

## The Effectiveness of Mathematics Worksheet Based on Creative Problem Solving (CPS) for Reasoning Ability of Elementary School Students

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**Abstract.** This study aims to know the effectiveness of using mathematics worksheets based on creative problem solving (CPS) for reasoning abilities of elementary school students. This research used experimental method with randomized subject posttest only control group design. The sample consisted of 2 classes, namely the experimental class (CPS model equipped with worksheets based on CPS) and the control class (conventional method). Sampling was done by cluster random sampling. The technique of collecting data on the cognitive aspect used the objective test method and the affective aspect used the questionnaire method. The data analysis technique used descriptive analysis and inferential analysis, to test the hypothesis using the t-test, with the prerequisite analysis of normality and homogeneity tests. The results showed that: (1) the teacher's ability processed learning with student worksheets based on creative problem solving (CPS) was well implemented. (2) the application of CPS-based worksheets in terms of: (a) the reasoning results of students with an average score of 87.12 were good category, and students' classical reasoning abilities were 91.25% 85%; (b) student learning activities were very good category; and (c) the response was very positive category. The results of hypothesis testing at a significant level of 0.05 with a t-test showed that mathematics worksheets based on creative problem solving (CPS) was effective for reasoning of elementary school students.

**Keywords:** Worksheet, Creative Problem Solving, Reasoning

## INTRODUCTION

The rapid development of science and technology is increasing along with these changes in the information age. This rapid

change in the process of creating and using this information also changes society's expectations of individuals (Ulaş et al., 2012). In this case, it can convey information and also get information

more easily. Communication, especially in Indonesia, feels as if it has become easier with the development of this technology. Thus in the world of education in the future there will be some fundamental paradigm changes, especially those caused by the application of information technology that accelerates the transfer of knowledge.

Education is a process of a person or group of people's changing attitudes and behavior in an effort to mature humans through teaching and training efforts. Law No.20 of 2003 concerning the National Education System Article 13 point 1 states that the education pathway consists of formal, non-formal and informal education which can complement and enrich each other.

Study of education formally described in Article 14 which states that, "Level of education formally composed on education basic, secondary education, and higher education". In formal education, especially basic education or education at the elementary school level, it cannot be separated from mathematics learning. In improving high-level cognitive skills students must build scientific understanding concepts, because basic concepts are taught at the elementary school level, teaching concepts are problems that must be emphasized strictly in elementary schools (Keleş & Demirel, 2010).

Mathematics is essential to be provided by students in elementary schools, so that these students can improve their reasoning skills in the learning process and the surrounding environment related to everyday life, so that they are able to solve problems.

Learning mathematics in elementary schools requires learning tools in the form of worksheets to improve the reasoning abilities of elementary school students, worksheets learning tools that are very effective in learning mathematics that can improve students' reasoning abilities in solving problems, namely learning tools in the form of worksheets based on creative problem solving (CPS) model. Student worksheets are very effective and efficient in the learning process, so students are encouraged to do assignments in their learning. In learning activities students form a process of reasoning and creative thinking with the existence of interesting student worksheets and more efficiency in their learning environment (Kibar & Ayas, 2010b).

Stages in the implementation of student

worksheets, in the first stage students individually focus on understanding the question, in the second stage students are asked to understand the problem in their learning, in the third stage they are asked to write down designing solutions to the problems obtained. The third stage asks students to follow the instructions in the student worksheets activity and they record the results obtained on a worksheet. The fourth stage is the assessment part, then students are asked to reflect and explain what is obtained or the solution to the problem (Kibar & Ayas, 2010a).

Reasoning ability is a fundamental skill that underlies success in everyday life (Majidi et al., 2021), critical reasoning ability is a skill that is acquired, developed, and practiced during the learning process (Majidi et al., 2021), kemampuan bernalar kritis suatu keterampilan yang diperoleh, dikembangkan, dan di praktikkan pada saat proses pembelajaran (Ayva, 2012). Improving inductive reasoning and thinking skills at all elementary school levels is contained in the curriculum and subject matter used (Van Vo & Csapó, 2020). The learning process in accordance with the indicators of learning and more advanced learning will produce better skills (Berndt et al., 2021).

Lack of critical reasoning skills is a factor causing decreased learning achievement (Woolley et al., 2018). Learning mathematics requires students to improve their reasoning abilities in elementary schools. Reasoning ability is the main focus of solving problems in the learning process (Schlatter et al., 2021). The development of critical thinking skills and reasoning abilities is the most important thing in education starting from basic education (Fiddler et al., 2016). To improve reasoning skills with creative problem solving models.

Creative problem solving model which requires students related to problem solving creatively in the learning process Those are applied to help students face problems in real contexts and practice problem solving skills with problems with simple structures, then assign tasks to the students in solving problems according to the process (Kwangmuang et al., 2021).

Creative problem solving is very suitable for learning mathematics that connects logical mathematics and applies mathematical abilities in real life. So that to improve students' reasoning abilities in solving problems

(Mukuka et al., 2020).

## METHOD

This research used experimental method with randomized subject posttest only control group design. The number of population were all fifth grade students of SD Tunas Bangsa Makassar which consisted of two classes, namely classes V.A and V.B with the technique, sampling was done by Cluster Random Sampling. This study consisted of two classes, namely the experimental class and the control class. Class V.A as the experimental class (which is taught using worksheets based CPS) which consists of 30 students and class V.B as the control class (which is taught by conventional method) which consists of 30 students.

The instruments used observation sheets on the implementation of learning or the ability of teachers to process learning, student activity observation sheets and student response questionnaires, as well as instruments in the form of tests to measure students' reasoning abilities.

The technique of collecting data used the objective test method (test to measure reasoning ability) and on the effective aspect using the questionnaire method (implementation of learning or teacher's ability to process learning, student activities and student responses) on cognitive aspects.

Based on the data obtained, the data analysis techniques used descriptive data analysis and inferential analysis.

Descriptive statistical analysis to measure the picture of the effectiveness of learning by using student worksheets based on creative problem solving (CPS) which is characterized by 1) the implementation of learning or the teacher's ability to process learning, 2) student activities, 3) student responses and 4) reasoning abilities, with the following categories :

The teacher's ability to process learning by using learning tools in the form of worksheets based on creative problem solving (CPS) to process the teacher's abilities during learning at each meeting with the categories described in table 1.

**Table 1** : Teacher's Ability Category

Score	Category
$3.2 < KG \leq 4.00$	Very Good
$2.4 < KG \leq 3.2$	Good
$1.6 < KG \leq 2.4$	Moderate
$0.8 < KG \leq 1.6$	Less
$0 < KG \leq 0.8$	Poor

Description: Teacher's Ability

### Student Activity data analysis

Student activities during the learning process use learning tools in the form of worksheets based on creative problem solving (CPS) to process student activities when learning takes place at each meeting with the categories described in table 2.

**Tabel 2.** Students' Activity Category

Score	Category
$3.2 < AS \leq 4.00$	Very Good
$2.4 < AS \leq 3.2$	Good
$1.6 < AS \leq 2.4$	Moderate
$0.8 < AS \leq 1.6$	Less
$0 < AS \leq 0.8$	Poor

Description: Students' Activity

Student responses after the implementation of learning by using learning tools in the form of worksheets based on creative problem solving (CPS) to process responses at the end of learning with the categories described in table 3.

**Table 3.** Students response Category

Score	Category
$3.2 < RS \leq 4.00$	Very Good
$2.4 < RS \leq 3.2$	Good
$1.6 < RS \leq 2.4$	Moderate
$0.8 < RS \leq 1.6$	Less
$0 < RS \leq 0.8$	Poor

Description: Students response

The students' reasoning abilities were measured after the implementation of learning by using learning tools in the form of worksheets based on creative problem solving (CPS) to process data on reasoning abilities at the end of learning with the categories described in table 4.

**Table 4.** Category of Reasoning Ability

Score	Category
$89 < KP \leq 100$	Very Good
$79 < KP \leq 89$	Good
$69 < KP \leq 79$	Moderate
$59 < KP \leq 69$	Less
$0 < KP \leq 59$	Poor

Description: Reasoning Ability

Inferential statistical analysis tests the hypothesis, before testing the hypothesis, the prerequisite tests were first, namely the normality test and homogeneity test, and then the hypothesis test was the t-test, with the following explanation: (1) The normalist test was used with the aim at knowing the data used were normal, provided that the significant value of with a level of  $= 0.05$  was seen in the One-Sample Kolmogorov-Smirnov Test on SPSS; (2) Homogeneity test to determine the distribution of data from two or more variants of a homogeneous population, provided that the significant value of with a level of  $= 0.05$ , seen in Levene's Test for Equality of Variance on SPSS; (3) Hypothesis Test (t -Test), Hypothesis testing with t-test was carried out after testing the normal and homogeneous prerequisite tests, the results of the t-test were provided with a significant value with a level  $= 0.05$  or t-count t-table.

The effectiveness of elementary school mathematics learning with creative problem solving-based worksheets is in accordance with the effectiveness indicators as follows: (a) The teacher's ability to process learning was said to be effective if the teacher activity score is more than 2.4 at least in the good category; (b) Student activities in learning are said to be effective if the AS score is more than 2.4 at least in the good category; (c) Student responses in learning are said to be effective if the student's response score was more than 2.4 at least in the positive response category; (d) Reasoning ability is said to be effective if the reasoning ability score was more than 79 at least in the good category; (e) Students' reasoning ability classically 85%.

## RESULTS AND DISCUSSION

### Result

Research that has been carried out at SD Tunas Bangsa Makassar City which was carried

out for five meetings using worksheets based on creative problem solving (CPS) which before being given treatment was given first (free test) to measure initial ability, then with treatment with worksheets based on creative problem solving (CPS). it was observed the teacher's ability to process learning and student activities during the learning process, after the last meeting was given (post test) to measure students' final abilities or students' reasoning abilities after learning using student worksheets based on CPS devices and given student responses after being done learning. The results of descriptive analysis and inferential analysis are as follows:

Descriptive statistical analysis to measure the picture of the effectiveness of learning by using student worksheets based on creative problem solving (CPS) which is characterized by 1) the implementation of learning or the teacher's ability to process learning, 2) student activities, 3) student responses and 4) reasoning abilities, with the following categories :

#### 1. Teacher's ability to process learning

The ability of teachers to teaching process using student worksheets based on creative problem solving (CPS) is shown in the following table 4.

**Table 4.** Teacher Ability

Meeting	Score	Category
I	2,76	Good
II	2,91	Good
III	3,32	Very Good
IV	3,52	Very Good
V	3,89	Very Good

Based on the results of observations, the teacher's ability to process learning carried out during the implementation of learning at the first meeting until the fifth meeting has increased with an average score of 3.28 which is in the very good category, thus meeting the effective criteria.

#### 2. Student Activities

Student activities during the learning process using student worksheets based on creative problem solving (CPS) are shown in the following table 5.

**Table 5.** Students Activity

Meeting	Score	Category
I	2,61	Good
II	2,87	Good
III	3,42	Very Good
IV	3,75	Very Good
V	3,91	Very Good

3. Student Response

Student responses with student worksheets based on creative problem solving (CPS), with an average score of 3.47 student responses are in the very positive response category, with effective criteria.

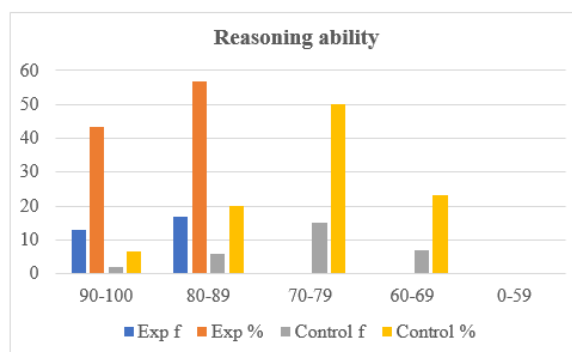
4. Reasoning Ability

The reasoning ability of students using student worksheets based on creative problem solving (CPS) in the experimental group and the reasoning abilities of students using conventional models in the control group are shown in the following table.

**Table 6.** Reasoning ability

Interval	Exp		Control		Explanation
	f	%	f	%	
90-100	13	43,3	2	6,7	Very Good
80-89	17	56,7	6	20	Good
70-79	0	0	15	50	Moderate
60-69	0	0	7	23,3	Less
0-59	0	0	0	0	Poor
<b>Total</b>	<b>30</b>	<b>100</b>	<b>30</b>	<b>100</b>	

The reasoning ability after the implementation of student worksheets based on creative problem solving (CPS) for fifth grade elementary school students, shows that in the experimental group the average score of 87.12 students' reasoning abilities is in the good category and students' classical reasoning abilities are 91.25% 85%, and the average score of students' reasoning abilities in the control group, the average score of students' reasoning abilities of 71.54 was in the good enough category and students' classical reasoning abilities were 79.81% 85%, in the experimental group students' reasoning abilities were effective compared to the group control.



**Figure 1.** Reasoning Ability

Based on the diagram shows the results of the reasoning ability in the experimental group using creative problem solving-based worksheets that are more effective than the control class using conventional learning.

In this analysis, before testing the hypothesis (t-test) first perform a pre-requisite test, namely the normality and homogeneity test, the test results are as follows:

The results of the Kolmogorov-Smirnov normality test for the experimental group with a significance value or P-value = 0.315 for the pretest, the significance of the P-value for the posttest = 0.284. For the control group, the significance value or P-value = 0.352 for the pretest, the significance of the P-value for the posttest = 0.127. This means that the data comes from a population that is normally distributed.

The results of the homogeneity test on Levene's test for equality of variances with a value of 0.283, this shows the data have the same variance.

The results of hypothesis testing on the independent sample test were significant with a value of 0.001, less than 0.05. This shows that  $H_1$  is accepted, learning mathematics with creative problem solving (CPS)-based worksheets improves the reasoning abilities of elementary school students.

**Discussion**

After applying the learning model and learning student worksheets based on creative problem solving (CPS) showing normal and homogeneous data, and the results of the t-test meeting significant criteria, the results of hypothesis testing on mathematics learning with student worksheets based on creative problem solving (CPS) improved the reasoning abilities of elementary school students.

The results showed that: (1) the teacher's ability to process learning student worksheets based on creative problem solving (CPS) was well implemented. (2) The application of worksheets based on CPS in terms of: (a) the reasoning results of students with an average score of 87.12 were good category, and students' classical reasoning abilities were 91.25% 85%; (b) student learning activities were very good category; and (c) the response was very positive category. The results of hypothesis testing at a significant level of 0.05 with a t-test showed that learning with student worksheets based on creative problem solving (CPS) was effective for reasoning of elementary school students.

Learning of mathematics in student worksheets based on creative problem solving (CPS) was effective on the reasoning abilities of elementary school students, this is in line with previous research that student are effective in improving students' reasoning abilities and understanding of basic concepts and eliminating students' alternative conceptions (Kolomuc et al., 2012). Learning using worksheets will provide meaningful learning and increase students' interest in learning (Celikler & Aksan, 2012). When their willpower increases, their abductive reasoning ability will also increase (Hwang et al., 2019). Improving the reasoning ability of elementary school students is effective if the students are consistent and bring their skills to learn (Kim et al., 2021).

## CONCLUSION AND SUGGESTION

The learning model and student worksheets based on creative problem solving (CPS) improves the reasoning abilities of elementary school students.

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