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Student-Centered and Contextualized Mathematics Instruction and Pupils' Problem-Solving Skills at Lunac Primary School

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ABSTRACT: Problem-solving is a core goal of Mathematics education, yet many elementary pupils struggle to apply mathematical concepts meaningfully beyond routine procedures. Student-centered and contextualized instruction has been advanced as an approach that situates learning within pupils' lived experiences while promoting active engagement and higher-order thinking. This qualitative case study examined how student-centered and contextualized Mathematics instruction was enacted at Lunac Primary School and how these practices influenced pupils' problem-solving skills. Data were gathered through classroom observations, focus group discussions with pupils, and semi-structured interviews with teachers, and analyzed using thematic analysis. Findings reveal that contextualized tasks strengthened conceptual understanding, student-centered strategies supported strategic thinking and collaboration, and scaffolded instruction promoted metacognitive regulation. Pupils' narratives highlight increased confidence, persistence, and flexibility in problem-solving. The study concludes that aligning student-centered pedagogy with contextualized Mathematics instruction fosters meaningful problem-solving skills in elementary classrooms and offers implications for teaching practice, curriculum design, and future research.

Keywords: student-centered instruction; contextualized learning; Mathematics education; problem-solving skills; elementary education

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I. Introduction

Problem-solving is widely recognized as a cornerstone of Mathematics education, enabling learners to apply mathematical knowledge to unfamiliar situations, reason logically, and make informed decisions in everyday life. Despite its centrality, many elementary pupils experience persistent difficulties in solving mathematical problems that require conceptual understanding, strategic planning, and reflection. Classroom practices that emphasize rote procedures and memorization often result in fragmented knowledge, limiting pupils' ability to transfer learning to real-world contexts.

In response, student-centered and contextualized Mathematics instruction has gained prominence as an approach that foregrounds learners' active participation and connects mathematical ideas to meaningful situations drawn from daily life. Student-centered pedagogy positions pupils as active constructors of knowledge through discussion, exploration, and collaboration, while contextualization situates mathematical concepts within familiar experiences that enhance relevance and understanding. Research suggests that when learners perceive Mathematics as meaningful and connected to their realities, they demonstrate stronger engagement and problem-solving competence (Bransford, Brown, & Cocking, 2000).

Within the Philippine elementary education context, curricular reforms encourage learner-centered and contextualized approaches to address diverse learner needs. However, empirical studies that examine how these approaches shape pupils' problem-solving skills particularly from pupils' own perspectives remain limited. This study addresses this gap by examining student-centered and contextualized Mathematics instruction at Lunac Primary School and exploring its influence on pupils' problem-solving skills.

Research Questions

1. How are student-centered and contextualized Mathematics instructional practices enacted at Lunac Primary School?
2. How do pupils experience these instructional practices during problem-solving activities?
3. In what ways do student-centered and contextualized approaches influence pupils' problem-solving skills?

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II. Review of Related Literature

Student-centered instruction in Mathematics is grounded in constructivist and sociocultural theories that view learning as an active, socially mediated process (Vygotsky, 1978). Rather than transmitting procedures, teachers facilitate exploration, discussion, and reflection, enabling pupils to construct understanding collaboratively. Studies indicate that student-centered strategies such as dialogic questioning, collaborative problem-solving, and formative feedback support deeper conceptual understanding and problem-solving competence (Hiebert et al., 1997; Prince, 2004).

Contextualized instruction embeds mathematical concepts within real-life situations meaningful to learners. Bransford et al. (2000) emphasize that learning is enhanced when new knowledge is linked to prior experiences and authentic contexts. Research shows that contextualized Mathematics tasks improve comprehension, engagement, and transfer by making abstract ideas concrete and relevant (Boaler, 2016).

Problem-solving involves understanding the problem, devising a plan, carrying out strategies, and reflecting on solutions (Polya, 1957). Effective problem solvers demonstrate conceptual understanding, strategic flexibility, persistence, and metacognitive awareness. Instructional environments that encourage discussion, justification, and reflection have been shown to support these skills (Stein et al., 1996; Schoenfeld, 2016).

III. Methodology

This study employed a qualitative case study design to examine student-centered and contextualized Mathematics instruction and its influence on pupils' problem-solving skills within a real-life school setting. The study was conducted at Lunac Primary School, a public elementary school serving pupils from varied socio-economic backgrounds. Participants included six Mathematics teachers and thirty pupils from Grades 4 to 6 selected through purposive sampling to capture varied problem-solving abilities and participation levels.

Data were collected over one academic term using multiple qualitative methods. Classroom observations documented instructional practices, task design, and pupil interactions during problem-solving activities. Focus group discussions with pupils explored their experiences, challenges, and perceptions of learning Mathematics through contextualized tasks. Semi-structured interviews with teachers examined pedagogical intentions, instructional strategies, and perceived challenges. All data were transcribed verbatim and analyzed using thematic analysis following Braun and Clarke's (2006) six-phase framework. Trustworthiness was ensured through triangulation, peer debriefing, and member checking. Ethical approval was secured, informed consent and pupil assent were obtained, and pseudonyms were used to protect participants' identities.

IV. Results and Findings

Analysis yielded four interrelated themes illustrating how student-centered and contextualized Mathematics instruction shaped pupils' problem-solving skills.

Theme 1: Contextualized Tasks Strengthened Conceptual Understanding

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Classroom observations revealed that Mathematics instruction at Lunac Primary School was consistently anchored in contexts familiar to pupils, such as market buying and selling, household budgeting, school activities, and community-based situations. Rather than presenting abstract numerical problems in isolation, teachers deliberately framed lessons as real-life scenarios that pupils could easily imagine and relate to. For instance, word problems involved calculating change from market purchases, dividing food portions among family members, or estimating materials needed for school projects. These contextualized tasks enabled pupils to visualize the problem situation, identify relevant information, and make sense of mathematical relationships before applying procedures. As a result, pupils demonstrated a clearer grasp of underlying concepts and relied less on rote memorization of formulas.

Pupils consistently articulated how contextualization supported their understanding. One pupil explained, *"Mas naiintindihan ko ang problem kapag parang totoong buhay, kasi naiisip ko talaga ang nangyayari."* Another shared, *"Hindi lang numero, may kwento kaya mas madali kong maintindihan kung ano ang gagawin."* Teachers similarly observed noticeable changes in pupils' learning behaviors, noting that pupils asked more clarifying questions, discussed problem situations in their own words, and showed greater confidence in explaining solutions. One teacher remarked that pupils were "mas handang magtanong at magpaliwanag kapag naiintindihan nila ang sitwasyon ng problema."

These findings indicate that contextualized tasks strengthened conceptual understanding by connecting new mathematical ideas to pupils' prior knowledge and lived experiences. This aligns with situated learning perspectives, which emphasize that understanding is enhanced when learning is embedded in meaningful contexts (Bransford et al., 2000). The findings also support Boaler's (2016) argument that real-world contexts promote mathematical sense-making by helping learners see Mathematics as a tool for interpreting and solving everyday problems, rather than as a set of disconnected procedures.

Theme 2: Student-Centered Strategies Promoted Strategic Thinking

Student-centered instructional practices played a critical role in fostering pupils' strategic thinking during problem-solving activities. Teachers consistently encouraged pupils to explain their reasoning, compare different solution strategies, and justify their answers. Rather than immediately demonstrating a single correct method, teachers posed open-ended questions such as "Paano mo naisip?" or "May iba pa bang paraan?" and facilitated whole-class and small-group discussions. This approach created opportunities for pupils to explore multiple pathways to a solution, reflect on their choices, and learn from alternative strategies shared by classmates.

Pupils recognized that these practices expanded their problem-solving approaches. One pupil noted, *"Maraming paraan pala sa pagsagot, hindi lang isa."* Another explained, *"Natuto akong mag-isip ng ibang strategy kapag hindi gumana ang una."* Teachers observed that pupils gradually became more flexible and less dependent on memorized procedures, demonstrating a willingness to try new approaches when faced with unfamiliar problems. According to one teacher, pupils were "hindi na agad sumusuko kapag nahirapan, dahil alam nilang puwedeng mag-isip ng ibang paraan."

These findings align closely with Polya's (1957) problem-solving framework, which emphasizes planning, strategy selection, and reflection as core components of effective problem-solving. The results also support Schoenfeld's (2016) work on mathematical thinking, which highlights strategic

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flexibility as a key indicator of mathematical proficiency. By positioning pupils as active thinkers rather than passive recipients of methods, student-centered strategies cultivated habits of strategic reasoning essential for complex problem-solving.

Theme 3: Collaborative Problem-Solving Sustained Persistence

Collaborative problem-solving emerged as a powerful mechanism for sustaining pupils' persistence during challenging mathematical tasks. Teachers regularly organized pupils into small groups to solve problems, discuss strategies, and check solutions. Observations showed that pupils were more willing to engage with difficult tasks when working with peers, as collaboration reduced anxiety and created a supportive learning environment. Pupils frequently asked questions, clarified misunderstandings, and encouraged one another to continue working when problems seemed difficult.

Pupils highlighted the motivational and emotional benefits of collaboration. One pupil shared, *"Kapag may kasama, hindi agad sumusuko kasi nagtutulungan kami."* Another noted that hearing classmates' explanations helped them understand the problem better. However, pupils also acknowledged challenges, particularly unequal participation within groups. One pupil remarked, *"May kagrupo na tahimik lang at hindi masyadong nakikilahok."* Teachers addressed this issue by assigning specific roles such as problem reader, solution writer, and checker—and by actively monitoring group interactions to ensure shared responsibility.

These findings suggest that collaborative learning sustained persistence by distributing cognitive effort and emotional support across group members. This is consistent with social interdependence theory, which posits that cooperative learning enhances motivation and persistence through positive interdependence (Johnson & Johnson, 2009). The observed need for structured roles supports Gillies' (2016) assertion that collaboration is most effective when participation is intentionally organized and accountability is clearly established.

Theme 4: Scaffolding and Reflection Enhanced Metacognitive Regulation

Instructional scaffolding was central to supporting pupils' metacognitive regulation during problem-solving. Teachers guided pupils through probing questions, step-by-step modeling, and feedback that emphasized reasoning processes rather than merely identifying correct or incorrect answers. Instead of correcting errors immediately, teachers encouraged pupils to reflect on their thinking, revisit problem steps, and evaluate alternative strategies. Reflection activities, such as discussing why a solution worked or did not work, were embedded into lessons to promote self-monitoring and deeper understanding.

Pupils emphasized the value of guided reflection in their learning. One pupil stated, *"Mas natututo ako kapag tinatanong kung paano ko naisip ang sagot."* Another shared that feedback helped them recognize mistakes and adjust strategies. Teachers likewise stressed the importance of reflection, with one noting, *"Mahalaga ang pagbalik-tanaw sa sagot para maintindihan nila ang proseso."* These practices helped pupils become more aware of their own thinking and more deliberate in selecting and evaluating strategies.

These findings indicate that scaffolding and reflection enhanced metacognitive regulation by prompting pupils to monitor understanding, evaluate strategies, and persist through difficulty. This aligns with research on guided inquiry and scaffolding, which emphasizes the role of teacher support

in maintaining cognitive demand while fostering learner independence (Hmelo-Silver et al., 2007). The focus on process-oriented feedback is also consistent with Hattie and Timperley's (2007) findings that effective feedback supports self-regulation by clarifying learning goals and guiding next steps.

V. Discussion

The findings of this study demonstrate that student-centered and contextualized Mathematics instruction meaningfully enhances pupils' problem-solving skills by simultaneously strengthening conceptual understanding, strategic thinking, collaborative engagement, and metacognitive regulation. Contextualized tasks functioned as powerful entry points for learning, enabling pupils to anchor abstract mathematical ideas in familiar, real-life situations. By situating problems within everyday experiences, pupils were better able to visualize problem contexts, interpret relationships among quantities, and articulate their understanding, thereby moving beyond mechanical application of formulas toward genuine sense-making. This conceptual grounding provided a foundation upon which higher-level problem-solving processes could develop.

Student-centered instructional practices further amplified these gains by encouraging pupils to actively explain their reasoning, compare alternative solution strategies, and reflect on their thinking. Through dialogic questioning, guided discussion, and collaborative problem-solving, pupils learned that Mathematics problems could be approached in multiple ways, fostering strategic flexibility and persistence. These practices reflect key principles of Polya's (1957) problem-solving model, particularly the emphasis on planning, strategy selection, and reflective review, and support research showing that active engagement and cognitive investment are central to effective learning (Fredricks et al., 2004). Moreover, scaffolded feedback and structured reflection promoted metacognitive awareness, enabling pupils to monitor understanding, evaluate strategies, and adjust approaches when confronted with difficulty.

At the same time, the study highlights important challenges that shape the enactment of student-centered and contextualized Mathematics instruction in elementary classrooms. Time constraints limited opportunities for extended discussion, individualized feedback, and in-depth reflection, while uneven participation in group work occasionally undermined collaborative learning benefits. These challenges underscore the need for intentional instructional design, including clear participation structures, well-defined group roles, and realistic pacing of lessons. Consistent with Schweisfurth's (2013) analysis of learner-centered reform, the findings suggest that effective implementation requires a careful balance between openness and structure, supported by institutional conditions such as adequate instructional time, professional development, and administrative support. Without these supports, the transformative potential of student-centered and contextualized Mathematics instruction may be difficult to sustain despite its demonstrated benefits for pupils' problem-solving development.

VI. Conclusions and Implications

This qualitative case study provides robust evidence that student-centered and contextualized Mathematics instruction significantly enhances pupils' problem-solving skills at Lunac Primary School by transforming how mathematical ideas are introduced, explored, and applied in classroom settings.

By deliberately grounding Mathematics instruction in real-life contexts familiar to pupils, teachers enabled learners to move beyond surface-level procedural work toward deeper conceptual understanding and meaningful sense-making. Contextualized problems allowed pupils to visualize situations, interpret relationships among quantities, and recognize Mathematics as a practical tool for addressing everyday challenges, thereby increasing both comprehension and motivation.

At the same time, the use of student-centered strategies—such as dialogic questioning, collaborative problem-solving, and guided reflection—created learning environments in which pupils were encouraged to think strategically, articulate reasoning, and explore multiple solution pathways. Collaborative work supported persistence and confidence by providing opportunities for peer explanation and shared problem-solving, while scaffolded instruction and formative feedback helped pupils monitor their thinking, reflect on errors, and refine strategies. Collectively, these practices fostered key dimensions of problem-solving competence, including flexibility, persistence, and metacognitive regulation, which are essential for long-term mathematical development.

The findings carry important implications for instructional practice. Mathematics teachers are encouraged to design contextualized tasks that emphasize reasoning, explanation, and reflection rather than speed and memorization. Collaborative problem-solving activities should be intentionally structured with clear roles and accountability to ensure equitable participation, while formative feedback should focus on processes and strategies that support pupils' self-regulation and independent thinking. From a curricular perspective, the study underscores the need to embed authentic problem contexts systematically within Mathematics programs to ensure alignment between instructional goals and classroom practice.

Finally, the study points to several directions for future research. Longitudinal studies may examine how sustained exposure to student-centered and contextualized Mathematics instruction influences pupils' achievement, attitudes, and problem-solving trajectories over time. Mixed-methods or comparative research across schools and grade levels may further illuminate how contextualized approaches can be adapted to diverse learning environments and institutional conditions, thereby strengthening the evidence base for effective Mathematics teaching in elementary education.

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