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Reciprocal Teaching on Solving Word Problems and its Effects on Mathematical Ability of Students in Mathematics in the Modern World

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Abstract

This study investigated the effect of reciprocal teaching on solving word problems among selected students enrolled in Mathematics in the Modern World at Tiwi Community College during the second semester of AY 2024–2025. It specifically examined the performance of control and experimental groups in the pre-test across Polya's four steps in problem solving, mathematical problems involving patterns, and recreational problems using mathematics. The study also assessed the post-test performance of both groups, determined whether significant differences existed between their pre-test and post-test results, identified difficult topics encountered by the experimental group, and proposed enhanced instructional materials to address these challenges. By focusing on reciprocal teaching, the research aimed to evaluate its effectiveness in improving students' mathematical problem-solving skills and overall performance.

A quasi-experimental design was employed, utilizing pre- and post-tests administered to both control and experimental groups. The teacher-made tests served as the primary instrument for data collection, with results analyzed through mean scores and performance levels. To establish statistical validity, a t-test for independent samples was conducted to determine significant differences between the groups' performances. Findings revealed that reciprocal teaching positively influenced the experimental group's ability to solve word problems, particularly in applying Polya's steps and recognizing mathematical patterns. However, certain topics remained difficult, underscoring the need for enhanced instructional materials tailored to students' learning needs. Overall, the study highlights the potential of reciprocal teaching as an effective pedagogical strategy in mathematics, while emphasizing the importance of continuous refinement of teaching materials to support student learning outcomes.

Keywords: Palya's Problem Solving in Mathematics; Quasi-Experimental; Recreational Problems in Mathematics

1. Introduction

Mathematics education plays a vital role in cultivating critical thinking and problem-solving skills, which are essential for students to thrive in a globally competitive environment. To achieve this, teachers must adopt innovative strategies that address diverse learning needs and ensure high-quality education. Reciprocal teaching is one such strategy that enhances comprehension and engagement through collaborative learning. It involves four key processes—summarizing, questioning, clarifying, and predicting—that encourage active participation and foster higher-order thinking skills. By integrating reciprocal teaching into mathematics instruction, educators can create interactive learning environments that not only improve comprehension but also strengthen students' ability to apply mathematical concepts in real-world contexts.

Aligned with international frameworks, the United Nations Sustainable Development Goal 4 emphasizes inclusive and equitable quality education and lifelong learning opportunities for all. In mathematics education, this goal underscores

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the importance of teaching methods that promote understanding and application of concepts. Similarly, the OECD Learning Compass 2030 advocates for the development of competencies such as critical thinking, collaboration, and problem-solving, enabling students to navigate unfamiliar contexts independently. Reciprocal teaching supports these objectives by engaging learners in peer discussions, collaborative problem-solving, and reflective practices, thereby deepening their mathematical understanding and enhancing their capacity to think critically.

In the Philippine context, educational policies further highlight the importance of adopting effective teaching methodologies. Republic Act No. 7722, also known as the Higher Education Act of 1994, established the Commission on Higher Education (CHED) to promote relevant and quality education, encouraging innovative strategies that respond to student needs. Complementing this, Republic Act No. 10931, the Universal Access to Quality Tertiary Education Act, emphasizes the improvement of curricula and teaching practices to achieve positive learning outcomes. CHED Memorandum Orders, including CMO No. 46 (2012) and CMO No. 20 (2013), reinforce the need for pedagogical approaches that foster critical thinking and ensure quality assurance in higher education. Within this framework, reciprocal teaching emerges as a crucial strategy for Mathematics in the Modern World, a core general education course, as it promotes collaborative learning, active participation, and the practical application of mathematical tools in daily life.

2. Materials Used

The study utilized the reciprocal teaching model and specially designed learning materials for solving word problems in Mathematics in the Modern World. These materials covered Polya's four steps in problem solving, mathematical problems involving patterns, and recreational problems using mathematics. A teacher-made multiple-choice test served as the primary instrument, consisting of 30 items distributed across the three topics. The instrument underwent face validation by the thesis committee and content validation by external mathematics instructors. A dry run was conducted with non-participant students to refine clarity, difficulty, and time allocation, ensuring reliability and appropriateness for the main study.

3. Methods Used

This study employed a quasi-experimental design using pre-test and post-test measures to assess the effectiveness of reciprocal teaching in enhancing students' performance in mathematical word problems. Sixty-six first-year students of Tiwi Community College were purposively selected and divided into control and experimental groups, each with 33 participants categorized by academic performance levels (above average, average, and below average). The experimental group received instruction through reciprocal teaching strategies, while the control group was taught using traditional methods. Data collection involved administering validated teacher-made tests before and after the intervention. Statistical tools such as mean, percentage, and t-test were applied to analyze performance levels and determine significant differences between groups. Ethical considerations were observed, including institutional approval and structured procedures to ensure fairness and accuracy. This design allowed the researcher to evaluate the causal relationship between reciprocal teaching and students' problem-solving performance.

4. Results

The results revealed notable differences in the performance of the control and experimental groups. In the pre-test, both groups demonstrated comparable levels of mastery across Polya's problem-solving steps, mathematical patterns, and recreational problems, with most students falling within the "near mastery" and "mastery" ranges. After the intervention, the experimental group showed significant improvement in their post-test scores compared to the control group. Specifically, students taught through reciprocal teaching exhibited higher mastery levels in applying Polya's steps, identifying mathematical patterns, and solving recreational problems. The mean scores of the experimental group increased substantially, indicating that reciprocal teaching positively influenced comprehension and problem-solving ability. Statistical analysis using the t-test confirmed that the difference between the pre-test and post-test results of the experimental group was significant, while the control group showed only minimal improvement. Difficult topics encountered by the experimental group included complex pattern recognition and time-intensive recreational problems, suggesting areas where enhanced instructional materials are needed. Overall, reciprocal teaching proved effective in improving students' mathematical performance, fostering collaboration, and encouraging active participation in problem-solving tasks.

5. Discussion

The findings highlight the effectiveness of reciprocal teaching as a pedagogical strategy in mathematics education. By engaging students in summarizing, questioning, clarifying, and predicting, reciprocal teaching fostered deeper comprehension and collaborative learning, which translated into improved performance in word problem-solving. The significant gains in the experimental group's post-test scores demonstrate that this approach enhances critical thinking and problem-solving skills more effectively than traditional instruction. However, challenges remained in topics requiring advanced pattern recognition and recreational problem-solving, indicating the need for supplementary materials and extended practice. These results align with educational policies such as CHED Memorandum Orders and Republic Act No. 10931, which emphasize innovative teaching strategies and quality education outcomes. The study underscores the importance of integrating reciprocal teaching into mathematics curricula to promote active learning, resilience, and mastery of complex concepts. Furthermore, it suggests that institutions should provide training for educators to effectively implement collaborative strategies and design enhanced materials tailored to students' needs. By addressing academic difficulties and fostering supportive learning environments, reciprocal teaching can contribute to achieving Sustainable Development Goal 4, ensuring inclusive and equitable quality education while equipping learners with essential problem-solving competencies for future success.

6. Conclusion

In conclusion, mathematics education is indispensable in nurturing critical thinking and problem-solving skills that prepare students to succeed in a competitive global environment, and reciprocal teaching stands out as an effective strategy to achieve this goal. By engaging learners in summarizing, questioning, clarifying, and predicting, reciprocal teaching fosters collaboration, deeper comprehension, and active participation, enabling students to apply mathematical concepts meaningfully in real-world contexts. This approach aligns with international frameworks such as the United Nations Sustainable Development Goal 4, which emphasizes inclusive and equitable quality education, and the OECD Learning Compass 2030, which advocates for competencies like critical thinking, problem-solving, and collaboration. In the Philippine setting, policies such as Republic Act No. 7722 and Republic Act No. 10931, along with CHED Memorandum Orders, highlight the importance of innovative teaching methodologies that enhance learning outcomes and ensure quality assurance in higher education. Within this framework, reciprocal teaching emerges as a vital pedagogical tool for Mathematics in the Modern World, promoting interactive learning environments that strengthen comprehension, encourage resilience, and equip students with essential skills for lifelong learning and national development. Ultimately, integrating reciprocal teaching into mathematics instruction ensures that education remains responsive, inclusive, and transformative.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest should be disclosed.

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