Al-Ishlah: Jurnal Pendidikan
Vol.17, 1 (March, 2025), pp. 512-523
ISSN: 2087-9490 EISSN: 2597-940X, DOI: 10.35445/alishlah.v17i1.5463

Impact of Multiple Intelligences and Problem-Based Learning on Mathematical Literacy and Self-Efficacy in Junior High School Students

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ARTICLE INFO

Keywords:

Mathematical Literacy;
Self-Efficacy in Mathematics;
Multiple Intelligence-Based Learning;
Problem-Based Mathematics Learning

Article history:

Received 2024-09-30
Revised 2024-10-18
Accepted 2025-02-14

ABSTRACT

Mathematical literacy and self-efficacy are essential skills that influence students' success in mathematics. This study examines the impact of multiple intelligence-based and problem-based mathematics learning on students' mathematical literacy and self-efficacy. Additionally, it investigates whether multiple intelligence and problem-based learning are more effective than scientific learning approaches in improving these competencies. This quasi-experimental study employed a one-group pretest-posttest design. The study was conducted at State Junior High School 3 Yogyakarta during the even semester of the 2023/2024 academic year. The sample consisted of 64 students from two eighth-grade classes (VIII F and VIII E, each with 32 students). Data were collected using questionnaires to assess multiple intelligences before learning, observations to monitor learning implementation, and pretest-posttest assessments and questionnaires to evaluate students' progress. Data were analyzed using Multivariate Analysis of Variance (MANOVA) with Hotteling's T^2 test and Independent Sample T-test statistics. Findings indicate that multiple intelligence-based mathematics learning using problem-based and scientific approaches significantly influences students' mathematical literacy and self-efficacy. Additionally, problem-based learning was found to be more effective than scientific learning, as it resulted in higher improvements in students' mathematical literacy and self-efficacy scores. The study concludes that integrating multiple intelligence with problem-based mathematics learning positively impacts students' mathematical literacy and self-efficacy. Future research should explore long-term effects and broader student populations to further validate these findings.

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1. INTRODUCTION

Literacy skills and self-efficacy are important skills in mathematics education. The importance of mathematical literacy and self-efficacy cannot be ignored, and usually one of the most objectives in education, especially in Indonesia (Ananda & Wandini, 2022). Currently, the world of education in Indonesia is in a period of curriculum transition. However, there are still several educational units that focus on implementing learning activities based on the 2013 curriculum. The curriculum in the process of learning activities emphasizes the process rather than results, which requires students to be active and independent so they can learn without having to be dictated by the teacher and students are able to implement the lessons directly in school in everyday life.

In reality, the problem of education in Indonesia is the lack of effectiveness of the learning process. Students are less actively involved in developing their thinking abilities. An elective strategy that can be utilized is the problem-based learning (PBL) strategy which is based on the 2013 curriculum. PBL allows students to connect lesson material with real life. However, in implementing PBL, teachers need to consider students with different mathematical logic abilities. It is important for instructors to utilizemultiple intelligences-based learning, which pays attention to students' intelligence tendencies. However, there are still some teachers who do not pay attention to students' intelligence tendencies in learning (Kusmaryono, 2016; Delisle, 1997; Levy R, 2008; Septiana & Ikhsan, 2017; Niroo et al., 2012). The learning approach used in schools often only pays attention to verbal and numerical intelligence abilities so that other intelligences are neglected. This causes only students with verbal and numerical intelligence tendencies to be able to develop mathematics well, even though students have different intelligences, so the implementation of learning should be adjusted to the type of student intelligence tendencies.

The hypothesis of multiple intelligences put forward by Howard Gardner could be a reference in building and creating learning within the classroom by considering the contrasts in intelligence tendencies of each student, especially at the junior high school level. This theory helps teachers in teaching practice, and education in managing the classroom. The learning process will take place optimally when teachers can create meaningful learning activities in the classroom where students are focused on understanding mathematical concepts, not just memorizing the concepts. Furthermore, Saidi (2016) believes that the theory of multiple intelligences can help teachers make decisions regarding the most effective way of teaching compared to using conventional methods that are commonly applied in the world of education.

Apart from the problem of applying learning methods in the classroom, there are several aspects of abilities in mathematics learning that students need to improve in the 21st Century, namely mathematical literacy abilities. However, the facts on the ground are that students' mathematical literacy skills in Indonesia are still relatively low when compared with other countries (Hidayat et al., 2019). This is proven by the results of the examination system initiated by the Organization for Economic Cooperation and Development (OECD) in PISA in 2022 to evaluate and assess the education systems of 81 countries throughout the world. Every three years, students aged 15 years are randomly selected to take tests on three basic aspects and competencies, namely reading, mathematics and science. Of the three categories tested, Indonesia's scores are always below average. PISA assesses what students can do (application) with their knowledge. Indonesia's PISA results in mathematics show that students' mathematical literacy abilities have not reached the criteria. In 2012, Indonesia had 375 points in the field of mathematics competency, which increased in 2015 to 386 points. In 2018 Indonesia's PISA results decreased to 379 points. In the last year, namely 2022, Indonesia's PISA results were still relatively low, namely getting 366 in mathematics, which means there was a decline from the previous year (OECD, 2023).

A similar issue was identified in a study by Masfufah & Afriansyah (2021), which found that the mathematical literacy skills of eighth-grade students were still low, with an index of only 23% in the Shape and Space content of flat-sided geometric figures. These findings highlight the persistent challenges students face in developing mathematical literacy, particularly in spatial reasoning and geometric concepts.

Beyond mathematical literacy, teachers must also consider students' psychological and cognitive needs in the learning process. Students enter the classroom with diverse intelligences, unique characteristics, and varying psychological conditions, all of which require careful attention when designing and delivering instruction. One of the key psychological factors that significantly influences students' learning outcomes is self-efficacy—their belief in their ability to succeed in mathematical tasks. Although self-efficacy is not explicitly part of the definition of mathematical literacy, it is considered a critical prerequisite for its development (De Lange, 2006).

Findings from PISA 2015 further emphasize this concern, revealing that Indonesian students' mathematics self-efficacy levels were significantly below the international average (OECD, 2016a). This suggests that improving mathematical literacy should not only focus on enhancing conceptual understanding but also on building students' confidence in their mathematical abilities, ensuring they develop both competence and a positive attitude toward learning mathematics.

Self-efficacy is considered important because mathematics is still considered a difficult subject and is of little interest to most students. Students who have high intelligence in mathematics tend to have high self-efficacy because they consider mathematics to be a fun subject and are more able to solve mathematics problems, while students with low intelligence tend to have less self-efficacy in learning mathematics. Teachers need to pay attention to students' self-efficacy towards mathematics because it is positively correlated with students' mathematical literacy. The low level of mathematical literacy skills is caused by students' level of self-efficacy (Safrida et al., 2023).

Observations and interviews with the eighth-grade mathematics teacher at State Junior High School 3 Yogyakarta revealed that mathematics had the lowest average score compared to other subjects in the 2023/2024 odd semester final assessment. Many students expressed a dislike for mathematics, finding it difficult, full of numbers, and requiring memorization of formulas. This negative perception affects their confidence, making them less active in class and leading to poor mathematical literacy skills. When given non-routine literacy problems, many students struggled to solve them, while others were reluctant to engage with reading-based math questions.

Additionally, students showed low self-efficacy in mathematics. Many easily gave up when facing difficult questions and were unwilling to attempt problem-solving tasks. Another issue was that teachers primarily focused on logical intelligence and students' mathematical ability levels (high, medium, or low), without considering their multiple intelligences. This is because multiple intelligence-based learning had never been implemented in the classroom.

Addressing these challenges requires a more engaging learning approach that accommodates students' varied intelligences. One effective method is problem-based learning (PBL), where students work actively in groups to solve real-world problems. This approach encourages collaboration, critical thinking, and creativity, making mathematics more interactive and enjoyable. By integrating multiple intelligences into PBL, students can contribute based on their strengths, helping them better understand mathematical concepts and boosting their confidence in learning mathematics.

From the problems above, teachers can apply multiple intelligences-based mathematics learning methods in problem-based learning which not only facilitate students to have problem-solving skills, communication ability or increase students' self-efficacy in learning mathematics, but by implementing problem-based learning It is also considered capable of improving mathematical literacy skills. Judging from the current era, which prioritizes the world of science and technology, mathematical literacy skills are considered important for every student and need to be utilized optimally to be applied in the real world. In line with the opinion of Maulina & Retnawati (2017), mathematics is not just studied at school but can be applied in everyday life.

Research supports the benefits of problem-based learning (PBL) and multiple intelligence-based approaches in improving mathematical literacy and self-efficacy. Madyaratri et al. (2019) found that PBL, combined with an understanding of learning styles, enhances students' mathematical literacy. Similarly, Ernawati (2020) concluded that PBL significantly improves students' self-efficacy and academic performance. Research by Rafianti (2013) and Fathonah et al. (2019) also shows that integrating multiple

intelligences into mathematics learning boosts conceptual understanding and self-confidence. Furthermore, Septiana & Ikhsan (2017) demonstrated that PBL fosters conceptual understanding and creative thinking, highlighting its effectiveness over traditional methods.

Despite its potential, many teachers do not fully utilize multiple intelligences in the classroom. Since every student has different dominant intelligences, teachers need to identify and develop these strengths to enhance learning outcomes (Srikonita, 2018). Failing to address students' multiple intelligences may lead to frustration, reduced motivation, and lower self-efficacy (Sujiono & Sujiono, 2010). When properly developed, these strengths can significantly improve problem-solving skills, mathematical literacy, and overall academic performance.

For 21st-century learning, integrating multiple intelligences with PBL can enhance student engagement, conceptual understanding, and problem-solving abilities (Putri & Widjajanti, 2020). Hasanah et al. (2017) found that this approach optimally explores students' intelligence potential, improving both academic achievement and psychological well-being. Additionally, it fosters creative thinking, problem-solving skills, and self-efficacy, making mathematics more accessible and engaging.

To measure its effectiveness, this study compares multiple intelligence-based PBL with the scientific approach, which is commonly used in schools and recommended by the Ministry of Education and Culture (Regulation No. 103, 2014). This comparison aims to determine the impact of multiple intelligence-based learning on students' mathematical literacy and self-efficacy, providing insights into its effectiveness as an alternative teaching method.

Subsequently, it is essential to conduct research on the impact of implementing multiple intelligence learning and problem-based learning compared to a scientific approach designed without considering students' intelligence tendencies. The research questions asked are: 1) Is there an influence of multiple intelligences and problem-based mathematics learning on students' literacy skills and self-efficacy? 2) whether mathematics learning based on multiple intelligences and problem-based learning is superior to learning using scientific learning in terms of the average mathematical literacy ability and students' self-efficacy. This research aims to describe whether there is an impact of multiple intelligence in problem-based mathematics learning and a scientific approach on students' literacy abilities and self-efficacy, as well as describe which is superior between multiple intelligence, problem-based mathematics learning and learning with scientific learning in terms of the average mathematical literacy ability and mathematical self-efficacy of understudies.

2. METHODS

This study uses a quasi-experimental research type. This investigation was conducted at State Junior High School 3 Yogyakarta in January-February 2024. The population of this study was 192 students of class VIII. The students were divided into six classes, namely class A, B, C, D, E, and F. All students have homogeneous characteristics. Thus, all populations have an equal opportunity to be used as research samples. The sampling technique used was the cluster random sampling technique using a lottery. The samples used as research subjects based on the lottery results were classes VIII E and VIII F. The treatment carried out in the experimental class was multiple intelligence in problem-based learning, while the control group was mathematics learning using a scientific approach that is commonly applied in schools.

This research design, namely Pretest-Posttest Nonequivalent Control Group Design, was used to obtain data on students' mathematical literacy skills and self-efficacy score data. In this plan, there are two groups, to be specific the experimental group and the control group which were not chosen haphazardly. The research design in this study can be seen in Table 1 below:

Table 1. Experimental Research Design Pretest-Posttest Nonequivalent Control Group Design

Group	Pretest	Treatment	Posttest
Experiment	O_1	X	O_2
Control	O_1	Y	O_2

Information:
O_1 : giving initial tests and questionnaires
X : multiple intelligence in problem-based mathematics learning
Y : learning mathematics with a scientific approach
O_2 : giving final tests and questionnaires

Data collection techniques were carried out in 3 ways, namely questionnaires, tests and observations. The questionnaire technique was carried out to identify the diversity of intelligence in the class, which was then used as material for determining groups, while the student self-efficacy questionnaire was used to determine students' self-confidence before and after learning. The test technique was carried out to determine the achievement of mathematics literacy ability scores before and after learning. Meanwhile, observation techniques are used to assess and observe the learning process carried out by teachers in accordance with the Learning Implementation Plan.

There were 4 instruments used in collecting data for this research, namely questionnaire sheets, mathematics literacy ability test questions and learning implementation observation sheets. So that the instrument used is able to measure what it should measure and produce consistent results, before conducting the research, a validation stage is carried out first.

Two validations were conducted in this study, namely content validation and construct validation. Content validation is used for test instruments that are designed to be feasible or not to measure the variables studied. Construct validation is carried out by testing the instrument on other classes that are not research samples on grade VIII students, so as to produce valid and reliable results. Analysis of the results of instrument testing, especially for test questions and questionnaires, is carried out using KMO (Kaiser-Meyer-Olkin) factor analysis.

The investigation method utilized in this investigate is one hypothesis which is able be tried utilizing multivariate analysis of variance (MANOVA), the other two hypotheses using the independent sample t-test statistic and effect size. Before testing the hypothesis, of course the multivariate and univariate assumptions, namely normality and homogeneity, must be fulfilled first.

3. FINDINGS AND DISCUSSION

3.1. Result

This research consisted of two sample classes, namely classes VIII F and VIII E with a total of 32 students as the experimental class and the control class. Based on the results of assessments and observations during the learning process, mathematics learning carried out by researchers in the experimental class went well and with high results. A recapitulation of observation sheets on student activities can be seen in Table 2 below:

Table 2. Experimental Research Design Pretest-Posttest Nonequivalent Control Group Design

Meeting	Experiment	Control
1	100%	100%
2	96%	87%
3	96%	93%
4	96%	87%
5	94%	93%
6	93%	93%

The results in Table 2 indicate that the learning process conducted by the researcher was successful, largely due to the well-prepared Learning Implementation Plan (RPP). A structured lesson plan plays a crucial role in ensuring effective and organized learning. According to Chatib (2011, p.193), the benefits of developing a lesson plan include its archival value, allowing teachers to refine and improve their teaching in subsequent years. Additionally, a well-structured plan helps maintain teaching quality, measure academic achievement, and manage time allocation effectively, ensuring that lessons are delivered in an engaging and structured manner.

During the learning process, students worked in groups based on their multiple intelligences. Grouping was determined by students' dominant intelligences to maximize their engagement and participation. As stated by Gardner in Munif Chatib (2011), an individual's intelligence can be identified through their habitual behaviors and tendencies. By applying this approach, the learning process becomes more personalized and effective, allowing students to leverage their strengths while actively participating in collaborative learning.

According to Bas (2010), one way to identify students' intelligence and potential is by engaging them in thinking activities that align with tasks they frequently perform in class. Grouping students based on their dominant intelligences allows for a more effective learning process. This approach was implemented in this study through a questionnaire, where students provided responses about their abilities and study habits, particularly in science subjects.

The multiple intelligences questionnaire serves as a valuable tool for understanding students' psychological profiles and intelligence tendencies. According to Chatib (2011), the results can provide useful insights for teachers and parents, helping them design habitual and creative activities that nurture students' talents. Based on the findings from this study, students in class VIII F at State Junior High School 3 Yogyakarta exhibit nine types of intelligence, as identified in Gardner's Multiple Intelligence Theory (Fathi Abdulkader et al., 2009). These intelligences include musical, visual-spatial, bodily-kinesthetic, intrapersonal, interpersonal, naturalist, verbal-linguistic, existential, and logical-mathematical. The distribution of these intelligence types among students in class VIII F is detailed in Table 3.

Table 3. Multiple Intelligences Tendencies In Class VIII F

Type of Intelligence	Number of Students	Percentage
Interpersonal	7	17.5%
Naturalist	6	15%
Intrapersonal	6	15%
Visual-Spatial	6	15%
Existential	5	12.5%
Logical-Mathematical	3	7.5%
Verbal-Linguistic	3	7.5%
Bodily-Kinesthetic	2	5%
Musical	2	5%

Based on Table 3, there are 9 intelligences possessed by students in a balanced proportion. In mathematics learning, all of these intelligence cannot be ignored and must be facilitated maximally. In accordance with the variables studied in this study, the learning carried out by the researcher aims to describe whether or not there is an impact on multiple intelligence and problem-based mathematics learning and scientific approaches on students' mathematical literacy and self-efficacy, and to describe which is superior between mathematics learning based on multiple intelligence in problem-based mathematics learning and learning with a scientific learning shows the average mathematical literacy skills and mathematics self-efficacy.

In accordance with the research design it was determined that before and after treatment a test was given to determine the initial and final scores on both variables students' mathematical literacy abilities and self-efficacy. The recapitulation results of the pretest posttest scores for mathematical literacy ability and self-efficacy in Table 4.

Table 4. Recapitulation of pretest-posttest scores

Group	Variable	Pretest	Posttest
Experiment	Mathematical Literacy	20.41	76.45
	Mathematics Self-Efficacy	53.75	67.94
Control	Mathematical Literacy	20.41	69.89
	Mathematics Self-Efficacy	53.31	58.09

The data recorded in Table 4, it appears that there has been an increment within the esteem for each variable. The following may be a chart of the pretest-posttest scores for mathematical literacy ability and self-efficacy.

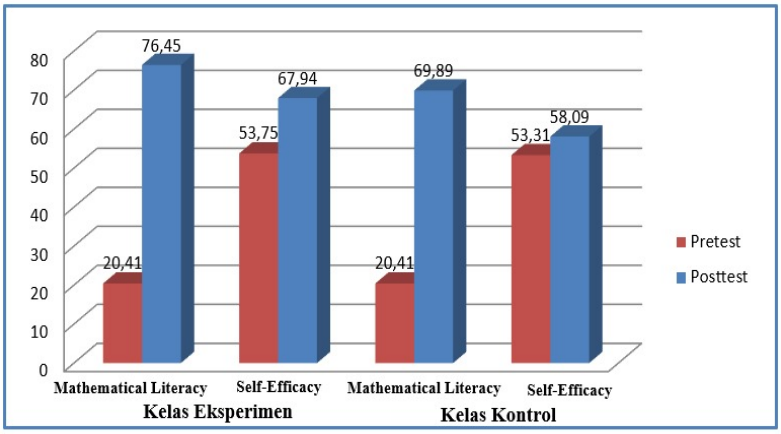

Figure 1. Recapitulation of pretest-posttest scores

The data obtained were then tested using multivariate analysis of variance (MANOVA), independent sample t-test and assumption test that must be met. The results of the assumption test analysis can be seen in Table 5.

Table 5. Recapitulation of Data Assumption Test Results for Mathematical Literacy Ability and Self-Efficacy

Group	Variable	Kolmogorov-Smirnov	Levene
Experiment	Mathematical Literacy	0.200	0.890
	Self-Efficacy	0.200	
Control	Mathematical Literacy	0.051	0.748
	Self-Efficacy	0.200	

The comes about of assumption test analysis above indicates that the data obtained is normally distributed and homogeneous. This means that the data meets the requirements for parametric testing. The comes about of the hypothesis test analysis using multivariate analysis of variance (MANOVA) for two data from each variable produced a Sig (2-tailed) value of 0.000. This value is much smaller than the value $\alpha = 0.05$. This means that it can be concluded that H_0 is rejected, so that there is a significant average difference between two class groups. Thus the first and second hypotheses have been answered, learning based on multiple intelligence and problem-based mathematics learning has an

impact on students' mathematical literacy abilities and mathematics self-efficacy. Then, the scientific approach influences students.

Furthermore, the conclusion of the independent sample t-test on Equal Variance assumed showed that the t value was 2.174 where t = 2.174 > 0 and the significance value was 0.034 (2-tailed) where 0.017 < 0.05, so H_0 was rejected. This means that the class group that uses multiple intelligences-based mathematics learning in problem-based learning is significantly different from the class group that uses a scientific approach in terms of mathematical literacy abilities. In other words, the experimental class with mathematics learning based on multiple intelligence and problem-based mathematics learning is superior to the control class, which uses learning with scientific learning in terms of the average mathematical literacy skills, or it could be said that mathematics learning based on multiple intelligence in problem-based mathematics learning influences mathematical literacy skills.

The conclusion of the independent sample t-test on Equal Variance not assumed showed that the t value was 6.911 where t = 6.911 > 0 and the significance value was 0.000 (2-tailed), where 0 < 0.05. So it can be concluded that H_0 is rejected, which means that the class group that uses multiple intelligences in problem-based mathematics learning is significantly different from the class group that uses a scientific approach in terms of average self-efficacy. In other words, the experimental class with multiple intelligences-based mathematics learning in problem-based learning is superior to the control class with a scientific approach in terms of the normal self-efficacy score, or it could be said that multiple intelligences-based mathematics learning in problem-based mathematics learning has an effect on mathematics self-efficacy.

Apart from that, the effect size test also further proves that the learning carried out in the experimental class is by applying multiple intelligences-based mathematics learning in problem-based learning, 0.54 for mathematical literacy skills and 1.72 for self-efficacy. Thus, it can be said that mathematics learning based on multiple intelligences in problem-based mathematics learning has a positive impact on students' mathematical literacy and self-efficacy. Furthermore, multiple intelligences-based mathematics learning and problem-based learning is superior to scientific learning in terms of the average score of mathematical literacy skills and mathematics self-efficacy.

3.2. Discussion

Students' mathematical literacy abilities before and after learning are very different. Based on the results of the independent sample t-test, the application of multiple intelligence is superior to the scientific learning in terms of students' mathematical literacy abilities. The results above are also in accordance with the opinion of Xie and Lin (2009) that the theory of multiple intelligences can be connected at domestic and at school to make an educating or learning strategy and give more of a gathering for creating imagination, emphasizing understanding and apply unused information, procedures and ideas to the learning prepare.

Learning that is combined with the diversity of multiple intelligences in problem-based mathematics learning has an influence on mathematical literacy skills. The multiple intelligences approach was successful in increasing student learning achievement through mathematical literacy test questions (Kurniawan et al., 2015). Multiple intelligence can further motivate students to be enthusiastic in learning, this is proven in a learning process that is tailored to students' intelligence. However, learning that is integrated with multiple intelligences in problem-based mathematics learning is superior to the scientific approach.

Multiple intelligences-based mathematics learning in problem-based learning (PBL) proves to be more effective than scientific learning in enhancing students' mathematical literacy. This advantage is due to the diverse and interest-based activities designed within the learning process. Unlike traditional methods that focus purely on mathematics, PBL allows students to engage in group discussions, present their findings, analyze concepts, and draw conclusions collaboratively. By incorporating

activities that align with students' individual interests and intelligence tendencies, students can explore mathematical concepts in a way that feels more natural and meaningful to them.

To optimize mathematics learning, teachers must consider students' intelligence profiles when designing lessons. Tailoring activities to students' strengths enhances engagement, conceptual understanding, and problem-solving skills. By integrating multiple intelligences into PBL, students not only develop better mathematical literacy but also gain higher motivation and confidence in learning mathematics.

At State Junior High School 3 Yogyakarta, students' mathematical literacy skills vary based on their ability levels. High-achieving students demonstrate strong literacy skills, successfully completing all three components of the mathematical process: formulating, employing, and interpreting mathematical concepts. Moderate-ability students can fulfill only two components, typically formulating and employing, but struggle with interpretation. Lower-ability students face greater challenges, often only able to complete the formulating stage, making it difficult for them to progress to employing and interpreting mathematical problems.

This difficulty arises because a single question often requires students to engage with all three components. Students who struggle with the formulate stage are unable to advance to employing and interpreting the problem. Among these three components, interpretation is the most challenging for students. This is evident in the average scores for the interpret aspect, which are consistently lower than the formulate and employ aspects in both groups: 5.96 (66.31%) in the experimental class and 5.43 (60.41%) in the control class.

Students' mathematics self-efficacy before and after learning is very different. After being given treatment with multiple intelligences-based in problem-based mathematics learning in the experimental class, there were 6 students with very high self-efficacy categories (18.75%). Meanwhile, in the control class which used a scientific approach after being given treatment, there were 9 students in the high self-efficacy category (28.125%), it appears that the majority of students in the experimental and control classes' mathematics self-efficacy categories were in the very high and high categories. The average result of the final student self-efficacy questionnaire has increased. The highest average increase in questionnaire results in the experimental class was in the strength dimension for an indicator of confidence in successfully achieving achievements or goals in learning mathematics of 3.5 (23.34%), while the highest average increase in questionnaire results in the control class was in the dimension strength as an indicator of confidence in successfully achieving achievements or goals in learning mathematics is 1.25 (8.33%). It appears that there's a positive impact of multiple intelligences-based mathematics learning in problem-based learning on students' self-efficacy.

This is different from learning mathematics with scientific learning without a multiple intelligence approach. Students who experience learning with a scientific learning are faced with science-based learning to discover a mathematical concept. Students' experience in solving problems in this research increases students' mathematics self-efficacy. Students' self-efficacy increases more rapidly by using problem-based learning compared to conventional learning (Rismayanti et al., 2023). Learning mathematics with problem-based learning gives students space for experience in solving daily life problems, and interaction in solving problems so that students' self-efficacy develops during the learning process. Bandura (1997) states that confidence will increase through vicarious experiences, namely by observing the behavior and experiences of other people.

Based on the expert opinion above and the findings obtained by researchers, it is proven that learning in experimental classes, namely multiple intelligence in problem-based mathematics learning, can progress students' mathematical literacy abilities and self-efficacy. The first hypothesis found that multiple intelligence and problem-based learning have an effect on students' mathematical literacy and self-efficacy, and the second hypothesis found that the experimental class is superior to the control class in terms of average mathematical literacy and self-efficacy. This is also in accordance with Rose and Nichols (1997), who states that by using all the intelligence a person has, students will be motivated to think about solving problems in everyday life. Apart from that, cultivating knowledge using various

types of intelligence allows students to be fluent in formal, non-formal and informal education. When students are fluent in the school, family and community environment, they will easily understand a concept and achieve good learning achievements (Sihombing, 2022). The results of these findings have the potential to make strides in the quality of instruction by paying consideration to the execution of instructors so that they are more mindful of the requests of the current worldwide time which places more prominent accentuation on students having mathematical literacy skills and student self-efficacy which are in understanding with current student needs so that student learning results can be completed get ideal comes about in applying mathematics learning results.

Apart from that, data teachers help students develop every potential intelligence they have. So it is easier for teachers to teach mathematical concepts according to each student's intelligence, so that the lessons taught can be applied optimally by students. Apart from that, teachers can better appreciate students' abilities based on the multiple intelligences possessed by each student. Another benefit is that it provides new experiences for students so that, in the future, students can play an active and creative role in learning activities. Training students' creative thinking skills can help students generate new ideas, improve students' high-level cognitive skills, and enable them to solve problems, which can help students compete in facing the challenges of 21st-century global life (Sukarso et al. , 2019). Based on this, mathematical literacy skills and self-efficacy are significantly impacted by learning that utilizes students' intelligent tendencies in problem-based mathematics learning, which can produce something that can improve victory aptitudes within the 21st century.

4. CONCLUSION

The results of the MANOVA test indicate a significant impact (Sig. value < 0.05) of multiple intelligence-based and problem-based mathematics learning on students' mathematical literacy skills and self-efficacy at State Junior High School 3 Yogyakarta, particularly in flat-sided geometric material. Additionally, the independent sample t-test under Equal Variance Assumed confirms that multiple intelligence-based problem-based learning is superior to the scientific approach, as evidenced by higher average scores in mathematical literacy and self-efficacy. These findings highlight the effectiveness of integrating multiple intelligences into problem-based learning to enhance students' mathematical competence and confidence.

Mathematical literacy is a critical 21st-century skill, especially for junior high school students, as it fosters problem-solving, critical thinking, and real-life application of mathematical concepts. Strengthening mathematical literacy not only improves academic achievement but also enhances self-confidence in learning mathematics. Thus, the study concludes that multiple intelligence-based problem-based mathematics learning has a positive impact on students' mathematical literacy and self-efficacy.

Despite these findings, this research has limitations, particularly in sample size and scope, as it was conducted in a single school with a specific focus on flat-sided geometric material. Future research should involve larger and more diverse samples to improve the generalizability of the findings. Additionally, further studies could explore the impact of multiple intelligence-based learning on other aspects of student achievement and motivation. Teachers are encouraged to incorporate multiple intelligence strategies into classroom instruction to engage students effectively, prevent learning fatigue, and enhance mathematical literacy and self-efficacy through varied and student-centered learning approaches.

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