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Pedagogical Practices in Early Numeracy Instruction: Perspectives of Elementary Education Undergraduates at A State Institution

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ABSTRACT

AEarly numeracy forms the foundational basis for mathematical cognition and lifelong learning. Despite its recognized importance, disparities in instructional practices and teacher preparedness continue to challenge effective numeracy acquisition in primary education systems, particularly in developing regions. This study examines pedagogical practices in early numeracy instruction from the perspectives of elementary education undergraduates enrolled at a state institution. The research adopts a qualitative phenomenological design to explore how future educators conceptualize, interpret, and intend to implement numeracy instruction strategies.

Drawing on purposive sampling, participants were selected based on their academic exposure to teaching methodologies and practicum experiences. Data were collected through semi-structured interviews and reflective narratives, and analyzed using thematic analysis to identify patterns, instructional beliefs, and emerging pedagogical orientations. The study is grounded in constructivist learning theory and teacher commitment frameworks, providing a theoretical lens for understanding instructional decision-making.

Findings reveal a complex interplay between theoretical knowledge and practical challenges. While undergraduates demonstrate awareness of student-centered approaches such as manipulatives, differentiated instruction, and contextualized learning, their confidence in implementation is constrained by limited classroom exposure and perceived systemic limitations. Key themes include the importance of patience and adaptability in instruction, the role of culturally relevant pedagogy, and the tension between curriculum demands and learner-centered practices.

The study contributes to the discourse on teacher education by highlighting gaps between pedagogical theory and practice, particularly in early numeracy contexts. It underscores the need for enhanced experiential learning opportunities, integration of reflective practice, and institutional reforms that align teacher preparation with contemporary educational challenges. Implications extend to curriculum developers, teacher educators, and policymakers seeking to strengthen foundational education.

Ultimately, this research advances understanding of how emerging educators perceive and construct early numeracy pedagogy, offering insights into improving instructional quality and educational outcomes in foundational mathematics.

INTRODUCTION

Early numeracy constitutes a critical component of foundational education, shaping children's ability to engage with mathematical concepts and problem-solving throughout their academic trajectory. It encompasses a range

of competencies, including number sense, counting, pattern recognition, and basic operations, which collectively support cognitive development and logical reasoning. However, despite its significance, the quality of early numeracy instruction remains uneven, particularly in regions where educational systems face structural and pedagogical challenges.

Recent educational discourse emphasizes the importance of teacher quality and pedagogical effectiveness in improving foundational learning outcomes. As highlighted by Asadullah et al. (2025), disparities in basic education across regions are often linked to inconsistencies in instructional quality, teacher preparedness, and curriculum implementation. These challenges are particularly evident in early mathematics education, where abstract concepts must be translated into accessible and meaningful learning experiences for young learners.

Teacher education programs play a pivotal role in addressing these challenges by equipping future educators with the knowledge, skills, and dispositions necessary for effective instruction. Elementary education undergraduates represent a critical cohort in this regard, as their pedagogical beliefs and practices are still in formation. Understanding their perspectives on early numeracy instruction provides valuable insights into the strengths and limitations of current teacher preparation models.

This study is situated within the broader context of qualitative educational research, which seeks to explore subjective experiences and meanings (Tenny et al., 2022). Specifically, it adopts a phenomenological approach to examine how undergraduates perceive and conceptualize pedagogical practices in early numeracy. Such an approach allows for an in-depth exploration of lived experiences, beliefs, and instructional intentions (Dumlao, 2024).

The problem addressed in this research lies in the apparent disconnect between theoretical knowledge and practical application in teacher education. While undergraduates are exposed to various pedagogical frameworks, including constructivist and student-centered approaches, their ability to implement these strategies effectively remains uncertain. This gap raises questions about the adequacy of current training models and the extent to which they prepare future educators for real classroom challenges.

The relevance of this study is underscored by ongoing concerns about educational quality in Asia and other developing regions. Newman and Gentile (2025) note that systemic issues such as overcrowded classrooms, limited resources, and insufficient teacher training contribute to suboptimal learning outcomes. In this context, enhancing pedagogical practices in early numeracy becomes a strategic priority for improving overall educational performance.

The objectives of this research are threefold. First, it aims to identify the pedagogical practices that elementary education undergraduates perceive as effective for early numeracy instruction. Second, it seeks to examine the factors influencing their instructional decisions, including theoretical knowledge, personal beliefs, and contextual constraints. Third, it aims to develop a conceptual understanding of how these future educators envision effective numeracy teaching.

The scope of the study is limited to undergraduates enrolled in a state institution, focusing on their perspectives rather than actual classroom practices. While this limits generalizability, it provides a focused and contextually rich understanding of emerging pedagogical orientations. The findings are expected to inform teacher education programs, curriculum development, and policy initiatives aimed at strengthening foundational education.

In terms of significance, this study contributes to the growing body of literature on teacher education and early numeracy by providing empirical insights into the perceptions of future educators. It highlights the importance of aligning theoretical instruction with practical application and underscores the need for continuous professional development. Furthermore, it offers a framework for understanding how pedagogical practices evolve within the context of teacher preparation.

LITERATURE REVIEW

The literature on early numeracy instruction and teacher education underscores the complexity of pedagogical practices and the multifaceted nature of teaching effectiveness. This section synthesizes the provided references to establish a theoretical and empirical foundation for the study.

Qualitative research methodologies play a central role in exploring educational phenomena, particularly those involving subjective experiences and perceptions. According to Bhandari (2025), qualitative research enables an

in-depth understanding of complex social processes, making it particularly suitable for studies on pedagogy. Tenny et al. (2022) further emphasize that qualitative approaches allow researchers to capture nuanced insights into participants' beliefs and practices.

Phenomenological research design, as discussed by Dumlao (2024), focuses on understanding lived experiences and the meanings individuals assign to them. This approach is particularly relevant for examining how undergraduates perceive pedagogical practices, as it prioritizes their subjective interpretations.

Thematic analysis is widely used in qualitative research to identify patterns and themes within data. Naeem et al. (2023) outline a systematic process for conducting thematic analysis, including data familiarization, coding, and theme development. Xu and Zammit (2020) propose a hybrid approach that integrates inductive and deductive methods, enhancing the depth and rigor of analysis.

Teacher commitment and professional identity are critical factors influencing pedagogical practices. Hariri and Sumintono (2020) argue that committed teachers are more likely to adopt innovative and student-centered approaches. Similarly, Teachers of Tomorrow (2025) highlight the societal importance of teachers and their role in shaping future generations.

Challenges in educational contexts, particularly in developing regions, significantly impact instructional practices. Asadullah et al. (2025) identify issues such as inadequate resources, teacher shortages, and curriculum misalignment as barriers to quality education. Newman and Gentile (2025) further note that systemic inefficiencies hinder effective learning outcomes.

In the context of early numeracy, pedagogical practices must be responsive to learners' developmental needs. Schwab (2021) emphasizes the importance of patience and adaptability in teaching, particularly when dealing with young learners. Rondero and Casupanan (2024) highlight the challenges faced by teachers in multigrade settings, including the need for differentiated instruction and classroom management strategies.

Participatory approaches in qualitative research, as discussed by Liebenberg et al. (2020), emphasize the inclusion of participants' voices in data analysis. This approach aligns with the study's focus on undergraduate perspectives, ensuring that their insights are accurately represented.

Content analysis, as described by Lou (2023), provides a systematic method for interpreting textual data. While distinct from thematic analysis, it complements qualitative research by offering structured analytical techniques.

Despite the extensive literature on pedagogy and teacher education, gaps remain in understanding how undergraduates conceptualize early numeracy instruction. Most studies focus on in-service teachers or student outcomes, leaving a gap in research on pre-service teacher perspectives.

This study addresses this gap by exploring the pedagogical beliefs and practices of elementary education undergraduates, contributing to a more comprehensive understanding of teacher preparation in early numeracy.

METHOD

1 Theoretical Foundations of Early Numeracy Pedagogy

Early numeracy pedagogy is grounded in constructivist learning theory, which posits that learners actively construct knowledge through interaction with their environment. This approach emphasizes hands-on activities, exploration, and social interaction as key components of learning. In the context of early mathematics, constructivism supports the use of manipulatives, visual aids, and real-life contexts to facilitate understanding.

Teacher commitment, as outlined by Hariri and Sumintono (2020), further strengthens pedagogical effectiveness. Committed educators are more likely to engage in reflective practice and adapt their teaching strategies to meet learners' needs. This theoretical alignment underscores the importance of both cognitive and affective dimensions in teaching.

2 Pedagogical Practices in Early Numeracy Instruction

Undergraduate perspectives reveal a preference for interactive and student-centered approaches. These include the use of manipulatives such as counting blocks, visual representations, and storytelling techniques to contextualize mathematical concepts. Such practices align with constructivist principles and support active learning.

However, the implementation of these strategies is often constrained by practical challenges. Limited classroom exposure and lack of resources hinder the ability of undergraduates to translate theory into practice. This gap highlights the need for experiential learning opportunities within teacher education programs.

3 Influencing Factors on Instructional Decision-Making

Instructional decisions are influenced by a combination of theoretical knowledge, personal beliefs, and contextual factors. Undergraduates draw on their academic training to inform their pedagogical choices, but these are often mediated by perceived classroom realities.

Systemic challenges, such as large class sizes and rigid curricula, further impact instructional practices (Asadullah et al., 2025). These constraints necessitate adaptive strategies and highlight the importance of flexibility in teaching.

4 Conceptual Model of Undergraduate Pedagogical Orientation

The study proposes a conceptual model that integrates theoretical knowledge, practical experience, and contextual awareness. This model suggests that effective pedagogy emerges from the interaction of these elements, with reflective practice serving as a mediating factor.

RESULTS

The analysis of qualitative data yielded several key findings regarding undergraduate perspectives on early numeracy instruction. First, participants demonstrated a strong conceptual understanding of student-centered pedagogy. They emphasized the importance of engaging learners through interactive methods, including the use of manipulatives, games, and real-life applications. This indicates a theoretical alignment with constructivist principles.

Second, a recurring theme was the perceived gap between theoretical knowledge and practical application. While undergraduates expressed confidence in their understanding of pedagogical concepts, many reported uncertainty in implementing these strategies in real classroom settings. This gap was attributed to limited teaching experience and insufficient exposure to diverse classroom environments.

Third, participants highlighted the importance of patience and adaptability in teaching early numeracy. They recognized that young learners require individualized attention and that instructional strategies must be tailored to varying levels of ability. This reflects an awareness of differentiated instruction and learner-centered approaches.

Fourth, contextual constraints emerged as a significant factor influencing pedagogical practices. Participants identified challenges such as large class sizes, limited resources, and rigid curricula as barriers to effective instruction. These constraints were perceived as limiting the feasibility of implementing innovative teaching methods.

Fifth, the role of teacher commitment and motivation was emphasized. Participants acknowledged that effective teaching requires dedication, continuous learning, and a willingness to adapt. This aligns with existing literature on teacher commitment and its impact on instructional quality.

Finally, the findings suggest a need for enhanced practical training within teacher education programs. Participants expressed a desire for more hands-on experiences, including teaching practicums and classroom simulations, to bridge the gap between theory and practice.

DISCUSSION

The findings of this study provide important insights into the pedagogical orientations of elementary education undergraduates. The alignment with constructivist principles suggests that teacher education programs are सफल in imparting theoretical knowledge. However, the gap between theory and practice raises concerns about the effectiveness of current training models.

This disconnect can be understood in light of the challenges identified in the literature. Asadullah et al. (2025) and Newman and Gentile (2025) highlight systemic issues that hinder educational quality, including resource constraints and inadequate teacher preparation. These factors are reflected in the participants' experiences and perceptions.

The emphasis on patience and adaptability aligns with Schwab's (2021) assertion that these qualities are essential for effective teaching. Similarly, the recognition of differentiated instruction reflects an understanding of diverse learner needs, as discussed by Rondero and Casupanan (2024).

The role of teacher commitment, as highlighted by Hariri and Sumintono (2020), is also evident in the findings. Participants' acknowledgment of the importance of dedication and continuous learning underscores the affective dimension of teaching.

However, the study also reveals limitations in the current teacher education framework. The lack of practical experience suggests a need for curriculum reform, including increased opportunities for experiential learning and reflective practice. This aligns with recommendations from qualitative research methodologies that emphasize the importance of participant engagement and real-world application (Naeem et al., 2023).

Overall, the findings highlight the need for a more integrated approach to teacher education, one that bridges the gap between theory and practice and addresses contextual challenges.

CONCLUSION

This study examined pedagogical practices in early numeracy instruction from the perspectives of elementary education undergraduates. The findings reveal a strong theoretical foundation in student-centered pedagogy, coupled with significant challenges in practical implementation.

The research contributes to the field by highlighting the importance of aligning teacher education programs with real-world classroom demands. It underscores the need for enhanced practical training, reflective practice, and institutional support to improve instructional quality.

Future research should explore longitudinal outcomes of teacher training programs and examine how pedagogical practices evolve over time. Additionally, studies involving in-service teachers and classroom observations would provide a more comprehensive understanding of early numeracy instruction

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