International Journal of Technology, AI and STEM Education
https://ijtase.mindураresearch.com/journal/index
ISSN (ONLINE): 3116-3718
Volume 1 Issue 2 - 2026

Contextualized Mathematics Instruction and Learners' Problem-Solving Skills at Rizal National High School

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Date Submitted:
January 8, 2026
Date Accepted:
March 10, 2026
Date Published:
March 31, 2026

ABSTRACT: Developing learners' problem-solving skills remains a central yet persistent challenge in secondary Mathematics education, particularly in contexts where instruction has traditionally emphasized procedural fluency over conceptual understanding. Contextualized Mathematics instruction has been proposed as a pedagogical approach that situates mathematical ideas within meaningful, real-life contexts, thereby supporting deeper understanding and transfer of learning. This qualitative case study examined how contextualized Mathematics instruction was implemented at Rizal National High School and how it influenced learners' problem-solving skills. Data were generated through classroom observations, focus group discussions with learners, and semi-structured interviews with Mathematics teachers. Using thematic analysis, four major themes emerged: (1) real-life contexts as anchors for conceptual understanding, (2) strategic and flexible problem-solving through contextualized tasks, (3) collaborative problem-solving as a catalyst for reasoning and persistence, and (4) teacher scaffolding and reflection in developing metacognitive regulation. Learners' accounts revealed increased confidence, reduced Mathematics anxiety, and greater willingness to engage in non-routine problems. The findings suggest that contextualized Mathematics instruction, when coupled with deliberate scaffolding and collaborative discourse, strengthens learners' problem-solving skills. Implications for instructional practice, curriculum development, and future research are discussed.

Keywords: contextualized instruction; Mathematics education; problem-solving skills; qualitative case study; secondary school

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I. Introduction

Problem-solving is widely recognized as a foundational goal of Mathematics education, as it equips learners with the capacity to apply mathematical knowledge to unfamiliar situations, reason logically, and make informed decisions in academic and real-life contexts. International frameworks in Mathematics education consistently emphasize problem-solving as central to mathematical proficiency, alongside conceptual understanding, procedural fluency, and strategic competence. Effective problem-solving requires learners to interpret problem situations, identify relevant information, select appropriate strategies, and reflect on the reasonableness of solutions. However, despite its acknowledged importance, many secondary school learners continue to experience persistent difficulties in solving mathematical problems, particularly those that demand conceptual understanding, flexible strategy use, and reflective thinking.

These challenges are frequently associated with instructional practices that emphasize rote procedures, algorithmic repetition, and formula memorization at the expense of conceptual meaning and sense-making. When Mathematics instruction is dominated by decontextualized exercises and routine problem types, learners often develop fragmented knowledge that is difficult to transfer to novel or real-world situations. Research has shown that such approaches can result in superficial understanding, overreliance on memorized steps, and heightened anxiety when learners encounter non-routine problems that do not conform to familiar patterns. Consequently, learners may struggle to adapt their knowledge, select appropriate strategies, or justify their reasoning during problem-solving tasks.

In response to these longstanding concerns, contextualized Mathematics instruction has gained increasing attention as a pedagogical approach that seeks to situate mathematical learning within meaningful, real-life contexts. Rooted in constructivist learning theory, contextualization emphasizes the active construction of knowledge by connecting new mathematical ideas to learners' prior experiences and everyday realities (Bransford, Brown, & Cocking, 2000). By embedding mathematical concepts in authentic situations—such as financial decision-making, measurement in daily activities, or problem scenarios drawn from community life—contextualized instruction enables learners to perceive Mathematics as a useful and coherent system rather than an abstract collection of rules. Studies suggest that when learners engage with mathematics in context, they are more likely to develop conceptual understanding, recognize the relevance of mathematical ideas, and employ flexible problem-solving strategies that extend beyond routine procedures.

Within the Philippine public secondary school system, contextualization has been explicitly encouraged as part of broader curricular reforms aimed at improving learner engagement, inclusivity, and academic achievement. These reforms recognize the diverse linguistic, cultural, and socio-economic backgrounds of learners and advocate instructional approaches that connect school learning to local contexts. In Mathematics education, contextualization is viewed as a means of making abstract concepts accessible and meaningful, particularly for learners who may struggle with purely symbolic representations. However, while policy and curriculum documents promote contextualized instruction, empirical research examining how such approaches influence learners' problem-solving skills in actual classroom settings remains limited. Moreover, few studies have foregrounded learners'

perspectives to understand how contextualized Mathematics instruction shapes their thinking, confidence, and approach to problem-solving.

This study addresses these gaps by examining the implementation of contextualized Mathematics instruction at Rizal National High School and exploring its influence on learners' problem-solving skills. By focusing on classroom practices and learner experiences, the study aims to contribute contextually grounded evidence on how contextualized instruction supports conceptual understanding, strategic reasoning, and reflective problem-solving in secondary Mathematics classrooms.

Research Questions

1. How is contextualized Mathematics instruction implemented at Rizal National High School?
2. How do learners experience contextualized Mathematics instruction during problem-solving tasks?
3. In what ways does contextualized instruction influence learners' problem-solving skills?

II. Review of Related Literature

Contextualized Mathematics Instruction

Contextualized instruction is grounded in constructivist and situated learning theories, which assert that learning is most effective when knowledge is constructed through interaction with meaningful contexts (Vygotsky, 1978; Lave & Wenger, 1991). In Mathematics education, contextualization involves framing lessons around real-world problems, practical applications, and authentic tasks that mirror learners' everyday experiences. Boaler (1998) demonstrated that learners exposed to contextualized Mathematics instruction developed stronger conceptual understanding and greater adaptability in problem-solving compared to those taught through traditional approaches.

Research further suggests that contextualization enhances learner engagement by reducing abstraction and making mathematical concepts more accessible (Hiebert et al., 1997). When learners understand the "why" behind mathematical procedures, they are better equipped to apply knowledge flexibly across different problem situations.

Mathematical Problem-Solving Skills

Mathematical problem-solving is a complex cognitive process involving understanding the problem, devising a strategy, implementing the strategy, and reflecting on the solution (Polya, 1957). Effective problem-solving requires not only procedural knowledge but also conceptual understanding, strategic competence, and metacognitive regulation. Learners often struggle when instruction emphasizes algorithmic procedures without fostering conceptual connections (Stein, Grover, & Henningsen, 1996).

Studies indicate that tasks requiring reasoning, explanation, and reflection promote higher-order thinking and problem-solving skills (Hiebert et al., 1997). Contextualized tasks, in particular, have been shown to support learners in developing problem-solving strategies that extend beyond routine exercises.

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Teacher Scaffolding and Collaborative Learning

Teacher scaffolding plays a critical role in guiding learners through complex problem-solving processes. Through questioning, feedback, and modeling, teachers help learners bridge gaps between current understanding and desired learning outcomes (Hmelo-Silver, Duncan, & Chinn, 2007). Collaborative learning further supports problem-solving by enabling learners to articulate reasoning, compare strategies, and persist through difficulty (Johnson & Johnson, 2009).

III. Methodology

This study employed a qualitative case study design to examine contextualized Mathematics instruction and its influence on learners' problem-solving skills within a real-life school setting. A case study approach was deemed appropriate as it allows for an in-depth, context-sensitive exploration of instructional practices and learner experiences, particularly in examining how pedagogical approaches are enacted and interpreted in everyday classroom interactions. The research was conducted at Rizal National High School, a public secondary school serving learners from varied socio-economic backgrounds, where contextualization had been informally integrated into Mathematics instruction. Participants included five Mathematics teachers and twenty-four learners from Grades 8 and 9, selected through purposive sampling to capture a range of instructional practices, learner abilities, and engagement profiles. This sampling strategy ensured that participants were information-rich cases capable of providing meaningful insights into contextualized problem-solving instruction. Data were collected over one academic quarter using multiple qualitative methods, including classroom observations to document instructional strategies, learner participation, and problem-solving processes as they naturally occurred; focus group discussions with learners to elicit perceptions, experiences, and reflections on contextualized Mathematics tasks; and semi-structured interviews with teachers to explore pedagogical intentions, instructional decisions, and challenges encountered in implementing contextualized instruction. All data were transcribed verbatim and analyzed using thematic analysis following Braun and Clarke's (2006) six-phase framework, allowing for systematic identification of recurring patterns and themes across data sources. The analytic process involved iterative coding, constant comparison, and theme refinement to ensure coherence and depth of interpretation. Trustworthiness was strengthened through methodological triangulation, peer debriefing to challenge emerging interpretations, and member checking to validate findings with participants. Ethical approval was secured prior to data collection, informed consent was obtained from teachers and parents, learner assent was obtained, and pseudonyms were used throughout the study to ensure confidentiality and ethical integrity.

IV. Results and Findings

Theme 1: Real-Life Contexts as Anchors for Conceptual Understanding

Classroom observations revealed that teachers consistently introduced mathematical concepts using situations drawn from learners' daily lives, such as budgeting household expenses, calculating travel fares, and measuring materials for practical tasks. These contexts served as cognitive anchors, enabling learners to visualize abstract concepts and understand their relevance. Instead of immediately presenting formulas, teachers guided learners to analyze the situation, identify relationships among quantities, and derive solutions based on understanding.

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Volume 1 Issue 2 - 2026

Learners expressed that contextualized problems made Mathematics easier to grasp. One learner shared, *"Mas naiintindihan ko ang Math kapag parang totoong problema sa buhay."* Another noted, *"Mas nagiging malinaw kung bakit ganito ang formula."* Teachers observed that learners were more engaged and asked more clarifying questions during contextualized lessons.

These findings support constructivist views that meaningful contexts enhance conceptual understanding (Bransford et al., 2000). Boaler (1998) similarly found that contextualized instruction fosters deeper understanding by allowing learners to connect mathematical ideas to real-world experiences.

Theme 2: Strategic and Flexible Problem-Solving through Contextualized Tasks

Contextualized tasks encouraged learners to engage in strategic planning rather than applying memorized procedures. Teachers presented non-routine problems that required learners to decide which mathematical concepts were relevant and to justify their chosen approaches. Learners were observed estimating answers, revising strategies, and reflecting on alternative solutions when initial attempts were unsuccessful.

Learners described a noticeable shift in their problem-solving approach. One participant explained, *"Hindi na agad solve, iniisip ko muna kung anong paraan ang tama."* Another stated, *"Natuto akong mag-try ng ibang strategy kapag hindi gumana ang una."* Teachers emphasized that contextualization prompted learners to think critically and flexibly.

This finding aligns with Polya's (1957) emphasis on strategic planning and reflection in problem-solving. Hiebert et al. (1997) also argue that instruction emphasizing reasoning over rote procedures supports adaptive problem-solving skills.

Theme 3: Collaborative Problem-Solving as a Catalyst for Reasoning and Persistence

Collaborative learning was a prominent feature of contextualized Mathematics instruction. Teachers frequently organized learners into small groups to discuss problem contexts, compare strategies, and jointly evaluate solutions. Observations indicated that learners remained engaged longer and demonstrated persistence when working collaboratively.

Learners highlighted the benefits of collaboration. One learner remarked, *"Kapag may ka-group, mas naiintindihan ko kasi may nagpapaliwanag."* Another shared, *"Hindi ako agad sumusuko kasi nagtutulungan kami."* Teachers noted that group discussions allowed learners to articulate reasoning and learn from peers.

These findings are consistent with social interdependence theory, which posits that cooperative learning enhances motivation and achievement through shared goals and mutual support (Johnson & Johnson, 2009). Stein et al. (1996) likewise emphasize the role of collaborative discourse in developing mathematical reasoning.

Theme 4: Teacher Scaffolding and Reflection in Developing Metacognitive Regulation

Teacher scaffolding was evident in the use of probing questions, prompts for explanation, and feedback focused on reasoning rather than correctness alone. Teachers encouraged learners to explain how they

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arrived at solutions, identify errors, and reflect on their problem-solving processes. This approach supported learners' awareness of their own thinking and promoted self-regulation.

Learners acknowledged the importance of teacher guidance. One participant stated, *"Hindi sinasabi agad ang sagot, tinutulungan kaming mag-isip."* Another noted, *"Natuto akong i-check kung tama ang ginawa ko."* Teachers viewed scaffolding as essential for developing independent problem-solvers.

These findings align with research highlighting the role of scaffolding in supporting metacognitive development during problem-solving (Hmelo-Silver et al., 2007). Zimmerman (2002) emphasizes that reflection and self-monitoring are critical components of effective problem-solving and lifelong learning.

V. Discussion

The findings of this study demonstrate that contextualized Mathematics instruction enhances learners' problem-solving skills by strengthening conceptual understanding, strategic thinking, collaborative reasoning, and metacognitive regulation. By situating mathematical ideas within real-life contexts familiar to learners, instruction provided meaningful entry points that reduced abstraction and enabled learners to construct conceptual understanding grounded in experience. This aligns with constructivist perspectives asserting that learning is most effective when new knowledge is connected to prior understanding and authentic situations (Bransford, Brown, & Cocking, 2000; Vygotsky, 1978). Research in Mathematics education similarly indicates that contextualized and application-oriented tasks promote deeper learning and facilitate the transfer of mathematical knowledge to novel problem situations (Boaler, 1998; Hiebert et al., 1997).

Strategic planning and flexible reasoning emerged as salient outcomes of contextualized problem-solving tasks. Learners demonstrated increased capacity to analyze problem conditions, select appropriate strategies, and revise approaches when initial attempts were unsuccessful. These findings are consistent with Polya's (1957) problem-solving framework, which emphasizes understanding, planning, execution, and reflection as core processes in mathematical reasoning. Empirical studies have further shown that tasks emphasizing reasoning over procedural repetition cultivate adaptive expertise, enabling learners to approach unfamiliar problems with confidence and flexibility (Hatano & Inagaki, 1986; Stein, Grover, & Henningsen, 1996). Contextualized instruction, therefore, appears to support not only procedural competence but also the development of strategic competence essential for meaningful problem-solving.

Collaboration and teacher scaffolding functioned as critical supports that enabled learners to persist through challenging problems and articulate their thinking processes. Collaborative problem-solving created opportunities for learners to externalize reasoning, compare strategies, and co-construct understanding, reinforcing social constructivist views of learning as a shared cognitive activity (Lave & Wenger, 1991). Prior research has consistently demonstrated that cooperative learning enhances mathematical achievement and motivation by fostering peer support and accountability (Johnson & Johnson, 2009). Additionally, teacher scaffolding through probing questions, feedback, and guided reflection supported learners' metacognitive regulation by prompting them to monitor progress, evaluate solutions, and adjust strategies. These findings corroborate studies emphasizing the role of guided support and discourse in problem-based and inquiry-oriented learning environments (Hmelo-Silver, Duncan, & Chinn, 2007; Zimmerman, 2002).

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Taken together, the findings affirm that contextualized Mathematics instruction is most effective when it is thoughtfully implemented as an integrated system of meaningful tasks, collaborative interaction, and scaffolded guidance. Rather than functioning as isolated real-life examples, contextualized tasks served as cognitive tools that supported reasoning, reflection, and transfer. This integrated approach aligns with research suggesting that problem-solving proficiency develops through sustained engagement in authentic tasks supported by social interaction and instructional scaffolding (Hiebert et al., 1997; Stein et al., 1996). Overall, the study reinforces the view that contextualized Mathematics instruction, when intentionally designed and supported, fosters robust and transferable problem-solving skills among secondary school learners.

VI. Conclusions and Implications

This qualitative case study provides compelling evidence that contextualized Mathematics instruction enhances learners' problem-solving skills at Rizal National High School by fostering deeper conceptual understanding, strategic reasoning, collaborative engagement, and metacognitive awareness. By grounding mathematical concepts in real-life contexts familiar to learners, teachers reduced the cognitive distance between abstract symbols and meaningful applications, enabling learners to construct understanding rather than rely on rote procedures. The integration of strategic and collaborative problem-solving tasks encouraged learners to analyze problems critically, explore multiple solution pathways, and persist in the face of difficulty, while scaffolded instructional support guided learners toward reflection and self-regulation. Collectively, these pedagogical practices created learning environments conducive to meaningful mathematical thinking and the development of transferable problem-solving skills.

The findings carry important implications for instructional practice in secondary Mathematics education. Mathematics teachers are encouraged to intentionally design contextualized tasks that move beyond surface-level real-life examples and instead require learners to reason, justify strategies, and reflect on solution processes. Emphasis should be placed on non-routine problems that promote flexible thinking, supported by collaborative structures and formative feedback that help learners articulate and refine their reasoning. Professional development initiatives may focus on equipping teachers with strategies for designing and facilitating contextualized problem-solving activities, as well as on strengthening scaffolding techniques that support learners' metacognitive growth.

At the curricular level, the study underscores the need to integrate authentic and contextually relevant problem situations into Mathematics programs. Curriculum developers and school leaders may consider aligning learning competencies with real-world applications that reflect learners' social and community contexts, thereby enhancing relevance and engagement. Embedding contextualized problem-solving across grade levels can support continuity in the development of mathematical reasoning and ensure that problem-solving is treated as a core curricular goal rather than an ancillary skill.

Directions for future research include examining the long-term effects of contextualized Mathematics instruction on learners' academic achievement, mathematical disposition, and transfer of learning. Mixed-methods or longitudinal studies could provide stronger evidence of causal relationships and track changes in learners' problem-solving skills over time. Future research may also explore how

contextualized instruction interacts with learner characteristics, teacher expertise, and school contexts to inform scalable and sustainable Mathematics education reforms.

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