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Culture-Based Discovery Learning and its Impact on Mathematical Critical Thinking Skills

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ABSTRAK

Pola kehidupan yang kompleks di abad-21 menuntut manusia untuk menguasai kompetensi dan keterampilan tertentu agar dapat beradaptasi dengan kehidupan. Kemampuan berpikir kritis merupakan salah satu kemampuan yang penting untuk dikuasi oleh siswa dewasa ini. Penelitian ini bertujuan untuk menganalisis pengaruh pembelajaran model discovery learning berbasis budaya. Jenis penelitian ini yaitu penelitian kuasi eksperimen. Sebanyak 55 siswa kelas V Sekolah Dasar dilibatkan dalam penelitian ini. Kelas eksperimen yang terdiri dari 27 siswa diberikan perlakukan berupa pembelajaran discovery learning berbasis budaya sedangkan kelas kontrol yang terdiri dari 28 siswa diberikan pembelajaran konvensional. Pengumpulan data penelitian dilakukan melalui pemberian tes kemampuan bepikir kritis matematika kepada dua kelas pasca pembelajaran. Analisis data dilakuan melalui analisis data deskriptif dan analisis inferensi melalui uji-t dua sampel independen dengan taraf signifikansi sebesar 5%. Hasil penelitian menunjukkan bahwa terdapat perbedaan kemampuan berpikir kritis yang signifikan antara siswa yang diajar melalui model pembelajaran discovery learning berbasis budaya dengan siswa yang diajar melalui model pembelajaran konvensional. Rata-rata kemampuan berpikir kritis siswa yang diajar melalui model pembelajaran discovery learning berbasis budaya lebih tinggi daripada rata-rata kemampuan berpikir kritis siswa yang diajar melalui model pembelajaran konvensional. Disimpulkan bahwa penerapan pembelajaran discovery learning berbasis budaya dapat meningkatkan kemampuan berpikir kritis siswa sekolah dasar.

ABSTRACT

Complex life patterns in the 21st century require humans to master certain competencies and skills to adapt to life. Critical thinking ability is one of the important abilities to be mastered by today's students. This study aims to analyze the influence of culture-based discovery learning model learning. This type of research is quasi-experimental research. A total of 55 elementary schools and fifth-grade students were involved in this study. The experimental class consisting of 27 students was given treatment in the form of culture-based discovery learning, while the control class, which consisted of 28 students, was given conventional learning. Research data collection was carried out by giving tests of critical thinking skills in mathematics to two post-learning classes. Data analysis was carried out through descriptive data analysis and inference analysis through two independent sample t-tests with a significance level of 5%. The results showed significant differences in critical thinking skills between students taught through the culture-based discovery learning model and those taught through conventional learning models. The average critical thinking ability of students taught through the culture-based discovery learning model is higher than that of students taught through conventional learning models. It was concluded that the application of culture-based discovery learning can improve the critical thinking skills of elementary school students.

1. INTRODUCTION

The 21st century has brought changes in all areas of life. Acceleration, novelty, radical discontinuity, and integration of technology in life are characteristics of the 21st century. Students living in the 21st century today face many problems that are not simple. Therefore, classroom learning must be transformed in such a way that it is following the demands of the 21st-century competency requirements

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(Mutakinati et al., 2018; Rohaeti & Koswara, 2018). One of the abilities that must be formed and pursued in the learning process is the ability to think critically (Azizah et al., 2018; Toheri et al., 2019).

Students' critical thinking skills enable them to solve social and life problems effectively, practically, and well (Astuti et al., 2019; Susilawati et al., 2020; Yusuf et al., 2022). Critical thinking is a methodical and systematic approach to mental tasks such as problem-solving, exploring ideas, producing solutions, analyzing assumptions, predicting, and decision-making (Chusni et al., 2022; Suherman & Vidákovich, 2022). Critical thinking refers to a systematic mental process for conceptualizing, applying, analyzing, synthesizing, and carefully evaluating. Critical thinking skills also refer to the process of assessing, evaluating, and drawing conclusions both deductively and inductively. The core components of critical thinking skills include interpretation, analysis, inference, evaluation, explanation, and self-regulation abilities (Facione, 2013; Kumala et al., 2022).

Students' critical thinking abilities in several regions in Indonesia such as Purwokerto (Rubiyanti et al., 2020), Yogyakarta (Purwaningsih & Wangid, 2021), Malang and Surabaya (Kumala et al., 2022) are still relatively low. The low critical thinking skills of students are caused by the learning process in class so far has not involved students optimally to construct their knowledge (Munawwarah et al., 2020; Yusuf et al., 2022). In addition, many students perceive mathematics as a subject that is culture-free and has nothing to do with everyday life. Efforts to improve critical thinking skills must be carried out early in elementary school because it will affect student academic achievement at the next level. Teachers must involve students fully in the learning process. That is, students must become learning subjects who actively construct their knowledge. Students who actively seek and analyze information related to learning concepts will improve their critical thinking skills (Aini et al., 2019; Indriyana & Susilowati, 2020).

One learning model that can encourage students' active attitudes in seeking information, analyzing, and discovering concepts independently is the discovery learning model learning (Hartati et al., 2020; Lethe et al., 2021; Mukarromah & Sartono, 2018). The discovery learning model refers to learning that is conditioned in such a way that concepts, information, and learning content are not presented in their final form so that students are encouraged to actively search for the concepts being studied (Bahari et al., 2018; Gallenstein, 2005). The discovery learning model is a series of experimental activities or observations of several data and information to find valid concepts and arguments and is carried out independently by students through the help of the teacher as a facilitator. Learning *discovery learning* aims to develop active student learning methods so that students are encouraged to actively think independently to solve problems and discover concepts (Setiyowati, 2019; Solikah & Novita, 2022).

Studies related to critical thinking skills have been carried out by several researchers. The application of the discovery learning model learning can improve critical thinking skills in class VII SMPN 8 Cirebon (Nugroho & Riyanto, 2019) . In addition, the implementation of discovery learning can improve critical thinking skills with an average N-gain of 0.53 in class VIII students at SMPN 25 Pekanbaru (Anike Putri et al., 2020). Discovery learning-based learning models and tools applied in 1 Babussalam Pekanbaru High School are proven to be able to improve student's critical thinking skills with an N-Gain value of 0.70 or in the high category (Ade Putri et al., 2020). Most of the studies on critical thinking skills only focus on high school-level students. Elementary school students can also demonstrate complex higher-order thinking skills (Kilpatrick et al., 2001; Leasa et al., 2020). In addition, several previous studies have not attempted to integrate cultural aspects into the learning process of discovery learning.

Mathematics and culture are two aspects that have strong relevance (Nahak & Feka, 2022; Pathuddin et al., 2021). When the mathematics learning process takes place, students do not logically construct the learned mathematical skills based on abstract cognitive structures but are built through a combination of knowledge and skills previously obtained from the environment or cultural influences (Rajendran & Shah, 2020; Yunita Anindya et al., 2019). The separation of mathematics from cultural objects is one of the causes of low mathematics learning outcomes in schools (Adam, 2004; Ba'ru et al., 2022). This argument means that involving cultural objects in learning mathematics will make mathematics a familiar subject and have links to everyday life. Indonesian society has a heterogeneous culture so the potential for involving cultural objects in mathematics classes is enormous. Several traditional agricultural tools in Pinrang Regency, South Sulawesi have geometric shapes that are relevant to formal mathematics learning materials in elementary schools (Akbar et al., 2021; Harding-Dekam, 2007). Based on the description above, it is necessary to conduct research related to culture-based discovery learning models and their impact on critical thinking skills. The purpose of this study was to identify and analyze the influence of the implementation of culture-based discovery learning models on the critical thinking skills of elementary school students.

2. METHOD

This study used a quasi-experimental design through a post-test-only design. The population of this study was all fifth-grade students of elementary schools in Gowa Regency for the 2021/2022 academic year with the target population being fifth-grade students of the Inpres Hombes Armed target school, Gowa Regency, South Sulawesi Province. Researchers involved 55 students who were divided into two classes, namely 27 students in the experimental class and 28 students in the control class who were selected through a purposive sampling technique. Students in the experimental class were given the treatment of culture-based discovery learning models and students in the control class used conventional learning. The meaning of conventional learning in this study does not connote a particular learning model but refers to a learning model that is generally and commonly applied by teachers in research locations.

The process of collecting data on critical thinking skills was carried out by giving critical thinking skills tests to both groups after being given mathematics learning on the subject of flat shapes. The instrument used in collecting data is a test instrument for critical thinking skills in mathematics in the form of descriptive questions. Researchers arranged tests on the subject of flat shapes to measure students' abilities after being given treatment, both in the experimental class and in the control class. Giving a score for each item depends on the level of difficulty of the problem. The instruments used have been validated by two experts, namely experts in mathematics education and experts in evaluation. The preparation of indicators and assessment of critical thinking skills test results consists of six components of critical thinking skills, namely interpretation, analysis, evaluation, inference, explanation, and self-regulation (Facione, 2013). Critical thinking ability assessment indicators is show in Table 1.

The data that has been collected is then analyzed through descriptive statistics and inferential statistics. Descriptive statistics are used to describe the size of the data center in the form of mean, average, maximum value, and minimum value. The researcher also used a grouping of students' critical thinking abilities using the following categorization references as show in Table 2.

Table 1. Critical Thinking Ability Assessment Indicators

Component	Indicator
Interpretation	1. Able to write down what is asked about the question clearly and precisely 2. Able to write down the information known in the problem
Analysis	3. Able to write down the relationship of the concepts used in solving the problem
Evaluation	4. Be able to write down the steps to solving the problem 5. Able to evaluate each step taken
Inferences	6. Able to conclude answers to questions logically
Explanation	7. Can provide reasons for the conclusions drawn.
Self-regulation	8. Can see back the answers given/written

Table 2. Categorization of Critical Thinking Abilities

Score	Category
0-39	Very low
40-54	Low
55-74	Currently
75 - 89	Tall
90 - 100	Very high

An Independent two-sample t-test with a significance level of 5% was performed to test the research hypothesis. Before testing the hypothesis through the t-test, the normality test and homogeneity test were first carried out. The assumption of normality of mathematical critical thinking skills in the control group and the experimental group uses the Shapiro-Wilk test. Furthermore, Levene's data homogeneity test was carried out to determine whether the data in the control group and the experimental group had homogeneous variants or not. Hypothesis testing was carried out using the IBM SPSS 20 application.

3. RESULT AND DISCUSSION

Result

The average critical thinking ability of students in the experimental class was 73.4 and the average critical thinking ability in the control class was 68. In the experimental class, the highest critical

thinking ability acquisition score was 85 and the lowest critical thinking ability acquisition value was 60. Meanwhile, Therefore, in the control class, the highest critical thinking ability acquisition score was 80 and the lowest critical thinking ability acquisition value was 55. The average critical thinking ability of students in the experimental class was higher than the average critical thinking ability in the control class. The results of the categorization of students' critical thinking ability scores in the experimental group are shown in Table 3. Base on Table 3 the results of the categorization of students' critical thinking ability scores in the control group are shown in Table 4. Base on Table 5 data from the Shapiro-Wilk normality test are said to be normal if the sig. >0.05. Based on the Table 5, the significance value in the culture-based discovery learning data group (DL-Culture) is 0.066 > 0.05 so it can be concluded that this data is normally distributed. Meanwhile, the significant value in the conventional data group was 0.782 > 0.05, so it can be concluded that the data is also normally distributed. The results of the Levene homogeneity test are said to be homogeneous if the significance value is more than 0.05. Based on the table above, a significance value of 0.199 > 0.05 is obtained. This means that the variance of the research data originating from the two groups is homogeneous. Furthermore, inference analysis to test the hypothesis was carried out through an independent sample test with the help of the IBM SPSS Statistics 20 application, the results are show in Table 6.

Base on Table 6 the basis for the first test to conclude this study is if the sig. (2-tailed) < 0.05, then there is a significant difference in the ability to think critically between students who are taught through culture-based discovery learning models and those who are taught through conventional learning. Second, if the sig. (2-tailed) > 0.05, then there is no significant difference between the ability to think critically between students who are taught with the culture-based discovery learning model and those who are taught through conventional learning. Based on the independent sample t-test Table 6, the Sig (2-tailed) value is 0.001, which is less than 0.05. This means that Ho is rejected and H1 is accepted, that is, there is a significant difference in mathematical critical thinking skills between students who are taught through the culture-based recovery learning model and students who are taught through conventional learning models.

Table 3. Categorization of Critical Thinking Skills Scores of the Experimental Group

Score	Category	Frequency
0-39	Very Low	-
40-54	Low	-
55-74	Currently	11
75 – 89	High	16
90 – 100	Very High	-

Table 4. Categorization of Critical Thinking Skills Scores of the Control Group

Score	Category	Frequency
0-39	Very low	-
40-54	Low	-
55-74	Currently	25
75 – 89	High	3
90 – 100	Very high	-

Table 5. Data Normality Test of Students' Critical Thinking Skills in Culture-Based Discovery Learning

Critical Thinking Ability	Learning Model	Kolmogorov-Smirnov			Shapiro-Wilk		
		Statistics	df	Sig	Statistics	df	Sig
	DL-Culture	0.196	27	0.009	0.929	27	0.066
	conventional	0.145	28	0.137	0.977	28	0.782

Table 6. The Outcome of Independent Sample Test Results

	F	Sig.	t	df	Sig. (2-tailed	Mean Differences	std. Error Difference	95% Confidence Interval	
								Lower	Upper
Equal Variances Assumed	1690	0.199	3.387	53	0.001	5.981	1.766	2.440	9.523

	F	Sig.	t	df	Sig. (2-tailed	Mean Differences	std. Error Difference	95% Confidence Interval	
								Lower	Upper
Equal Variances not Assumed			3.376	50.532	0.001	5.981	1.772	2.423	9.540

Discussion

The results of this study indicate that the culture-based discovery learning model can be applied in elementary school mathematics learning, especially in flat shape material. The results of this study have confirmed that students' critical thinking skills in mathematics can be improved from elementary school age. This is consistent with several previous studies which found that children of primary school age can think about certain objects in a complex way. The results of this research data analysis also show that the culture-based discovery learning model can be applied in mathematics classes to improve elementary school students' critical thinking skills in mathematics.

This research is relevant to the findings of previous studies that several factors influence the development of critical thinking skills such as educational factors, student background, personal factors, student parenting factors, and the learning method factor applied by the teacher. The learning method applied by the teacher in the classroom will influence the development of critical thinking skills (Elshami et al., 2021; Kumala et al., 2022). The practice of learning through the discovery learning model which provides maximum opportunities for students to seek information and knowledge will improve critical thinking skills in mathematics (Pallant, 2016; Sutoyo & Priantari, 2018). Discovery learning model learning can help students find their answers through information-gathering efforts that are carried out independently (Ayu & Rusnilawati, 2022; Ningrum et al., 2022). In practice, the discovery learning model is designed in such a way that the subject matter given to students is not presented in its entirety. Therefore, students are encouraged to seek, analyze, and prove information obtained through a series of observing activities in class. Through a framework like this, students will be actively involved in constructing their knowledge. Discovery learning models are designed in such a way that the subject matter given to students is not presented in its entirety. Therefore, students are encouraged to seek, analyze, and prove information obtained through a series of observing activities in class. Through a framework like this, students will be actively involved in constructing their knowledge (Ade - Ojo et al., 2022; Darma Putra & Sujana, 2020). Discovery learning models are designed in such a way that the subject matter given to students is not presented in its entirety. Therefore, students are encouraged to seek, analyze, and prove information obtained through a series of observing activities in class. Through a framework like this, students will be actively involved in constructing their knowledge.

Another important finding in this study is that integrating cultural aspects in learning mathematics is an important thing that must be considered by teachers to improve critical thinking skills (Awofala & Lawal, 2022; Martyanti & Suhartini, 2018). Integrating cultural aspects in learning can encourage motivation, independent activity, and a positive disposition of students toward mathematics so that it will encourage academic achievement in mathematics including problem-solving skills and mathematical critical thinking skills (Nurhikmayanti & Sunendar, 2020; Pathuddin et al., 2021). This means that the presence of cultural objects in the mathematics class will affect students' achievement in learning mathematics (Adam, 2004; Pathuddin et al., 2021). Therefore, teachers should consider environment- and culture-based classroom arrangements to encourage students' critical thinking skills. However, a number of researchers have believed that culture is one aspect that influences thinking skills students' critical thinking (Dennett & DeDonno, 2021; Lianqing et al., 2020; Nuryadi et al., 2022).

The sample of this study only involved two small classes in a relatively short time, so the results of this study cannot be generalized to a wider scope. Further research is needed with a wider target population and sample, as well as more time to obtain more complete and comprehensive research results. In addition, the focus of learning materials in this study is limited to geometric shapes so that it does not rule out the possibility of culture-based discovery learning being effectively applied to other materials or vice versa. Therefore, further research related to the implementation of culture-based discovery learning needs to be done for other materials

4. CONCLUSION

This study shows that there are significant differences in mathematical critical thinking skills between students who are taught through the culture-based discovery learning model and students who are taught through conventional learning models. The average critical thinking ability of students taught

through the culture-based discovery learning model is higher than the average critical thinking ability of students taught through conventional learning models. It can be concluded that the culture-based discovery learning model is effectively applied to elementary school mathematics learning and can improve students' critical thinking skills, especially in flat shape material.

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