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Mathematical Reasoning on the Impact of the Firing Line Strategy with Probing Prompting in View from the Adversity Quotient

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ABSTRACT

This research was motivated by low mathematical reasoning abilities. Based on pre-research results which show that 81% of students scored below the KKM for mathematical reasoning ability. So researchers are interested in implementing the fiing line strategy with the probing pomting technique to involve students during the learning process so that students are actively involved. The research method used was quantitative research with a population of all class VIII students at SMPN 2 Penawrtama. The sampling technique in this research was carried out using the Cluster random sampling technique. Data collection techniques include mathematical reasoning ability tests, adversity quotient questionnaires and documentation. Hypothesis testing uses two-way analysis of variance with a significance level of 5%. Based on the research results, it can be concluded that (1) there is an influence of the firing line strategy with the probing prompting technique on mathematical reasoning abilities. (2) there is no influence of the adversity quotient on mathematical reasoning abilities. (3) there is no interaction between the firing line strategy and the probing promting technique and the adversity quotient on mathematical reasoning abilities.

Keywords: Firing Line Strategy, Probing Prompting Technique, Adversity Quotient Mathematical Reasoning Ability

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INTRODUCTION

Mathematics has an important role in mastering science as a basic science. In solving every problem that involves mathematical calculations, reasoning is needed, because mathematics itself is obtained through the thinking process. In learning mathematics, students need to develop and master various mathematical abilities, including reasoning abilities (Rany Widyastuti et al., 2020). If thinking skills are not emphasized in students, then mathematics material will only be seen as a series of procedures and examples that are imitated without in-depth understanding (Pratiwi, Bahri, & Pratiwi, 2021). Shadig explains that mathematical reasoning is the brain's thinking activity to conclude from existing statements and in accordance with the facts (Saputri, Susanti, & Aisyah, 2017). Based on the experts' explanations, it can be concluded that mathematical reasoning is a person's ability to think to draw conclusions based on statements that are in accordance with the facts.

According to NCTM, reasoning is one of the standards that students must have in learning mathematics (Saputri et al., 2017). Reasoning and mathematics are interrelated, because solving mathematical problems requires reasoning abilities which can be trained through learning mathematics. Mathematical reasoning is a skill that makes a significant contribution to students' overall progress, because it allows them to think logically in facing challenging tasks inside and outside the classroom (Mukuka, Balimuttajjo, & Mutarutinya, 2023). Setiyani emphasized that to be successful in mathematics, it is not just about memorizing, but also the importance of having three basic skill levels, namely remembering, understanding, and applying (Anggoro, Puspita, & Pratiwi, 2021). Thus, reasoning has a very important role in the context of mathematics learning. The importance of reasoning is also in line with the objectives of Minister of Education and Culture Regulation no. 21 of 2016 which emphasizes that secondary education must develop reasoning, managing, creative, productive, critical, collaborative, communicative, independent skills, and be able to use methods in accordance with scientific standards.

However, field facts show that students' reasoning abilities are still low, so they need to get more attention. This is evident from the results of a survey conducted in 2012 by The Trends in International Mathematics and Science Study (TIMSS), where Indonesia was ranked 41st out of 45 participants. Setiadi stated that the low TIMSS results obtained by Indonesia were caused by students' lack of practice in solving questions that required reasoning abilities. On average, Indonesian students are only able to answer correctly 17% of questions related to the cognitive domain of reasoning (Putri, Sulianto, & Azizah, 2019). The low level of students' mathematical reasoning abilities can also be seen from the results of pre-research conducted at SMP 2 Penawartama, where the students' mathematical reasoning tests have not reached the Minimum Completeness Criteria (KKM). It was found that only 19% of students achieved the KKM, while 81% of students did not achieve it. Therefore, it can be concluded that students' mathematical reasoning abilities are still low.

In dealing with mathematical problems, students have various ways and styles of thinking because their mathematical reasoning abilities are different. This difference is caused by variations in the ability to overcome obstacles (Endrawati, 2021). Yani and his colleagues stated that the adversity quotient plays an important role in overcoming mathematical problems, which refers to the ability to face challenges and obstacles (Farhan & Hakim, 2021). This research will focus on three types of adversity quotient according to Stoltz, namely high (Climbers), medium (Campers), and low (Quitters).

If we correlate intelligence in facing difficulties (AQ) with students' mathematical thinking abilities, it is possible that there are variations in the level of AQ possessed by students. This is reflected in the results of the mathematical thinking test which shows that not all students are able to solve the questions given. Therefore, it can be concluded that the higher a person's AQ, the better their thinking ability and their learning achievement tends to be higher. Conversely, if AQ is low, then students' thinking abilities and learning achievements also tend to be low. This opinion is in line with Supardi's view which states that

AQ has an impact on learning achievement, where the higher the AQ, the higher the learning achievement (Nas Sulastri, 2019).

Student success is influenced by the role of educators during the learning process (Anggoro, Diyanto, & Nasution, 2018). The learning process plays a key role in achieving learning goals (Anggoro, Agustina, et al., 2019), so appropriate actions are needed from educators during learning, one of which is by using various learning methods. Choosing an appropriate learning strategy will help students understand mathematics material (Apriani, Mujib, & Pratiwi, 2019), an example of which is using active learning strategies. Active learning that focuses on students, such as cooperative learning, provides greater support to the learning environment than teacher-centered learning (Mukuka, Mutarutinya, & Balimuttajjo, 2021). Learning objectives and an interesting learning atmosphere can be achieved when students actively interact (Anggoro, Haka, & Hawani, 2019). One active learning strategy that can be used is the firing line strategy, which involves asking questions between students in a fast-paced format, giving students the opportunity to discuss and think actively during learning. In addition, mathematical thinking abilities can develop when students are actively involved in learning (Fatimah, Ahmad, & Nurlyana, as expressed by Farhan & Hakim, 2021), because active learning helps improve reasoning abilities and sensitivity to surrounding problems.

Previous research using the firing line strategy has shown better improvements in understanding mathematical concepts compared to conventional methods (Maskur, 2018). The difference in the research that the author will carry out is that the author will combine firing line learning with probing prompting techniques to improve mathematical reasoning abilities.

Probing technique is a learning method in which teachers ask students questions to help them understand concepts. Probing prompting is a learning approach that involves a series of questions that guide and encourage students to think deeply, connecting their knowledge and experiences with new concepts being learned (Rany Widyastuti et al., 2020).

The use of the probing prompting technique aims to overcome the weakness of the firing line strategy, where this strategy can cause students to receive inaccurate information from their peers. Therefore, by using the probing prompting technique, students are given the opportunity to ask questions about things that are unclear, so that the teacher can provide additional explanations. Apart from that, good communication between students and educators, and vice versa, can be established directly. Research conducted by Ni Made Fitiri Suyani and I Gusti Agung Ayu Wulandari shows that the use of probing prompting in learning produces effective communication, with students being active in expressing opinions (Suyani & Wulandari, 2020). The firing line learning strategy combined with the probing prompting technique is expected to improve students' mathematical reasoning abilities.

METHOD

This research adopts a quantitative approach with an experimental type of research. The author uses experimental research to explore the influence of the independent variable on the dependent variable under controlled conditions (Sugiyono, 2019). This experimental research used a quasi-experimental design, with a 3 x 3 factor design consisting of two groups: a control group that received mathematics learning using the direct instruction method, and an experimental group that received learning using the Firing Line strategy and the Probing Prompting technique. The population taken was class VIII students of SMPN 2 Penawartama in the 2023/2024 academic year. The sampling technique used is Cluster random sampling, which is used to take samples from a population consisting of several groups. Data collection techniques are used to collect the data needed in the research process. In research, data collection techniques use tests, questionnaires and documentation.

RESULTS AND DISCUSSION

The data used in this research is prerequisite test data, namely *adversity questionnaire data quotient* and ability test reasoning mathematical. Normality test use SPSS *Kolmogrov Smirnov* test with the following results:

Table 1. Results Test Normality Question Test Ability Reasoning Mathematical

No	Class	P- Value	Significatio n	Decision	Conclusion
1	Experiment 1	0.99	0.05	H_0 Accepted	Distributed Normal
2	Experiment 2	0.173	0.05	H_0 Accepted	Distributed Normal
3	Control	0.200	0.05	H_0 Accepted	Distributed Normal

In Table 1. are the results of the calculation of the normality test for the mathematical reasoning ability test on level significance α = 0.05 showing results that data normally distributed because the *p-value* is $\geq$ 0.05, so H_0 is accepted and H_1 is rejected in both experimental class 1 , experimental class 2 and control class.

Table 2. Results Test Normality Questionnaire

No	Class	P- Value	Significati on	Decision	Conclusion
1	Experiment 1	0.074	0.05	H_0 Accepted	Distributed Normal
2	Experiment 2	0.200	0.05	H_0 Accepted	Distributed Normal
3	Control	0.200	0.05	H_0 Accepted	Distributed Normal

In Table 2. are the results of calculating the normality test of *the adversity quotient questionnaire* at the significance level α = 0.05 which shows the results that the data is normally distributed because the *p-value* is $\geq$ 0.05, so that H_0 is accepted and H_1 is rejected in both experimental class 1 , experimental class 2 and control class.

Table 3. Results Test Homogeneity Question Test Ability Reasoning Mathematical

	Levene Statistics	df1	df2	Sig.
PM Based on Mean	0.288	2	85	0.750
Based on Median	0.274	2	85	0.761
Based on Median and with adjusted df	0.274	2	83,529	0.761
Based on trimmed mean	0.279	2	85	0.758

In table 3, it can be seen that the homogeneity test data for the mathematical reasoning ability test questions come from the same population because the significance value is 0.750 > 0.05. So it can be concluded that the data is homogeneous.

Table 4. Results Test Homogeneity Questionnaire

	Levene Statistics	df1	df2	Sig.
AQ Mean	Based on 1.320	2	85	0.273
Based on Median	1,120	2	85	0.331
Based on Median and with adjusted df	1,120	2	80,593	0.331
Based on trimmed mean	1,350	2	85	0.265

In table 4, it can be seen that the data from the questionnaire homogeneity test results come from the same population because the significance value is 0.273 > 0.05. So it can be concluded that the data is homogeneous. After the data meets the prerequisite tests, namely the normality test and homogeneity test Then a hypothesis test was carried out using a two-way ANOVA test. The two-way anova test was carried out to test the comparative hypothesis of more than two samples simultaneously if each sample consists of two or more categories. The results of the two-way ANOVA test calculation using *SPSS* are as follows:

Table 5. Test Anova Two Direction

Tests of Between-Subjects Effects

Dependent Variable: MATHEMATICAL REASONING

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2998,758[a]	8	374,845	6,219	0,000
Intercept	328535,312	1	328535,312	5450,795	0,000
KELAS	1569,904	2	784,952	13,023	0,000
AQ	199,506	2	99,753	1,655	0,198
KELAS * AQ	352,084	4	88,021	1,460	0,222
Error	4761,560	79	60,273		
Total	540348,000	88			
Corrected Total	7760,318	87			

a. R Squared = ,386 (Adjusted R Squared = ,324)

In table 5. Above, the results of the two-way ANOVA analysis were obtained at the significance level α = 0.05 can concluded that: (1) $H_{0}A$ rejected, Because level significance in the class of 0,000 < 0.05, it can be concluded that there is an influence of the firing line strategy with the probing prompting technique on mathematical reasoning abilities. (2) $H_{0}B$ accepted, because the level of significance is at category *adversity quotient* as big as 0.198 > 0.05 so can concluded that There is no influence of students' *adversity quotient* (*climbers, campers,* and *quitters)* on mathematical reasoning abilities. (3) $H_{0}AB$ accepted, because the significance level shows an interaction of 0.222 > 0.05 so that concluded that No there is interaction between strategy firing line And *adversity quotient (climbers, campers,* And *quitters)* to ability reasoning mathematical.

The research results showed that students' mathematical reasoning abilities increased when learning using the firing line strategy with the probing prompting technique. The learning process in the experimental class, which applies the firing line strategy with the probing prompting technique, shows more active student participation in answering and asking questions during learning. The firing line strategy directs students to actively ask and answer questions, by forming groups for discussion. Implementing the firing line strategy with the probing prompting technique makes students more enthusiastic and active in learning, compared to classes that only use the firing line strategy or direct instruction. The process of exchanging questions between groups using question cards and providing explanations of the material made students enthusiastically involved. In addition, with the probing prompting stage, students are asked to solve problems individually, and the teacher gives random questions to students. If the requested student cannot answer, the question will be thrown to another student, which increases the student's enthusiasm. In this way, students are not only trained in solving problems in groups, but are also taught to solve problems individually.

In classes that apply the firing line strategy, students show good involvement in learning, although at first they may be less enthusiastic because they are confused when exchanging questions using question cards. However, in classes that implement direct instruction, students tend to be more passive and sometimes some students pay less attention during the learning process.

Based on these results, it can be concluded that the firing line strategy with the probing prompting technique encourages active student involvement and increases the effectiveness of the learning process compared to the application of the firing line strategy and direct instruction. This finding is consistent with research conducted by Selvia Lovita Sari (Maskur, 2018). Based on the two-way ANOVA test, it can be concluded that the use of the firing line strategy with the probing prompting technique has a positive influence on students' mathematical reasoning abilities. The probing prompting technique has been proven to optimize learning and improve learning outcomes, this is supported by research conducted by Ni Made Fitri Suyani (Suyani & Wulandari, 2020). The learning outcomes measured in this research focus on mathematical reasoning abilities, and the tests used to measure these

abilities show that students who follow the firing line strategy with the probing prompting technique obtain better results.

Furthermore, there were no significant differences in the Adversity Quotient (AQ) or the influence of AQ on mathematical reasoning abilities, both in experimental classes 1 and 2 and in the control class. This finding is in line with the results of research conducted by Komarudin, which showed that there was no significant influence of AQ type on students' mathematical creative thinking abilities (Komarudin, Monica, Rinaldi, Rahmawati, & Mutia, 2021).

Furthermore, there was no interaction between the firing line learning strategy with the probing prompting technique and the adversity quotient on mathematical reasoning abilities. These findings indicate that each variable has an independent effect and is not interrelated with students' AQ. Several other factors that influence research results include students being dishonest in working on questions by working together or filling out questionnaires carelessly without reading carefully. Apart from that, irregular attendance is also a factor, where some students do not attend due to permission or dispensation so they fall behind in learning. These factors influence the research results, although in theory it is expected that there will be an interaction between learning strategies and the adversity quotient on mathematical reasoning abilities. Research related to the Adversity Quotient conducted by Indah Cahya Al Hakim showed similar results, namely that there was no interaction between the learning model and the Adversity Quotient on problem solving abilities (Al-Hikmah, Netriwati, Widyastuti, & Jamilah, 2022). This finding is also consistent with research conducted by Komarudin, which showed that there was no interaction between the learning model and AQ on students' mathematical creative thinking abilities (Komarudin et al., 2021).

CONCLUSION

The results of the analysis show that the use of the firing line strategy with the probing prompting technique has a positive influence on mathematical reasoning abilities. Students who use this strategy have better reasoning abilities compared to those who receive direct instruction. However, there was no influence from the Adversity Quotient category (climbers, campers, and quitters) on students' mathematical reasoning abilities. Apart from that, there was no significant interaction between the firing line strategy and the probing prompting technique and the Adversity Quotient on mathematical reasoning abilities.

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