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Implementation of the Cooperative Integrated Reading and Composition (CIRC) model on students' understanding in solving mathematical story problems

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Abstract

This study aims to determine the state of mathematics learning at MI Muhammadiyah Blondo prior to the implementation of the CIRC model, understand the steps for applying the CIRC model during the classroom learning process, and determine the effect of the CIRC model on students' understanding in solving mathematical word problems. This research used quantitative study utilizing a pre-experimental method with a one-group pre-test post-test design. The subject of this research was madrasa ibtidaiyah Blondo with 20 students used fractions as the research material. The CIRC model was applied in groups of 4-5 students, where the researcher used a purposive sampling technique for group division to ensure equal distribution and heterogeneity among group members. The results showed that the average student pre-test score before the implementation of the CIRC model was 64.5. However, after the implementation of the CIRC model, the average student post-test score was 83. Based on the normality test results, the pre-test significance value was 0.200 and the post-test significance value was 0.061, both greater than 0.05, indicating that the data is normally distributed. The T-test results from the students' pre-test and post-test scores obtained a t-count value of 7.594. When comparing the t-table and t-count values, the t-count 7.594 was greater than the t-table 2.093, therefore H0 is rejected and Ha is accepted. Thus, it can be concluded that the CIRC model influences students' understanding in solving mathematical word problems.

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Keywords

Cooperative Integrated Reading and Composition (CIRC), Student understanding, Fractions

Introduction

Education constitutes an inseparable aspect of human life [1], serving as the cornerstone of national development worldwide, evidenced by international bodies like UNESCO under the United Nations [2]. In Indonesia, the National Education System, governed by Law No. 20/2003, defines education as a conscious and planned effort to foster learning environments where students actively develop spiritual-religious strength [3]-[4], self-control, personality, intelligence, noble morals, and skills essential for individuals and society. Amid rapid technological progress, Indonesia entered the Society 5.0 era in 2019, intertwined with Industry 4.0, promoting high-quality [5], sustainable lifestyles tailored to user needs [6]. Preparation for Society 5.0 aligns with the Merdeka Curriculum, emphasizing character education, critical thinking, creativity, innovation, and technology application [7]. Literacy encompassing reading, writing, speaking, and problem solving forms a core competency, evaluated through the Computer Based National Assessment (ANBK) alongside numeracy and character traits, vital for national sustainability [8].

Indonesia's digital literacy stands at 62%, the lowest in ASEAN (average 70%) [9]. PISA 2015 ranked Indonesia 62nd out of 70 countries in reading interest, while TIMSS 2015 recorded math proficiency at 397 points, below the 500-point benchmark. The School Literacy Movement (GLS), mandated by Minister of Education Regulation No. 23/2015, cultivates non-curricular reading habits to build foundational knowledge. Numeracy, closely linked to literacy, enhances critical thinking through mathematical computations. Mathematics, an exact science interconnecting with other disciplines, is compulsory from elementary to high school levels [10]. At the elementary stage, it cultivates systematic thinking, problem-solving, and creativity [11], yet its abstract nature and prevalent stereotypes deter motivation, particularly for word problems demanding conceptual depth beyond rote formulas [12].

Mathematical word problems require sequential interpretation, not direct computation [13], challenging many students evidenced by average scores of 57 in prior studies. At MI Muhammadiyah Blondo, fifth-grade fraction chapter tests revealed only 32 students mastering word problems, corroborated by teacher reports. Conventional lecture methods induce boredom, contrasting successful Cooperative Integrated Reading and Composition (CIRC) application in Indonesian classes for main idea comprehension [14]. CIRC model, a cooperative strategy in heterogeneous groups of four, involves mutual reading, narrative prediction, and summarization, suits madrasah environments rich in supportive literacy activities like public speaking [15],[16].

Method

This study uses a quantitative approach with a pre-experimental research type, then the research design used is one group pre-test post-test design, where before the treatment is given the researcher first gives the sample a pre-test (initial test) and at the end of the learning the sample is given a post-test (final test) [17]. This design is used in accordance

with the objectives to be achieved by the researcher, namely, to determine the level of student understanding in solving elementary school mathematics story problems MI, especially on fraction material. The following is a table of one group pre-test post-test design research design. This study took a sample of 20 students where the sample consisted of most of the 5th grade students of MI Muhammadiyah Blondo from a total student population of 172 students. Data collection techniques used observation, documentation, tests, literature studies, and interviews. Then for data analysis using question instrument tests, item validity tests, reliability tests, question difficulty level tests, large power tests, normality tests, and T-tests all using the SPSS 25 for Windows application.

Results and discussion

This quantitative research employs a pre-experimental one-group pre-test post-test design. The population comprises 172 students at MI Muhammadiyah Blondo (2023-2024), with a purposive sample of 20 fifth graders focusing on fractions. CIRC was implemented in 4-5 member heterogeneous groups. Data collection methods include: documentation (prior student assessments), tests (pre- and post-intervention), literature review (CIRC and math resources), observation (pre-, during, and post-process), and interviews (teacher and student learning processes). Instrument analysis encompassed validity, reliability, difficulty level, and discrimination power tests. Normality used Shapiro-Wilk, hypothesis testing via paired t-test (α=0.05).

CIRC Implementation Steps

CIRC unfolded in seven phases: (a) Brief fraction introduction linking concepts to daily life; (b) Heterogeneous grouping (4-5 students) via purposive sampling; (c) Collaborative solving of complex word problems through discussion; (d) Unique problems per group, followed by class presentations; (e) Peer questioning and critique; (f) Teacher-led summary and Q&A; (g) Closing with hamdallah and apologies. This fostered active participation, mutual understanding, and critical thinking. The comparison between students' pre-test and post-test results is presented in Figures 1 and 2. Pre-intervention, lecture-dominant classes limited engagement, yielding low word problem comprehension HOTS items needing systematic steps. Interviews revealed student aversion to narrative reading. Post-CIRC, collaboration enhanced mathematical connections via shared language.

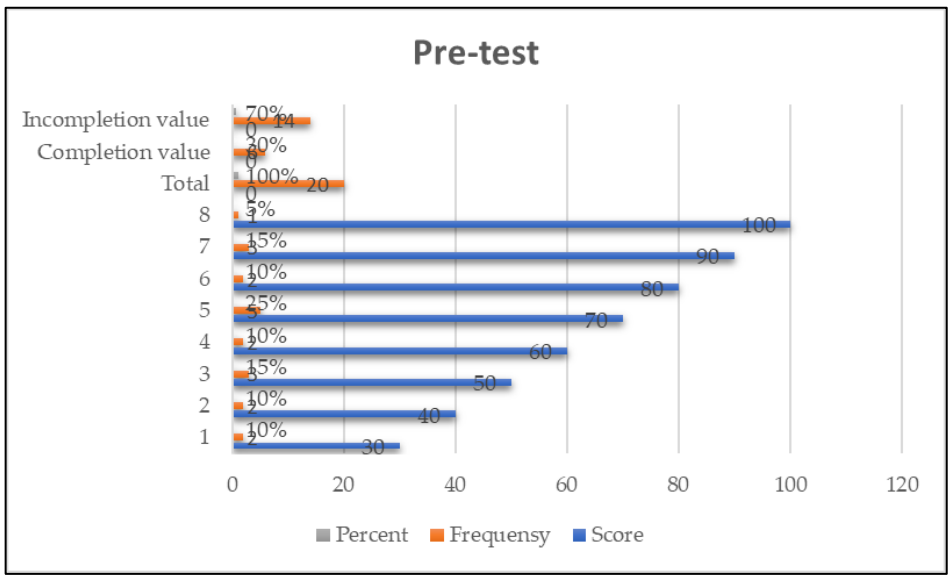

Figure 1. Pre-test result

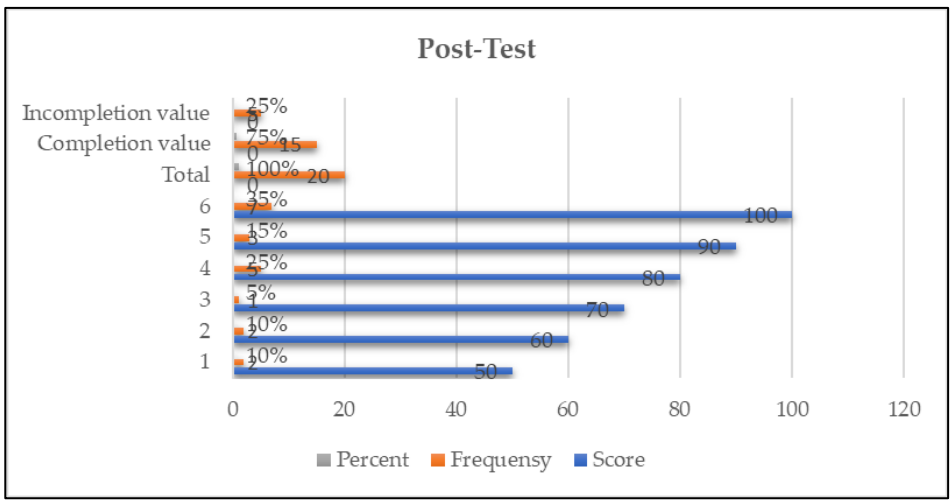

Figure 2. Post-test results

Statistical Analysis

Test	Mean	Significance	t-count	t-table (df=19, α=0.05)	Decision
Pre-test	64.5	0.200	-	-	Normal
Post-test	83	0.061	7.594	2.093	Reject Ho [1]

Ho: CIRC has no effect. Ha: CIRC improves understanding. t-count > t-table confirms Ha.

Discussion

The research results obtained through field observations and interviews with classroom teachers show that the learning process in the classroom is based on task completion

and the delivery of material by the teacher through lectures. Consequently, student engagement in the classroom is less than optimal, which causes a lack of understanding among students in solving mathematical word problems. Mathematical word problems are one type of HOTS (Higher Order Thinking Skills) problem that requires deeper understanding and systematic steps [18]. In addition to classroom teachers, researchers also conducted interviews with several students regarding word problems. Some of them stated that they tend to be lazy when faced with word problems and still have a minimal desire for literacy or reading.

Based on the monitoring and evaluation (ME) of the Centre for Development and Empowerment of Teachers and Education Personnel Mathematics in 2007 and the Centre for Teacher Development and Empowerment Mathematics in previous years, it was shown that more than 50% of teachers stated that the majority of students experienced difficulty in solving word problems [19]. Most elementary school students have difficulty understanding the intent or content of a presented word problem [20]. When students misunderstand the intent of the problem, their work results do not meet expectations. The more often this happens, the easier it is for students to become discouraged when working on word problems.

1. Implementation of the CIRC Model in the Classroom Learning Process

The CIRC model is carried out in stages, beginning with the delivery of brief material about fractions. Then, students are grouped according to assignments based on *purposive sampling*. After that, students solve complex word problems together with their groups and discuss them with one another. Each group works on a different problem. Once finished, all group members present the results of their discussion in front of the class. After the presentation of the discussion results, other group members may ask questions or challenge the results presented. Following this, the teacher delivers learning conclusions and ends with a closing. By implementing the CIRC model, cooperation and togetherness among peers increase. In addition, students can discuss with each other to understand a story so that the understanding obtained is more coherent using language that is mutually understood. Practically, the CIRC model is able to create a classroom learning implementation atmosphere conducive to improving mathematical connection skills.

2. The influence of the CIRC model in improving students' understanding in solving mathematical story problems

The effect of the CIRC model in improving students' understanding in solving mathematical story problems can be compared from the hypothesis that has been mentioned, namely, Ho (Nuclear Hypothesis): The CIRC model has no effect on improving students' understanding in solving mathematical story problems. Ha (Working hypothesis): The CIRC model has an effect on increasing students' understanding in solving mathematical story problems.

Based on the results of the paired sample test table, it is known that df is 19 and the significance value is 0.000. The df value is used as a reference in finding the t table value in the distribution of statistical t values, so that the t table value with a correlation coefficient of 0.05 is 2.09302. Thus, the calculated t value of 7.594 is greater than (>) the t table of 2.09302, so as the basis for making the decision above, it can be concluded that Ho is rejected and Ha is accepted. Thus, it can be concluded that the CIRC model can have an effect on improving students' understanding in solving story problems, especially in fraction material.

As students build knowledge about mathematical concepts [21], they need opportunities to think, discuss, develop, listen, write, and read. Through CIRC cooperative learning, they have the opportunity to do just that [19].

Conclusion

The study concludes that traditional lecture-based teaching at MI Muhammadiyah Blondo resulted in low student engagement and difficulty solving Higher Order Thinking Skills (HOTS) word problems. Before implementing the new model, student performance was suboptimal, with a *pre-test* average score of 64.5, which fell below the minimum competency standard (KKM) of 75. The implementation of the Cooperative Integrated Reading and Composition (CIRC) model significantly improved these outcomes through the following impacts: Increased Engagement: The model fosters cooperation and allows students to discuss problems using language they easily understand, making the learning atmosphere more conducive to mathematical connections; Improved Literacy: It addresses student "laziness" toward reading by requiring them to think, listen, write, and read together to identify the core intent of a word problem. Statistical Significance: Statistical analysis using a *paired sample test* yielded a **t**-calculated value of 7.594, which is significantly higher than the t-table value of 2.09302. The null hypothesis was rejected, proving that the CIRC model effectively enhances student understanding and success in solving mathematical word problems, particularly those involving fractions.

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