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Cooperative Learning Strategies on Developing Problem-Solving Skills in Mathematics among High School Learners

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ABSTRACT
This descriptive case study examined teachers' and learners' perceptions of cooperative learning strategies in developing problem-solving skills in mathematics among junior high school students. Based on classroom observations and student reflections, the findings indicate that cooperative learning enhances collaboration, critical thinking, and effective communication, leading to increased student engagement, confidence, and enjoyment in tackling mathematical challenges. Teachers reported deeper conceptual understanding, while students valued the interactive and supportive environment fostered through peer collaboration. Despite these positive outcomes, challenges such as the need for careful lesson planning, equitable participation, and professional development for teachers were also identified. These challenges underscore the importance of structured implementation and targeted training to maximize the benefits of cooperative learning in mathematics instruction. The study highlights the potential of cooperative strategies to promote analytical reasoning, social interaction, and overall academic performance, recommending their systematic integration into the mathematics curriculum to foster a learner-centered classroom.

KEYWORDS: collaborative strategies, cooperative learning, critical thinking, engagement

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1. Introduction

Mathematics forms the foundation of academic success across subjects and grade levels, equipping students with essential problem-solving and critical thinking skills. However, international and local assessments reveal that high school students often struggle with mathematical problem-solving, particularly tasks requiring analytical and higher-order thinking (Celik, 2020; Amoudi, 2023). In the Philippines, educational disparities, limited resources, and traditional teaching methods contribute to low

performance, especially in public schools serving marginalized communities (Ramirez Yee, 2023; Saha, 2024). These statistics point to an urgent need for effective, evidence-based instructional strategies in mathematics.

One instructional approach gaining prominence is cooperative learning (CL), a collaborative method that emphasizes shared responsibility, communication, and teamwork to enhance problem-solving skills. Research has shown that CL fosters critical thinking, deeper conceptual understanding, and increased engagement (Abdullah & Fadil, 2019; Mukuka et al., 2020). Despite this, implementing CL presents challenges. Teachers may face difficulties in managing diverse classrooms, addressing skill gaps, and integrating higher-order thinking practices. Students may also struggle to adapt to collaborative tasks if accustomed to traditional, teacher-centered methods.

Although cooperative learning's benefits are well-documented internationally, most studies focus on urban, well-resourced schools. There remains limited research on the use of CL in rural or under-resourced contexts, particularly in the Philippines. Studies by Gillies (2016) and Habtamu et al. (2022) highlight the importance of contextualized strategies, yet little is known about how teachers and learners in Filipino schools experience CL. This lack of qualitative studies limits understanding of how CL impacts mathematical problem-solving in specific contexts such as Dalamas Integrated School in Iligan City.

This study investigates the role of cooperative learning strategies in enhancing problem-solving skills among junior high school students at Dalamas Integrated School. Specifically, it seeks to answer the following questions:

- How do teachers employ cooperative learning to develop problem-solving skills in mathematics among junior high school students?
- How do cooperative learning strategies impact students' outcomes in problem-solving skills in mathematics?

2. Methodology

This study employed a qualitative descriptive case study approach to examine how cooperative learning strategies influence problem-solving skills in Junior High School Mathematics at Dalamas Integrated School in Iligan City. The descriptive case study design, based on Stake's (2020) framework, was chosen to explore the perceptions, experiences, and challenges of teachers and students as they engaged with cooperative learning in a real classroom setting. This design enabled a contextualized understanding of how cooperative learning unfolds in a rural, resource-constrained environment where learners face difficulties in mathematical problem-solving (Alipio & Torres, 2023; Torres et al., 2021).

The research was conducted at Dalamas Integrated School, a Department of Education-supervised public school located in a highland area of Iligan City. The school serves Junior High School students from diverse socioeconomic and cultural backgrounds. Despite its remote location, the school maintains a strong commitment to academic excellence and innovation in teaching practices. Its infrastructure includes

well-maintained classrooms, interactive whiteboards, projectors, and digital learning resources, though challenges such as limited internet connectivity persist. The school's profile provided a fitting environment for investigating the implementation and impact of cooperative learning strategies.

Participants in this study included three mathematics teachers and five junior high school students, purposively selected based on their involvement in mathematics instruction and learning. Teachers were chosen for their experience in implementing cooperative learning strategies, while students were selected to represent a range of abilities and engagement levels. The selection criteria adhered to recommendations by Polkinghorne (1989) and Creswell (2013) for small, focused qualitative samples that allow in-depth exploration of experiences and perspectives. This approach ensured the collection of rich, detailed data from both teacher and learner viewpoints.

Data were collected through semi-structured interviews, classroom observations, focus groups, and document analysis. Interviews and observations documented the strategies teachers employed, the dynamics of student collaboration, and students' experiences with cooperative learning. Students also provided reflections through journal entries or open-ended survey responses. The interview guides were developed by the researcher and validated for content by education experts. Observations were scheduled in coordination with the school administration to ensure minimal disruption to regular classes and to maintain confidentiality.

Ethical considerations were observed throughout the data collection process. Informed consent was obtained from all participants, including parents or guardians of student participants. Participants were assured of confidentiality and anonymity, and their right to withdraw at any time was emphasized. The study adhered to established ethical guidelines to protect the rights and welfare of all involved, ensuring the trustworthiness and integrity of the data.

Interview transcripts, observation notes, and document excerpts were analyzed using thematic analysis, following the framework outlined by Braun and Clarke (2019). The process involved familiarization with the data, generating initial codes, identifying and refining themes, and producing a coherent narrative aligned with the study's objectives. Themes were reviewed and synthesized in relation to existing literature and theoretical frameworks, including social constructivism, to provide insights into how cooperative learning strategies influence problem-solving skills. The analysis was systematically documented to maintain methodological rigor and transparency.

3. Results

Experiences on Cooperative Learning in Mathematics

Four key themes emerged in response to the first research question on how teachers employed cooperative learning strategies to develop problem-solving skills in mathematics: (1) peer collaboration, (2) task structuring, (3) teacher facilitation, and (4) supportive learning environment.

Peer Collaboration. Teachers emphasized that peer collaboration was central to enhancing students' problem-solving abilities. Students worked together to discuss problems, share strategies, and solve tasks collectively. One teacher shared:

> *"I set up group activities where students work together to solve math problems. In these activities, students are encouraged to discuss different strategies and ask each other questions, which helps them think critically about their solutions. They can share their diverse perspectives, which often leads to a deeper understanding of the problem and various ways to approach it. I also guide them to challenge each other's thinking, which fosters a more active and reflective learning environment. This peer interaction not only allows them to reinforce their understanding but also builds their communication and reasoning skills. As students explain their thinking to others, they gain confidence in their problem-solving abilities and develop a greater sense of ownership over their learning process." (T1)*

Task Structuring. Teachers structured tasks so that each student had a role within the group. This approach promoted active participation and accountability. A teacher explained:

> *"I assign specific roles within the groups. Some students explain the steps, others solve portions of the problem, and some double-check the work. This allows all students to stay engaged and ensures that each student actively contributes to the group's progress, fostering a sense of accountability. By rotating these roles, students also get the opportunity to experience different aspects of problem-solving, helping them to strengthen various skills and gain a more holistic understanding of the material." (T3)*

Teacher Facilitation. Teachers acted as facilitators during group activities, guiding students through problem-solving without providing direct answers. One teacher noted:

> *"I move between groups and provide support by asking students to explain their thought processes. I help them think through the steps, ensuring they understand the solution's reasoning. By encouraging them to articulate their thinking, I help build their confidence in problem-solving and ensure that each student is actively engaged in the learning process." (T2)*

Supportive Learning Environment. Teachers focused on creating a classroom atmosphere where students felt comfortable sharing ideas without fear of judgment. One participant shared:

> *"I aim to create an environment where students feel safe to share their ideas. They understand that making mistakes is part of learning, which helps them approach problems with confidence. This supportive atmosphere encourages risk-taking in problem-solving, allowing students to explore different methods without fear of failure." (T1)*

Impact of Cooperative Learning in Mathematics

Four key themes emerged in response to the second research question on the impact of cooperative learning strategies on student outcomes: (1) enhanced problem-solving skills, (2) increased engagement and motivation, (3) improved communication skills, and (4) peer learning.

Enhanced Problem-Solving Skills. Teachers observed that cooperative learning significantly enhanced students' abilities to think critically, creatively, and approach problems from multiple perspectives. One teacher shared:

> *"Cooperative learning has allowed my students to think more critically and creatively. They are now more willing to explore different ways of solving problems than just relying on one method. This approach encourages them to experiment with various strategies, leading to a deeper understanding of mathematical concepts and more flexible problem-solving skills. They are exposed to diverse perspectives as they share their ideas, which enriches their overall learning experience." (T1)*

Increased Engagement and Motivation. Learners expressed enthusiasm for mathematics because of collaborative learning. One stated:

> *"I enjoy math more now because we get to work together. It makes me feel excited to contribute my ideas and learn from others. Collaborating with my classmates helps me see different ways to solve problems, and it feels rewarding when we all work together to find the best solution." (S2)*

Improved Communication Skills. Students recognized gains in communicating their reasoning. One learner noted:

> *"I am more confident in explaining my ideas to the group. I have also learned how to listen and understand other people's approaches. This has helped me better understand different problem-solving methods, and I can now apply these new techniques when tackling math problems on my own." (S1)*

Peer Learning. Teachers emphasized that students benefited from learning through peers' diverse perspectives. One teacher stated:

"Students learn a lot from each other. If one student does not understand a concept, their peers can explain it in simpler terms. This peer-to-peer support creates an environment where students feel more comfortable asking questions and seeking clarification. When they hear explanations from their classmates, it often makes the concept clearer because it is presented in a more relatable way." (T1)

4. Discussion

This study revealed that cooperative learning strategies play a vital role in developing problem-solving skills in mathematics among junior high school students. Four key themes emerged: peer collaboration, task structuring, teacher facilitation, and supportive learning environment. These findings align with existing literature emphasizing how cooperative learning improves engagement, critical thinking, and collaborative skills. Studies by Siddiqi and Ahmad (2021) and Bassachs et al. (2020) support the role of structured peer interaction in enhancing problem-solving, while Vygotsky (1978) highlights the importance of social interaction in guided learning. Likewise, research by Arici (2021) and Castaneda et al. (2023) confirms that collaborative discussion deepens reasoning skills and promotes reflective problem-solving.

Peer collaboration enabled students to explore diverse problem-solving strategies, challenge one another's thinking, and share perspectives. Task structuring ensured active participation through defined group roles, such as explaining steps, solving portions of problems, or verifying solutions. Teacher facilitation guided students to articulate reasoning and reflect on problem-solving processes rather than providing direct answers. Supportive learning environments encouraged risk-taking, experimentation, and open dialogue, fostering deeper understanding of mathematical concepts. These strategies collectively reinforced critical thinking, communication, and teamwork, consistent with prior research (Siddiqi & Ahmad, 2021; Bassachs et al., 2020).

These findings are consistent with Vygotsky's Sociocultural Theory (1978), which emphasizes the role of mediated learning, and Bandura's Social Learning Theory (1977), highlighting learning through observation and interaction. However, implementation was challenged by several factors: single-school setting, small sample size, reliance on self-reported data, limited observation of long-term effects, and exclusive focus on mathematics. These barriers mirror systemic issues reported in earlier studies. Slavin (2020) and Arici (2021) emphasized the need for broader contexts and longitudinal data, while Castaneda et al. (2023) noted that teacher training and consistent application of cooperative strategies are critical for effectiveness.

These findings suggest the need for structured support in curriculum planning, teacher professional development, and resource allocation. Although focused on a single school, the study contributes valuable insights for enhancing cooperative learning practices in similar educational contexts. Future research may expand the participant pool, explore student-led collaborative strategies, investigate cross-subject applications, and assess long-term effects on problem-solving abilities and interpersonal skills using longitudinal and multi-site designs.

5. Conclusion

This study concluded that cooperative learning strategies significantly enhance problem-solving skills, engagement, communication, and teamwork among junior high school students. Teachers and learners recognized the value of peer collaboration, task structuring, teacher facilitation, and a supportive learning environment in improving mathematical performance. However, challenges such as small sample size, reliance on self-reports, limited subject focus, and lack of long-term observation hindered full implementation. Addressing these barriers through curriculum planning, teacher training, and adequate resources can strengthen the integration of cooperative learning strategies in school classrooms.

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Conflict of Interest Statement

The author declares no conflict of interest.

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