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Problem-solving ability and learning interest in realistic mathematics learning with the use of Mathcitymap Application

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ABSTRACT This study examined the effect of a realistic mathematics learning approach assisted by the mathcitymap application on students' mathematical problem-solving ability and learning interest. This study used an experimental research method with a quasi-experimental post-test-only control group design that involved two equal groups. As an experimental class, one group was treated with realistic mathematics learning assisted by the mathcitymap application, while the control group was given conventional learning. Data was collected through tests and observations using test instruments validated theoretically and empirically. The results of this study showed that descriptively, the average mathematics problem-solving ability and students' interest in learning in the group treated with realistic mathematics learning with the mathcitymap application was higher than the group treated with conventional learning. Inferentially, it was concluded that there was a significant difference in problem-solving ability and interest in learning between the group treated with realistic mathematics learning with the mathcitymap application and the group treated with conventional learning. The high Partial Eta Squared value shows that the group with realistic mathematics learning with the mathcitymap application significantly impacts students' problem-solving ability and interest in learning

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1. INTRODUCTION

The purpose of learning mathematics, as described by the Indonesian Ministry of Education, Culture, Research and Technology in 2022, is to emphasise the importance of developing mathematical problem-solving skills and interest in learning mathematics (Kemdikbudristek, 2022). This was in line with the National Council Teachers of Mathematics (NCTM) key standards that emphasise five essential processes, including problem-solving, reasoning and proof, communication, connection and representation. However, the results of the Programme for International Student Assessment (PISA) evaluation in mathematics achievement showed that Indonesia still has challenges; where in 2015, it ranked 63rd out of 70 countries with a score of 386 (Cahyono & Ludwig, 2018). In 2018, it ranked 73rd out of 79, and in 2022, it increased five positions from before. Furthermore, at the national level, the results of the 2021 Computer-Based National Assessment (CBNA) showed that mathematics skills in South Sulawesi Province are still relatively low, with an index of 1.57. Meanwhile, students' mathematics skills for the South Sulawesi Province level, Makassar City as the provincial capital, have an index of 1.54, which is still relatively low.

Mathematics is a subject that has an important role at all levels of education (Darmawati et al., 2022). Mathematics is one of the subjects that need to be mastered by students, especially at the primary school level, because at this level of education, it is an important stage to instil initial knowledge for the learning process of students at school (Kurniani et al., 2021). Having initial knowledge of mathematical concepts is an important foundation for students, so with this foundation, students can follow their education to the next level properly. Learners' Learners' ability to learn mathematics is often associated with their ability in other subjects. Learners who excel in mathematics are also able to excel in other subjects (Zurahmah & Isnaniah, 2023). This is because, in learning mathematics, students are trained to have problem-solving skills through habituation to practice critical, logical, and systematic thinking (Apriliani et al., 2022). This ability is an important ability not only in learning mathematics in the classroom but also in real life. Thus, problem-solving ability is the main competency that must be possessed by students in school (Widana, 2021).

Problems in the context of mathematics are called problems that require a lot of thinking, theories, and techniques that are owned so that a solution is finally found (Suryawan, 2021). Problems are different from exercise problems, where the solution is immediately known (Simatupang et al., 2022). In another review, problems are non-routine problems given to students, in contrast to routine problems, which are not the problems in question. Problem-solving refers to four stages based on Polya's steps, namely understanding the problem, planning strategies, problem-solving, carrying out calculations, and check-

ing back (Waliq et al., 2021). TIMSS, or Trends in International Mathematics and Science Study, reported the results of its research on the low mathematics skills of Indonesian students. One of the reasons for the low mathematics skills of students in Indonesia is the low problem-solving ability of students in Indonesia. This is in line with several previous studies by Simsek et al. (2020).

Realistic mathematics education is one of the mathematics learning methods that can accommodate students' problem-solving skills (Soraya et al., 2023). Realistic Mathematics Education (RME) is a mathematics learning approach that emphasises the understanding of mathematical concepts in the context of real life. This approach considers mathematics as a human construction that is relevant to the needs and context of learners. RME emphasises a deep understanding of mathematical concepts rather than simply memorising formulas or procedures. Learners are invited to understand the concept through real situations that are relevant to everyday life (Soraya et al., 2023). One of the main principles of RME is to relate mathematical concepts to real situations or problems. This can help learners to see the relevance of mathematics in everyday life and develop their ability to apply the concepts in various contexts. RME also emphasises the development of learners' mathematical problem-solving skills. Through this approach, learners are invited to face real problems and find solutions using the understanding of mathematical concepts they have learned. Realistic mathematics education contains six principles: reality principle, level principle, activity principle, guidance principle, interactivity principle, and intertwinement principle (Revina & Leung, 2019). The concept of horizontal and vertical mathematisation can help learners easily solve problems. Some previous research results show that realistic mathematics learning can help learners to improve their problem-solving skills (Naiheli et al., 2024).

Realistic mathematics education, when combined with certain strategies, can improve mathematics problem-solving skills. One application that can be used is the Mathcitymap application (Paramitha & Agoestanto, 2023). The Mathcitymap application is one of the applications that can be used in outdoor learning; it is easy to install and easy to use (Wulandari et al., 2023). The use of applications such as MathCityMap can be an effective tool in implementing RME. The application allows learners to learn mathematics directly in their surrounding environment, thus strengthening the concept of realistic and contextualised mathematics learning. Through the use of this application, students can learn mathematics directly in the field by finding and solving mathematical problems related to objects around them (Cahyono & Ludwig, 2016). The learning framework with Mathcitymap is based on outdoor learning, where outdoor learning can accommodate learners to be more in direct contact with nature (Jucker & Von Au, 2022). MathCityMap can be used to relate mathematical concepts to the surrounding environment of learners, thus making learning more relevant and interesting. By using MathCityMap, it is expected that students can train their ability to solve mathematical problems in a real and contextual manner. Some previous studies have shown that the use of the mathcitymap application can improve students' mathematical problem-solving ability (Astiani, 2024; Paramitha & Agoestanto, 2023). In addition to problem-solving ability, a learning interest in learning mathematics also plays a crucial role in the success of learners' mathematics education.

Learning interest can be defined as a person's intrinsic desire or motivation to learn mathematics, which strongly influences their engagement and achievement in this subject (Arends, 2014). Studies show that learning interest in mathematics has a direct and significant effect on mathematics learning outcomes (Zhang & Wang, 2020). Research has shown that mathematics learning approaches that are engaging and relevant to everyday life, such as Realistic Mathematics Education (RME) using applications such as MathCityMap, can increase learners' interest in learning mathematics (Nurhayati et al., 2022). The interest arising from the practical application of mathematics in real-life contexts helps to create a learning environment that captivates and sustains interest in learning mathematics. In the Indonesian context, where PISA and CBNA evaluation results show challenges in mathematics achievement, increasing interest in learning mathematics is expected to be a key factor in improving academic achievement. Efforts to integrate learning methods that emphasise problem-solving and relevance with educational technology applications, such as MathCityMap, not only improve mathematical competence (Cahyono & Ludwig, 2018), but can also generate learners ' intrinsic interest and motivation towards learning mathematics (Cahyono & Ludwig, 2016).

Thus, considering the aspect of interest in learning mathematics in the context of mathematics learning in Indonesia, it is crucial to optimise students' achievement and ability to solve mathematical problems effectively. Therefore, the topic that becomes the focus of this research is to determine the effect of realistic mathematics education learning assisted by the mathcitymap application on problem-solving ability and students' interest in learning mathematics. This study aims to compare students' problem-solving ability in solving mathematics problems and students' interest in learning through realistic mathematics education learning assisted by mathcitymap to students who are taught with conventional learning methods.

2. METHOD

The research is quantitative descriptive research that descriptively describes the problem-solving ability of students and student's interest in learning mathematics subjects in elementary schools. This research was conducted in one of the elementary schools in Makassar City in the 2023/2024 school year. Samples were selected from two classes, namely classes Va and Vb, each of which had 38 students in it. Based on the summative test data obtained, the average value of the summative test of each class is similar, where class V_a is 73.06 and V_b is 74.09, which shows that the two selected samples are homogeneous. Class Va was then determined as the control class and Class Vb as the experimental class. The experimental group was taught realistic mathematics education with the assistance of Mathcitymap, while the control group was given conventional learning treatment. Each group was taught for four meetings. The research design used was a quasi-experiment with a posttest-only control group design model, as shown in Table 1 below.

The instruments used are Learning Implementation Plans (RPP), which are used as guidelines in implementing realistic mathematics education learning assisted by math-

TABLE 1. Research Design

Group	Treatment	Posttest
Experiment	X1	O_2
Control	X2	O_2

citymap, written tests containing five numbers of questions to measure students' mathematical problem-solving skills, and a test to measure students' learning interest. The research instrument was validated theoretically and empirically. The data analysis techniques used were descriptive and inferential statistics. The research hypotheses for mathematical problem-solving ability and student interest are presented in Table 2 below

TABLE 2. Hypothesis

Problem-Solving Ability Aspect	Learning Interest Aspect
H_0: v_1=v_2	H_0: v_3=v_4
H_1: $v_1 \neq v_2$	H_1: $\mu_3 \neq v_4$

3. RESULT & DISCUSSION

3.1 Results

Data on the results of mathematics problem-solving ability (PSA) and students' interest (SI) were obtained through problem-solving tests and interest questionnaires. Data from both groups were then analysed descriptively and inferentially. Descriptively, the test results of both groups are presented in Table 3 below. The descriptive results

TABLE 3. Hypothesis

	Group	Mean	Std. Deviation	N
PSA	Experiment	80.21	7.39	38
	Control	68.42	13.71	38
SI	Experiment	81.61	6.38	38
	Control	60.29	8.95	38

showed that the mean mathematics problem-solving ability of the experimental group (80.21) was higher than the control group (68.42). The lower standard deviation in the experimental group (7.39) indicates that the variation in students' ability tends to be more homogeneous compared to the control group (13.71). This data indicates that most of the students in the experimental group showed relatively high and almost homogeneous performance in solving problems. The mean learning interest of the experimental group (81.61) was higher than that of the control group (60.29), with the standard deviation of the experimental group (6.38) being smaller than that of the control group (8.95). This also indicates that the student's interest in the experimental group is higher than the control group. The box plots of the four datasets are presented in Figure 1 below.

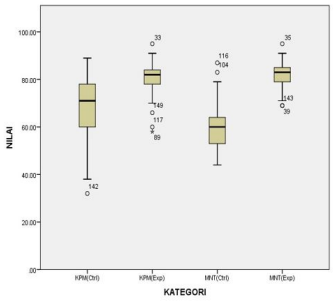

FIGURE 1. Boxplot of the Four Variables

Boxplots are displayed as four boxes representing each of the four data points, accompanied by a centre line representing the median and upper and lower whiskers representing data variability. The results of MANOVA inferential analysis using SPSS application assistance are presented in Table 4 below.

TABLE 4. Inferential Statistical Test Result

Source	Dependent Variable	Sig.	Partial Eta Squared
Corrected Model	KPM	.000	.224
	MNT	.000	.659
Intercept	KPM	.000	.979
	MNT	.000	.988
Group	KPM	.000	.224
	MNT	.000	.659
Error	KPM		
	MNT		
Total	KPM		
	MNT		
Corrected Total	KPM		
	MNT		

3.2 Discussion

The results of the descriptive analysis showed that, on average, the mathematical problem-solving ability of the experimental group was higher than that of the control group, indicating that realistic mathematics learning assisted by the mathcitymap application may have a positive impact on students' mathematical problem-solving ability. In addition, based on the standard deviation score, the mathematics problem-solving ability of the experimental group was lower than that of the control group, indicating that the variation in problem-solving ability among students in the experimental group was lower than that of the control group. This information indicates that overall, the students in the experimental group had a relatively high level of mathematical problem-solving ability, with most students having scores that were quite close to the mean.

The results of the descriptive analysis also showed that interest in learning in the experimental group was higher than in the control group, indicating that realistic mathe-

matics learning may be able to increase students' interest in learning mathematics. In addition, the standard deviation in the experimental group was lower than that in the control group, indicating that the variation in learning interest among students in the experimental group was lower than that in the control group. This information shows that the average learning interest of learners in the experimental group is higher than that of the control group, with most learners having more uniform learning interest.

Based on the boxplot shown in Figure 1 explains that the distribution of problem-solving ability data in the experimental group is smaller than in the control group. Similarly, the data distribution of students' interest in the treatment given to the experimental group is smaller than the control group. The data means that the first quartile, second quartile, and third quartile of the problem-solving ability and learning interest of the experimental group lie in a narrower range compared to the control group. The smaller distribution indicates that the variation in problem-solving ability and interest in learning among students in the experimental group is more limited or more homogeneous compared to the control group. This information indicates that the student's problem-solving ability and their learning interest in mathematics using realistic mathematics assisted by the MathCityMap application have a lower variation or are more homogeneous than the problem-solving ability and students' interest in conventional learning.

The middle line of the boxplot explains the median, so based on Figure 1, it can be explained that the median value of the experimental group is higher than the control group, as well as in student interest in learning, the median of student interest data in the experimental group is higher than the control group. This figure indicates that at least half of the students in the experimental group have problem-solving skills and an interest in learning, which tend to be higher than in the control group. The lower whisker of the experimental group is shorter than the control group, indicating that the data distribution is densest around the median of the experimental group. Similarly, the upper whisker of the control group is longer than the experimental group, indicating that the variability of the control group's problem-solving is quite high. As for learning interest, the control group has a longer upper whisker than the experimental group, which indicates that the variability of student interest in the control group is very diverse.

MANOVA analysis results show the p-value (Sig.) for all variables and groups (Corrected Model and Group) is less than 0.05 ($p<0.05$). This means that there is a significant difference in problem-solving ability (PMI) and interest in learning mathematics (MNT) between the experimental group and the control group. The high partial eta squared values (0.224 for KPM and 0.659 for MNT) indicate that the experimental group has a great influence on students' mathematical problem-solving ability and interest in learning mathematics. This output indicates that the differences between the experimental and control groups are practically significant.

Based on these results, it can be concluded that the realistic mathematics learning approach with the help of the MathCityMap application (experimental group) significantly improved students' mathematical problem-solving ability (Simsek et al., 2020; Sirajuddin et al., 2023), and interest in learning mathematics (Barbosa& Isabel, 2020; Hartmann & Schukajlow, 2021), compared to the conventional learning method (control group). These results support the use of technology in mathematics education to improve student learning outcomes, this result linear with Bright et al. (2024); Syahrini et al. (2024).

4. CONCLUSION

Based on the discussion, it has been shown that descriptively, the mathematics problem-solving ability and learning interest of students taught with the use of the mathcitymap application are higher than the problem-solving ability and learning interest of students taught with conventional learning, with variations in problem-solving ability and learning interest of students in the experimental group being more focused and more homogeneous compared to the control group. Inferentially, it has been shown that the differences between the experimental and control groups in mathematics problem-solving ability and interest in learning mathematics are statistically significant.

Thus, this study concludes that the realistic mathematics learning approach, using the MathCityMap application, significantly improves students' mathematical problem-solving ability and interest in learning mathematics compared to the conventional learning method.

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