Analysis of Creative Thinking Ability Reviewed from Science Process Skills Through Creative Problem Solving Learning Assisted by Mobile Learning

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ABSTRACT

Science is defined as a concept or flow of related results from observation and experimentation. Science education during the Industrial Revolution 4.0 encourages massive and dynamic changes to be able to integrate data processing, utilization of big data, work systems through digitalization by utilizing information technology related to human interaction with the surrounding environment. Science education during the Industrial Revolution 4.0 is in the process of developing strategies to solve these problems. The aim of this research is Describe the results of the analysis of creative thinking skills in terms of science process skills through Creative Problem-Solving learning assisted by Mobile Learning. The research was compiled by researchers using a mixed methods research design where the design is sequential explanatory (sequence of evidence). Mixed methods are used as a research plan, where the structure is sequential (sequence of evidence). The population in this study were fifth grade students of Gugus Cokroaminoto Elementary School. The determination of research subjects by purposive sampling consisted of 6 students out of 10 students in the experimental class consisting of two low students, two medium students, and two high students. The researcher as an instrument was equipped with observation sheets, test questions, interview guidelines, documentation. The results of the study showed that learning using the Creative Problem-Solving model assisted by mobile learning, the average creative thinking ability of students after implementing Creative Problem-Solving learning assisted by mobile learning was better than the creative thinking ability of students who implemented Problem Based Learning. The creative thinking ability of students in the experimental class was higher in the control class with an average of 80.00 in the experimental class while the control class was 54.32 on a scale of 100. Based on the results of the study above, it can be concluded that there is an effectiveness of the application of the Creative Problem-Solving model in water cycle learning on creative thinking skills in terms of science process skills. The average science process skills of students using the Creative Problem-Solving model.

Learning media assisted by mobile learning are 9.06% higher than the control class 5.26. The results of the regression test of students' creative thinking skills in terms of science process skills got a regression value of 0.892 or 89.2%. There is a correlation between creative thinking skills and students' science process skills. The classical average of the experimental class is 80.00 and the control

class is 54.32.

INTRODUCTION

Mastery of academic competencies is a curriculum content at the elementary level. This development process allows students to develop scientific competencies when identifying natural phenomena based on their observations. Mastery of scientific competencies encourages students to find and act in a deep understanding of the natural environment independently. According to Wahyana (Trianto, 2015: 136) explains that science is a collection of systematic knowledge studying natural phenomena.

Creative thinking ability as the main point and basis of competence to facilitate problem solving to achieve the key to a successful life and a responsible life that is beneficial to society, answering the challenges of the times and the future. The thoughts expressed by Kadir, et al. (2017) explain that the creative thinking process is a basic ability that must be mastered by the community and educational subjects in the era of openness of technology and information.

Creative thinking skills are basic skills that must be mastered by students starting from elementary school to university as a goal of educational curriculum demands. Another opinion was put forward by Bambang Subali (2019) that the ability to think creatively in science at the school level produces various alternative extraordinary ideas, one of which is able to become a solution to contextual science problems. So that the aspect being targeted is not the element of creative work but underlines the element of novelty in the scope of science. In general, there are four indicators used to measure students' creative thinking abilities, namely aspects of fluency, flexibility, originality, and elaboration. For more details, as stated by Munandar [6], the indicators of creative thinking abilities are as follows:

Fluency is the ability to generate many answers, solve problems, ideas, questions, create many ways or suggestions to do something, and find more answers.

Flexibility is the ability to generate questions and varied answers, identify problems from different perspectives, seek various alternatives or methods, and be able to change approaches or ways of thinking.

Originality is the ability to ask diverse and unique questions, think of unusual ways of expressing oneself, and be able to combine unusual parts or elements.

Elaboration is the ability to develop and improve ideas or concepts by adding or detailing subjects, ideas, or situations to make them more interesting.

It is clear that students are so attached to smartphones and apathetic to printed sources such as textbooks, articles, wall magazines and the like. Data obtained from observations in class V of SDN 2 Patalan show that science learning, although it has implemented innovative models such as contextual, in practice the model has not been able to literally develop science process skills. Information obtained from the results of observations shows that process skills in learning natural science subjects are at a low level, at a level that needs to be developed, so students are bored with learning.

The results of the facts in the field encourage the existence of alternative solutions that can be applied, namely learning models that stimulate problem solving using creative thinking skills.

Based on the description above, the following problems can be formulated: (1) Is Creative Problem-Solving learning assisted by mobile learning effective in improving students' creative thinking skills? (2) How is the analysis of creative thinking skills reviewed from science process skills through Creative Problem-Solving learning assisted by mobile learning?

The purpose of this study is (1) To analyze the effectiveness of Creative Problem-Solving learning assisted by Mobile Learning in improving students' creative thinking skills (2) To describe the results of the analysis of creative thinking skills reviewed

from science process skills through Creative Problem-Solving learning assisted by Mobile Learning

MATERIALS & METHODS

This study uses Sequential explanatory research that combines or integrates quantitative methods then continues with qualitative methods in a series of studies continuously or sequentially (Creswell, 2016). The selection of using a mixed methods design with sequential explanatory collecting and analyzing data quantitatively continuously collecting and analyzing qualitative category data.

The first step of quantitative research is in the preparation stage, implementation then quantitative analysis. The preparation of learning devices and instruments is included in the preparation stage including learning devices consisting of syllabus and lesson plans. The preparation of learning instruments is equipped with creative thinking skills test grids, practice questions, pre-tests and post-tests.

Before intervening the experimental class and control class to obtain initial data, an initial test of creative thinking skills was given to encourage scientific problem solving. Learning took place for two (2) meetings in the experimental class and class. At the end of the implementation of this study, a post-test was given to analyze creative thinking skills in solving science problems and distributed process skills questionnaire instruments as material for final data analysis.

The research using the mix method sequential explanatory model aims to prove the hypothesis by continuing the application of qualitative research methods as evidence to strengthen and deepen the acquisition that produces qualitative research data (Creswell, 2016). The method in this qualitative research is based on the results obtained from quantitative research on students' creative thinking skills in solving science problems.

Data Analysis Method
1. Analysis of Creative Thinking Ability

Test Trial Data

Test questions to measure creative thinking ability must be in accordance with the guidelines or grid for compiling creative thinking ability questions, then scoring guidelines are also compiled. The test items must be tested first in order to obtain good test items. Analysis of the data from the trial of creative thinking ability questions is explained below.

a. **Validity of question items**

The alignment that occurs means that there is a correlation using a certain formula, so this study is more appropriate to use the product moment correlation formula to determine the validity of the product as below:

$$r_{xy} = \frac{N \sum XY - \sum X \sum Y}{\sqrt{[\sum X^2 - (\sum X)^2][N \sum Y^2 - (\sum Y)^2]}}$$

b. **Reliability of Question Items**

The set of tests must be tested for reliability to obtain consistent test results. Test reliability refers to questions about the accuracy of test results. The test items referred to in this study are objective, namely a set of tests in the form of "true" or "false" questions (Arikunto, 2019: 109). How to conduct a reliability test of the essay-type test instrument to measure creative thinking skills according to the Cronbach's Alpha formula calculation, namely:

$$r_{11} = \left(\frac{n}{(n-1)}\right)\left(1 - \frac{\sum s_i^2}{s_i^2}\right)$$

c. **Difficulty Level of Question Items**

The importance of knowing the level or index of difficulty of a question item is an indicator of determining whether the question is easy to be in the medium or difficult category for students, of course using certain criteria. The expert opinion used by researchers as a reference is Arikunto (2015: 223), stating that a question is said to be good if it is not too easy and also does not make it too difficult for students in the process of working on it. If the question is too easy, students do not need analytical skills to

solve it, if the question is too difficult, it results in despair and reluctance so that students are lazy to try. Departing from this reason, the following formula is used by researchers as a basis for measuring the level of difficulty of each question description using the formula below.

$$TK = \frac{A + B - (2NSmin)}{2N(Smaks - Smin)}$$

d. Distinguishing Power of Question Items

The ability of questions to distinguish between smart (highly capable) and not smart (lowly capable) students requires a specific test. The calculation of discriminatory power is intended to categorize students with higher and lower abilities. Based on Suherman's explanation quoted by Zainal Arifin (2016: 280), the effort to find the discriminatory power of essay questions using a formula is clearly written below.

$$Dp = \frac{A - B}{N(S_{maks} - S_{min})}$$

2. Valid Learning Device Data Analysis

Before conducting the research, the researcher prepared the completeness of the required devices including the syllabus, RPP (Learning Implementation Plan), creative thinking ability test instruments, observation/observation guidelines, questionnaires to measure science process skills and interview guidelines. The completeness of the learning devices requires validation by a team of expert validators. The involvement of validators is a team of expert validators who are competent in their fields, in this case consisting of three expert validators. Validation is carried out by giving a score on a scale of 1-5, if a scale of 1 indicates the lowest value and a scale of 5 for the highest value of each learning device. The results of the assessment by the validator are then analyzed based on the average score. The average score value uses the following formula calculation (Fatmawati, 2016)

$$Validation\ score = \frac{validation\ total\ score}{maximum\ total\ score} \times 100\%$$

Tabel 3.1 Validation Criteria

Nilai	Keterangan
$85\% \leq skor \leq 100\%$	Very valid
$70\% \leq skor \leq 85\%$	Quite valid
$50\% \leq skor \leq 70\%$	Less Valid
$skor \leq 50\%$	Not Valid

Learning devices are said to be valid if the score shows the criteria are quite valid or very valid. If it is in the criteria of less valid then the device needs to be revised.

3. Quantitative Data Analysis

When the data needed for the research has been collected, the data analysis stage is continued. The researcher took references according to Sugiyono's opinion (2016:147) explaining that data analysis is carried out after the process of collecting the required data. Data analysis activities include grouping data according to the variables of all sources needed, tabulating and presenting data for each research variable, calculating and finding answers according to the problem formulation made previously, and calculating hypothesis testing according to the previous research formulation.

4. Normality Test

The normality test is used when the process of finding research data that is desired is then used according to the characteristics of a normal distribution followed by the stages of special parametric statistical tests for normally distributed category data. The implementation of non-parametric statistical tests is carried out in conditions where the data found is not normally distributed. Data testing using data normality is intended to measure the condition of the initial sample data including normal distribution or not.

Ho: The pretest value of creative thinking ability includes a normal distribution

H1: The pretest value of creative thinking ability does not include a normal distribution

5. Homogeneity Test

Homogeneity testing uses the basic Levene test formula to determine whether the sample has a homogeneous or different variant. Writing a statistical hypothesis chooses the formula as written below.

$$W = \frac{(N-k)\sum_{i=1}^{k} n_i(\bar{z_i} - \bar{z_{..}})^2}{(k-1)\sum_{i=1}^{k}\sum_{j=1}^{Ni}(z_{ij} - \bar{z_i})^2}$$

6. Initial Mean Equality Test

The third stage is to test the average similarity to find out whether the average ability of the two classes shows similarities or differences. The use of data based on the results of the initial test of students' creative thinking abilities as a measure of the initial average similarity of the class.

The writing of the hypothesis in the average similarity test process is:

H0: $\mu1 = \mu2$ a both classes have the same average

Ha: $\mu1 \neq \mu2$ means that the two classes do not have the same average

The implementation of the average similarity test in question uses the independent t-Test Significant for the similarity test, which is 5% or 0.05. If the significance value is more > 0.05, it means that H0 is accepted and Ha is rejected. If the significance value is less <0.05, it is stated that H0 is rejected and Ha is accepted.

The population used in this study took the student population at grade IV level of Gugus Cokroaminoto, Blora District, Blora Regency, which consists of 11 schools.

The sample was taken from students in grade IV of SDN 2 Patalan and SDN 1 Patalan consisting of 10 students. All students have the same abilities in each class. Grade IV of SDN 1 Patalan as the control class did not receive treatment so that the school implemented learning using the Problem Based Learning model. The experimental class implemented in grade IV of SDN 2 Patalan received treatment so that the class implemented the *Creative Problem-Solving* model. While the trial class in this study was grade IV of SDN 2 Tempurejo.

RESULT

(1) Students' creative thinking ability in Creative Problem-Solving learning assisted by mobile learning reaches the completion criteria of ≥75%. The H0 test criteria are accepted if Zcount ≤ Ztable with a 5% error rate of 1.645. The test results show that Zcount = 3.59, which means 3.59> 1.645 or Zcount> Ztable, so it can be concluded that H0 is rejected and vice versa H1 is accepted. This states that the proportion of creative thinking ability test scores in Creative Problem Solving (CPS) learning models assisted by mobile learning has reached the actual completion limit of at least 70 more than 75%.

Proportion = x / n x 100% = 8/10 x 100% = 80%

Based on this calculation, students who reach the actual completion limit value reach 80%. So, it can be concluded that students in the class who receive learning materials using Creative Problem Solving (CPS) assisted by mobile learning have achieved completion of more than 75%.

(2) The average creative thinking ability of students with the Creative Problem-Solving model assisted by mobile learning is greater than the Actual Completion Limit (BTA), the test criteria H0 is accepted if t count ≤ t table with degrees of freedom (dk) = n-1 = 10-1 = 9 and a 5% error rate, namely 2.262. The calculation results show that t count = 3.339 which means 3.339 > 2.262 or t count > table, then it can be concluded that H0 is rejected and vice versa H1 is accepted. This can be concluded that the average creative thinking ability in solving water cycle problems in Creative Problem-Solving learning assisted by Mobile Learning is more than 70.

(3) The proportion of students' creative thinking ability completion taught with the Creative Problem-Solving learning model assisted by mobile learning is better than the proportion of students' creative thinking ability completion with

the Problem Based Learning model. The significance level in this hypothesis test is 5%, the Z value is 1.645. The calculation results obtained a value of $2.37 \geq 1.645$, so the calculated $z \geq z$ (0.05 - α), meaning H1 is accepted. It can be concluded that the proportion of students' completion in the class who received learning materials using the Creative Problem-Solving model assisted by mobile learning is more than the proportion of students' completion in the class who received learning using the Problem Based Learning learning model. In accordance with the results of Sumarli's research (2018) which shows that learning the Creative Problem-Solving model assisted by mobile learning meets the proportion of completion classically.

(4) The average creative thinking ability of students after the application of Creative Problem Solving learning assisted by mobile learning is better than the creative thinking ability of students who applied Problem Based Learning learning, with the testing criteria, namely H0 is rejected if the count $\geq$ t (1-α), obtained from t (1-α), a list of t distributions with dk = (n1 + n2 - 2) and probability (1-α), and vice versa. The data used for testing are the results of the post-test of the experimental class and the control class. Based on the table above, the sig value (2 tailed) is -190 < 0.05, so it can be concluded that there is a difference in the average learning outcomes of students between the Creative Problem-Solving model assisted by Mobile Learning and the Problem Based Learning model.

(5) There is an influence of science process skills on students' creative thinking skills after the implementation of Creative Problem-Solving learning assisted by mobile learning. Testing is carried out using SPSS regression test with a Sig value of 5%. With the testing criteria if the Sig value> 5% means H0 is accepted and vice versa if the Sig value <5% means H0 is rejected and H1 is accepted.

From the results of the regression test of creative thinking skills reviewed from science process skills, a correlation value of 0.892 was obtained with a Sig value of 0.000 or a Sig value <5% that H0 was rejected and H1 was accepted, which means there is a significant influence of creative thinking skills reviewed from science process skills. The results of the SPSS test can be seen in the attachment sheet Creative Thinking Skills Reviewed from Science Process Skills.
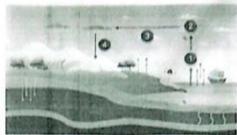
Description of Research Results
From the data obtained, the highest score was 69, and the lowest score was 20 with a score range of 0 to 96. Overall, students' creative thinking ability in science is in the moderate category, namely 45.52%. The results of the water cycle creative thinking ability test are based on four indicators of water cycle creative thinking ability, namely fluency, flexibility, originality, and elaboration.

DISCUSSION
1) Fluency
For the first indicator, fluency, students are able to provide a range of appropriate answers accompanied by clear problem solving. Students are asked to create 1 question from the statement provided. This indicator is in question number 5. Students who are able to create questions correctly get a score of 2. Students who create questions incorrectly get a score of 1, while students who do not answer get a score of 0. The overall maximum score is obtained from 20 students multiplied by the maximum score for each question. The results of the calculation of the total pretest score from 48 students on this indicator obtained a score of 69, while the total posttest score obtained a score of 72. The average result of the assessment of the fluent thinking aspect of the experimental class got an average of 3.58 with a st.Dev distribution of 0.649 while the average for the control class was 3.20 with a st.Dev distribution of 1.052.

2) Flexibility

In the second indicator, namely flexibility, students are able to provide answers in more than one way of solving (various) differently. Students are asked to provide further explanations regarding the chart provided in the question. This indicator is found in question number 6. Students who are able to answer correctly and completely are given a score of 6. Students who do not answer at all are given a score of 0. The results of the calculation of the total pre- test score from 20 students on this indicator obtained a score of 138. Then the researcher tried to create general assessment criteria that could accept various answers. for the assessment criteria can be seen on the two flexible thinking aspect assessment sheets. the results of the broad thinking aspect assessment show that the average for class 5 is 2.64 higher than the average for class 5 getting 1.97.

3) Originality

In the third indicator, namely originality, students have not been able to provide answers in a unique way or a way that is different from that given by other students, the calculation

process and the results are correct. Students are asked to provide a simple explanation of the indicator providing alternative solutions and solving science problems. This indicator is in question number 1. Students who are able to answer correctly and completely are given a score of 8. Students who do not answer at all are given a score of 0. The overall maximum score is obtained from 20 students multiplied by the maximum score for each question. The results of the calculation of the total pretest score from 20 students on this indicator obtained a score of 196, while the total posttest score obtained a score of 294.

4) Elaboration

In the fourth indicator, namely elaboration, students are able to provide correct answers to one or more ways to solve problems, accompanied by detailed steps. Students who are able to answer correctly and completely are given a score of 2 on question number 2a, while on question number 2b they are given a score of 3. Students who do not answer at all are given a score of 0. The overall maximum score is obtained from 20 students multiplied by the maximum score for each question. The results of the calculation of the total pretest score from 48 students on this indicator obtained a score of 145, while the total posttest score obtained a score of 196.

Based on the results of the study and the results of data analysis, this creative thinking ability is categorized as high, medium and low. The description of the characteristics of each category is reviewed from the indicators of creative thinking ability of the water cycle, namely as follows:

1) High Category

Based on data analysis from the research results, that overall, out of 20 students, there are only 4 students who are in the high category. Students who are in the high category are students who have met the 4 indicators of creative thinking ability as previously mentioned, but the scores obtained for each indicator are different. This is indicated by the students' ability to solve problems, students are not only fixated on one alternative answer, but are also able to provide ideas, solutions, or other alternatives that are different from other students in solving problems. Some students' answers use more than one solution with the same results. Students are also able to provide detailed answers in solving problems. However, for students who meet the originality indicator, students are only able to provide answers with the correct solution process but have not been able to provide unique answers or different methods given by other students in solving problems.

2) Medium Category

Students who are in the medium category are 12 out of 20 people. It can be said that more than 50% of students are able to provide ideas or solutions in solving problems using one solution method and the results are correct. Some students are also able to provide sequence and detail in solving several questions, but there are still students who do not write their answers in sequence and detail. Thus, students are able to meet 2 indicators of creative thinking, namely fluency and detail.

3) Low Category

There are 4 students who fall into the low category out of a total of 20 students. This is because in this category students are able to solve the questions given but they solve the questions using methods with incorrect results and some do not provide solutions to several questions. Students in the low category only meet 1 indicator of creative thinking, namely fluency.

From the explanation above, it can be concluded that the fifth-grade students of SDN 2 Patalan are quite capable in terms of fluency and detail indicators, but in terms of flexibility and originality indicators, they are still classified as moderate. There are several factors that influence each indicator of students' creative thinking abilities, including the following. First, students are not used to

solving open-ended questions (questions that have various answers or solutions to solving problems), causing students to be confused and find it difficult to work on the questions given because they do not know what method or alternative will be used to solve the question. Second, students solve more water cycle questions using existing solutions and memorizing problem solving from routine questions that have been taught by teachers, causing students to tend to work on questions only focusing on one way to solve the problem. Students' creativity in thinking varies, causing students' curiosity and accuracy in solving questions to be optimal and some not optimal.

Third, the varying problem-solving abilities cause students to be accustomed to solving problems based on examples given by the teacher or following the steps of solving that are already in the guidebook or on the internet. So that students tend to be lazy to think or try to work on the problem using different methods or alternatives or make new discoveries that can solve the problem and make students not confident with their own answers so that they expect answers from other students. From the results of the discussion that the author has described above, the creative thinking ability of fifth grade students in science in completing tests on the water cycle material is predominantly in the moderate category with a score percentage of 59.26%. Most students have not been able to meet the four indicators of creative thinking ability.

CONCLUSION
Based on the description of the research results and discussion above, the conclusions in this study are:
1. The Creative Problem-Solving learning model on students' creative thinking skills in solving problems about the water cycle is effective. This can be concluded as follows.
a. Students' creative thinking skills in Creative Problem-Solving learning assisted by mobile learning achieve a completion criterion of ≥75%

b. The average creative thinking skills of students with the Creative Problem-Solving model assisted by mobile learning are greater than the Actual Completion Limit (BTA)
c. The proportion of completion of students' creative thinking skills taught with the Creative Problem-Solving learning model assisted by mobile learning is better than the proportion of completion of students' creative thinking skills with the Problem Based Learning model.
d. The average creative thinking ability of students after the implementation of Creative Problem-Solving learning assisted by mobile learning is better than the creative thinking ability of students who implemented Problem Based Learning.
e. There is an influence of science process skills on students' creative thinking ability after the implementation of Creative Problem-Solving learning assisted by mobile learning.
2. The creative thinking ability of fifth grade elementary school students on the water cycle material increased after learning implemented the Creative Problem-Solving model assisted by mobile learning.
3. The science process skills of fifth grade elementary school students on the water cycle material achieved a moderate category. Students who have high science process skills are marked by the achievement of each indicator in the high category except for the aspect of asking for explanations and presenting discussion results (communicating) which obtained a moderate category. Students with moderate science process skills are marked by the achievement of each indicator in the medium or high category, except for the indicator of compiling reports which on average obtained a low category. Students with low science process skills are marked by the achievement of indicators in the low and medium categories, except for the indicator of planning experiments which

on average is in the high category.

4. Variants of creative thinking ability reviewed from science process skills have a strong relationship. Science process skills affect creative thinking ability by 41.5%, while the remaining 58.5% is caused by other factors. Students with high process skills have a tendency to have high creative thinking ability. Students with moderate process skills have two tendencies, namely they have high or moderate creative thinking ability. Students with low process skills have two tendencies, namely they have moderate or low creative thinking ability.

Declaration by Authors

Conflict of Interest: No conflicts of interest declared.

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