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The Effect of Implementing Learning Models Cycle 7e on Mathematical Problems-Solving Ability

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

This research was motivated by the low mathematical problem-solving abilities of students at Batanghari 15 State Junior High School, Jambi. This research aims to determine the effect of the Learning Cycle 7e learning model on students' mathematical problem abilities at Batanghari 15 State Junior High School. This research uses the quasi-experimental method, using a post-test-only control design. There are two groups, each of which is chosen randomly. The population of this research is all students in class VIII of Batanghari 15 State Junior High School for the 2023/2024 academic year, totalling 90 students and divided into four classes. In this research, the sample used was 50 students divided into two classes (experimental and control classes). The sample was determined using the Random Sampling technique. The data collection techniques used in this research were observation and mathematical problem-solving tests. This research indicates that the Learning Cycle 7e learning model is more effective in influencing problem-solving abilities than the direct learning model.

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Keywords: Mathematics; problem-solving abilities; learning cycle 7e.

1. INTRODUCTION

Education is a long-term process that cannot be separated from human life. Through education, humans can develop their various abilities. With this ability, humans can have understanding as a provision for living their lives in the future. In education, mathematics is one of the subjects we always encounter, even in everyday life, and mathematics arises from human thoughts related to ideas, processes and intuition (Lesi & Husen, 2017). Mathematics, one of the subjects taught in schools, contributes to realizing national education goals and building a productive, creative, innovative and insightful Indonesian nation. Students need mathematics to meet real-world needs and solve problems [1]. It shows that problem-solving ability is an important ability in learning mathematics. However, several studies reveal that students perform poorly in solving mathematical problems. The results of the PISA (Program for International Students Assessment) in 2022, in the mathematics ability category, show that Indonesia is in the 69th position out of 79 participating countries with an average score of 366.

Meanwhile, the international average score is 500 (Hewi & Shaleh, 2020). So, a solution is needed to improve the low problem-solving ability. Problem-solving is an essential and fundamental ability in mathematics that every student must have (Af-idah & Suhendar, 2020).

In detail, the Regulation of the Minister of Education and Culture of the Republic of Indonesia number 7 of 2022 concerning basic and secondary education content standards stipulates that the competencies that must be achieved in mathematics lessons are as follows: (1) Applying mathematical concepts in everyday situations, including numbers, counting, one-to-one relationships, classification and sorting, recognition of space and shape, measurement, patterns, and data processing, (2) Have curiosity, enthusiasm for continuous learning, self-confidence and interest in mathematics, (3) skills to increasing the competence of students so that they can live independently and participate in further education according to their vocation, (4) have an open, objective attitude in interactions in groups or daily activities, and (5) can communicate mathematical ideas.

In line with this, the National Council of Teachers of Mathematics (NCTM) states that problem-solving is an ability students must have through mathematics. The skills that students need to have through learning mathematics, as determined by NCTM, are (1) Problem-solving, (2) Reasoning and proof, (3) Communication, (4) Connection, and (5) Representation. These skills include high-level mathematical thinking, which must be developed during the mathematics learning process.

Based on the results of interviews with mathematics subject teachers (RA) conducted by researchers regarding problem-solving abilities carried out in class VIII of SMP Negeri 15 Batanghari on Wednesday, 30 August 2023, in the odd semester of the 2022/2023 academic year, information can be gathered that students' mathematical problem-solving abilities are still low. Students need to be aware that they generally experience difficulty learning mathematics at varying levels. Some students find it difficult in certain subjects, some students find it difficult in certain areas of mathematics, and some students find it difficult in all mathematics material. So you can be sure that every mathematics student has experienced difficulties.

Based on the observations and expert opinions above, the solution to support students' mathematical problem-solving abilities is to develop a learning activity that can involve students in being more independent, creative, and active in solving problems related to their mathematical problem-solving abilities. One of them is by applying the 7e learning cycle learning model.

The learning cycle is a learning model specifically designed to stimulate students to observe phenomena that occur in the world, find out about a problem, solve the problem, and look for different problems that occur in other places (Maryani, 2018). “The learning cycle is also a series of activity stages organized so that students can master the competencies that must be achieved by playing an active role” (Mulana et al., 2018). “The characteristic of learning cycle learning is that each student individually learns learning material that the educator has prepared. Then, the individual learning results are brought to the group for discussion on the overall answers” (Khashan, 2016). So, it can be concluded that the learning cycle is an innovative learning model that can help students construct

their knowledge to improve their problem-solving abilities later.

According to Eisenkraft (Unaenah & Rahmah, 2019), “the stages of the Learning Cycle 7E learning model include: Elicit, Engage, Explore, Explain, Elaborate, Evaluate, and Extend”. Hopefully, students' mathematical problem-solving abilities can be improved through the 7E learning cycle. Based on the results of interviews with (RA), the mathematics subject teacher at SMP Negeri 15 Batanghari on Wednesday, 30 August 2023, in the odd semester of the 2022/2023 academic year, information can be gathered that RA has not implemented the 7E learning cycle model and when teaching RA still uses the conventional assisted learning model. Marker and whiteboard media. Then, the researchers made observations, and the results showed that students' mathematical problem-solving abilities were still relatively low. In working on the questions given, students do not carry out the indicator stages of understanding the problem and do not plan to solve the problem. Students just solve the problem straight away.

Meanwhile, the questions were about mathematical problem-solving abilities regarding linear equations, but students did not use the principles of linear equations. With the meaning of the words, students do not understand the meaning of the questions given. It can be seen from the results of student work in Fig. 1 as follows:

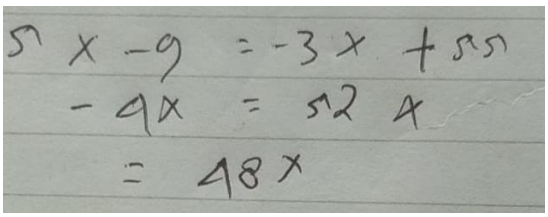

Fig. 1. Test of students' mathematical problem-solving abilities

Then, when working on the other questions given, it appeared that students could understand the problem of the problem, as seen from the students' answers, which depicted illustrations of the questions given because the questions given were questions about problem-solving abilities in linear equations. However, students were wrong in carrying out the problem-solving plan and got incorrect answers. It can be seen on the student answer sheet in Fig. 2.

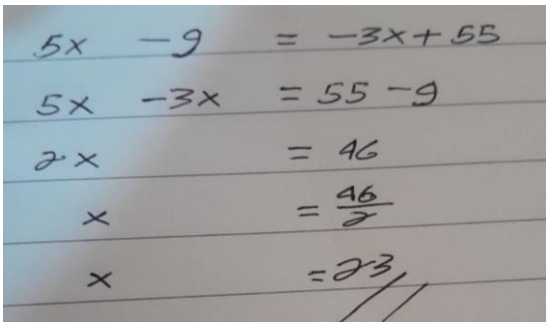

Fig. 2. Test of students' mathematical problem-solving abilities

It can also be seen that students have tried to prepare a plan to solve the problem. Meanwhile, Polya [2] said that problems can be solved by understanding them, planning a solution, devising a plan, carrying out the plan, and checking the solution again (looking back). Based on the background of the problem above, mathematical problem-solving skills are required for mathematics learning. Researchers are interested in conducting learning innovation research regarding the influence of the Learning Cycle 7e learning model on mathematical problem-solving abilities.

2. METHODS

In this research, a Posttest-Only Control Design was also used, where the experimental group and control group were not chosen randomly. The population in this study was all class VIII of Batanghari 15 State Junior High School for the 2023/2024 academic year, consisting of 4 classes. Where 32 students were in class VIII A, 20 students in class VIII B, 18 students in class VIII C, and 20 students in class VIII D. In its implementation, the research used an experimental group and a control group. In the experimental group applying the 7e learning cycle approach to see students' mathematical problem-solving abilities, a comparison group is needed without special treatment, namely the control group with direct instruction learning. This research was conducted using the Simple Cluster Random Sampling technique. The sample consisted of 52 students taken for two classes, an experimental class and a control class, with 32 experimental class students and 18 control class students, respectively. As for data collection using research instruments, data analysis is quantitative/statistical with the aim of testing predetermined hypotheses [3].

Table 1. Research design

Class	Action	Post-test
Experiment (*learning cycle 7E*)	X_1	O_1
Control (DI)	X_2	O_2

Information:
X1: learning with the 7E learning cycle model
X2: Learning with the DI model

This study consists of two variables: the independent variable and the dependent variable. The independent variable is the 7e learning cycle learning model, while the dependent variable is mathematical problem-solving. This research uses a posttest-only Control Design. Circle material was used. In this design, experimental group 1 uses the learning cycle 7e learning model, and the control group uses Direct Instruction learning. Each group is tested to determine the problem-solving abilities of students using the learning cycle 7e model.

The research instruments used were Problem-Solving Ability Test Questions. The mathematical problem-solving ability test instrument consists of 2 test questions. The questions assess students' mathematical problem-solving abilities after applying the 7e learning cycle learning model. The test questions given are in the form of essay questions. Through tests in the form of essays, students can find out the steps in their work and thus determine the level of their mathematical problem-solving abilities. So that the test questions used are good and of good quality, the test questions are first tried out using item analysis. It was done to determine the validity and reliability of the instruments used in the research. The design of this research can be seen in Table 1.

3. RESULTS AND DISCUSSION

The collected data was first tested for normality as Table 2.

Based on the decision-making criteria, if the significance value is ≥ 0.05, then H_0 is accepted, and if the significance value is <0.05, then H_0 is rejected. The Table 2 shows that for the experimental class and control class, the significance value is ≥ 0.05, so it can be concluded that H_0 is accepted so that the posttest data for the experimental class and control class have a normal distribution. After carrying out the normality test, the post-test data was then tested for homogeneity.

Based on the decision-making criteria, if the significance value is ≥ 0.05, then H_0 is accepted, but if the significance value is <0.05, then H_0 is rejected. Based on the Table 3, it can be seen that if the significance value is ≥ 0.05, then H_0 is accepted; in other words, the post-test data has a homogeneous variance. Referring to the prerequisite test results, it can be seen that the data has a normal and homogeneous distribution so that researchers can carry out further testing, namely the Independent Sample T-Test with the help of SPSS version 25.

Table 2. One-sample kolmogorov-smirnov test

		Experiment I	Control
N		32	18
Normal Parameters[b]	Mean	75,7813	58,8889
	Std. Deviation	12,57939	13,01080
Most Extreme Differences	Absolute	,135	,197
	Positive	,083	,197
	Negative	-,135	-,114
Test Statistic		,135	,197
Asymp. Sig. (2-tailed)		,143[c]	,062[c]

Table 3. Test of homogeneity of variance

		Levene Statistic	df1	df2	Sig.
Result	Based on Mean	0.139	2	67	0.871
	Based on Median	0.084	2	67	0.920
	Based on the Median and with adjusted df	0.084	2	66,852	0.920
	Based on trimmed mean	0.129	2	67	0.879

Table 4. Independent samples test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Score test	Equal variances assumed	0.036	0851	4.503	48	0.000	16.892	3.752	9.349	24.436
	Equal variances are not assumed.			4.459	34.367	0.000	16.892	3.788	9.197	24.588

Based on the "Independent Samples T Test" table in the "Equal Variances Assumed" section, it is known that t_count is 4,503 > t_Table 1, 676 with a significant value (sig.) of 0.000 < 0.05, so as the basis for decision making in the independent samples t-test is that H_0 is rejected and H_1 accepted, it can be concluded that there is a difference in the average results of students' problem-solving abilities between the experimental class which uses the Learning Cycle 7e learning method and the control class which uses the DI learning model.

In the discussion section, the researcher will discuss several results of data analysis that have been obtained. The discussion includes 1) interpretation of research results, 2) comparison of research results with theory, and 3) comparison of results with relevant research. The data analysis results using SPSS version 25 showed significant differences between the application of learning methods in the two classes, where the experimental class that used the Learning Cycle 7e learning method got a superior mean score when compared with the control class that used the DI learning method. Thus, it can be concluded that the Learning Cycle 7e learning method is more effective than the direct instruction learning method in improving students' problem-solving abilities.

The findings from the analysis show differences in the use of the Brainstorming method compared to the Learning Cycle 7e model for problem-solving. These findings align with the findings [4], which show several advantages of the Learning Cycle 7e model, including training students to think logically, activating students' thinking to express their opinions, and creating a disciplined and democratic learning environment. This method allows students to apply previously held knowledge to new, unknown situations in searching for and solving a problem.

In line with the theory above (Octaviana & Rahman, 2021), Learning Cycle 7e is a creative problem-solving method that uses group activities. Learning Cycle 7e is a teaching strategy that has seven syntaxes in the learning cycle 7e learning model, namely Elicit (generating students' initial knowledge), namely the phase to find out the extent of students' knowledge of the lesson to be studied by asking questions that stimulate students' initial knowledge so that a response arises. Students' thoughts raise curiosity about the answers to the teacher's questions. This phase begins with basic questions related to the lesson to be learned by taking easy examples that students know, such as everyday events that generally occur.

The following phase is called engagement, where teachers and students share experiences and information concerning the first questions, as well as ideas and lesson plans, all in an effort to get students more engaged in learning new material and paying attention to what their teachers are teaching. Demonstrations, conversations, reading, and other activities can be used in this phase to expand students' understanding and pique their curiosity.

During the third phase, known as exploration or investigating, students acquire knowledge by firsthand experience pertaining to the idea under study. Pupils get the opportunity to observe, inquire, and research concepts from the previously offered learning resources. At this point, the instructor takes on the role of a facilitator, assisting students in working on the breadth of the problem and giving them chances to test their presumptions. Students are supposed to learn about the subjects they have learned in this way—by firsthand experience.

The explanation phase, which comes after the discovery phase, asks students to define and elaborate on the basic ideas they learned. After then, a discussion of the current definitions and notions results in the development of more formal concepts.

The fifth stage, called Elaboration, is designed to help students apply definitions, skills, symbols, and concepts to situations pertaining to real-world examples of the teachings they have learned. Assessment, or assessment, refers to the process of assessing the completed learning objectives. Several formal and informal assessment techniques can be applied during this stage. Instructors must constantly monitor their students' skills and talents in order to evaluate their knowledge and abilities. They must also look for shifts in the way that students think about their initial ideas.

Extend, the last stage of this inquiry, seeks to consider, look for, identify, and clarify instances of applying the ideas that have been covered. This task has the potential to encourage pupils to seek connections between the ideas they have learned and other ideas.

It aligns with the opinion [5] that the learning cycle is a student-centred learning process. The Learning Cycle is a series of activity stages organized so that learners can master the competencies that must be achieved in learning by playing an active role. This is also supported by the opinion of Sritresna [6], who states that knowledge constructed by students themselves will become meaningful, while knowledge that is only obtained through the notification process will not be meaningful.

The findings prove that there are differences between each learning method. These findings are in line with the findings of Oktaviana and Rahman (2021), Rukmana [4] and Lestari and Rosdiana [7]. Research findings prove that students taught using the 7e learning cycle method have superior problem-solving abilities than students taught using learning without applying the direct instruction method.

The results of this research align with the findings of Oktavianda et al [8], who found that students taught using the 7e learning cycle method had superior problem-solving abilities compared to those not taught using this method. Students have more skills in solving questions that require problem-solving abilities [9]. The researchers concluded that there are differences in learning cycle 7e learning methods and direct instruction on problem-solving abilities [10].

Based on the research carried out above, it is hoped that future researchers can develop this research and expand the scope of research, starting from subjects and objects and exploring other models further so that the research can be used more widely [11].

4. CONCLUSION

Based on the "Independent Samples T Test" table in the "Equal Variances Assumed" section, it is known that t_count is 4,503 > t_Table 1, 676 with a significant value (sig.) of 0.000 < 0.05, so as the basis for decision making in the independent samples t-test is that H_0 is rejected and H_1 accepted, it can be concluded that there is a difference in the average results of students' problem-solving abilities between the experimental class which uses the Learning Cycle 7e learning method and the control class which uses the DI learning model. The research data analysis found that the average problem-solving ability for the experimental class with the learning cycle 7e learning model was 68.2173, while the control class with Direct Instruction (DI) learning, the average was 45.6230. It shows that the 7e learning cycle learning model produces higher mathematical problem-solving abilities than the DI learning model.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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