

Analysis of the Impact of Problem-Based Learning on Student Learning Styles

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Abstract. *This study aims to analyze the impact of problem-based learning on student learning styles. The research approach used is experimental by adopting observation and questionnaire methods. Data was collected from students who engaged in problem-based learning and students who followed conventional learning approaches. Analysis was carried out to compare differences in student learning styles before and after implementing problem-based learning. The results showed that problem-based learning had a significant impact on changes in students' learning styles, with more students tending to adopt active, collaborative, and reflective learning styles.*

Keywords: *problem-based learning, learning styles, impact, experimental education, observation, questionnaire.*

BACKGROUND

Education plays an important role in preparing quality human resources for improving science and technology. One branch of science in the world of education is mathematics. Mathematics is a science that has an important role in the world of education. It can be said that mathematics is a bridge between sciences, because mathematics connects various fields of science and technology, for example physics, chemistry, biology, medicine, economics, pharmacy and information technology. So that the development of science and technology (IPTEK) that occurs cannot be separated from mathematics. In addition, mathematics not only meets current needs, but also meets future needs. This is in line with what Purwosusilo (2014 : 31) stated that mathematics education essentially has two development directions, namely to meet current and future needs.

Learning effectiveness consists of four indicators, namely the teacher's ability to manage learning, student activity in learning activities, student response in learning, and student learning completeness. Teacher quality can make a major contribution to increasing learning effectiveness. According to Chotimah (2014: 25) effectiveness in a good teaching and learning process is the teacher's efforts to educate students so they can learn well. Effectiveness can be determined by the results of student learning tests. The results of these tests can be used to evaluate various aspects during the learning process. The effectiveness of learning can be seen

from student activities during learning, student responses in learning, and student mastery of concepts.

According to *the National Council of Teacher Mathematics* (2020: 4) there are 5 stages of ability that must be achieved, namely: problem solving, making connections, communicating, reasoning, and representation. So problem solving is one of the four basic abilities that students must have after learning mathematics . With use problem solving in mathematics students know how to think , the habit of perseverance , high curiosity, and confidence in unusual situations. However, in reality, junior high school students' mathematical problem solving abilities are still very low .

According to data published by the OECD from the 2009-2015 survey period, Indonesia is consistently in the bottom 10. In this survey, one aspect of cognitive solving ability that was assessed was mathematical problem solving ability . In the 2015 PISA survey , Indonesia was ranked 6th out of 72 participating countries with an average score of 386 , while the OECD average score was 490 . Experienced a decline in 2018 , the results of the 2018 *Program for International Student Assessment (PISA)* study published by *the Organization for Economic Cooperation and Development* (OECD) that the ability of students in Indonesia in mathematics is in 74th place 79 participating countries with an average score of 379 and an OECD average score of 489. Referring to *the Trends in International Mathematics and Science Study report* (TIMSS) year 2015 states that Indonesia ranks 44th out of 49 countries with a score of 397 .

From these problems, one learning that can improve mathematical problem solving abilities is learning *Problem Solving* . In line with the opinion of Sutiawan (2019: 58) who states that students' abilities in solving mathematical problems with *Problem Solving learning* are better than students who receive conventional learning . From This opinion can be concluded that *Problem Solving learning* is a model that focuses learning on problem solving so that students can strengthen their reasoning power by developing new ways , strategies or techniques to solve a problem and draw conclusions. There are several models that can be used to measure this, one of which is quite popular is *Polya* . According to Hendriana and Soemarmo (2014: 76) indicators of problem solving based on the problem solving stage by *Polya* are : a) identifying known data, questions, and data adequacy for problem solving , b) identifying strategies that can be taken, c) completing the mathematical model with reasons , d) checking the correctness of the solution.

One factor that influences differences in problem solving abilities is learning style . According to Ula (2013: 31) argues that the way a person absorbs information , processes it and conveys it universally or how a person learns is called with learning style . Style learning

refers to the learner's preferred way of learning . A good learning style can help people learn productively. Each student's learning style is certainly different from each other . Identification of learning styles according to Bhat (2014: 1) can help students to become effective *problem solvers and is one of the factors that influences how students learn*. With students' different learning styles , it is very important for teachers to analyze students' learning styles so that information is obtained that can help teachers to be more sensitive in understanding differences in the classroom and can carry out meaningful learning (Willia, Annurwanda, & Friantini, 2020: 117).

According to DePotter & Hernacki (2016: 110-120) learning styles can be classified into three, namely visual, auditory and kinesthetic learning styles which are characterized by certain behavioral characteristics . This categorization is only a guideline that individuals have one of the most prominent characteristics so that if individuals receive appropriate stimulation when studying, it will make it easier for them to absorb the lessons. In other words, if individuals find a learning method that suits their characteristics, they will quickly understand the material being taught, so intensive courses or private lessons may no longer be needed . Style Study own connection tightly And influence to process learning in frame reach objective learning . By knowing their learning style , *problem solving* learning can be done easily, so that students have the ability to face and solve mathematical problems. nor problems in real life . Based on the previous explanation, the author intends to conduct research entitled "**Effectiveness of Problem Solving Learning in View of Student Learning Styles**" .

THEORETICAL STUDY

1. Learning Effectiveness

a. Understanding Learning Effectiveness

Effectiveness comes from the word effective. Being said to be effective means having an effect or consequence and getting results. So effectiveness is the effectiveness or suitability of an activity to achieve goals. According to Rohmawati (2015: 17) said that learning effectiveness is one of the benchmarks or standards for the quality of education to achieve a desired goal. Meanwhile, according to Supriyono (2014 : 1) learning effectiveness refers to being empowered and successful in using all learning components that are organized to achieve learning goals .

b. Main Conditions for Effective Learning

According to Soemosasmito (2017: 22) if learning meets the main requirements for effectiveness, then the learning is considered effective, namely:

- 1) Long student learning presentations are designed for the teaching and learning process.
- 2) The average student behavior in taking assignments is very high.
- 3) Determination between the content of teaching materials and student abilities (learning success orientation).
- 4) Developing a friendly and positive learning atmosphere, as well as developing class structure.

c. Characteristics of Learning Effectiveness

According to Surya in Firdaus (2016: 64) the characteristics of learning effectiveness are as follows:

- 1) Successfully delivers students to achieve the set instructional goals.
- 2) Providing an attractive learning experience, actively involving students so as to support the achievement of instructional goals.
- 3) Have facilities that support the teaching and learning process.

2. Problem Solving

a. Understanding *Problem Solving*

According to Uno (2014 : 134) *Problem Solving* is the ability to use thinking processes in solving problems by collecting facts , analyzing information, compiling alternative solutions, and choose more effective problem solutions. This means that *Problem Solving* is a search for solutions through a systematic thinking process. Meanwhile , according to Made (2016 : 52) *Problem Solving* can be seen as a process of finding a combination of a number of rules that can be applied in an effort to overcome a new situation . The combination of a number of rules can be understood as an algorithm or steps that can solve a problem. Based on the expert opinion above , it can be concluded that *Problem Solving* is a thought process activity to find a solution in the form of specific steps in solving a problem systematically based on one's abilities .

b. Principles of *Problem Solving*

Problem Solving Model can expand the thinking process so that it makes students develop their ideas and thoughts. According to Iskandar (2017: 12) there are three principles of *Problem Solving* , namely:

- 1) *Problem Solving* is a skill that is usually learned and is not a talent that only some people have.
- 2) *Problem Solving* is a systematic and complete thinking framework for obtaining solutions.

3) *Problem Solving* is a combination of thinking and acting.

c. Steps for Learning *Problem Solving*

Problem learning steps Solving according to Sh oi min (2014 : 137) are as follows:

- 1) The problem already exists and the material is provided.
- 2) Students are given problems as solutions or discussions .
- 3) Problems are not found .
- 4) Students are assigned to evaluate .
- 5) Students provide conclusions from the answers given as the final result .
- 6) The application of problem solving to the problems faced also acts as a test of the correctness of the solution in order to arrive at a conclusion .

3. Learning Style

a. Understanding Learning Styles

According to Ghufon & Risnawita (2014 : 42) learning style is an approach that explains how individuals learn or the methods taken by individuals to concentrate on process, and master difficult information through different perceptions. Furthermore , according to Kasmirawati (2013 : 5-6) learning styles are individual ways of obtaining and absorbing information from their environment, including the learning environment . So it can be concluded that learning style is a way that is often done or a tendency students to obtain information, store or absorb information in the learning process . Not everyone has the same learning style , even if they are at school or even sit in the same class, a person's ability to absorb lessons different.

b. Types of Learning Styles

There are several types of learning styles that students have. This is in accordance with the characteristics of students who are different from each other. In Gilakjani's opinion (2012: 105-106) Learning styles are grouped into three , namely :

- 1) style is a learning style in which ideas, concepts, data and other information are packaged in the form of images and techniques .
- 2) The learning style of an oral audit is a learning style in which students learn through rapid memorization , reading text aloud or listening to audio media .
- 3) style is that students learn by doing, touching, feeling, moving and experiencing .

c. Factors that Influence Learning Style

According to Darmadi (2017 : 172-173) factors influence learning styles can be divided into two, namely intrinsic factors and extrinsic factors. Intrinsic factors include physical factors , psychological factors , and fatigue. Meanwhile , extrinsic factors

include family factors, school factors and community factors. Meanwhile, according to David Kolb in Darmadi (2017: 171) students' learning styles are influenced by personality type, habits or habits, and develop over time and experience.

RESEARCH METHODS

Type of research used is quantitative research . Quantitative research is research by examining how much influence the independent (free) variable has on the variable dependent (bound). This research method uses quantitative or statistical data analysis with the aim of testing predetermined hypotheses . The design in this research is *One Group Pretest-Posttest Design* with the aim of knowing whether learning is effective or not *Problem Solving* with student learning styles on mathematics learning outcomes . This design only uses one class without any other classes as a comparison . The research procedure was carried out twice , the first procedure was carried out *pretest* (before being given treatment) , then the second procedure, namely *posttest* (after being given treatment) . From the procedures carried out, the results of the treatment can be known more accurately , because they can be compared state after given treatment (Sugiyono , 2014 : 74) . This research was conducted on class VIII A students of MTs Plus Sunan Drajat Kedungsantren

RESULTS AND DISCUSSION

1. Learning Style Questionnaire

At the first meeting, students were given a learning style questionnaire and data was obtained that each student had a different learning style. Based on the results of the analysis, there were 9 students with a visual learning style, 14 students with an auditory learning style, and 1 student with a kinesthetic learning style. So it can be concluded that class VIII A MTs Plus Sunan Drajat Kedungsantren students mostly have an auditory learning style. Based on the results of *the pretest* and *posttest*, students who have a visual learning style get scores above the KKM or above average. The following is the data from the learning style questionnaire for class VIII A MTs Plus Sunan Drajat Kedungsantren students:

Table 1. 1Student Learning Style Questionnaire VIII

A

NO.	NAME	LEARNING STYLE
1	Ahmad Dzakkir Zakka	Auditory
2	Ahmad Khafi	Auditory
3	Ahmad Nur Rizki F.	Auditory

4	Ahmad Labib	Visual
5	Akhtar Farruq	Auditory
6	Akmal Hikam	Auditory
7	Alvino Eka Adi N.	Auditory
8	Fahad Yullah Riffarhan	Visual
9	Fajar Rizzqi Pratama	Auditory
10	Ardiansah said	Visual
11	Galih Iyan Maulana	Visual
12	Jaka Surya Tama	Auditory
13	Latitude Talent S.	Auditory
14	M. Ridho Saputra	Auditory
15	M. Reza Dwi Prasetya	Auditory
16	M. Choirur roziqin	Visual
17	M. Aziz Alim	Visual
18	M. Andika Dava R.	Kinesthetic
19	M. Habil Raisa R.	Auditorium
20	M. Khoirum Misbahudin	Visual
21	M. Ula Hidayatus S.	Auditorium
22	Nafish Kurnia Arsyad	Visual
23	Satria Rafa Putra Zen	Auditorium
24	Vinno Nandika Putra	Visual

In analyzing the learning style questionnaire data, a reliability test was carried out to measure the consistency of the questionnaire which is an indicator of the variable . Instrument A reliable instrument is one that, if used several times, can be used several times measuring the same object will result data Which The same . For this test, *the Split Half* reliability test is used with the conditions, namely (a) if $r_{hitung} \leq r_{tabel}$ the instrument is said to be unreliable , (b) if the $r_{hitung} \geq r_{tabel}$ instrument is said to be reliable . The reliability test results are presented in the following table:

Tabel 1. 2 Uji Reliabilitas Angket Gaya Belajar

Reliability Statistics

Cronbach's Alpha	Part 1	Value	,777
		N of Items	24 ^a
	Part 2	Value	,792
		N of Items	24 ^b
	Total N of Items		48
Correlation Between Forms			,593
Spearman-Brown Coefficient	Equal Length		,744
	Unequal Length		,744
Guttman Split-Half Coefficient			,743

reliability test value r_{tabel} for 24 respondents with a significance level of 5% is 0.404. The reliability test results in table 1.2 show that the Cronbach's Alpha value is 0.777 for part

1 and 0.792 for part 2, which means this value is more than the value r_{tabel} . So it can be concluded that the learning style questionnaire instrument is reliable.

2. Student learning outcomes

a. Pretest Result Data

Before being given treatment, namely learning *Problem Solving*, students first carry out a *pretest* to determine the initial knowledge of class VIII A MTs Plus Sunan Drajat Kedungsantren students. The *pretest* results are presented in the following table:

Table 1. 3Pretest Results for Class VIII A Students

NO.	NAME	1	2	3	4	5	SCORE
1	Ahmad Dzakkir Zakka	2	2	2	1	1	8
2	Ahmad Khafi	4	6	8	14	12	44
3	Ahmad Nur Rizki Fuadilla	14	7	12	20	12	65
4	Akhmad Labib	14	7	12	20	12	65
5	Akhtar Farruq	14	10	12	15	4	55
6	Akmal Hikam	14	10	12	6	7	49
7	Alvino Eka Adi Nugraha	18	10	12	7	11	58
8	Fahad Yullah Riffarhan	4	6	8	14	12	44
9	Fajar Rizzqi Pratama	8	8	5	8	3	32
10	Ardiansah said	5	6	8	12	4	35
11	Galih Iyan Maulana	15	15	16	19	13	78
12	Jaka Surya Tama	0	0	0	0	0	0
13	Ocean Talent Star	5	4	8	9	10	36
14	M. Ridho Saputra	4	6	7	2	1	20
15	M. Reza Dwi Prasetya	8	5	6	4	0	23
16	M. Choirur roziqin	4	6	4	14	12	40
17	M. Aziz Alim	14	13	12	2	1	42
18	M. Andika Dava	13	9	11	14	8	55
19	M. Habil Raisa Ramadhan	5	4	4	0	0	13
20	M. Khoirum Misbahudin	14	14	12	16	16	72
21	M. Ula Hidayatus Sya'bana	5	8	8	0	0	21
22	Nafish Kurnia Arsyad	16	16	16	18	17	83
23	Satria Rafa Putra Zen	4	6	8	14	12	44
24	Vinno Nandika Putra	18	17	16	15	13	79

b. Data Hasil Posttest

Problem Solving learning, researchers will give a *posttest* to determine the level of effectiveness of *Problem Solving learning* or the level of difference in scores before and after the treatment is given. The *posttest* results are presented in the following table:

Table 1. 4Student *Posttest* Results

NO.	NAME	1	2	3	4	5	SCORE
1	Ahmad Dzakkir Zakka	11	14	15	15	10	65
2	Ahmad Khafi	12	15	17	17	9	70
3	Ahmad Nur Rizki Fuadilla	15	15	15	20	15	80
4	Akhmad Labib	16	14	17	20	13	80
5	Akhtar Farruq	15	15	17	18	15	80
6	Akmal Hikam	17	16	18	20	13	84
7	Alvino Eka Adi Nugraha	15	15	15	15	15	75
8	Fahad Yullah Riffarhan	16	16	17	18	12	79
9	Fajar Rizzqi Pratama	14	13	15	16	10	68
10	Ardiansah 's words	13	12	17	18	10	70
11	Galih Iyan Maulana	18	18	17	20	17	90
12	Jaka Surya Tama	15	12	17	18	10	72
13	Latang Talenta Samudra	15	15	17	18	12	77
14	M. Ridho Saputra	13	12	17	17	10	69
15	M. Reza Dwi Prasetya	14	13	17	15	10	69
16	M. Choirur roziqin	17	12	18	20	13	80
17	M. Aziz Alim	16	16	18	18	14	82
18	M. Andika Dava	15	18	18	18	12	81
19	M. Habil Raisa Ramadhan	15	12	14	17	10	68
20	M. Khoirum Misbahudin	17	17	18	18	16	86
21	M. Ula Hidayatus Sya'bana	11	13	15	13	8	60
22	Nafish Kurnia Arsyad	18	19	17	20	16	90
23	Satria Rafa Putra Zen	13	13	16	16	14	72
24	Vinno Nandika Putra	18	20	18	20	17	93

Next, the Paired Sample T-Test was carried out . This hypothesis test was carried out to find out whether *pretest* and *post t test data* were present difference significant or not with the conditions , namely (a) if $t_{hitung} > t_{tabel}$ then H_0 is rejected and H_a is accepted , meaning that there is a significant difference , (b) if $t_{hitung} < t_{tabel}$ then H_0 is accepted and H_a is rejected, meaning there is no significant difference . Following are the results of the hypothesis test:

		Paired Samples Statistics			
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	pretest	44,21	24	22,916	4,678
	posttest	76,67	24	8,540	1,743

		Paired Samples Correlations			
		N	Correlation	Significance	
				One-Sided p	Two-Sided p
Pair 1	pretest & posttest	24	,845	<,001	<,001

		Paired Samples Test							Significance	
		Paired Differences					t	df	One-Sided p	Two-Sided p
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference					
					Lower	Upper				
Pair 1	pretest - posttest	-32,458	16,349	3,337	-39,362	-25,555	-9,726	23	<,001	<,001

Paired Samples Effect Sizes			95% Confidence Interval			
			Standardizer ^a	Point Estimate	Lower	Upper
Pair 1	pretest - posttest	Cohen's d	16,349	-1,985	-2,674	-1,28
		Hedges' correction	16,908	-1,920	-2,586	-1,23

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

Tabel 1. 5 Uji Paired Sample T-Test

From the table above it is known that the sig value. (2-tailed) is $0.001 < 0.05$, so there is a difference in the average value of the *pretest* and *posttest*. Apart from the significance value, it can also be seen from the value t_{hitung} . The results of the Paired Sample T-Test show that the value t_{hitung} is -9.726. This value t_{hitung} has a negative meaning, because the average *pretest value* is lower than the average *posttest value*. In this case, the value t_{hitung} can have a positive meaning so it becomes 9.726. Meanwhile, for values t_{tabel} with $\alpha = 0,05$ and The degree of freedom t ($dk = n - 1$) with the number of respondents being 24 students is 1.714. So you can see $t_{hitung} > t_{tabel}$ then H_0 is rejected and H_a is accepted, meaning there is a significant difference. So it can be concluded that the *Problem Solving* learning model is quite effective in the teaching and learning process for class VIII A students on the material of flat-sided cubes and blocks according to each student's learning style.

CONCLUSION

Based on the results of the analysis and discussion carried out by researchers, it can be concluded that the application of the *Problem Solving learning model* is quite effective in the teaching and learning process for class VIII A students on the material of flat-sided cubes and blocks. Testing the mathematics learning outcomes data using the Paired Sample T-Test stated that the value t_{hitung} was -9.726. This value t_{hitung} has a negative meaning, because the average *pretest value* is lower than the average *posttest value*. In this case, the value t_{hitung} can have a

positive meaning so it becomes 9.726. Meanwhile, for values t_{tabel} with $\alpha = 0,05$ and The degree of freedom t ($dk = n - 1$) with the number of respondents being 24 students is 1.714. So you can see $t_{\text{hitung}} > t_{\text{tabel}}$ then H_0 is rejected and H_a is accepted, meaning that there is a significant difference.

SUGGESTION

Based on the results of research conducted by researchers regarding the effectiveness of learning *Problem Solving* on mathematics learning outcomes if reviewed from style student learning, the researcher provides the following suggestions:

1. For student

Can improve student abilities, student activity, and student interest in learning mathematics through their learning style.

2. For Teachers

It can be used as a reference for teachers to use appropriate learning models for students who have different learning styles.

3. For Schools

Can be used as a weighing material to improve the mathematics learning process and add variety to learning.

4. For Researchers

Can be used as material for consideration, input and development for conducting similar research.

THANK-YOU NOTE

This article is part of the author's thesis/final project. On this occasion the author realizes that this article received a lot of support, guidance and assistance from various parties during its preparation, so the author would like to express his sincere thanks to:

1. Mrs. Dr. Junarti, M.Pd. as Chancellor of IKIP PGRI Bojonegoro.
2. Mrs. Anis Umi K, S.Pd., M.Pd. and Mrs. Rika Pristian F. A, S.Pd., M.Pd. as Supervisor.
3. Mr. Ahmad Nashir Falachuddin, SE as Head of Madrasah Tsanawiyah Plus Sunan Drajat Kedungsantren Bojonegoro.
4. Mrs. Maziyatul Afifah, S.Pd. as a class VIII mathematics teacher at MTs Plus Sunan Drajat Kedungsantren Bojonegoro.

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