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DEVELOPMENT OF NATURAL SCIENCE LEARNING INSTRUMENTS WITH CONTEXTUAL APPROACH USING PROBLEM SOLVING MODEL TO IMPROVE CRITICAL THINKING SKILL OF JUNIOR HIGH SCHOOL STUDENTS

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Abstract. The aim of this research is to develop learning instruments of science through Contextual Approach using problem solving model which are reasonable to increase critical thinking skills of students. Learning Instruments are developed using 4-D model with one group pretest-posttest design. The Learning Instruments are tested at 74 students class VIII MTs Negeri Bonde Majene Regency West Sulawesi Province third semester 2016/ 2017 school Year for measuring application of lesson plan, hindrances during learning process, result of learning which is critical thinking skills of students, and respons of students to the learning instruments developed. Data Collection uses validation method, observation, testing, and questionnaires. The data of this research are analyzed quantitatively and qualitatively description. Finding of the research result, namely: (1) Instrument Validity including lesson Plan, Text book of students, activity sheets of students, test instruments of critical thinking indicated valid; (2) practically learning instruments are obtained from: (a) application of Lesson plan categorized by 95.23% with excellent category, and (b) obstacles during learning process; and (3) affectivity of learning instruments in terms of : (a) critical thinking skills of students through n-gain with higher category over 0.7 (Hake, 1999), and (b) the respons of students to the instruments and application of learning are very good. Based on the result of data analysis, can be concluded that learning instruments of science through Contextual Approach using problem solving model are feasible to increase critical thinking skills of students.

Key words: Developing learning instrument, Kontekstual Approach, Problem solving Model, critical thinking skills

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INTRODUCTION

The era of globalization is a time of challenge and competition. The era of unlimited time and place makes Human Resources (HR) that there is always want to improve the quality of himself so as not to lag behind others. Therefore, education plays an important role in preparing qualified human resources. Schools must prepare students who master the science and be able to apply it in his life and be able to solve various problems in everyday life. To implement the school's role in preparing qualified graduates, quality education is required.

The quality of education in Indonesia is still below other Asian countries. Based on the 2015 Indonesia Program for International Student Assessment (PISA) survey, Indonesia is ranked 69 out of 76 countries. According to Kertayasa (2015), several factors contributing to the low achievement of Indonesian students include the lack of problem solving skills, especially the problems of day-to-day, the evaluation system in Indonesia still uses low-level questions, and students are accustomed to using formal knowledge in the classroom.

Students are expected to master 21st century skills such as problem solving skill, critical thinking skill, collaboration skill, communication skill, and creativity and innovation skill (Hosnan, 2014). To achieve this, the school is directed not solely on the mastery and understanding of scientific concepts, but also on improving the ability and thinking skills of students, especially high-level thinking skills, namely critical thinking skills (Sadia, 2008).

Preliminary research results and discussions with science teachers in MTs Negeri Bonde obtained the fact that the low critical thinking skills are influenced by 1) the material presented is still less related to daily life; 2) learning still tends to be rote so as not to develop students' thinking skills; 3) the absence of learning tools developed specifically to improve students' critical thinking skills.

The results of initial observations have been presented, the researchers proposed an alternative solution to the problem of the lack of critical thinking skills of students. The solution is a device development that is expected to improve students' critical thinking skills using Contextual approach using problem solving model. Contextual Teaching and Learning is one approach that involves students to think critically (Yustina, 2013). Contextual Learning links the learned material to the real-life context that students encounter. By linking between matter and the real world, learning

will be more meaningful. Contextual learning process allows students to understand the meaning of the lessons they learn.

Contextual learning allows for the following five forms of learning (1) learning to associate new concepts with something students already know; (2) learning to experience that is doing activity directly; (3) learning to apply concepts to conduct problem-solving activities; (4) learning to work together in groups to solve problems; and (5) learning to transfer that is to condition the students with various learning experiences so that they learn to understand the teaching materials. The five forms of learning that train students' thinking skills especially high-level thinking. The first point in accordance with research Ranjan and Chandra (2013) explained that teachers play an important role to create a learning environment taught through modeling associated with everyday life so as to reduce student anxiety to the lesson so that students more easily understand the material and support students in thinking high.

Model problem solving is a series of stages that help students in developing critical thinking skills. This is supported by research by Ristiasari et al (2012), concluding that the problem solving model influences students' critical thinking skills. Meanwhile, according to Majid (2015), problem solving model includes a model that trains the thinking skills in problem solving in accordance with the steps of scientific methods that began by looking for data to draw conclusions.

The learning process using problem solving model of students faced with the problem that must be solved to solve itself or together to achieve the learning objectives (Abdullah, 2013). The problem solving learning procedure for the student must investigate to solve the problem: analyze and define the problem, develop the hypothesis, collect and analyze the data, and draw conclusions.

The steps in problem solving according to Dewey (Sumiati, 2007) are: (a) feel the existence of difficulties or problems demanding solutions; (b) to formulate and limit the problem as a basis for finding facts in an attempt to find solutions; (c) propose a tentative conclusion to the problem-solving (hypothesis) to be truth-tested; (d) testing the proposed hypothesis with a proof that could be the basis for rejecting or accepting the correctness of the hypothesis made; and (e) formulating the conclusions from the results of hypothesis testing.

Based on the above description, the research titled "Development of natural science learning instruments with contextual approach using problem solving model to improve critical thinking skills of junior high school students".

RESEARCH METHOD

The development of learning tools that was conducted in this study using adaptation of 4D (Four D Models) consisting of four stages, namely defining (Define), Design (design), Development (developing), and Disseminate (adapted from Ibrahim, 2002). Development of learning tools in this study only until the development stage (Develop), due to the limitations of researchers.

The study was conducted in the academic year of 2016/2017. Learning devices are tested on 74 students of class VIII MTs Negeri Bonde Kab. Majene West Sulawesi.

This research is a development research that aims to develop learning tools IPA with contextual approach using problem solving model to improve students' critical thinking skills. This learning tool will be implemented through classroom research using the Pre-Test and Post-Test Group design developed by Campbell and Stanley in Suharsimi (2010).

Data collection of learning device validation is done by collecting the scoring score from the validator by taking into account the validation aspects of the device specified in the validation sheet. Validation is done to get feedback for device improvements and produce a decent device tested.

The test is used to determine students' critical thinking skills developed based on critical thinking indicators. Test critical thinking skills in the form of a subjective test in the form of a description of 16 items. The test is done twice, the test before the learning (pretest) and posttest (posttest).

Questionnaires were used to collect information about students' responses about IPA learning tools with a contextual approach using problem solving learning model. The level of critical thinking skills of students can be known by using descriptive quantitative with percentage to describe the level of achievement of each indicator of critical thinking skills.

$$\text{Critical thinking level} = \frac{\text{students score}}{\text{total score}} \times 100\%$$

The result of critical thinking test is analyzed on students' learning mastery. Criteria for mastery learning or KKM (Criteria completeness minimal) used in different research with KKM science subjects in school. This is because the analyzed is not the result of learning but the test results of critical thinking skills. Critical thinking skills are part of higher order thinking skill so that it is necessary to create a separate KKM.

Test 2 was conducted using 3 test classes to determine the consistency of students' critical thinking skills. Statistical analysis on trial 2 used the ANOVA test because it compares more than two averages. The requirements of the ANOVA test are N-Gain from the three classes of normal and homogeneous distribution.

Gain shows differences in critical thinking skills before and after being treated. The normalized score gains show the effectiveness level of the treatment rather than the scores. How to calculate N-Gain is used the following equation:

$$g = \frac{(\%S_f - \%S_i)}{(100 - \%S_i)}$$

(Hake, 1999)

Details:

g = Gain index (N-Gain)

S_f = posttest average score

S_i = pretest average score

Nilai g yang diperoleh diinterpretasikan dengan klasifikasi pada tabel 1.

Table 1. Interpretation Normalized Gain

Value g	Interpretation
$g \geq 0,7$	High
$0,3 < g < 0,7$	Intermediet
$g < 0,3$	Low

(Hake, 1999)

RESULTS AND DISCUSSION

RESULTS

To know the improvement of critical thinking skill of students between before and after learning, then tested by paired t-test in three classes of trial with SPSS application.

In general, students' critical thinking skills show improvement with the application of learning problem solving models. The following visualization of the analysis of N gain critical thinking skills on each of the test classes in the form of bar charts in Figure 1.

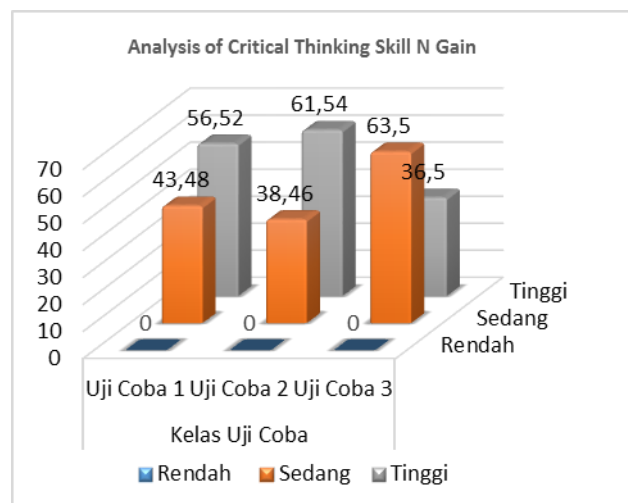


Figure 1. Analysis of Critical Thinking Skill N-Gain

From the analysis of the level of critical thinking, then determine the categories of students' thinking skills. The purpose of this categorization is to know the qualification of the percentage of students' critical thinking skills. The result of critical skill level analysis is shown in Table 2.

Table 2. Students Critical Thinking Skill Level

No.	Level	Students Total %	
		Pretest	Posttest
1	Very skilled	0	23
2	Skilled	0	77
3	Rather Skillful	0	0
4	Not Skilled	100	0

The result of critical thinking skills test is then tested by paired t-test and ANOVA (Analysis of Variance) test. The data obtained were analyzed by ANOVA test to see the consistency of learning devices developed in improving critical thinking skills. The following descriptions of the three test classes.

Table 3. Description

	N	Rata-rata	Std. Deviasi	Std. Error	Interval kepercayaan 95% dari		Maksimum
					Rata-rata		
					Batas bawah	Batas atas	
kelas VIII B	23	70.5174	9.64566	2.01126	66.3463	74.6885	82.80
kelas VIII C	26	71.0885	7.66171	1.50259	67.9938	74.1831	84.40
kelas VIII D	25	70.0600	7.24229	1.44846	67.0705	73.0495	79.70
Total	74	70.5635	8.09767	.94133	68.6874	72.4396	84.40

Prior to the ANOVA test, there was a similarity test of variance (Homogeneity) with Levene Test, this test was used to find out whether the variants of the three groups of the same class. The variance similarity test is shown in Table 4.

Table 4. Homogeneity Similarity Tes

Statistik	df1	df2	Sig.
Levene			
2.366	2	71	.101

*P < 0,05

Based on Table 4 on the homogeneity of variance obtained sig. 0.101 > 0.05 so that H0 is accepted which means the three variance is identical.

Table 5. ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Antar kelompok	13.552	2	6.776	.101	.904
Dalam kelompok	4773.220	71	67.228		
Total	4786.771	73			

*P < 0,05

Based on table 5 obtained sig. 0.904 > 0.05 so that H0 is accepted which means the third average is identical. The statistical test results of critical thinking skills are

shown in Table 6. Based on table 5, Fct = 0.101 and FTable (2; 71; 0.05) = 3.13. From the data FTable (2;71; 0.05) > FHitung (3.13 > 0.101) then H0 is accepted.

DISCUSSION

Based on the data in Figure 1, it is found that the average of students who are categorized high is the value of N-Gain 0,7 whereas the students of N-Gain 0,3-0,7 are categorized as medium (Hake, 1999). Overall, the results of the analysis showed that the students in the medium category were 36.5% and the students with the highest category were 63.5%. In general, students' critical thinking skills show improvement with the application of learning problem solving models. Analysis of critical thinking skill of class VIII B students showed N-gain of high categorized student equal to 56,5% and student with medium category value 43,5%, hence there is improvement of posttest test result of student of class VIII B. Based on individual mastery level of student's thinking skill, students who are categorized as complete as 74%. Students categorized completely if the value obtained > 62 (KKM critical thinking skills). The presence of some students who are not complete due to the ability of students in class VIII B is heterogeneous. This is in accordance with Piaget's theory that students' learning ability is determined by volition, liveliness, and individual independence. Analysis of critical thinking skill of class VIII C students showed N-gain of high categorized student equal to 61,5% and student with medium category value 38,5%, there was improvement of result of pretest and posttest test of student of class VIII C. Based on N-gain value obtained at least moderate category (> 0.3). Based on the level of mastery of individual thinking skills of students, the students who categorized as complete as 84.6%. Students categorize if the value obtained by students > 62 as KKM critical thinking skills.

Analysis of critical thinking skill of class VIII D students showed N-gain of 72% high categorized students and students with moderate category score 28%, there was an increase of pretest and posttest test result of grade VIII D students. Based on N-gain value obtained N-gain at least moderate (> 0.3). In addition to the heterogeneous student's ability, it is also a factor because to teach high-level thinking skills as well as critical thinking takes a longer time in order for students to better understand and familiarize themselves with critical thinking. This is in accordance with the results of research Shin, et al (2015) states that the challenges faced in teaching high-level thinking there are three namely time, student factors, and teachers.

The results are in line with Astuti's (2015) research result that learning with problem solving model improves

students' critical thinking skills. In addition, Raub's research (2015) on contextual learning can develop students' higher-order thinking skills. This is also supported by the research of Wright and Bar, Sartorelli, Swartz and Parks (Hassoubah, 2008) ways to develop critical thinking skills include a) critical reading; b) improve the analytical power; c) develop observational / observational capabilities; d) increase curiosity; e) engage in discussion. It is also done in learning model of problem solving model, so it can be said that problem solving model is suitable to improve students' critical thinking skill. Research A. Forawi (2012), mentioned that science teachers can make learning more meaningful class by incorporating critical thinking skills in learning.

Based on Table 2, the results of the post-test showed an increase of 77% skilled students and 23% highly skilled categorized students. This result indicates that the learning tool of contextual approach uses effective problem solving model in improving critical thinking skill to material pressure substance. The results of this study are supported by the previous studies results (Prahani, et al., 2015; Prahani et al., 2016; Prahani, et al., 2018; Sudiarman et al., 2016; Yasir, et al., 2016) that the media, teaching materials, devices, and learning models of quality and feasible (meet the valid, practical, and effective aspects) can improve student learning outcomes.

ANOVA test is used to determine the consistency of learning tools developed to improve students' critical thinking skills. Some assumptions that must be met in the ANOVA test include normal distribution data and homogeneity of variance (Rostina, 2014). The data were analyzed using SPSS 23 application, including normality test, paired t-test, and ANOVA (Analysis of Variance) test.

Based on the result of N-gain normality test, it is found that the three classes VIII B, VIII C, and VIII D are normal distributed because sig is obtained. > 0.05 . Normally distributed statistical data was then analyzed by ANOVA test by testing the mean difference (average) data in the three experimental classes. Prior to the ANOVA test, there was a similarity test of variance (Homogeneity) with Levene Test, this test was used to find out whether the variants of the three groups of the same class.

From table 5 of the variance similarity test obtained sig. $0.101 > 0.05$ so that H_0 is accepted which means the three variance is identical (homogeneous). Thus it has been eligible for ANOVA test. After the conditions are met then tested ANOVA and obtained sig value. $= 0.904 > 0.05$ then H_0 is accepted. From ANOVA test, the value of Fhitung = 0,101. This means that the mean of the three classes is identical. From three test classes it was

found that learning tools developed can improve critical thinking skills.

Based on paired pair t test and ANOVA test in three classes of experiment it was found that there was an increase of critical thinking skill result after learning and N-gain value of high categorical average. ANOVA test results obtained the results of the three test classes are identical or obtain the same results. This means that the learning tools developed are consistent in improving students' critical thinking skills. Because the result of paired t test and ANOVA test have fulfilled the requirement of instructional device effectiveness, the learning tool developed is effective in improving students' critical thinking skill.

CONCLUSION

Based on the analysis of research results, the discussion and the findings of the research results can be concluded that learning tools with contextual approach using problem solving model developed meet validity with valid categories, practicality with very good category, and effectiveness with effective categories that can improve students' critical thinking skills, worthy of use to improve students' critical thinking skills of SMP on substance pressure materials. Critical thinking skill of students with n -gain with high category above 0.7 (Hake, 1999). Based on the results of data analysis, it can be concluded that learning tools IPA Contextual approach with problem solving model developed feasible to improve students' critical thinking skills.

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