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Comparing Probing-Prompting and Problem-Based Learning to Improve Mathematical Reasoning, Self-Efficacy, and Adversity Quotient in Junior High Students

Sophia Elma[1], Elly Arliani[2]

[1] Universitas Negeri Yogyakarta, Yogyakarta, Indonesia; sophiaelma21@gmail.com
[2] Universitas Negeri Yogyakarta, Yogyakarta, Indonesia; arlianielly@uny.ac.id

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ABSTRACT

Developing students' mathematical reasoning, self-efficacy, and adversity quotient is essential in supporting their academic resilience and problem-solving skills. This study compares the effectiveness of Probing-Prompting (PP) and Problem-Based Learning (PBL) models in enhancing these three domains among junior high school students. A quasi-experimental design with a nonequivalent (pretest-posttest) control-group approach was used. The study involved 56 seventh-grade students from a public junior high school in Yogyakarta, divided into two classes: an experimental group using PP and a control group using PBL. Data were collected using validated and reliable instruments, including mathematical reasoning tests and self-report questionnaires on self-efficacy and adversity quotient. Data analysis employed paired t-tests, independent t-tests, Mann–Whitney U tests, and Hotelling's T^2 with a significance level of 0.05. Both PP and PBL significantly improved students' mathematical reasoning, self-efficacy, and adversity quotient. However, comparative analyses showed no statistically significant differences in the mean gain scores between the two groups for all three variables: mathematical reasoning ($t = 0.829$, $p = 0.206$), self-efficacy ($U = 351.50$, $p = 0.256$), and adversity quotient ($U = 334.00$, $p = 0.173$). While PP and PBL are both effective, neither demonstrated clear superiority in improving the targeted skills. The short intervention period may have limited the full impact of the PP model. Nonetheless, the findings suggest both models offer valuable strategies for supporting students' cognitive and non-cognitive development.

Corresponding Author:
Sophia Elma
Universitas Negeri Yogyakarta; sophiaelma21@gmail.com

1. INTRODUCTION

Mathematical reasoning is a fundamental component of mathematics education because it enables students to analyze problems, formulate logical arguments, and construct meaningful solutions. The development of reasoning skills not only contributes to improved academic achievement in mathematics but also strengthens students' ability to solve complex problems in various contexts. According to Alan

H. Schoenfeld (2016), one of the primary goals of mathematics education is to cultivate reasoning abilities that support effective problem-solving processes. When students are trained to reason mathematically, they are better equipped to interpret mathematical concepts, justify procedures, and evaluate the validity of their solutions. Consequently, the cultivation of mathematical reasoning should become a central focus of classroom instruction. This view is supported by Günhan Cingisiz (2014), who argues that mathematics learning should prioritize reasoning development as a core objective rather than merely emphasizing procedural competence.

To foster mathematical reasoning, instructional strategies that encourage active engagement and collaboration among students are essential. One approach widely recognized for its effectiveness in promoting higher-order thinking is cooperative learning. Cooperative learning environments enable students to discuss ideas, exchange perspectives, and construct knowledge collectively, thereby facilitating deeper conceptual understanding. Research by Melissa F. Mueller, David Yankelewitz, and Carolyn A. Maher (2014) highlights that reasoning skills are more likely to develop in classrooms where students' ideas are openly shared and discussed. In such environments, teachers encourage learners to articulate their thinking processes, making their reasoning visible to peers who can then respond, question, or extend these ideas. Through this process, reasoning becomes a social and communicative activity rather than an isolated cognitive process.

In addition, questioning strategies play an important role in stimulating students' reasoning processes. Purposeful questioning encourages learners to reflect on their understanding, justify their answers, and explore alternative solutions. According to Noreen M. Webb and Claire E. Webb (2016), classroom interactions that involve structured questioning can significantly enhance mathematical reasoning by prompting students to explain and defend their ideas. When students are asked to provide reasons for their answers, they engage more deeply with the problem-solving process and develop stronger conceptual understanding. Such interactions also encourage students to critically evaluate both their own reasoning and that of their peers.

One cooperative learning technique that explicitly incorporates questioning as a central instructional component is probing–prompting learning. Probing–prompting is characterized by the use of sequential, guiding questions designed to stimulate students' thinking and lead them toward discovering mathematical concepts independently. According to Miftahul Huda (2014), probing–prompting learning involves presenting exploratory questions that encourage students to connect prior knowledge with new information. Through this structured questioning process, students are guided to construct their own understanding rather than passively receiving information from the teacher. As a result, students become more actively involved in learning activities and develop stronger reasoning skills.

Several studies have demonstrated the effectiveness of probing–prompting learning in improving various aspects of students' mathematical abilities. Research conducted by Ulya, Masrukan, and Kartono (2012) indicates that this instructional strategy increases students' engagement during mathematics lessons at the junior high school level. Similarly, Kurniasari and Susanah (2013) found that probing–prompting learning helps students achieve indicators of mathematical reasoning ability. Further evidence from Pratiwi, Ramlah, and Roesdiana (2017) suggests that the strategy effectively enhances high school students' mathematical reasoning skills. In addition, Hartinah et al. (2019) reported that probing–prompting learning positively influences students' mathematical communication abilities, particularly in their capacity to present logical arguments and rational explanations. More recently, Manoppo, Pomalato, Zakiyah, and Puloo (2022) demonstrated that this learning approach also improves junior high school students' overall mathematics learning outcomes.

Beyond cognitive abilities, students' psychological factors also play a significant role in mathematics learning. One such factor is self-efficacy, which refers to students' beliefs about their capability to successfully perform specific academic tasks. According to Frank Pajares (2002), students with high self-efficacy tend to show greater persistence, motivation, and confidence when solving mathematical problems. These students are more willing to engage in challenging tasks and are less likely to give up when encountering difficulties. Consequently, their academic performance often surpasses that of students with lower levels of self-efficacy. Conversely, students who doubt their abilities frequently experience anxiety, lack motivation, and struggle to sustain effort when faced with complex mathematical tasks. As noted by Sewell and St. George (2000), low self-efficacy can lead students to perceive themselves as incapable, which ultimately hinders their learning achievement.

Self-efficacy is closely related to another psychological construct known as the adversity quotient (AQ). The concept of adversity quotient, introduced by Paul G. Stoltz (2000), describes an individual's capacity to withstand challenges and persist despite obstacles. Individuals with high AQ demonstrate resilience and determination when facing difficulties, enabling them to overcome problems and achieve success. In the context of education, adversity quotient influences how students respond to academic challenges, including those encountered in mathematics learning. Research by Suryadi and Santoso (2017) indicates that both self-efficacy and adversity quotient significantly contribute to students' academic success. Their findings reveal that approximately 13% of students' mathematics achievement can be explained by these two psychological factors. Furthermore, Parvathy and Praseeda (2014) found that students with higher AQ levels tend to demonstrate stronger perseverance and experience fewer academic difficulties compared to those with lower AQ levels.

Considering the importance of mathematical reasoning, self-efficacy, and adversity quotient in mathematics learning, instructional strategies that simultaneously support the development of these aspects are needed. Probing–prompting learning appears to offer such support because its questioning-based approach encourages active participation, reflective thinking, and persistence in problem solving. However, in many schools, another widely implemented active learning approach is Problem-Based Learning (PBL). PBL emphasizes the use of real-world problems as a starting point for learning, encouraging students to collaboratively investigate solutions and construct knowledge through inquiry.

Previous research comparing probing–prompting learning and PBL has produced interesting findings. For instance, Sari (2018) reported that there was no statistically significant difference in students' problem-solving abilities between classes taught using probing–prompting and those taught using PBL, as indicated by the results of a t-test. Nevertheless, the average score of students in the probing–prompting class was slightly higher by 2.66 points. Since problem-solving ability is closely related to mathematical reasoning (Mukuka, Mutarutinya, & Balimuttajjo, 2021) and influenced by self-efficacy (Öztürk, Akkan, & Kaplan, 2020), these findings suggest that probing–prompting learning may provide additional benefits in supporting reasoning processes. Similarly, research conducted by Awaliah, Sanusi, and Aswi (2021) showed that both learning models are effective in improving students' learning outcomes. Their results indicated a mean improvement of 0.77 for probing–prompting learning and 0.76 for PBL, suggesting that both methods contribute positively to students' academic development.

Despite these findings, previous studies have primarily focused on cognitive outcomes such as problem-solving ability and learning achievement, while relatively limited attention has been given to psychological factors such as adversity quotient. Integrating adversity quotient into the analysis of mathematics learning provides a broader perspective on how students cope with academic challenges and persist in the learning process. Mathematics often requires sustained effort and resilience, making AQ an important factor in determining long-term learning effectiveness. Moreover, research examining adversity quotient within the context of mathematics learning—particularly in comparative studies involving questioning-based and problem-based instructional approaches—remains limited.

Therefore, this study adopts a comparative research design to examine the effectiveness of probing–prompting learning and Problem-Based Learning in improving students' mathematical reasoning ability, self-efficacy, and adversity quotient. By comparing two active learning models, the study not only evaluates the effectiveness of each approach but also provides insights into which instructional strategy is more suitable for developing specific cognitive and psychological competencies. Furthermore, this comparative approach enables the identification of the distinctive strengths of each learning model in supporting students' learning processes.

Based on the background described above, the present study aims to investigate which learning method—probing–prompting learning or Problem-Based Learning—is superior in terms of the average improvement in students' mathematical reasoning ability, self-efficacy, and adversity quotient. In addition, this study examines whether both instructional approaches significantly enhance these three aspects of students' learning. Accordingly, the main research question addressed in this study is: Which learning approach is more effective, probing–prompting learning or Problem-Based Learning, in improving students' mathematical reasoning ability, self-efficacy, and adversity quotient?

2. METHODS

This study uses a quantitative approach with a quasi-experimental research type. Among the various types of quasi-experiments, this study uses a non-equivalent (pretest-posttest) control-group design (Creswell, 2014). The selection of this type of research is due to the impossibility of researchers to place students into experimental and control groups randomly as in true experiments. Therefore, researchers use groups or classes that have been formed previously at the school where the research was conducted. The study was conducted using two groups, namely the experimental group that was given treatment in the form of probing-prompting learning and the control group that was not given special treatment, in this case, the control group learning used problem-based learning (PBL).

The study was conducted in stages: (1) observation; (2) planning; (3) implementation and application of learning innovations that began with the provision of pretests and initial questionnaires, as well as the provision of posttests and final questionnaires as reflection. The study was conducted at a State Junior High School in Yogyakarta in the 2023/2024 academic year from March to April 2024. The population in this study were all grade VII students at a State Junior High School in Yogyakarta with characteristics ranging in age from 12-14 years. The sample in this study was 56 students (24 boys and 32 girls) of grade VII of junior high school taken from two classes using convenience sampling techniques. This technique is likely to be selected if applying a quasi-experiment because researchers usually use groups/classes that have formed naturally (such as classes, organizations, or a family) or volunteers (Creswell, 2014). The use of this sampling technique was based on several practical considerations, including limited access, established class groups, and school permission. The administrative limitations of the classes limited the researcher's ability to randomly divide students into experimental and control classes, making intact classes is the most realistic option. The researcher's preference for classes available and permitted by the school allowed the study to proceed within the time, effort, and funding constraints anticipated. In addition to practical considerations, the choice of convenience sampling was also based on ethical constraints, namely to avoid disrupting students' learning processes. Randomizing all students in a school for experimental purposes could disrupt the learning process, which would be difficult for the school to approve. The researcher's limited control over the natural setting also placed limitations on the researcher, as the researcher was not the one who managed the classes. Therefore, ethically, using available classes was a feasible and responsible choice.

Data were collected using test and non-test techniques, with research instruments in the form of questions and questionnaires. The indicators of the mathematical reasoning test instrument, self-efficacy questionnaire, and adversity quotient questionnaire are shown in Table 1.

Table 1. Indicators of Mathematical Reasoning Test, Self-efficacy Questionnaire, and Adversity Quotient Questionnaire

Instrument	Reliability Coefficient	Indicators
Pretest mathematical reasoning	$\alpha = 0.713$	• Finding patterns or structures. • Proposing conjectures.
Posttest mathematical reasoning	$\alpha = 0.669$	• Evaluating conjectures. • Drawing conclusions with logical reasons.

Self-efficacy questionnaire	$\alpha = 0.931$	• Confidence in being able to complete math tasks/problems with varying levels of difficulty. • Confidence in self-resilience in facing obstacles/difficulties. • Confidence in being able to develop strategies or actions to solve math problems. • Confidence in being able to master situations or concepts. • Confidence in being able to achieve good results.
Adversity quotient questionnaire	$\alpha = 0.798$	• Ownership of control over difficult situations. • The ability to admit responsibly for the difficulties faced. • The ability to take responsibility without blaming oneself, others, or the environment as the source of the difficulties. • The ability to provide boundaries to the problems faced so that they do not spread to other lives. • The ability to survive difficulties by considering the difficulties as temporary.

The mathematical reasoning test consisted of pretest and posttest questions, each consisting of five essay questions, which have been adjusted to the learning achievements of grade VII related to the material on flat-sided geometric shapes. The self-efficacy questionnaire is compiled based on five indicators that have been adjusted to the three dimensions of self-efficacy (generality, magnitude, and strength). Meanwhile, the adversity quotient questionnaire is compiled based on five indicators that have been derived from the AQ dimension (CO2RE). The self-efficacy and adversity quotient indicators are then described in 25 statements with five alternative answers on a Likert scale of 1-5 from "Never (TP)" to "Always (SL)".

Validity evidence concludes that the instruments in this study are valid. Evidence of content validity for the three instruments was obtained based on expert judgment by two expert lecturers. Meanwhile, evidence of construct validity was obtained through a pilot study whose results were then analyzed using factor analysis. Data were analyzed descriptively and inferentially. Descriptive analysis was carried out by looking at the average, standard deviation, maximum and minimum scores. Meanwhile, inferential analysis was conducted using the *t*-test and *U*-test to test the hypothesis regarding which learning is superior between the two learning methods in terms of the average increase in mathematical reasoning ability, self-efficacy, and adversity quotient, and to investigate whether probing-prompting and PBL learning can significantly improve students' mathematical reasoning ability, self-efficacy, and adversity quotient.

3. FINDINGS AND DISCUSSION

3.1. Findings

3.1.1 Mathematical reasoning ability

The assessment of mathematical reasoning ability is based on the pretest and posttest scores. Descriptively, the average pretest score of students' mathematical reasoning ability with probing prompting learning ($M = 33.62$; $SD = 18.96$) is lower than with problem-based learning ($M = 44.14$; $SD = 11.04$). However, the increase in the average score of mathematical reasoning ability from pretest to posttest of the probing-prompting class is higher than that of the problem-based learning class. The probing-prompting class (*Mpostes* = 80.46; *SDpostes* = 12.85) experienced an increase in the average score of 46.84, while the problem-based learning class was 37.65 (*Mpostes* = 81.79; *SDpostes* = 13.68).

Based on inferential analysis, the results showed that there was a significant difference between the pretest and posttest results of students' mathematical reasoning ability, both in the probing-prompting class ($t(28) = 20.21$; $p = 0.000$ (one-tailed)) and the problem-based learning class ($t(26) = 17.15$; $p = 0.000$ (one-tailed)). In other words, there was an increase in the mathematical reasoning ability of students in the probing-prompting and problem-based learning classes from before to after treatment.

3.1.2 Self-efficacy

The assessment of students' self-efficacy was based on the questionnaire scores before (beginning) and after treatment (end). Descriptively, the initial self-efficacy questionnaire scores of students in the probing-prompting class ($M = 79.31$; $SD = 15.94$) were lower than those in the problem-based learning class ($M = 89.48$; $SD = 13.72$). However, the increase in the average self-efficacy score from before to after the probing-prompting class treatment was higher than that of the problem-based learning class. The probing-prompting class (*Makhir* = 87.17; *SDakhir* = 16.53) experienced an increase in the average score of 7.86, while the problem-based learning class was 7.59 (*Makhir* = 97.07; *SDakhir* = 13.83).

Based on inferential analysis, the results showed that there was a significant difference between the results of the initial questionnaire and the final questionnaire of students' self-efficacy, both in the probing-prompting class ($t(28) = 6.91$; $p = 0.000$ (one-tailed)) and the problem-based learning class ($t(26) = 5.835$; $p = 0.000$ (one-tailed)). In other words, there was an increase in the self-efficacy of students in the probing-prompting and problem-based learning classes from before to after treatment.

3.1.3 Adversity quotient

The assessment of students' adversity quotient was based on the questionnaire scores before (beginning) and after treatment (end). Descriptively, the initial adversity quotient questionnaire scores of students in the probing-prompting class ($M = 82.41$; $SD = 11.84$) were lower than those in the problem-based learning class ($M = 89.52$; $SD = 7.44$). The probing-prompting class (*Makhir* = 87.10; *SDakhir* = 9.83) experienced an increase in the average score of 4.69, while the problem-based learning class was 4.7 (*Makhir* = 94.22; *SDakhir* = 8.09). Based on these results, there is a very small difference of 0.01 where the problem-based learning is superior descriptively.

Based on inferential analysis, the results showed that there was a significant difference between the results of the initial questionnaire and the final questionnaire of students' adversity quotient, both in the probing-prompting class ($t(28) = 5.77$; $p = 0.000$ (one-tailed)) and the problem-based learning class ($t(26) = 6.61$; $p = 0.000$ (one-tailed)). In other words, there was an increase in the adversity quotient of students in the probing-prompting and problem-based learning classes from before to after treatment.

3.1.4 Comparison of The Probing-Prombing and Problem-Based Learning in Terms of Improving Students' Mathematical Reasoning Ability, Self-efficacy, and Adversity Quotient

Based on inferential analysis, the results of the test of the difference in the average initial mathematical reasoning ability, self-efficacy, and adversity quotient of students in the probing-prompting and problem-based learning classes before treatment showed a difference in both classes ($F(3, 52) = 3.236$; $p = 0.029$). In other words, the initial abilities of students in the two classes differ with a significance value of $p < 0.05$. The results of the univariate test for each ability also showed the same thing, that there was a significant difference between the average values of mathematical reasoning ability ($t(54) = -2.557$; $p = 0.014$), self-efficacy ($t(54) = -2.550$; $p = 0.014$), and adversity quotient ($t(54) = -2.708$; $p = 0.09$) of the probing-prompting class and the problem-based learning class. Due to the difference in initial abilities, the comparative test of learning excellence was conducted using improvement data or n-gain data.

The comparison of n-gain of mathematical reasoning ability, self-efficacy, and adversity quotient of probing-prompting class (29 students) and PBL (27 students) is shown in Table 2 below.

Table 2. Comparison of N-Gain in Mathematical Reasoning, Self-Efficacy, and Adversity Quotient between the Probing-Prompting and PBL

Variable	Pretest (*M*)	Posttest (*M*)	N-Gain	Group
Mathematical reasoning	33.62	80.46	0.73	Probing-prompting
	44.14	81.79	0.69	PBL
Self-efficacy	79.31	87.17	0.19	Probing-prompting
	89.48	97.07	0.25	PBL
Adversity quotient	82.41	87.10	0.10	Probing-prompting
	89.52	94.22	0.14	PBL

Before conducting a comparative test of learning excellence, a normality and homogeneity assumption test was first conducted. The normality test of the n-gain data of mathematical reasoning ability in the probing-prompting class ($W = 0.977$; $p = 0.753$) and problem-based learning ($W = 0.954$; $p = 0.262$) showed that the data were normally distributed. However, the n-gain self-efficacy data of the probing-prompting class ($W = 0.868$; $p = 0.002$) and problem-based learning class ($W = 0.842$; $p = 0.001$) were not normally distributed. Likewise, with the n-gain adversity quotient data, the results of the normality test showed that the n-gain adversity quotient data of the probing-prompting class ($W = 0.903$; $p = 0.012$) and problem-based learning class ($W = 0.922$; $p = 0.043$) were not normally distributed. The homogeneity test shows that the n-gain data of mathematical reasoning ability ($F(1, 54) = 2.343$; $p = 0.132$) and self-efficacy ($F(1, 54) = 3.692$; $p = 0.060$) meet the homogeneity assumption, while the n-gain adversity quotient data does not meet the homogeneity assumption ($F(1, 54) = 5.517$; $p = 0.023$). However, there are other considerations that can support the assumption of homogeneity can be ignored, namely if the amount of data used in the study is ≥ 30, then the data is robust to the homogeneity test (Kirk, 2016). Because the data used in this study were ≥ 30 students, the homogeneity assumption is considered fulfilled.

The results of the *t*-test showed that probing-prompting learning was not found to be superior to PBL when viewed from the average increase in mathematical reasoning ability scores ($t = 0.829$; $p = 0.206$ (one-tailed)). In other words, since the difference between probing-prompting and PBL was not statistically significant, no conclusion can be drawn regarding the superiority of either learning in terms of the average increase in mathematical reasoning ability scores. The results of the descriptive analysis showed that the average increase in mathematical reasoning ability scores in the probing-prompting class was 9.19 points higher than in the problem-based learning class. Likewise, the results of the U test showed that probing prompting learning was not found to be superior to PBL when viewed from the average increase in self-efficacy scores ($U = 351.50$, $p = 0.256$ (one-tailed)) and adversity quotient ($U = 334.00$, $p = 0.173$ (one-tailed)). In other words, since the difference between probing-prompting and PBL was not statistically significant, no conclusion can be drawn regarding the superiority of either learning in terms of the average increase in self-efficacy and adversity quotient scores. The results of the descriptive analysis show that the increase in the average self-efficacy score has a difference of about 0.27 points where the probing-prompting class is higher. In addition, the increase in the average adversity quotient score of the probing-prompting class has a difference of about 0.01 points where the problem-based learning class is higher.

3.2. Discussion

The results of the study showed that probing-prompting learning was not found to be superior to problem-based learning, or in other words, there was no significant difference between probing-prompting and problem-based learning in terms of increasing mathematical reasoning ability, self-efficacy, and adversity quotient. However, the increase in the average value of mathematical reasoning ability and self-efficacy in the probing-prompting class was higher than in the problem-based learning class. As for the adversity quotient, it had a very small difference, which was 0.01, where the problem-based learning class had a higher increase than the probing-prompting class.

These findings imply that PBL learning implemented in schools is a good choice for developing students' mathematical reasoning skills, self-efficacy, and adversity quotient. However, teachers can use alternative learning methods, such as probing-prompting, which emphasizes interaction, argumentation, problem-solving, critical thinking, and logistics, to develop students' mathematical reasoning. Furthermore, probing-prompting provides opportunities for students to ask and answer more questions, thus fostering self-confidence and self-efficacy.

Although the results show that both learning methods do not have significant differences, both are able to improve students' mathematical reasoning skills, self-efficacy, and adversity quotient. In probing-prompting learning, there are steps of providing instructions with guiding questions and providing probing questions that train one of the indicators of mathematical reasoning that has the highest increase compared to other indicators, namely drawing conclusions with logical reasons. In accordance with the statement of Webb & Webb (2016) that the use of questions to test knowledge and guide the development of student understanding is able to optimize reasoning skills. Asking questions, as well as giving problems by teachers have a major role so that students can be provoked to reflect on what they are learning (Steen, 1999). When students reflect on what they are learning, students are able to find relationships and logical reasons why something can happen.

The results of the study generally show that probing prompting learning can facilitate students' mathematical reasoning abilities. Like the research of Mueller et al. (2014) which states that this probing-prompting learning is able to create meaningful learning by forming a combination of conditions in which: (a) students are actively challenged; (b) teachers who observe and pay attention to the development of students' ideas; (c) appropriate and open-ended tasks that invite students to expand their learning as they build and justify solutions; (d) student collaboration that allows for the exchange of ideas; and (e) an environment that values and welcomes students' ideas, conjectures, and alternative ways of working. In these conditions, students develop their confidence to solve problems. The results of the study by Mueller et al. (2014) strengthen the reasons why this probing-prompting learning is able to facilitate students' mathematical reasoning abilities. The development of arguments by responsive teachers has an important role in the development of students' mathematical reasoning abilities. The results of the study by Gardenia, Herman, Rahadyan, & Dahlan (2020) also showed something similar, where this learning was able to improve adaptive reasoning abilities better than conventional learning. This is due to the learning process that challenges students to think and solve problems, develop questions, plan solutions, and explore concepts and principles through the problems they face.

The use of probing-prompting that presents guiding and probing questions, as well as final questions causes a thinking process that connects students' knowledge with newly learned experiences. This learning has also been shown to improve students' mathematical reasoning abilities (Pratiwi et al., 2017) and has a good influence on students' ability to provide rational reasons (Hartinah et al., 2019). Therefore, it can be concluded that this learning is indeed able to facilitate students' mathematical reasoning abilities.

When viewed from self-efficacy, the average self-efficacy score of the probing-prompting class increased in each indicator. At first glance, this increase did not differ much in each indicator. The highest increase occurred in the indicator of confidence in being able to develop strategies or actions to solve math problems. This is because in probing-prompting learning there is a formulation discussion stage and a stage of answering questions by students, which also trains this ability. Students' understanding is strengthened by discussions with peers who are able to explain to them in a simpler way. The question and answer process that occurs when students answer probing questions also affects this indicator. This process allows students to hear and think about other people's ideas. So that they are able to train their ability to develop strategies or solve problems. Nauvalia's research (2021) also states that social support from peers also influences the level of an individual's academic self-efficacy.

When viewed from the adversity quotient, the average adversity quotient score of the probing-prompting class increased in each indicator. At a glance, this increase is not much different for each indicator. The highest increase occurred in the indicator of ownership of control over difficult situations. This is because in probing-prompting learning there are stages of providing problem situations and formulation discussions that also train this ability. At these stages, students are trained to think calmly when given math problems and are trained not to assume that all math problems are as difficult as imagined. When students are calm, they are able to control themselves until they finally realize that there must be a way to solve the problem. Students are also trained to be able to control their egos at the formulation discussion stage, where in addition to expressing opinions, they are also trained to accept the opinions of other friends.

Meanwhile, in problem-based learning, there are many studies that say that the use of problem-based learning has a significant effect on various abilities, including mathematical reasoning abilities. Research by Sari, Susanto, Yuliati, Imamah, & Laily (2020) suggests that PBL learning can stimulate students to improve their reasoning abilities because PBL requires students to think deeply during the learning process. PBL learning is suitable for developing reasoning abilities. This reasoning ability is an important process used by students in solving mathematical problems (Wahyuni, Susanto, & Hadi, 2019). The application of PBL has a positive impact and a strong influence on students' mathematical reasoning abilities (Susanti, Juandi, & Tamur, 2020; Fitriyah, Putro, Apino, 2022)). This problem-based learning is also able to increase the average self-efficacy score. As stated by Manz & Manz (1991) who stated that students are in a better state to apply something they have learned when they have self-confidence. In learning, students must have confidence in their ability to perform and believe that they can succeed (Dunlap, 2005). This is reinforced by the results of research by Syarafina, Jailani, & Winarni (2018) which states that the implementation of PBL has been proven to be able to increase students' self-efficacy. According to Syarafina et al. (2018), PBL is able to increase students' self-efficacy, because in the process, PBL is interactive, challenging learning, and at the same time motivates students to actively participate.

The lack of superiority of probing-prompting learning compared to problem-based learning, when viewed from the increase in the average value of mathematical reasoning ability, self-efficacy, and aversity quotient, was caused by several things. The researcher suspects that this happened because the research time was limited to only four meetings. In short, this learning meeting has not succeeded in making students accustomed to the probing-prompting learning model that requires students to be more active in answering teacher questions. This is different from the application of problem-based learning that is familiar to students. Therefore, the application of new learning for students requires them to adapt more to this learning.

According to Fullan (2007), adaptation is a gradual process. He stated that it is important to give students time to adapt to changes in learning. Rapid and direct changes in learning without sufficient transitions make students feel confused and burdened. Students may not be ready for changes in learning. The lack of student readiness for the implementation of this new learning causes students to lose focus. In addition, unpreparedness for change also affects the effectiveness of learning (Hattie, 2008).

Another factor that may also influence the conclusion of this study is student resistance to change in learning. Fullan (2007) stated that this resistance is often caused by a sense of security and comfort in learning that is already known. In addition, the implementation of probing-prompting learning which was only carried out four times was also indicated to be the cause of this learning not being superior to problem-based learning. This is due to the possibility that this learning has not had a significant impact on student learning outcomes.

Research related to probing-prompting and PBL learning has been conducted by Sari (2018) and Awaliah et al. (2021). Sari's (2018) research revealed that there was no significant difference between students' problem-solving abilities with probing-prompting and problem-based learning. However, based on descriptive analysis, he further explained that there was a slight difference in mean scores between the two, where probing-prompting had a higher mean score. This mathematical problem-solving ability triggers students' high-level thinking and mathematical reasoning abilities (Mukuka et al., 2021). Meanwhile, Awaliah et al.'s (2021) research also showed something similar that both of these learning methods were effective in improving student learning outcomes. Overall, there was no difference in improving student learning outcomes between the two learning methods, although probing-prompting learning was slightly superior descriptively. These two studies broadly provide an overview that probing prompting and problem-based learning are both equally good at facilitating students' abilities.

4. CONCLUSION

This study revealed that probing-prompting learning was not found to be superior to problem-based learning in terms of the average increase in mathematical reasoning ability, self-efficacy, and adversity quotient scores. The suspected cause of why probing-prompting was not superior to problem-based learning was that the limited research time of only four meetings had not succeeded in making students accustomed to probing-prompting learning which required students to be more active in answering teacher questions. However, both can develop students' mathematical reasoning ability, self-efficacy, and adversity quotient.

The findings of this study provide important practical implications for teachers, researchers, and curriculum developers in the field of mathematics education. For teachers, the findings of probing-prompting learning that improve mathematical reasoning and self-efficacy suggest that teachers can implement this learning routinely to encourage students to think critically and logically in mathematics. Probing-prompting learning, which encourages students to ask questions, answer questions, and express opinions, provides a safe space for students to develop confidence in the problem-solving process. Further researchers can compare and explore how probing-prompting and PBL can influence other non-cognitive aspects, such as student learning motivation or collaboration. In addition, the results of this study provide implications for curriculum developers that probing-prompting learning can be integrated into the curriculum as part of an active learning strategy that emphasizes interaction, argumentation, and problem solving.

To improve the results of the study, the following suggestions can be considered. This study only involved grade VII students from several public junior high schools selected in one region in Indonesia and only on the material of flat-sided spatial figures. This provides limitations related to the extent to which the results of this study can be generalized. Therefore, future research could attempt to implement the probing-prompting and PBL in different grade levels, topics, or regions to expand the generalizability of the research findings. In addition, future researchers are highly recommended to implement probing-prompting learning over a longer duration (more than four meetings) in order to capture longitudinal effects and reduce other potential influencing factors on the effectiveness of this learning (such as students’ habituation to certain instructional models or methods). The findings of this study provide important reflections, as while both methods were effective, the limited intervention period and novelty of the probing-prompting approach may have masked its potential benefits.

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