools Division of Lipa City, Batangas, specifically in public Senior High Schools. The research targeted 43 Senior High School mathematics teachers across thirteen schools, including Fernando Air Base INHS, Anilao INHS, Pinagkawitan INHS, Bulacnin INHS, Lipa City Science INHS, Pinagtongulan INHS, San Celestino INHS, Rizal INHS, San Isidro INHS, Bolbok INHS, Lodlod INHS, Lumbang INHS, and Bugtongnapulo INHS.

These schools provided a suitable setting for the study because of the presence of qualified mathematics teachers and the accessibility of respondents for data collection. Moreover, it helped examine teachers' epistemological knowledge and classroom discourse practices in a real instructional environment. This ensures that the findings are relevant, contextually grounded, and directly applicable to the development of a data-driven professional development program for Senior High School mathematics teachers.

Instrumentation

To collect data relevant to the study, a researcher-developed instrument was utilized. Specifically, two primary instruments were developed and will undergo validation. The first is the Epistemological Knowledge in Mathematics Questionnaire (EKMQ), which measures the independent variable. The second is the Mathematical Discourse Practices Questionnaire (MDPQ), which measures the dependent variable. A structured profile questionnaire was included at the beginning of the instrument to capture respondents' demographic and professional characteristics. This includes years of teaching experience, highest educational attainment with specialization, instructional demand, subjects currently taught, and mathematics-related trainings or seminars attended.

Description of Instruments

The research instrument is divided into three parts: demographic profile, epistemological knowledge of mathematics, and mathematical discourse.

The first part, the Respondent Profile Questionnaire, gathered demographic and professional information such as teaching experience, educational attainment, instructional load, subjects taught, and relevant trainings or seminars. Respondents are asked to select the option that best describes their profile.
The second part is the Epistemological Knowledge in Mathematics Questionnaire (EKMQ). This measured the teachers' beliefs and understanding of mathematical knowledge. Based on a scale and description, respondents were asked to indicate the Extent of their beliefs about mathematics and its learning.

The third one is the Mathematical Discourse Practices Questionnaire (MDPQ). This assessed teachers' instructional practices in using communicative explanations to teach mathematics in the classroom. As in Part II, respondents were asked to describe the Extent of their response using the provided scale.

The results of the questionnaire administration were interpreted using the following descriptive scale, based on respondents' mean scores from the four-point Likert-scale instrument. The interpretation serves as the basis for determining the Extent of respondents' epistemological knowledge about mathematics and the level of their mathematical discourse practices

To quantify the level of Epistemological Knowledge in Mathematics (EK) and Mathematical Discourse Practices (MDP), a 4-point Likert scale was utilized. Participants selected numerical responses from 1 to 4, where each option corresponded to specific descriptors representing their degree of belief and practice frequency:

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Scale	Extent of Epistemological Knowledge	Mathematical Discourse Practices
4	To a Very High Extent	Always Practiced
3	To a High Extent	Frequently Practiced
2	To a Moderate Extent	Moderately Practiced
1	To a Low Extent	Rarely or Not Practiced

To interpret the overall composite means derived from these numerical responses, established statistical limits were applied as shown in the tables below:

Numerical Scale	Mean Score Range	Verbal Interpretation
4	3.50 – 4.00	To a Very High Extent Always Practiced
3	2.50 – 3.49	To a High Extent / Frequently Practiced
2	1.50 – 2.49	To a Moderate Extent / Moderately Practiced
1	1.00 – 1.49	To a Low Extent / Rarely or Not Practiced

Validity and Reliability Measures

The instruments have undergone validation through review by a panel of experts in mathematics education and research methodology. Pilot testing was conducted to assess the instrument's validity and reliability. Reliability was established using internal consistency measures, such as Cronbach's alpha, and refined as necessary to enhance stability and consistency.

The instruments provided systematic, reliable measures of the study variables and yielded empirical data to inform the development of a data-driven professional development program tailored to SHS mathematics teachers' needs. The validated instrument was attached in the Appendices to ensure transparency, enable replication, and support future research initiatives.

Data Gathering Procedure

A systematic process for collecting data from respondents in the locale was followed. Administrative and ethical preparations were undertaken. This includes securing permits from the Schools Division of Lipa City. Next is obtaining institutional approvals from the participating institutions. schools. Last is finalizing the researcher-developed instruments, the Epistemological Knowledge in Mathematics Questionnaire (EKMQ) and the Mathematical Discourse Practices Questionnaire (MDPQ).

The researchers explained to each participant the purpose, scope, and significance of the study. In the consent, voluntary participation is emphasized, along with confidentiality and the secure handling of data. They were assured that their responses would be used exclusively for research and to inform the design of a professional development program.

The EKMQ and MDPQ were administered face-to-face or through online modality. Each participant was given sufficient time to complete the instruments. Moreover, standardized instructions were provided to ensure a consistent understanding of the items. Pilot testing was done to evaluate the clarity, coherence, and appropriateness of the questionnaires, and necessary adjustments will be made based on feedback.

The questionnaires were retrieved, reviewed for completeness, and analyzed upon completion. For online modality, responses were retrieved automatically through google forms. Data were organized using appropriate statistical software or applications. This is to facilitate descriptive, relational, group-comparison, and predictive analyses.

Once the data were collected, they formed the foundation for developing a data-driven professional development program. The program was designed to enhance classroom discourse practices among Senior High School mathematics teachers in the Division of Lipa City.

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Ethical Considerations

Ethical principles were upheld to protect the dignity and rights of all participants in this study. Prior to data collection, permission was sought through communication from the authorities. More so, this study adhered to ethical standards and complied with relevant legal regulations, including the Data Privacy Act of 2012 (Republic Act No. 10173).

The study's details, such as purpose, procedures, expected duration, and potential benefits and risks, were communicated to the respondents. Participation was voluntary, and they had the right to withdraw from the study at any point without any penalty or prejudice. Informed consent forms were provided to each participant, as attached to the questionnaire, to formally document their voluntary agreement.

All personal information and responses were treated with strict confidentiality. The data collected were stored securely and retained only for the duration necessary for research purposes. It will be disposed of using secure methods to prevent unauthorized access.

The study was designed to avoid causing harm to participants. Any AI-assisted processes are disclosed in the research documentation to ensure transparency and adherence to ethical research practices. These ensured that the research was done responsibly.

Data Management and Data Analysis Procedures

Before the statistical analysis, the collected data were organized, coded, and entered into the statistical software (s), and carefully cleaned to identify and correct missing values, inconsistencies, or outliers. Entries against the original questionnaires were checked to ensure accuracy. Coded identifiers helped keep responses confidential while linking them to respondents' profile variables. The prepared data were organized to align with the research questions and variables. Each column corresponded to a specific item from the research instrument.

Descriptive Statistics

Descriptive statistical methods were used to summarize the characteristics of the respondents and give an overview of the collected data. Frequency counts and percentages were used to describe profile variables, including years of teaching experience, highest educational level, instructional demand, subjects taught, and math-related training or seminars attended.

Means and weighted means were computed to find the general level of teachers' epistemological knowledge and math discourse practices. Standard deviations measure the variability of responses.

Inferential Statistics

Inferential statistical tests were used to examine relationships, group differences, and predictive effects. Pearson Product-Moment Correlation was used to assess the relationship between epistemological knowledge and mathematical discourse practices. Independent-samples t-tests and one-way ANOVA were then used to determine whether significant differences exist between groups in the dependent variable when respondents are grouped by profile variables. Moreover, multiple regression analysis predicted the Extent to which epistemological knowledge influences mathematical discourse practices.

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RESULTS AND DISCUSSION

Descriptive Statistics Summary Tables

This section presents the descriptive analysis of the data obtained from the study. The results are summarized using appropriate descriptive statistics to provide a clear overview of the dataset's characteristics. Measures of central tendency, variability, and distribution, where applicable, are used to describe the variables and identify emerging patterns and trends. The descriptive findings serve as the foundation for the subsequent inferential analyses and interpretation of the study's results.

Research Question 1: What is the profile of the respondents in terms of their Bachelor's Degree?

To answer this research question, respondents were categorized according to their Bachelor's degree specialization. Frequency counts and percentage distributions were calculated to show how the sample is distributed across these academic backgrounds. These findings are summarized in Table 1.1.

Table 1.1. *Profile of the Respondents in terms of Bachelor's Degree*

Bachelor's Degree	**Frequency n = 43**	**Percentage**
BS Engineering (any field)	4	9.30%
BS Mathematics / Applied Mathematics / Statistics	5	11.63%
Bachelor of Secondary Education (BSEd) Major in Mathematics	32	74.42%
BS Information Technology / Computer Science	2	4.65%

Table 1.1 presents the distribution of the 43 respondents categorized by their undergraduate academic backgrounds. The data reveal that a substantial majority of 32 participants hold a Bachelor of Secondary Education (BSEd) Major in Mathematics, representing 74.42% of the total sample. This is followed by 5 respondents (11.63%) who earned degrees in BS Mathematics, Applied Mathematics, or Statistics. Furthermore, 4 participants, accounting for 9.30%, completed a degree in BS Engineering across various disciplines, while the remaining 2 respondents, comprising 4.65%, possess a degree in BS Information Technology or Computer Science.

These findings indicate that the sample is predominantly composed of professionally trained secondary mathematics educators, supplemented by a minor proportion of graduates from other fields. This academic distribution provides essential contextual information regarding the participants' foundational expertise. Such specialized backgrounds in pedagogy and mathematics may significantly influence the teachers' insights, classroom practices, and evaluation of the core variables investigated in this study. What is the profile of the respondents in terms of their years of teaching experience?

What is the profile of the respondents in terms of their years of teaching experience?

Participants were grouped based on their total length of teaching experience. The researcher utilized frequency counts alongside relative percentage distributions to illustrate the professional distribution across different experience tiers. A full summary of these data is detailed in Table 1.2.

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Table 1.2 .*Profile of the Respondents in terms of Teaching Experience*

Teaching Experience	Frequency n = 43	Percentage
Less than 1 year	3	13.95%
1–3 years	14	32.56%
4–6 years	5	11.63%
7–10 years	11	25.58%
11–15 years	6	6.98%
16–20 years	2	4.65%
More than 20 years	2	4.65%

Table 1.2 presents the distribution of the 43 respondents by length of teaching experience. The data indicate that the largest cohort consists of 14 educators with 1 to 3 years of service, representing 32.56% of the total sample. This is followed by 11 respondents (25.58%) who have taught for 7 to 10 years. Meanwhile, 6 teachers, accounting for 13.95%, possess 11 to 15 years of professional experience, and 5 participants, or 11.63%, fall within the 4 to 6 years bracket. A smaller group of 3 respondents, representing 6.98%, have less than 1 year of tenure, while those with 16 to 20 years and more than 20 years account for 2 educators (4.65%) each.

This shows a fairly balanced distribution of novice and experienced educators across the sample, though early-career teachers predominate. This variation in classroom exposure provides valuable analytical context, as teaching longevity directly affects pedagogical familiarity, instructional competence, and the overall perspective teachers bring to assessing the primary variables under investigation in this study.

What is the profile of the respondents in terms of their highest educational attainment?

To address this specific research objective, participants were grouped by advanced academic qualifications and completed degrees. Using frequency counts and percentage distributions, the structural composition of the sample's educational background was established. Findings are presented in Table 1.3.

Table 1.3. *Profile of the Respondents in terms of Highest Educational Attainment*

Highest Educational Attainment	Frequency n = 43	Percentage
Bachelor's Degree – Mathematics	11	25.58%
Bachelor's Degree – Mathematics Education	15	34.88%
Bachelor's Degree – Non-Mathematics (e.g., English, Science, etc.)	2	16.28%
Master's Degree – Mathematics	7	9.30%
Master's Degree – Mathematics Education	4	9.30%
Master's Degree – Non-Mathematics Field	4	4.65%

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Table 1.3 presents the distribution of the 43 respondents according to their highest educational attainment. The data show that the largest group comprises 15 participants with a Bachelor's Degree in Mathematics Education, accounting for 34.88% of the total sample. This is followed by 11 respondents, accounting for 25.58%, with the highest level being a Bachelor's Degree in Mathematics. Meanwhile, 7 educators (16.28%) completed a Master's Degree in Mathematics, and 4 participants (9.30%) earned a Master's Degree in Mathematics Education. Additionally, 2 respondents, representing 4.65%, hold a Bachelor's Degree in a non-mathematics field, while 4 teachers, comprising 9.30%, achieved a Master's Degree in a non-mathematics specialization.

The data show that while most respondents' highest qualification remains at the undergraduate level, a noteworthy segment has pursued postgraduate studies. This academic composition provides important contextual insight, as advanced degree qualifications are enhanced. subject mastery and pedagogical skills, which may considerably influence the respondents' professional evaluations and insights regarding the key variables analyzed in this study.

What is the profile of the respondents in terms of the number of ancillary roles they hold?

To evaluate this inquiry, participants were categorized by the number of supplementary administrative and institutional designations they held. Frequency tallies and percentage calculations were conducted to capture the Extent of extra duties assigned across the sample. The comprehensive distribution is outlined in Table 1.4.

Table 1.4. *Profile of the Respondents in terms of Number of Ancillary Roles*

Number of Ancillary Roles	**Frequency n = 43**	**Percentage**
0 role	12	27.91%
1-2 roles	31	72.09%

Table 1.4 presents the distribution of the 43 respondents by assigned ancillary role. The data indicate that a substantial majority of 31 educators, representing 72.09% of the sample, handle between 1 and 2 ancillary duties alongside teaching. In contrast, 12 participants (27.91%) hold no additional institutional roles.

These findings show that most teachers take on administrative or supplementary assignments in addition to classroom instruction. This workload context is crucial, as extra responsibilities can influence teacher time Management, stress levels, and instructional effectiveness, directly shaping their responses to the main variables under study.

What is the profile of the respondents in terms of the number of Mathematics-related trainings and seminars attended?

To explore this objective, respondents were categorized into distinct brackets according to the number of mathematics-focused seminars they attended. The proportion of participants in each training-frequency tier was calculated from frequency counts and percentages. This is illustrated in Table 1.5.

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Table 1.5. *Profile of the Respondents in terms of Number of Mathematics-related Trainings/Seminars Attended*

Number of Trainings/Seminars Attended	Frequency n = 43	Percentage
None	6	51.16%
1–2 trainings/seminars	22	25.58%
3–5 trainings/seminars	11	4.65%
6–10 trainings/seminars	2	4.65%
More than 10 trainings/seminars	2	13.95%

Table 1.5 presents the distribution of the 43 respondents based on their participation in discipline-specific professional development. As shown in the data, a slight majority of 22 educators (51.16% of the sample) have attended 1 to 2 mathematics-related training sessions or seminars. This is followed by 11 respondents (25.58%) who engaged in 3 to 5 training sessions. Conversely, 6 participants (13.95%) reported no attendance at any mathematics-focused professional development activities. Lastly, teachers who attended 6 to 10 seminars and those with more than 10 training sessions comprised 2 respondents (4.65%) each.

While most educators have received moderate professional training, high levels of seminar participation remain relatively limited within the sample. This training profile provides significant background context, as continuous professional learning sharpens pedagogical content knowledge and updates instructional strategies. Consequently, varying levels of training experience may significantly affect how teachers implement curriculum standards and assess the primary variables explored in this research project.

Research Question 2: What is the extent of Senior High School teachers' epistemological knowledge about mathematics as measured by the Epistemological Knowledge in Mathematics Questionnaire (EKMQ)?

To measure the extent of Senior High School teachers' epistemological knowledge about mathematics, the mean and standard deviation were calculated for each item on the questionnaire. The mean shows the average score of the teachers for every indicator, while the standard deviation reflects how much their answers varied. These summary scores are detailed in Table 2.

Table 2. *Extent of Senior High School Teachers' Epistemological Knowledge about Mathematics*

Statements	Weighted Mean	sd	Remarks
1. Mathematical knowledge consists of fixed truths that remain stable over time.	1.65	0.87	To a Moderate Extent
2. Mathematical ideas can evolve as new understandings are developed.	3.65	0.48	To a Very High Extent
3. Once a mathematical solution is proven, it is not typically subject to further questioning.	1.86	0.86	To a Moderate Extent
4. Mathematical knowledge may be refined through exploration and discussion.	3.70	0.56	To a Very High Extent
5. All mathematical problems have only one correct interpretation.	2.53	0.98	To a High Extent

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6. Mathematical concepts can be interpreted in multiple valid ways.	3.70	0.51	To a Very High Extent
7. Mathematics is composed of isolated facts and procedures.	2.14	1.06	To a Moderate Extent
8. Mathematical concepts are interconnected and build upon one another.	3.67	0.52	To a Very High Extent
9. Understanding mathematics requires seeing relationships among concepts.	3.70	0.51	To a Very High Extent
10. Mathematical topics can be learned independently without connections.	2.30	1.06	To a Moderate Extent
11. Deep understanding in mathematics involves integrating multiple ideas.	3.72	0.45	To a Very High Extent
12. Mathematics is mainly about memorizing separate formulas.	2.88	1.07	To a High Extent
13. Mathematical knowledge mainly comes from textbooks and authorities.	2.67	1.08	To a High Extent
14. Learners can construct mathematical understanding through reasoning.	3.60	0.54	To a Very High Extent
15. Teachers are the primary source of correct mathematical knowledge.	2.26	0.98	To a Moderate Extent
16. Mathematical knowledge can be developed through collaborative inquiry.	3.77	0.43	To a Very High Extent
17. Students should rely on experts rather than their own thinking.	2.44	0.98	To a Moderate Extent
18. Personal reasoning plays a role in developing mathematical knowledge.	3.67	0.47	To a Very High Extent
19. Mathematical answers are correct if they match the teacher's solution.	2.67	1.08	To a High Extent
20. Mathematical claims should be justified using logical reasoning.	3.53	0.55	To a Very High Extent
21. Memorized procedures are sufficient to validate mathematical answers.	2.58	1.03	To a High Extent
22. Explaining why a solution works is essential in mathematics.	3.65	0.65	To a Very High Extent
23. Authority is enough to determine whether a mathematical idea is correct.	2.53	1.18	To a High Extent
24. Mathematical understanding requires evidence and justification.	3.67	0.64	To a Very High Extent
25. Learning mathematics mainly involves memorizing steps and formulas.	2.47	1.08	To a Moderate Extent
26. Understanding mathematics involves constructing meaning from concepts.	3.65	0.53	To a Very High Extent
27. Mathematical ability is something people are born with and cannot change.	2.58	1.14	To a High Extent
28. Effort and strategy can improve one's ability to learn mathematics.	3.74	0.49	To a Very High Extent
29. Quick problem-solving indicates better mathematical understanding.	1.88	0.88	To a Moderate Extent

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30. Learning mathematics is a gradual process that develops over time.	3.65	0.48	To a Very High Extent
Composite Mean	**3.02**	**0.44**	**To a High Extent**

Note: For interpretation, the following remarks apply to the mean interval: 3.50 – 4.00 for To a Very High Extent, 2.50 – 3.49 for To a High Extent, 1.50 – 2.49 for To a Moderate Extent, and 1.00 – 1.49 for To a Low Extent.

Table 2 presents the mean and standard deviation for each indicator measuring Senior High School teachers' epistemological knowledge about mathematics. The overall composite mean score of 3.02 corresponds to a verbal interpretation of To a High Extent, indicating that respondents generally demonstrated a strong level of mathematical epistemological understanding. It should be noted that the EKMQ includes both positively and negatively worded statements. The negatively worded statements, Items 1, 3, 5, 7, 10, 12, 13, 15, 17, 19, 21, 23, 25, 27, and 29, represent less constructivist or less sophisticated views of mathematical knowledge and were scored in their original response direction for purposes of describing the Extent to which respondents endorsed each statement. Thus, lower mean scores on these negatively worded items indicate less endorsement of the corresponding traditional or less epistemologically informed view, while higher mean scores on the positively worded items indicate stronger endorsement of contemporary epistemological views of mathematics. The items presented in Table 2 were therefore interpreted using the same response-scale intervals shown in the table, without reversing the item-level descriptive ratings.

Among the indicators, statement 16 ("Mathematical knowledge can be developed through collaborative inquiry") obtained the highest mean score of 3.77, suggesting that collaborative discovery was most strongly manifested among the educators. In contrast, statement 1 ("Mathematical knowledge consists of fixed truths that remain stable over time") recorded the lowest mean score of 1.65 (To a Moderate Extent), reflecting lower alignment with static views of knowledge. The overall standard deviation of 0.44 indicates that the responses were relatively clustered, suggesting a high level of agreement among the teachers.

Research Question 3: What is the level of Senior High School teachers' mathematical discourse practices as measured by the Mathematical Discourse Practices Questionnaire (MDPQ)?

To determine the level of Senior High School teachers' mathematical discourse practices as measured by the Mathematical Discourse Practices Questionnaire (MDPQ), the mean and standard deviation were computed for each indicator. The mean represents the average rating of respondents for each item, while the standard deviation indicates the variability of the responses. The results are presented in Table 3.

Table 3. *Level of Senior High School Teachers' Mathematical Discourse Practices*

Statements	Weighted Mean	sd	Remarks
1. I ask students to explain their mathematical reasoning during class discussions.	3.77	0.53	Very Highly Practiced
2. I present solutions without requiring further explanation from students.	2.79	1.26	Highly Practiced
3. I encourage learners to elaborate on how they arrived at their answers.	3.74	0.49	Very Highly Practiced
4. I demonstrate multiple ways of explaining mathematical concepts.	3.70	0.46	Very Highly Practiced

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5. I focus mainly on giving final answers rather than explanations.	3.21	1.10	Highly Practiced
6. I prompt students to clarify incomplete mathematical explanations.	3.58	0.59	Very Highly Practiced
7. I require students to justify their mathematical solutions during lessons by explaining the reasoning behind their answers.	3.65	0.48	Very Highly Practiced
8. I allow students to give answers without explaining their reasoning.	3.12	1.00	Highly Practiced
9. I ask learners to defend their mathematical ideas using logical arguments.	3.37	0.72	Highly Practiced
10. I rarely ask students to explain why their answers are correct.	2.91	1.09	Highly Practiced
11. I encourage students to compare and justify different solution methods.	3.60	0.58	Very Highly Practiced
12. I accept correct answers even without reasoning from students.	2.86	0.97	Highly Practiced
13. I promote classroom discussions where students respond to each other's ideas.	3.70	0.51	Very Highly Practiced
14. I conduct lessons in a teacher-centered manner with minimal student participation and interaction.	2.91	1.11	Highly Practiced
15. I encourage students to ask questions during mathematical discussions when they need clarification or further explanation.	3.74	0.49	Very Highly Practiced
16. I limit student interaction to maintain classroom control.	3.33	0.92	Highly Practiced
17. I facilitate open-ended discussions in which students explain, compare, and justify different mathematical solutions to problems.	3.60	0.66	Very Highly Practiced
18. I rarely allow students to engage in mathematical dialogue with peers.	3.02	1.08	Highly Practiced
19. I encourage students to use precise mathematical language when explaining ideas.	3.47	0.77	Highly Practiced
20. I focus more on answers than on mathematical terminology.	2.70	0.91	Highly Practiced
21. I require students to represent solutions using diagrams, symbols, or graphs.	3.28	0.70	Highly Practiced
22. I avoid using multiple representations when teaching mathematics.	2.72	1.01	Highly Practiced
23. I emphasize correct mathematical vocabulary during instruction.	3.60	0.54	Very Highly Practiced
24. I allow informal language even when discussing formal mathematical concepts.	2.12	0.85	Moderately Practiced
25. I guide students in discussing and refining mathematical ideas together.	3.58	0.54	Very Highly Practiced
26. I present mathematical knowledge as fixed and non-negotiable.	2.63	0.98	Highly Practiced

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27. I encourage students to revisit and revise their mathematical thinking.	3.53	0.63	Very Highly Practiced
28. I discourage students from questioning established procedures.	3.23	1.07	Highly Practiced
29. I support learners in building shared understanding of mathematical concepts.	3.74	0.58	Very Highly Practiced
30. I treat mathematical answers as final once presented in class.	2.49	1.18	Moderately Practiced
Composite Mean	**3.26**	**0.46**	**Highly Practiced**

Note: For interpretation, the following remarks apply to the mean interval: 3.50 – 4.00 for Very Highly Practiced, 2.50 – 3.49 for Highly Practiced, 1.50 – 2.49 for Moderately Practiced, and 1.00 – 1.49 for Least Practiced.

Table 3 presents the mean and standard deviation for each indicator measuring the Level of Senior High School Teachers' Mathematical Discourse Practices. The MDPQ includes both positively and negatively worded statements. The negatively worded items, Items 2, 5, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, and 30, were reverse-coded during data analysis (4 = 1, 3 = 2, 2 = 3, and 1 = 4) so that higher scores consistently indicate a higher level of mathematical discourse practice. The item means and composite means were interpreted using the response-scale intervals presented below.

The overall composite mean score of 3.26 corresponds to a verbal interpretation of Highly Practiced, indicating that respondents generally engaged in effective discourse strategies at a high level. Among the indicators, statement 1 ("I ask students to explain their mathematical reasoning during class discussions") obtained the highest mean score of 3.77 (Very Highly Practiced), suggesting that eliciting student reasoning was most strongly manifested among the respondents. In contrast, statement 24 ("I allow informal language even when discussing formal mathematical concepts") recorded the lowest mean score of 2.12 (Moderately Practiced), indicating relatively lower application. The overall standard deviation of 0.46 indicates a high level of agreement among the respondents.

Hypothesis / Research Question Test Results

This section details the outcomes of the inferential statistical procedures used to evaluate the study's core hypotheses and research questions. Depending on the nature of the data and research design, parametric or non-parametric analyses were used to assess significant associations, variances, or predictive relationships among the targeted variables. The presentation of these empirical findings strictly mirrors the logical sequence of hypotheses outlined in the opening chapter.

Differences in Senior High School Teachers' Epistemological Knowledge About Mathematics When Respondents Are Grouped According to Their Profile Variables

To test this hypothesis, an independent samples t-test was conducted to determine whether a statistically significant difference exists between the two groups. Results of the analysis are presented in Table 4.

Table 4. *Significant Difference in Senior High School Teachers' Epistemological Knowledge about Mathematics when Respondents are grouped according to the Profile Variables*

Profile	F-value	p-value	Decision	Remarks
Bachelor's Degree	2.44	0.204	Failed to Reject Ho	Not Significant
Years of Teaching Experience	1.44	0.548	Failed to Reject Ho	Not Significant
Highest Educational Attainment	2.44	0.204	Failed to Reject Ho	Not Significant
Number of Ancillary Roles	1.99*	0.053	Failed to Reject Ho	Not Significant

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Number of Trainings/Seminars Attended	0.53	0.726	Failed to Reject Ho	Not Significant

** Independent t-test*

Table 4 presents the results of the independent samples t-test conducted to determine whether a significant difference exists in Senior High School teachers' epistemological knowledge about mathematics when grouped by the number of ancillary roles. The results show that the computed t-value of 1.99 with a p-value of 0.053 indicates that the difference between the two groups is not statistically significant at the .05 level of significance. Since the p-value is greater than .05, the null hypothesis is failed to be rejected. This suggests that the respondents' epistemological knowledge about mathematics does not differ significantly based on the number of ancillary roles they hold.

This finding suggests that the number of ancillary roles does not significantly influence teachers' epistemological knowledge about mathematics. Although teachers may differ in the number of additional responsibilities they perform, these differences do not appear to result in meaningful differences in their epistemological knowledge. This indicates that teachers' understanding of mathematical knowledge may remain relatively consistent regardless of their ancillary assignments.

Differences in Senior High School Teachers' Mathematical Discourse Practices When Respondents Are Grouped According to Their Profile Variables

To examine whether differences exist among multiple groups, a one-way analysis of variance (ANOVA) was conducted. The results of the analysis are presented in Table 5.

Table 5. *Significant Difference Senior High School Teachers' Mathematical Discourse Practices when Respondents are grouped according to the Profile Variables*

Profile	F-value	p-value	Decision	Remarks
Bachelor's Degree	2.64	0.204	Failed to Reject Ho	Not Significant
Years of Teaching Experience	0.90	0.548	Failed to Reject Ho	Not Significant
Highest Educational Attainment	2.64	0.201	Failed to Reject Ho	Not Significant
Number of Ancillary Roles	0.75*	0.459	Failed to Reject Ho	Not Significant
Number of Trainings/ Seminars Attended	4.58	0.049**	Reject Ho	Significant

** Independent t-test*

***Using Post-hoc Tukey test: 1-2 trainings vs 3-5 trainings <0.03 (significant)*

Table 5 presents the results of the one-way ANOVA conducted to determine whether significant differences exist among Senior High School teachers' mathematical discourse practices when grouped by their profile variables. For the majority of the profile variables, including Bachelor's Degree ($F = 2.64$, $p = 0.204$), Years of Teaching Experience ($F = 0.90$, $p = 0.548$), Highest Educational Attainment ($F = 2.64$, $p = 0.201$), and Number of Ancillary Roles $t = 0.75$, $p = 0.459$), the differences are not statistically significant at the .05 level of significance, and the null hypothesis was failed to be rejected. However, for Number of Trainings/Seminars Attended, the computed F-value of 4.58 with a p-value of 0.049 indicates that the differences among the groups are statistically significant at the .05 level of significance. Since the p-value is less than .05, the null hypothesis is rejected.

Because the overall ANOVA for the number of trainings attended was statistically significant ($p = 0.049$), a Post Hoc Tukey HSD test was conducted to identify the specific pairwise group differences. The post-hoc analysis indicated a significant difference between teachers who attended 1–2 trainings and those who attended 3–5 trainings ($p < 0.03$). Teachers who participated in 3–5 professional development training

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sessions reported significantly higher levels of mathematical discourse practices than their peers who completed only 1–2 training sessions.

This finding implies that active participation in continuous professional development plays a vital role in enhancing how teachers facilitate math talks, explanations, and meaning negotiation in the classroom. Attending 1 to 2 trainings may provide foundational Awareness, but reaching a threshold of 3 to 5 targeted seminars provides teachers with the pedagogy, strategy repetition, and mastery needed to translate learning into frequent classroom discourse. Specialized training equips educators with effective scaffolding techniques to shift instruction from traditional lecturing toward interactive discourse.

This result aligns with the findings of Desimone (2009), who emphasized that sustained professional development with greater depth and frequency directly transforms instructional practices in mathematics. Similarly, research by Darling-Hammond et al. (2017) demonstrated that ongoing teacher training provides the collaborative frameworks necessary to successfully implement active-learning and discourse-rich environments. These findings reinforce that investing in multiple training opportunities directly elevates classroom instructional quality.

Relationship Between Senior High School Teachers' Epistemological Knowledge About Mathematics and Their Mathematical Discourse Practices

To determine whether a significant relationship exists between Senior High School teachers' epistemological knowledge about mathematics and their mathematical discourse practices, a Pearson product-moment correlation analysis was conducted. The results of the analysis are presented in Table 6.

Table 6. *Significant Relationship between Senior High School Teachers' Epistemological Knowledge about Mathematics and their Mathematical Discourse Practices*

Variables	Pearson-r	p-value	Decision	Remarks
Teachers' Epistemological Knowledge vs. Mathematical Discourse Practices	0.76	< .001	Reject Ho	Significant

Table 6 presents the results of the Pearson correlation analysis conducted to determine whether a significant relationship exists between Senior High School teachers' epistemological knowledge about mathematics and their mathematical discourse practices. The computed Pearson-r coefficient of 0.76, with a p-value < .001, indicates a strong, positive, and statistically significant correlation at the .05 level of significance. Since the p-value is less than 0.05, the null hypothesis is rejected. This result suggests that higher levels of epistemological knowledge about mathematics are significantly associated with more effective mathematical discourse practices among the respondents.

The strong positive relationship further indicates that teachers with higher epistemological knowledge of mathematics tend to exhibit stronger mathematical discourse practices. This suggests that teachers' understanding of the nature and development of mathematical knowledge may be reflected in how they engage learners in mathematical discussions and communication.

Predictive Influence of Senior High School Teachers' Epistemological Knowledge About Mathematics on Their Mathematical Discourse Practices

To evaluate Hypothesis 4 and determine the Extent to which Senior High School teachers' epistemological knowledge about mathematics predicts or influences their mathematical discourse practices, a simple linear regression analysis was conducted. The results of the analysis are presented in Table 7.

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Table 7. *Regression Analysis Predicting Mathematics Discourse Practices*

Predictor Variable	*B*	*SE*	*B*	*T*	*P*
Intercept	0.88	0.32	-	2.72	0.010
School Teachers' Epistemological Knowledge	0.79	0.11	0.76	7.38	< .001

Model Summary	VALUE
R	0.76
R^2	0.57
ADJUSTED R^2	0.56
F	54.53
P	<.001

Note. *B* = unstandardized coefficient; *β* = standardized coefficient; *SE* = standard error; *t* = t statistic; *p* = probability value.

Table 7 presents the results of the multiple regression analysis conducted to determine the Extent to which teachers' epistemological knowledge about mathematics predicts mathematical discourse practices. The model explains 57% of the variance in the dependent variable ($R^2 = 0.57$), indicating that epistemological knowledge accounts for a substantial proportion of the variation in teachers' mathematical discourse practices. Teachers' epistemological knowledge about mathematics emerged as a significant predictor ($\beta = 0.76$, $p < .001$), indicating a strong positive influence on mathematical discourse practices. The results suggest that teachers' epistemological knowledge about mathematics plays an important role in predicting their mathematical discourse practices. These findings provide empirical support for the proposed relationship between epistemological knowledge and mathematical discourse practices in the conceptual framework.

The significant regression result indicates that teachers' epistemological knowledge about mathematics is a meaningful predictor of their mathematical discourse practices. The standardized coefficient ($\beta = 0.76$) indicates a strong positive contribution, suggesting that teachers with higher epistemological knowledge tend to demonstrate stronger mathematical discourse practices. The overall model was also statistically significant ($F = 54.53$, $p < .001$), confirming that the regression model provides a significant prediction of mathematical discourse practices.

Interpretation of Statistical Findings

The statistical analyses provide a comprehensive description of the respondents' profiles, their epistemological knowledge of mathematics, their mathematical discourse practices, and the relationships among these variables. The findings collectively address the research questions and hypotheses by presenting both descriptive and inferential evidence regarding the characteristics and instructional orientations of the participating Senior High School mathematics teachers.

The highest concentrations in the respondents' profile show that the majority were BSEd Mathematics graduates (74%), held one to two ancillary school responsibilities (72%), and had attended one to two training sessions (51%). The lowest representation was among those in the early career stage, with only 33% having 1 to 3 years of teaching experience, alongside a smaller subset possessing postgraduate qualifications or attending more than 2 training programs. These extreme points indicate a core group of early-to-mid-career teachers with similar foundational preparation, contrasted by a much smaller segment of highly experienced or extensively trained educators.

The highest-rated indicators of epistemological knowledge centered on the evolving, interconnected, and reasoning-oriented nature of mathematics. Conversely, the lowest-rated indicators were statements reflecting fixed, authority-dependent, or memorization-oriented conceptions. Grouping these extremes reveals that while teachers strongly endorse constructivist and dynamic views of mathematics, they consistently reject rigid, traditional views of the discipline.

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The highest-rated practices focused on student explanation, justification, collaborative discussion, and active participation. In contrast, the lowest-rated practices involved limited classroom interaction, accepting answers without justification, and reliance on teacher-centered instruction. Comparing these two extremes demonstrates a clear instructional shift toward interactive, student-centered discourse over traditional, low-engagement teaching methods. Across most demographic variables, the highest and lowest subgroups showed no significant differences in epistemological knowledge or discourse practices. The only area of divergence was training frequency: teachers with three to five trainings scored significantly higher in mathematical discourse practices than the lowest group, attending only one to two trainings ($F = 4.58$, $p = .049$). This highlights that lower attendance in professional development corresponds to lower implementation of discourse practices, whereas higher training involvement directly elevates classroom practice.

The strongest statistical dynamic emerged between low and high epistemological knowledge and discourse practices. Teachers scoring at the highest levels of epistemological knowledge systematically demonstrated the highest levels of discourse practices ($r = .76$, $p < .001$), with regression showing a strong positive effect (Estimate = 0.79, $t = 7.38$, $p < .001$). Conversely, lower epistemological knowledge directly predicted lower engagement in classroom discourse practices.

Dominant Demographic Characteristics

The respondents' dominant demographic characteristics across the profile variables examined in the study highlight key baseline patterns among the participants.

Respondents holding a Bachelor of Secondary Education degree recorded the highest frequency ($n = 32$), followed closely by those handling 1–2 ancillary roles ($n = 31$). In terms of professional development and academic background, 22 respondents attended 1–2 training sessions or seminars, while 15 respondents held a Bachelor's degree in Math Education. Meanwhile, respondents with 1–3 years of teaching experience represented the lowest dominant category ($n = 14$).

These numbers summarize the predominant profile characteristics of the respondents and directly support the detailed statistical distributions presented in Tables 1.1 to 1.5.

Interpretation of Results in Light of Frameworks and Literature

Research Question 1: What is the profile of the respondents in terms of their Bachelor's degree, years of teaching experience, highest educational attainment, number of ancillary roles, and number of Mathematics-related trainings/seminars attended?

The findings reveal that the respondents are predominantly professionally trained mathematics educators, with most holding a Bachelor of Secondary Education major in Mathematics. The teaching workforce is largely composed of early-career teachers; most respondents have undergraduate qualifications as their highest educational attainment, the majority perform one to two ancillary roles, and participation in mathematics-related professional development is generally limited to one or two training activities. Collectively, these characteristics establish the professional context within which teachers' epistemological knowledge and mathematical discourse practices are examined.

The respondent profile aligns with the study's theoretical foundation, particularly Teacher Cognition Theory and Epistemological Beliefs Theory. As discussed in Chapter 2, teachers' beliefs, knowledge structures, and instructional orientations are shaped by their professional preparation and experiences, which subsequently influence classroom practices (Trakulphadetkrai, 2022; Thurm & Barzel, 2022). Likewise, teacher knowledge extends beyond disciplinary expertise to encompass adaptive professional competence developed through authentic classroom engagement (Hamar, 2023; Chapman, 2021). The predominance of respondents with specialized mathematics education backgrounds suggests that the participants possess foundational disciplinary preparation consistent with the study's independent

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variable, while variations in teaching experience, educational attainment, ancillary responsibilities, and professional development provide meaningful contextual differences that may shape instructional cognition and practice.

The findings likewise correspond with the study's conceptual framework, which identifies respondent profile variables as contextual and grouping factors rather than primary causal variables. The framework proposes that years of teaching experience, educational attainment, specialization, and mathematics-related professional development may contribute to differences in teachers' epistemological knowledge and mathematical discourse practices, thereby providing an important basis for interpreting subsequent comparative, correlational, and predictive. analyses. Rather than functioning as direct determinants, these characteristics establish the professional conditions under which teachers construct and enact their instructional beliefs.

The demographic composition is likewise consistent with contemporary literature emphasizing that teacher competence develops through the interaction of formal academic preparation, professional experience, and continuous learning opportunities (Horn & Garner, 2022; Ribeiro et al., 2021). Furthermore, the relatively modest participation in mathematics-related professional development supports previous discussions that epistemological knowledge remains insufficiently developed when opportunities for sustained professional reflection are limited (Goldenberg et al., 2021; Fatima, 2023). Overall, the respondent profile provides an important contextual foundation for understanding the succeeding analyses, strengthening the interpretation of how professional characteristics relate to teachers' epistemological knowledge and mathematical discourse practices within the present research context.

Research Question 2: What is the extent of Senior High School teachers' epistemological knowledge about mathematics as measured by the Epistemological Knowledge in Mathematics Questionnaire (EKMQ)?

The findings indicate that Senior High School teachers demonstrated a high extent of epistemological knowledge about mathematics, suggesting that they generally hold sophisticated beliefs regarding the nature, acquisition, and development of mathematical knowledge. Notably, respondents most strongly endorsed the view that mathematical knowledge is developed through collaborative inquiry, while exhibiting comparatively lower agreement with the notion that mathematics consists of fixed and unchanging truths. These findings suggest that the respondents recognize mathematics as a dynamic, socially constructed, and evolving discipline rather than a body of absolute knowledge, reflecting a contemporary epistemological orientation toward mathematics teaching and learning.

The results strongly support the study's theoretical framework, particularly Epistemological Beliefs Theory, which posits that teachers' beliefs about the nature of knowledge influence how they interpret, construct, and facilitate learning experiences. As discussed in Chapter 2, sophisticated epistemological beliefs are characterized by recognizing knowledge as tentative, evolving, and developed through reasoning, inquiry, and social interaction rather than through passive transmission (Hofer & Pintrich, 1997; Greene et al., 2018). The respondents' strong endorsement of collaborative inquiry and their limited agreement with absolutist conceptions of mathematical knowledge demonstrate the practical manifestation of these theoretical propositions. Similarly, the findings are consistent with the study's theoretical foundation emphasizing that teachers' epistemological orientations shape instructional decisions and classroom discourse, thereby influencing students' opportunities to engage in mathematical reasoning and knowledge construction.

The findings likewise affirm the study's conceptual framework, which identifies epistemological knowledge as a foundational construct influencing teachers' mathematical discourse practices. The generally high level of epistemological knowledge suggests that the respondents possess the cognitive and philosophical orientations necessary to support learner-centered mathematical communication and inquiry-based instruction. The observed variation among indicators further implies that while sophisticated

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epistemological beliefs are generally evident, certain dimensions remain less strongly developed, reflecting the multidimensional nature of teachers' epistemological knowledge.

The present findings are consistent with the empirical literature reviewed in Chapter 2, which emphasizes that mathematics teachers increasingly view knowledge as constructed through exploration, collaboration, and reflective inquiry rather than as a collection of immutable facts (Chapman, 2021; Hamar, 2023; Thurm & Barzel, 2022). Likewise, studies highlighting the importance of collaborative knowledge construction and inquiry-oriented mathematics instruction support the respondents' strong endorsement of collaborative learning as a means of developing mathematical understanding (Horn & Garner, 2022; Ribeiro et al., 2021). At the same time, the comparatively lower endorsement of fixed conceptions of mathematical knowledge reinforces contemporary perspectives that effective mathematics teaching requires flexible and constructivist epistemological beliefs (Goldenberg et al., 2021; Fatima, 2023). Collectively, these findings strengthen existing evidence that teachers' sophisticated epistemological knowledge constitutes an essential foundation for effective mathematics instruction and provides important contextual support for examining its relationship with mathematical discourse practices in the succeeding analyses.

Research Question 3: What is the level of Senior High School teachers' mathematical discourse practices as measured by the Mathematical Discourse Practices Questionnaire (MDPQ)?

The findings indicate that Senior High School teachers exhibit a high level of mathematical discourse practices, suggesting that discourse-oriented instructional strategies are consistently integrated into their mathematics classrooms. Teachers most frequently encouraged students to explain their mathematical reasoning during class discussions, whereas the use of informal language in discussions of formal mathematical concepts was less common. These findings indicate that respondents generally facilitate learning environments that emphasize mathematical reasoning, justification, and purposeful communication while maintaining the precision expected in formal mathematical discourse.

These findings strongly support the study's theoretical framework, particularly Sociocultural Theory and mathematical discourse perspectives. Sociocultural Theory posits that learning is mediated through language and social interaction, making discourse a fundamental mechanism through which learners construct and refine mathematical understanding (Vygotsky, 1978, as cited in Kooloos et al., 2022). Likewise, the mathematical discourse perspectives of Cobb et al. (1993) and Sfard (2008), as discussed by Trakulphadetkrai (2022) and Thurm and Barzel (2022), emphasize that mathematical thinking develops through communication, explanation, justification, and collaborative meaning-making. The respondents' frequent practice of eliciting students' mathematical reasoning aligns with these theoretical propositions, demonstrating that classroom dialogue serves not merely as a vehicle for transmitting knowledge but as an essential process for developing mathematical understanding.

The findings likewise affirm the study's conceptual framework, which positions mathematical discourse practices as the dependent variable influenced by teachers' epistemological knowledge while recognizing teacher profile characteristics as contextual factors that may explain variations in instructional practice. The consistently high level of discourse practices supports the framework's assumption that teachers who possess more sophisticated epistemological orientations are more likely to implement discourse-rich, student-centered instructional approaches.

Contemporary studies describe mathematical discourse as a social process through which mathematical ideas are communicated, justified, negotiated, and refined, with effective teacher facilitation promoting higher levels of student reasoning and conceptual understanding (Kooloos et al., 2022; Shinno & Fujita, 2021). Similarly, discourse-rich classrooms are characterized by open-ended questioning, sustained justification, and meaningful student participation (Castro Superfine et al., 2024; Boran Yu & Cao, 2025), while high-quality discourse depends on teachers' ability to scaffold mathematical argumentation and reflective dialogue (Planas et al., 2024; Howell et al., 2025). The respondents' strong

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emphasis on asking students to explain their reasoning is therefore consistent with these findings. Furthermore, the comparatively lower use of informal language reflects the literature's recognition that productive mathematical discourse requires balancing accessible communication with the development of formal mathematical language and reasoning (Ribeiro et al., 2021; Smith, 2023).

Findings reinforce existing evidence that effective mathematical discourse is a defining feature of high-quality mathematics instruction. Within the context of the present study, they provide empirical support for the proposition that discourse-oriented teaching practices constitute an observable manifestation of teachers' professional knowledge and instructional beliefs, thereby strengthening the conceptual link between epistemological knowledge and the mathematical discourse practices examined in the subsequent analyses.

Research Question 4: Are there significant differences in Senior High School teachers' epistemological knowledge about mathematics when respondents are grouped according to their profile variables?

The findings indicate that Senior High School teachers' epistemological knowledge of mathematics does not differ significantly with the number of ancillary roles they hold. Although respondents varied in the Extent of their administrative and institutional responsibilities, these differences were not associated with statistically significant variations in their beliefs about the nature, acquisition, and development of mathematical knowledge. This suggests that teachers' epistemological knowledge remains relatively stable regardless of whether they perform classroom instruction exclusively or simultaneously undertake additional school assignments.

These findings are consistent with the study's theoretical framework, particularly Epistemological Beliefs Theory, which conceptualizes epistemological beliefs as relatively enduring cognitive structures developed through accumulated educational experiences, disciplinary preparation, and professional learning rather than through situational or administrative conditions (Hofer & Pintrich, 1997; Greene et al., 2018, as discussed in Chapter 2). Likewise, Sociocultural Theory recognizes that teachers' knowledge and beliefs evolve through sustained participation in professional communities and instructional practice rather than being determined solely by organizational roles (Vygotsky, 1978, as cited in Kooloos et al., 2022). The absence of significant differences, therefore, supports the theoretical proposition that epistemological knowledge is primarily shaped by teachers' educational and professional experiences rather than by the quantity of ancillary responsibilities they assume.

The findings likewise align with the study's conceptual framework, in which teacher profile variables function as contextual characteristics rather than direct determinants of epistemological knowledge. Although ancillary roles were included as a profile variable to explain variation among respondents, the results indicate that this characteristic does not substantially influence teachers' epistemological orientations. Consequently, the conceptual model is refined to suggest that administrative workload alone may not account for meaningful differences in teachers' beliefs about mathematics, while other factors within the framework may exert greater influence.

The present findings are generally consistent with the literature reviewed in Chapter 2, emphasizing that teachers' epistemological beliefs are more closely associated with professional preparation, disciplinary knowledge, reflective practice, and continuous learning than with organizational or administrative assignments (Greene et al., 2018; Chapman, 2021; Thurm & Barzel, 2022).

The reviewed studies likewise suggest that sophisticated epistemological beliefs develop through sustained engagement with mathematical inquiry, instructional experience, and collaborative professional learning rather than through additional institutional responsibilities (Horn & Garner, 2022; Ribeiro et al., 2021). Viewed alongside these studies, the present findings reinforce the proposition that administrative assignments neither enhance nor diminish teachers' epistemological knowledge in any measurable way.

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Findings show that teachers' epistemological knowledge represents a relatively stable professional characteristic that is not significantly influenced by ancillary roles. Within the context of the present study, this evidence strengthens the understanding that differences in teachers' beliefs about mathematics are more likely to arise from professional and educational factors than from variations in administrative responsibilities, thereby providing a clearer contextual foundation for interpreting the subsequent analyses involving epistemological knowledge and mathematical discourse practices.

Research Question 5. Are there significant differences in Senior High School teachers' mathematical discourse practices when respondents are grouped according to their profile variables?

The findings indicate that Senior High School teachers' mathematical discourse practices are generally consistent across most demographic and professional profile variables, as no statistically significant differences were found based on bachelor's degree, years of teaching experience, highest educational attainment, or number of ancillary roles. However, participation in mathematics-related training and seminars emerged as the only profile variable associated with significant differences in mathematical discourse practices, with the post hoc analysis revealing a significant difference between teachers who attended 1–2 seminars and those who attended 3–5 seminars. These results suggest that while teachers' demographic and professional backgrounds may not substantially influence their classroom discourse practices, engagement in professional development is associated with meaningful variation in the implementation of discourse during mathematics instruction.

These findings coincide with the study's theoretical framework. From the perspective of Sociocultural Theory, effective mathematical discourse develops through continuous participation in professional and instructional communities where teachers refine their pedagogical practices through interaction, reflection, and collaborative learning (Vygotsky, 1978, as cited in Kooloos et al., 2022). Likewise, Sfard's Commognitive Theory emphasizes that mathematical discourse is a learned professional practice that evolves through sustained engagement with mathematical communication rather than through personal or demographic characteristics alone (Sfard, 2008, as discussed in Trakulphadetkrai (2022) and Thurm & Barzel (2022). The absence of significant differences across most profile variables supports these theoretical propositions, suggesting that discourse practices are not inherently determined by teachers' academic backgrounds, experience, or institutional responsibilities. Instead, the significant variation observed according to training participation reinforces the theoretical view that professional learning experiences provide opportunities for teachers to refine discourse-oriented instructional strategies and mathematical communication.

The findings likewise support the study's conceptual framework, which recognizes teacher profile variables as contextual characteristics that may influence mathematical discourse practices. While most profile variables did not account for significant differences, the significant effect of mathematics-related professional development suggests that targeted training represents a more influential contextual factor than demographic or career-related characteristics. Consequently, the conceptual framework is refined to indicate that professional learning opportunities, rather than static teacher characteristics, are more closely associated with variation in discourse-oriented instructional practices.

These findings are consistent with the empirical literature reviewed in Chapter 2, which emphasizes that teachers' capacity to facilitate productive mathematical discourse is strengthened through sustained professional development that enhances questioning techniques, classroom facilitation, and mathematical communication (Horn & Garner, 2022; Ribeiro et al., 2021; Planas et al., 2024). Similarly, studies by Shinno and Fujita (2021), Castro Superfine et al. (2024), and Howell et al. (2025) underscore that discourse-oriented instructional practices develop through intentional professional learning and continued pedagogical refinement rather than through years of experience or academic qualifications alone. The lack of significant differences across bachelor's degrees, teaching experience, educational attainment, and

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ancillary roles further aligns with the reviewed literature, suggesting that demographic characteristics are not necessarily reliable predictors of instructional discourse quality when teachers share comparable professional contexts and curricular expectations.

Findings contribute to the growing body of evidence that professional development is a distinguishing factor in strengthening mathematical discourse practices, whereas other teacher profile characteristics may exert comparatively limited influence. Within the context of the present study, these results provide additional empirical support for the importance of mathematics-specific professional learning as a contextual condition associated with discourse-rich classroom instruction while reinforcing the view that effective mathematical discourse is primarily cultivated through continuous professional growth rather than demographic or occupational characteristics alone.

Research Question 6. Is there a significant relationship between Senior High School teachers' epistemological knowledge about mathematics and their mathematical discourse practices?

The findings revealed a strong, positive, and statistically significant relationship between Senior High School teachers' epistemological knowledge about mathematics and their mathematical discourse practices. Specifically, teachers who demonstrated more sophisticated epistemological knowledge tended to exhibit higher levels of discourse-oriented instructional practices. This finding suggests that teachers' beliefs about the nature of mathematics knowledge is closely associated with how they facilitate mathematical communication, encourage reasoning, and engage students in meaningful classroom discourse. Rather than functioning as independent constructs, epistemological knowledge and mathematical discourse practices appear to operate in a mutually reinforcing manner, wherein teachers' conceptions of mathematics are reflected in their instructional behaviors.

The observed relationship strongly supports the theoretical framework underpinning the present study. Hofer and Pintrich's (1997) Epistemological Beliefs Theory posits that individuals' beliefs about the certainty, structure, source, and justification of knowledge influence cognitive processes and instructional decision-making. Likewise, Ernest's (1989) model of teachers' beliefs about mathematics argues that teachers' conceptions of mathematics fundamentally shape the pedagogical approaches they adopt, including the opportunities they provide for inquiry, reasoning, and mathematical discussion. The significant positive correlation obtained in this study provides empirical support for these theoretical propositions, demonstrating that teachers who hold more sophisticated epistemological views are also more likely to employ discourse practices that promote explanation, justification, and collaborative mathematical thinking. Rather than viewing mathematical knowledge as fixed and transmissible, these teachers appear to facilitate learning as an active process of knowledge construction, consistent with the assumptions embedded in both theoretical perspectives.

The findings likewise affirm the study's conceptual framework, which posits that epistemological knowledge is an important antecedent to mathematical discourse practices. The strong association observed between the two variables confirms the hypothesized relationship and demonstrates that teachers' beliefs about mathematics are closely linked to their classroom communication practices. The conceptual model is therefore empirically supported, indicating that improvements in teachers' epistemological knowledge are accompanied by corresponding improvements in the implementation of discourse-oriented instructional practices.

The present findings are consistent with several empirical studies reviewed in Chapter 2. Beswick (2018) reported that teachers' beliefs about mathematics significantly influence the nature of classroom interactions and the instructional opportunities they create for students to reason mathematically. Similarly, Wilkie (2022) found that teachers who possess more sophisticated conceptions of mathematical knowledge are more likely to facilitate dialogic instruction and encourage students to articulate, justify, and evaluate mathematical ideas. Studies by Hunter et al. (2023) and Planas et al. (2024) likewise emphasized that productive mathematical discourse is closely associated with teachers' underlying beliefs about knowledge

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construction and student participation in mathematical inquiry. Collectively, these studies reinforce the present findings by demonstrating that epistemological orientations influence not only what teachers teach but also how they structure classroom communication to support conceptual understanding and mathematical reasoning.

By empirically establishing a strong positive relationship between these variables within the context of Senior High School mathematics education, the present study extends existing evidence to the Philippine educational setting and reinforces the proposition that teachers' beliefs about mathematics are closely intertwined with the quality of discourse they foster in their classrooms.

Research Question 7 : To what extent does Senior High School teachers' epistemological knowledge about mathematics predict or influence their mathematical discourse practices?

The findings demonstrate that Senior High School teachers' epistemological knowledge about mathematics is a statistically significant predictor of their mathematical discourse practices. The regression analysis indicates that teachers with more developed epistemological knowledge are more likely to implement discourse-oriented instructional practices, providing evidence that epistemological knowledge not only relates to, but also significantly explains, variation in teachers' classroom discourse. This finding suggests that teachers' beliefs about the nature and development of mathematical knowledge are an important professional characteristic that influences how they facilitate mathematical communication, reasoning, and classroom interaction.

The findings provide strong support for the study's theoretical framework. Ernest's (1989) Theory of Mathematics Education posits that teachers' conceptions of mathematics fundamentally shape their instructional decisions, classroom practices, and pedagogical orientations. The significant predictive effect observed in the present study supports this theoretical proposition by showing that teachers' epistemological knowledge serves as an antecedent to discourse-oriented teaching practices rather than merely coexisting with them. Likewise, Hofer and Pintrich's (1997) Epistemological Beliefs Theory explains that individuals' beliefs about the nature of knowledge influence how knowledge is acquired, justified, and communicated. The present findings extend this proposition to mathematics education by demonstrating that teachers' epistemological beliefs translate into observable instructional behaviors, particularly those that promote dialogue, reasoning, and collaborative knowledge construction.

The results likewise provide empirical support for the study's conceptual framework, which hypothesized that epistemological knowledge directly influences mathematical discourse practices. The significant regression coefficient confirms the directional relationship proposed in the conceptual model, indicating that epistemological knowledge is an important explanatory variable for variation in teachers' discourse practices. Although the findings establish epistemological knowledge as a significant predictor, they also suggest that other contextual and instructional factors not included in the present model may account for the remaining variation in mathematical discourse practices. Thus, the conceptual framework is supported while recognizing that teacher practice is influenced by multiple interacting factors.

The present findings are consistent with the empirical literature reviewed in Chapter 2, demonstrating that teachers' beliefs substantially influence instructional practice. Cross Francis (2015) argued that teachers' epistemological beliefs shape the instructional environments they create and influence how mathematical understanding is developed through classroom interaction. Similarly, Charalambous and Praetorius (2020) emphasized that teachers' knowledge and beliefs are essential determinants of instructional quality, shaping how learning opportunities are organized and enacted. Studies by Kaiser et al. (2021) and Depaepe et al. (2020) likewise reported that teachers' professional knowledge and beliefs significantly influence instructional decision-making and classroom practices, supporting the proposition that epistemological knowledge functions as a meaningful predictor of effective mathematics instruction. Collectively, these studies reinforce the present findings teachers' beliefs translate into pedagogical actions that shape the quality of classroom discourse and students' learning opportunities.

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Epistemological knowledge is a significant determinant of mathematics teaching practice. By demonstrating that teachers' epistemological knowledge significantly predicts mathematical discourse practices among Senior High School teachers, the present study provides empirical support for the proposed conceptual model and strengthens existing evidence that teachers' beliefs constitute an essential foundation for implementing discourse-rich mathematics instruction. This contribution extends the existing literature by confirming the predictive role of epistemological knowledge within the Philippine Senior High School context.

Synthesis of Findings

The study's findings provide empirical support for the theoretical and conceptual frameworks underpinning the research, demonstrating that teachers' epistemological knowledge of mathematics is closely associated with their mathematical discourse practices. The respondents were predominantly mathematics-trained educators with relatively limited participation in mathematics-specific professional development, yet they exhibited a high Extent of epistemological knowledge and highly practiced mathematical discourse.

While most profile variables did not significantly influence either epistemological knowledge or mathematical discourse practices, participation in mathematics-related trainings emerged as a significant differentiating factor in discourse practices. Furthermore, the study established a strong positive relationship between epistemological knowledge and mathematical discourse practices, with epistemological knowledge significantly predicting discourse practices.

Collectively, these findings reinforce the proposition that teachers' beliefs about the nature of mathematical knowledge play a fundamental role in shaping discourse-oriented instructional practices. The study also contributes context-specific evidence to the existing literature by validating these relationships among Senior High School mathematics teachers in the Philippine educational context, thereby strengthening current understanding of the factors that support effective mathematics instruction.

Theoretical Implications

The findings advance mathematics education by providing empirical evidence supporting the study's theoretical and conceptual foundations. The significant relationship and predictive influence of teachers' epistemological knowledge on mathematical discourse practices reinforce the proposition that teachers' beliefs about the nature of mathematical knowledge shape their instructional decisions and classroom interactions. This finding supports Ernest's (1989) Theory of Mathematics Education and Hofer and Pintrich's (1997) Epistemological Beliefs Theory, which posit that teachers' beliefs influence pedagogical behavior and classroom practice. Likewise, the findings are consistent with Vygotsky's (1978) Sociocultural Theory and Sfard's (2008) Commognitive Theory, both of which emphasize that knowledge construction occurs through meaningful social interaction and mathematical discourse. Furthermore, the results align with recent literature suggesting that sophisticated epistemological beliefs promote inquiry-oriented teaching and discourse-rich learning environments (Greene et al., 2018; Thurm & Barzel, 2022). By validating these relationships within the Philippine Senior High School context, the study extends existing theoretical perspectives through context-specific empirical evidence.

Practical Implications

The findings have important implications for mathematics instruction and teacher professional development. Since epistemological knowledge significantly predicts mathematical discourse practices, strengthening teachers' conceptions of mathematical knowledge may improve the quality of classroom discourse. Moreover, the significant differences observed according to participation in mathematics-related professional development indicate that continuous learning opportunities contribute to more effective instructional practices.

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These findings suggest that school leaders and teacher educators should design professional development programs that integrate reflective inquiry, mathematical reasoning, and discourse-oriented pedagogies. Such initiatives are consistent with studies emphasizing that sustained, content-focused professional development enhances instructional quality and teachers' capacity to facilitate productive classroom discourse (Horn & Garner, 2022; Ribeiro et al., 2021; Darling-Hammond et al., 2022). These efforts may ultimately foster richer mathematical communication and deeper student engagement in mathematics learning.

Policy Implications

The findings likewise offer valuable insights for educational policy and institutional planning. The demonstrated influence of epistemological knowledge on mathematical discourse practices suggests that teacher development policies should extend beyond strengthening content knowledge to include the cultivation of teachers' beliefs about mathematics and effective discourse facilitation. Likewise, the significant role of mathematics-related professional development supports policies that prioritize sustained, discipline-specific training for mathematics teachers.

Consistent with the recommendations of the OECD (2023) and contemporary teacher development research (Darling-Hammond et al., 2022), educational institutions may consider integrating epistemological development and discourse-based instructional approaches into pre-service preparation, in-service education, and continuing professional development frameworks. Institutional leaders may likewise strengthen professional learning communities that encourage collaborative reflection, lesson study, and the exchange of effective discourse practices. Grounding teacher development initiatives in empirical evidence can contribute to more responsive and effective mathematics instruction across educational settings.

Alignment with National and Global Research Priorities

The findings of this study align with both national and global priorities aimed at improving the quality of education and strengthening teacher capacity. Specifically, the results support Sustainable Development Goal (SDG) 4: Quality Education, which advocates for inclusive and equitable quality education and the promotion of lifelong learning opportunities for all (United Nations, 2023). The study demonstrated that Senior High School teachers generally possessed a high extent of epistemological knowledge about mathematics and highly practiced mathematical discourse. Moreover, the significant predictive influence of epistemological knowledge on mathematical discourse practices and the positive effect of mathematics-related professional development highlight the importance of strengthening teachers' professional competencies as a means of enhancing instructional quality. These findings reinforce the value of continuous teacher learning in promoting classroom practices that foster mathematical reasoning, communication, and conceptual understanding.

The study supports the aspirations of AmBisyon Natin 2040, which envisions a prosperous and globally competitive Filipino society supported by a highly competent and continuously developing workforce (National Economic and Development Authority [NEDA], 2023). The findings emphasize that strengthening teachers' epistemological understanding and providing sustained mathematics-specific professional development can contribute to improving instructional practices, thereby enhancing the quality of mathematics education within Philippine schools. Such improvements are consistent with the national vision of developing human capital capable of responding to the demands of a knowledge-driven society.

The study aligns with the objectives of the Philippine Development Plan (PDP) 2023–2028, which emphasizes improving learning outcomes through strengthened teacher quality, evidence-based educational reforms, and continuous professional development (NEDA, 2023). The significant relationship and predictive influence of teachers' epistemological knowledge on mathematical discourse practices provide empirical evidence supporting initiatives that prioritize teacher capacity building as a strategy for improving classroom instruction. Likewise, the finding that participation in mathematics-related professional

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development significantly influences discourse practices underscores the importance of sustained, discipline-specific learning opportunities for teachers.

The study contributes to ongoing national and international efforts to strengthen mathematics education through research-informed practice. By providing empirical evidence on the role of teachers' epistemological knowledge in fostering effective mathematical discourse, the study offers context-specific insights that support evidence-based educational improvement, teacher professional development, and policies aimed at enhancing the quality of mathematics instruction within the Philippine educational system.

Researcher's Critical Reflections

Conducting this study provided the researcher with a deeper appreciation of the complex relationship between teachers' epistemological knowledge about mathematics and their classroom discourse practices. While the study initially focused on examining the statistical relationships between these variables, the research process revealed that teachers' beliefs about mathematics are closely intertwined with their instructional decisions and the ways they engage students in mathematical communication. The findings demonstrated that teachers generally possessed a high level of epistemological knowledge and frequently employed mathematical discourse practices, suggesting that meaningful classroom interactions are influenced not only by content expertise but also by teachers' underlying conceptions of mathematical knowledge.

Throughout the research process, several practical realities became evident. Collecting data from Senior High School mathematics teachers required careful coordination with participating schools while accommodating teachers' professional responsibilities and schedules. Although the respondents represented diverse educational backgrounds and varying levels of teaching experience, the results showed relatively consistent patterns across most profile variables. One particularly noteworthy finding was that mathematics-related professional development, rather than demographic or professional characteristics, significantly differentiated teachers' mathematical discourse practices. This highlighted the value of sustained discipline-specific professional learning and underscored the importance of examining instructional practices through multiple perspectives rather than relying solely on demographic characteristics.

The study also encouraged the researcher to critically reflect on the importance of teacher beliefs as a foundation for effective mathematics instruction. The strong relationship and predictive influence of epistemological knowledge on mathematical discourse practices reinforced the view that improving classroom instruction requires attention not only to pedagogical techniques but also to the beliefs that shape teachers' instructional choices. This realization broadened the researcher's understanding of mathematics education by illustrating how cognitive and instructional dimensions function together to influence classroom practice.

At the same time, the researcher recognizes that the study was limited to Senior High School mathematics teachers from the selected research setting and relied on self-reported questionnaire responses, which may not fully capture actual classroom practices. These limitations should be considered when interpreting the findings and provide opportunities for future studies employing broader samples, classroom observations, or mixed-method approaches. Despite these constraints, the research process contributed significantly to the researcher's scholarly and professional growth by strengthening an evidence-based perspective on mathematics teaching and reinforcing the importance of integrating teachers' epistemological development into efforts to improve mathematics instruction.

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Summary of Key Findings

This section presents a concise synthesis of the major findings of the study based on the statistical analyses conducted and discussed in the preceding chapters. The findings are organized according to the research questions to provide a clear overview of the empirical results obtained.

1. Profile of the Respondents. The respondents were predominantly Bachelor of Secondary Education (BSEd) graduates majoring in Mathematics, with most having one to three years of teaching experience. The majority held bachelor's degrees as their highest educational attainment, performed one to two ancillary roles in addition to their teaching responsibilities, and had participated in one to two mathematics-related trainings or seminars. Overall, the respondent profile reflects a group of professionally trained mathematics teachers who are generally in the early stages of their teaching careers and possess moderate levels of professional development engagement.
2. Extent of Senior High School Teachers' Epistemological Knowledge about Mathematics. Teachers demonstrated a high extent of epistemological knowledge about mathematics. The respondents exhibited stronger endorsement of constructivist beliefs, particularly regarding the development of mathematical knowledge through collaborative inquiry, while showing relatively lower agreement with the view that mathematical knowledge consists of fixed and unchanging truths. Overall, the findings suggest that teachers possess well-developed and contemporary conceptions of mathematical knowledge.
3. Level of Senior High School Teachers' Mathematical Discourse Practices. The respondents demonstrated highly practiced mathematical discourse practices. Teachers most frequently encouraged students to explain their mathematical reasoning during classroom discussions, whereas the use of informal language when discussing formal mathematical concepts was practiced to a comparatively lesser extent. These findings indicate that student-centered mathematical discourse is widely implemented among the respondents.
4. Differences in Senior High School Teachers' Epistemological Knowledge about Mathematics According to Profile Variables. The inferential analysis revealed that there was no statistically significant difference in teachers' epistemological knowledge when respondents were grouped according to the number of ancillary roles they held. Thus, the null hypothesis was not rejected, indicating that teachers' epistemological knowledge remained relatively consistent regardless of additional institutional responsibilities.
5. Differences in Senior High School Teachers' Mathematical Discourse Practices According to Profile Variables. The results showed that mathematical discourse practices did not differ significantly when respondents were grouped according to bachelor's degree, years of teaching experience, highest educational attainment, or number of ancillary roles. However, a statistically significant difference was found when respondents were grouped according to the number of mathematics-related trainings or seminars attended. Post hoc analysis further indicated that teachers who attended three to five trainings demonstrated significantly different discourse practices compared with those who attended one to two trainings. Accordingly, the null hypothesis was rejected only for professional development participation.
6. Relationship Between Epistemological Knowledge and Mathematical Discourse Practices. The Pearson correlation analysis revealed a strong, positive, and statistically significant relationship between teachers' epistemological knowledge about mathematics and their mathematical discourse practices. The findings indicate that higher levels of epistemological knowledge are associated with more effective implementation of mathematical discourse practices, leading to the rejection of the null hypothesis.
7. Predictive Influence of Epistemological Knowledge on Mathematical Discourse Practices. The regression analysis demonstrated that teachers' epistemological knowledge significantly predicts their mathematical discourse practices. The findings confirm that epistemological knowledge

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serves as an important predictor of teachers' classroom discourse practices, providing empirical support for the conceptual framework and resulting in the rejection of the null hypothesis.

The foregoing findings provide empirical evidence that Senior High School teachers generally possess high levels of epistemological knowledge and mathematical discourse practices. While most demographic characteristics showed no significant influence on these variables, participation in mathematics-related professional development emerged as a significant factor affecting discourse practices. Furthermore, the strong positive relationship and predictive influence of epistemological knowledge on mathematical discourse practices underscore the important role of teachers' beliefs about mathematical knowledge in shaping the quality of classroom mathematical discourse.

CONCLUSIONS

This section presents the conclusions derived from the major findings of the study. The conclusions are based on the empirical evidence presented in the preceding chapters and directly address the research questions that guided the investigation. Each conclusion synthesizes the essential meaning of the findings without restating statistical details.

Based on the findings of the study, the following conclusions were drawn:

1. Respondent Profile. The respondents were predominantly professionally trained mathematics educators, generally in the early stages of their teaching careers, with bachelor's-level qualifications, moderate participation in mathematics-related professional development, and additional institutional responsibilities. This demographic profile provides an appropriate contextual foundation for examining teachers' epistemological knowledge and mathematical discourse practices within the Senior High School mathematics setting.
2. Extent of Senior High School Teachers' Epistemological Knowledge about Mathematics. Senior High School mathematics teachers generally demonstrated a high extent of epistemological knowledge, indicating that they largely embrace contemporary views of mathematics as a dynamic, collaborative, and evolving body of knowledge rather than a collection of fixed truths. This suggests that the respondents possess epistemological orientations that are conducive to learner-centered mathematics instruction.
3. Level of Senior High School Teachers' Mathematical Discourse Practices. The respondents exhibited a highly practiced level of mathematical discourse practices, reflecting the consistent implementation of classroom strategies that promote mathematical reasoning, communication, and meaningful student participation. This indicates that productive mathematical discourse is a well-established feature of the instructional practices of the teachers included in the study.
4. Differences in Epistemological Knowledge According to Profile Variables. Teachers' epistemological knowledge did not differ significantly based on the number of ancillary roles they performed. This suggests that additional institutional responsibilities do not substantially influence teachers' beliefs and understanding regarding the nature of mathematical knowledge.
5. Differences in Mathematical Discourse Practices According to Profile Variables. Mathematical discourse practices remained generally consistent across teachers with different academic backgrounds, teaching experience, educational attainment, and ancillary responsibilities. However, participation in mathematics-related professional development emerged as a distinguishing factor, indicating that continued engagement in discipline-specific training contributes to variations in teachers' classroom discourse practices.
6. Relationship Between Epistemological Knowledge and Mathematical Discourse Practices. A strong positive relationship exists between teachers' epistemological knowledge about mathematics and their mathematical discourse practices. This indicates that teachers who possess more sophisticated conceptions of mathematical knowledge are more likely to implement effective

discourse practices that encourage reasoning, explanation, and meaningful mathematical communication.

7. Predictive Influence of Epistemological Knowledge on Mathematical Discourse Practices. Teachers' epistemological knowledge significantly predicts their mathematical discourse practices, demonstrating that beliefs about the nature of mathematical knowledge constitute an important factor influencing how teachers facilitate mathematical discussions and interactions in the classroom.

Taken together, these conclusions highlight the central role of teachers' epistemological knowledge in shaping the quality of mathematical discourse practices among Senior High School mathematics teachers. The findings reinforce the importance of fostering sophisticated epistemological beliefs and sustained mathematics-focused professional development as complementary elements in promoting effective mathematics instruction. Collectively, the study enhances understanding of teachers' beliefs and instructional practices while providing empirical evidence that contributes to mathematics education research within the Philippine Senior High School context.

Recommendations for Future Research

Based on the findings and limitations of the present study, the following recommendations are proposed for future research:

1. Future studies may replicate this research using larger samples and across different educational contexts, such as public and private Senior High Schools, higher education institutions, or schools from different regions of the Philippines. Such investigations would help determine whether the observed relationships between teachers' epistemological knowledge and mathematical discourse practices are consistent across diverse instructional settings.
2. Future researchers may examine additional variables that could influence teachers' mathematical discourse practices, including pedagogical content knowledge, teacher self-efficacy, beliefs about mathematics teaching and learning, instructional leadership, school culture, collaborative professional learning, and technology integration. Investigating these variables may provide a more comprehensive understanding of the factors that shape discourse-oriented mathematics instruction.
3. Considering that mathematics-related professional development was the only profile variable that produced significant differences in mathematical discourse practices, future studies may explore the characteristics of professional development programs, such as duration, content, delivery mode, and quality, to determine which aspects most effectively enhance teachers' classroom discourse practices and epistemological development.
4. Future research may employ alternative research designs, including mixed-methods, longitudinal, quasi-experimental, or intervention-based studies, to examine how teachers' epistemological knowledge and mathematical discourse practices develop over time and whether targeted professional development initiatives produce sustained improvements in instructional practice.
5. Subsequent studies may incorporate the perspectives of other educational stakeholders, such as students, school administrators, instructional coaches, curriculum specialists, and supervisors. Including multiple perspectives may provide a more comprehensive understanding of how teachers' epistemological knowledge is reflected in classroom discourse and how these practices influence mathematics teaching and learning.

These recommendations are intended to encourage further scholarly inquiry into the relationship between teachers' epistemological knowledge and mathematical discourse practices. Expanding research in these areas may strengthen the evidence base for mathematics education and contribute to the continued

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improvement of mathematics teaching, teacher professional development, and classroom instructional practices.

Recommendations for Policy, Practice, or Curriculum Integration

Based on the findings and conclusions of the study, the following recommendations are proposed to support improvements in educational policy, professional practice, and curriculum implementation:

1. Institutional Policy Development. Educational institutions and school leaders may consider strengthening policies that promote the development of teachers' epistemological knowledge through sustained mathematics-focused professional learning. Given that professional development participation was associated with significant differences in mathematical discourse practices, institutional policies should encourage regular participation in high-quality, discipline-specific training as part of teachers' continuing professional development.
2. Professional Practice Enhancement. Mathematics teachers, instructional leaders, and department heads are encouraged to implement professional learning initiatives that emphasize inquiry-oriented teaching, mathematical reasoning, collaborative problem-solving, and effective classroom discourse. Professional learning communities, peer mentoring, lesson study, and instructional coaching may serve as viable strategies for strengthening teachers' epistemological beliefs and translating these into more effective mathematical discourse practices.
3. Curriculum Integration. Curriculum developers and educational leaders may integrate learning experiences that explicitly promote contemporary epistemological perspectives on mathematics within pre-service teacher education and in-service professional development programs. Likewise, curriculum guides and instructional resources should incorporate opportunities for meaningful mathematical discussion, justification, argumentation, and collaborative knowledge construction to strengthen discourse-based teaching practices.
4. Institutional Capacity Building. Schools may establish structured capacity-building programs that systematically support the continuous enhancement of mathematics instruction through regular classroom observations, mentoring, collaborative lesson planning, and reflective teaching practices. Such initiatives can strengthen teachers' ability to facilitate productive mathematical discourse while reinforcing sophisticated understandings of mathematical knowledge.
5. Evidence-Based Decision-Making. Educational policymakers, school administrators, and curriculum planners are encouraged to utilize the findings of this study in designing evidence-informed policies, professional development frameworks, and instructional improvement initiatives. The demonstrated relationship between teachers' epistemological knowledge and mathematical discourse practices highlights the importance of considering teachers' beliefs about mathematics as a key component of mathematics education reforms and quality improvement efforts.

These recommendations are intended to translate the empirical findings of the study into actionable strategies that support improvements in educational policy, professional practice, and curriculum implementation. By strengthening teachers' epistemological knowledge and fostering high-quality mathematical discourse, educational institutions can further enhance the effectiveness of mathematics instruction and contribute to improved teaching and learning outcomes in Senior High School mathematics.

Practical Output

Based on the findings of the study, the Mathematical Discourse Enhancement Program (MDEP): A Professional Development Program for Strengthening Senior High School Teachers' Epistemological Knowledge and Mathematical Discourse Practices was developed as the practical output of this research. The program is intended to provide a structured, evidence-based professional development framework that

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enhances mathematics teachers' epistemological knowledge and translates these beliefs into effective mathematical discourse practices in the classroom. It directly addresses the needs identified through the empirical findings and serves as a practical resource for improving mathematics instruction in Senior High School settings.

The development of the MDEP was informed by the study's major findings. While the respondents demonstrated a high extent of epistemological knowledge and highly practiced mathematical discourse, the results also revealed opportunities to strengthen teachers' constructivist views of mathematics and specific discourse practices, particularly in bridging students' informal language with formal mathematical communication. Furthermore, the study established that participation in mathematics-related professional development significantly influenced teachers' mathematical discourse practices. More importantly, epistemological knowledge was found to have a strong positive relationship with and a significant predictive influence on mathematical discourse practices. These findings indicate that enhancing teachers' epistemological beliefs through sustained professional learning can contribute to richer and more effective mathematical discourse in the classroom.

The proposed program consists of six interconnected trainings that systematically address the identified needs. Training 1, Understanding Mathematical Epistemology, and Training 2, From Beliefs to Classroom Practice, strengthen teachers' understanding of the nature of mathematical knowledge and its influence on instructional decision-making. Training 3, Designing Discourse-Rich Mathematics Lessons, and Training 4, Facilitating High-Quality Mathematical Discussions, focus on developing effective discourse strategies that promote mathematical reasoning, collaborative inquiry, justification, and productive classroom communication. To ensure sustained professional growth, Training 5, Professional Learning Communities for Mathematics Teachers, emphasizes lesson study, peer coaching, and reflective practice, while Training 6, Action Planning and Classroom Implementation, supports teachers in translating their learning into classroom-based improvement plans. The program incorporates interactive lectures, lesson study, microteaching, classroom simulations, collaborative lesson planning, peer observation, and reflective activities to promote meaningful and sustained professional learning.

The MDEP is designed for Senior High School Mathematics teachers and may also serve as a professional development resource for school heads, department coordinators, instructional supervisors, and curriculum leaders responsible for mathematics instruction. The program culminates in the development of practical outputs, including discourse-rich lesson plans, classroom observation tools, professional growth portfolios, and school-based action plans. Its effectiveness may be evaluated through pre- and post-training administration of the Epistemological Knowledge in Mathematics Questionnaire (EKMQ), classroom observations using a Mathematical Discourse Practices rubric, participant reflection journals, peer coaching feedback, and implementation reports.

By translating the empirical findings into a structured professional development program, the MDEP provides schools and educational leaders with an evidence-informed mechanism for strengthening mathematics teaching. The alignment map developed as part of the program demonstrates how each major finding of the study informed the corresponding trainings, ensuring that every component of the program directly addresses the needs identified through the research. The complete practical output, including the program framework, training descriptions, implementation procedures, alignment matrix, learning activities, assessment tools, and supporting materials, is presented in the Appendices of this thesis for reference and potential adoption by educational institutions.

Concluding Remarks

This study examined the epistemological knowledge about mathematics and mathematical discourse practices of Senior High School mathematics teachers to address the research problem and contribute to a deeper understanding of how teachers' beliefs about the nature of mathematical knowledge relate to their instructional discourse practices. Through systematic data collection, statistical analysis, and

interpretation, the study generated empirical evidence demonstrating the levels of these two constructs, their differences across selected profile variables, their relationship, and the predictive influence of epistemological knowledge on mathematical discourse practices.

The findings show the important role of teachers' epistemological knowledge in shaping their mathematical discourse practices. While most demographic and professional profile variables did not produce significant differences in either construct, participation in mathematics-related professional development emerged as a distinguishing factor influencing mathematical discourse practices. More importantly, the study established that teachers with more sophisticated epistemological knowledge tend to demonstrate stronger discourse practices, and that epistemological knowledge significantly predicts the quality of classroom mathematical discourse. These findings provide empirical support for the theoretical and conceptual frameworks underpinning the study while reinforcing the value of fostering constructivist beliefs about mathematics in promoting effective mathematics instruction.

Furthermore, the practical output developed from this research, in the form of a professional development framework for strengthening teachers' epistemological knowledge and mathematical discourse practices, provides a structured and evidence-based resource that may assist schools, educational leaders, and teacher educators in designing initiatives that enhance mathematics teaching. By translating empirical findings into a practical intervention, the study contributes not only to the advancement of scholarly knowledge but also to the continuous improvement of professional practice in mathematics education.

This study shows the importance of research-informed inquiry in understanding the factors that influence effective mathematics instruction. By establishing the significant role of teachers' epistemological knowledge in fostering productive mathematical discourse, the study contributes to the growing body of mathematics education research and supports ongoing efforts to improve the quality of teaching and learning in Senior High School mathematics through evidence-based professional development, instructional enhancement, and educational decision-making.

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