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The Development of Project-based Student Worksheet to Escalate Creative Thinking Skills in Mathematics Learning on Geometry of Fifth Grade Students at Public Elementary School o BalungLor 03 in Jember Regency

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ABSTRACT

This research departs from the problems faced by students in learning mathematics; many fifth-grade students struggle in studying the material of geometry, because students often learn instantaneously. This is shown by the fact that there are still many students whose learning outcomes are below the minimum passing criteria. The research objective was to develop learning instrument in the form of Project-based student worksheets in Mathematics. The research method applied Research and Development in reference to Borg and Gall (1983). The research subjects were class VIA and class VIB at Public Elementary School of BalungLor 3, Jember regency. The research subjects were 54 students who were divided into 2 classes. Data collection methods used were documentation, interviews, questionnaires, observation and learning achievement tests. After the data had been collected completely, the data were analyzed by using the t-test and the relative effectiveness test. The results showed that the results of the t-test for independent data generated a t-count value of -4,987 with p 0,000. To contrast, the results of the relative effectiveness test obtained a value of 57.91% with moderate effectiveness category.

Keywords: *creative thinking, student worksheets, project-based learning*

INTRODUCTION

According to the Law of the Republic of Indonesia no.20 of 2003 concerning the National Education System in Sudjana, (2008:1),education is defined as a real and planned effort to create an atmosphere of learning and supportive learning which aim to encourage students to actively develop their potential. The final outcome is to have religious spiritual strength, self-control, personality, intelligence, noble morals and skills needed by individual student, society, and the nation. Permendikbud RI Number 23 of 2016 points out that one of the skills in the 21st century is 4C's skills which include Communication, Collaboration, Critical Thinking and Problem Solving, and Creativity and Innovation.

Project based learning poses substantial influence on the thinking skills of elementary school students (Nugroho, 2019). Kurniasih (2014:81) states that project-based learning (PBL) is a learning method that uses projects or activities as a medium for introducing complex problems students need to investigate and understand. According to the Educational Technology Division (2006, 22-25) there are 6 syntax or steps in PBL, namely: (1) starting with the essential question (determination of fundamental questions), (2) designing a plan for the project (project planning),(3) creating a schedule, (4) monitoring Students and project progress (monitoring students and project progress), (5) assessing the project outcome (achievement test), (6) evaluating the experience.

Professional teachers need to conduct sustainable self-development in order to keep students feel motivated and challenged. Equally important is the need to help them enjoy

learning process and gain the utmost of the teaching materials or materials provided. Therefore, a teacher has to consistently develop teaching materials for students. There are many kinds of teaching materials commonly used to teach in class, namely 1) modules;2) compiled materials;3) student work sheets; and 4) hand out.

Mardapi (2012:35) states that student worksheets are a series of assignments available in the form of questions. By answering these questions, students can master the subject matter being studied. According to Suprehiningrum (2016:145) the learning method is an imitation or example of a conceptual framework that describes systematic learning procedures in managing student learning activities in order to generate positive learning atmosphere and experience.

Warsono (2013:152) argues that project-based learning is the application of active learning, in linkage to Piaget's theory of constructivism and Seymour Paper's theory of constructionism. In this study, PBL steps were carried out in the following stages: a) presentating problem, b) planning, c) scheduling, d) making projects and monitoring, e) assessment, and f) evaluation. One of the activities that can be raised through creative thinking is to create something new, original, valuable, and tangible in the form of ideas and seek innovative meanings as well as solutions to contextualized problems. Creative thinking skills are a habit of sharp thinking with intuition that stirs the imagination, aiming to reveal new possibilities or new ideas to solve problems from different points of view, Siswono (2004: 78)

Based on the description above, the present study formulates the following research questions: (1) How can Mathematics student worksheets be developed through project-based learning on Geometry in improving the creative thinking skills of grade VI students of Public Elementary School of BalugLor 3? (2) Is the application of Mathematics student worksheets on Geometry Material in project-based learning effective to improve the creative thinking skills of grade VI students of Public Elementary School of BalugLor 3?

The objectives of this study were two folds. First, it aimed to describe the process of developing Mathematics student worksheets through project-based learning on Geometry in improving creative thinking skills in grade VI students of Public Elementary School of BalugLor 3, Balung Jember regency. In addition, it was devoted to testing the effectiveness of implementing the results of developing Mathematics Student Worksheets through project-based learning on Geometry for grade VI students in improving creative thinking skills for students at Public Elementary School of BalugLor 3, Balung district.

The benefits expected from this research are specifically aimed at the following parties. First, this study is expected to improve students' creative thinking skills, especially in class VI Public Elementary School of BalungLor 3Jember. Also, the findings are meant to help teachers develop pedagogical skills in applying project based learning. School principals can also benefit from the present study. This research is expected to be a resource for the principals to develop innovative learning for mathematics subjects. In the same vein, school supervisors can use the research findings as the source of information for school supervisors about variations in learning methods to improve the quality of learning process. Lastly, researchers can resort to the research findings as new insight into the preparation of quality student worksheets as well as providing experience in developing innovative learning for mathematics subjects. Future researchers can also base future studies based on the findings from the present study.

RESEARCH METHOD

The research procedure employed design byBorg & Gall (1983), as shown in the following figure.

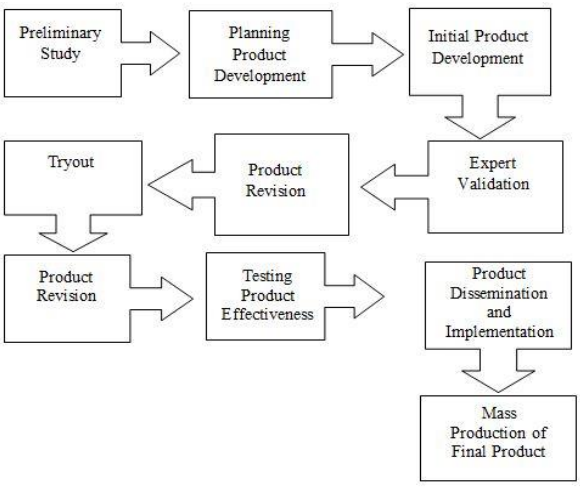

Figure1. *Research Procedure*

Source: Masyhud (2016:228)

The research subjects were students of class VI at Public Elementary School of BalungLor 3. The research samples included 27 students in class VI A as the experimental class and 27 students in VI B as the control class. Sampling was done by using purposive sampling technique. The instruments used were interviews, questionnaires, observations, and learning achievement tests. The quantitative data obtained were analyzed using the T-test.

FINDINGS AND DISCUSSION

The Results of Product Validation

There were 2 validators on student worksheets. The first validator was an expert of instructional materials and a lecturer at the Open University, namely Dra. Iswati, M.Pd. The second validator was a practitioner and supervisor of Balung district, Drs. H. Shofyan, M.Si.

After the product had been validated by the two validators, validation obtained 56 from validator I and validator II, with the average score of 56.The score was converted to a value of 100 with the formula:$Valpro = \frac{srt}{smt}\ x\ 100$, with the following result:

$$valpro = \frac{56}{70}\ x\ 100 = 80$$

Where:

Valpro = Product validity

srt = Achieved real score

smt = Achieved maximal score

After the lesson plans had been validated by both validators, the test obtained scores of47byvalidator I dan 48 by II, with the average score of 47.5. This score was converted using the following equation.

This convertion generates the following score $Score = \frac{47,5}{7060}\ x\ 100 = 79,2$

What follows is the table presenting validation criteria for the validators.

Table1. *Product Validation Criteria*

Criteria	Product Quality
81 – 100	Very Good
61 – 80	Good
41 – 60	Fair
21 – 40	Poor
0 – 20	Very Poor

(Masyhud, 2016:243)

After finding out that the student worksheet and lesson plan have achieved fine scores, 80 and 79.2, respectively, with reference to the table, the authors acknowledged that the products were eligible for further test and revision.

The Results of Trial

The check list on the project learning-based on Mathematics student worksheet trial was done by 10 students of Public Elementary School of BalungLor 03, Jember. Each student was given a check list sheet, and then the data were collected, tabulated, and analyzed. The criteria guiding the trial were that most of the students or at least 80% students chose "YES" in each check list point. When the criterion was met, that meant the product was eligible for further testing. On the other hand, when it was below 80%, the product still had to be revised. Simply put, 8 of 10 students need to choose "YES" to acknowledge that the product can continue to the next stage.

The following is a tabulation of the results of the trial on student worksheets, which is a recapitulation of the 10 questionnaires filled out by students.

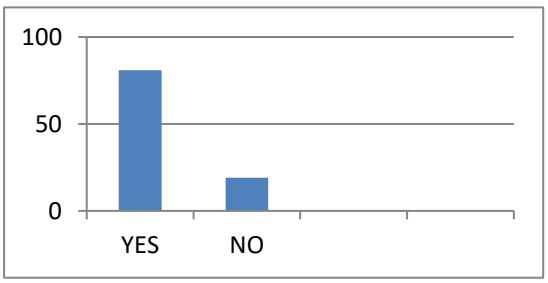

Figure2. *Average Scores on Student Worksheet*

Of the 10 aspects that were tried out, 9 were declared good and 1 was stated as a revision, namely the eighth point about "*The illustrations*

on the product support the effectiveness of learning".

Product Revision

The feedback received from the trial results, the frequency of “YES” or “NO” answers, is very useful material for product revisions. As shown in the table, in general the product is ready for actual use, subsequent to the improvement in the eighth point.

Test Results of Product Effectiveness

The product was put into a test to ensure that the project learning-based student worksheet in Mathematics is applicable. In the same vein, the effectiveness test was to ensure that the resulting product possessed fine effectiveness value.

The results of the student's creative thinking achievement showed fine results across aspects of the student's creative thinking skills in the control class. With regard to fluency aspect, the study found the following class profiles: hardly creative 0% (0 students), almost creative 26.93% (8 students), fairly creative 25.93% (7 students), creative 33.33% (9 students) and very creative 11.11% (3 students). In the second aspect, flexibility, the findings highlighted the following results: hardly creative 0% (0 students), almost creative 33.33% (9 students), fairly creative 29.63% (8 students), creative 25.93% (7 students) and very creative 11.11% (3 students). The findings on originality demonstrated that the percentage achievement was characterized by the following profiles: hardly creative 0% (0 students), almost creative 40.74% (11 students), fairly creative 18.53% (5 students), creative 25.93% (7 students) and very creative 7.40% (2 students). The last aspect concerning elaboration demonstrated the following class profiles: hardly creative 0% (0 students), almost creative 40.74% (11 students), fairly creative 25.93% (7 students), creative 25.93% (7 students), and very creative 7.40% (2 students). The following charts summarize the overall findings abovementioned.

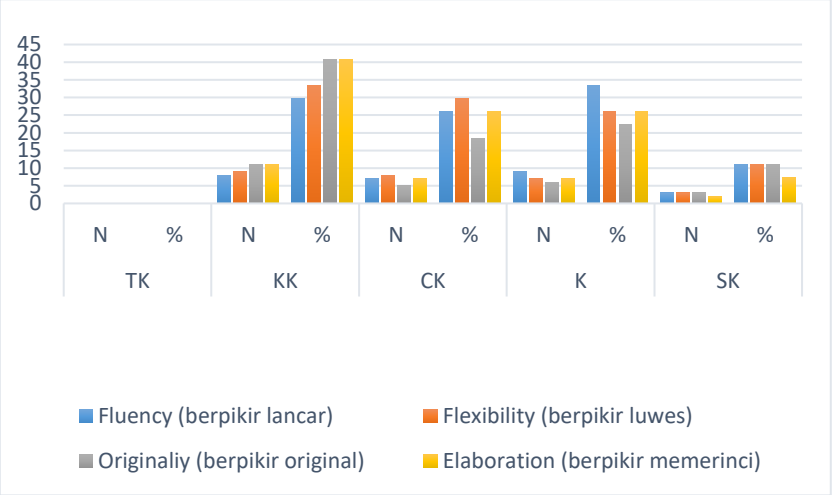

Figure3. *Post test Results on Creative Think in Skills in Control Class*

The results of students 'creative thinking skills on the post-test results in the experimental class showed the following aspects of creative thinking skills in the experimental class. In reference to fluency aspect, the study has found the following profiles: hardly creative 0% (0 students), almost creative 7, 41% (2 students), fairly creative 29.63% (8 students), creative 44.44% (12 students) and very creative 18.52% (5 students). In the second aspect, flexibility, the findings demonstrate the following class profiles: hardly creative 0 % (0 students), almost creative 14.82% (4 students), fairly creative 25.93% (7 students), creative 37.01% (10 students) and very creative 22.22% (6 students).The test results on originality generated the following portrait: hardly creative 0% (0 students), almost creative 11.11% (3 students), fairly creative 33.33% (9 students), creative 26.93% (8 students) and very creative 25.93% (7 students). The findings concerning elaboration showed the following compositions: hardly creative 0% (0 students), less creative 14.82% (4 students), fairly creative 37.01% (10 students), creative 26.93 % (8 students) and very creative 18.53% (5 students). The following

figure presents the overall summary of the abovementioned findings.

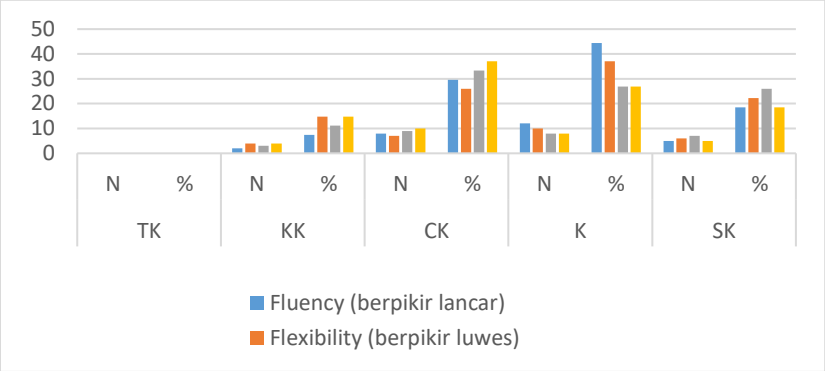

Figure4. *Post test Results on Creative Think in Skills in Experimental Class*

Based on Figure 4, it can be concluded that the post-test results have acknowledged significant increase in creative thinking between experimental class and control class.

In field trials, observations were made during the learning process. Field trials were divided into 2 stages involving two groups, namely the experimental group and the control group. The experimental group usually receives a new treatment, (a treatment under investigation). Meanwhile, the control group did not receive any treatments. The effectiveness of student worksheets was tested by comparing test results between the control group and the experimental group, on the basis of the pre-test and post-test scores. The pre-test and post-test scores were put into homogeneity test, normality test, and the t–test. After the t–test had been conducted, the existing data were put into the test of relative effectiveness. In order to generate descriptive statistics and conduct post-test on both classes, Kolmogorov-Smirnov homogeneity test and the data normality test were further employed, to find out the pretest value of both classes. The final test was paired-t test to investigate whether both classes are significantly different with respect to their critical thinking skills. By implication, this aimed to test the effectiveness of student worksheets.

SPSS 17 software, as a first step, was employed to run the homogeneity test, the results of which were shown in Table 5.

Table2. *Homo genity Test Results of Control and Experimental Class*

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Selisih Hasil	Based on Mean	,117	1	52	,734
	Based on Median	,063	1	52	,803
	Based on Median and with adjusted df	,063	1	47,133	,803
	Based on trimmed mean	,096	1	52	,758

The results of the homogeneity test for the difference in value between the control and experimental classes obtained a Levene Statistic (F) value of 0.117 with a significance value of 0.734.The significance value is greater than the α value (0.05).This means that the pre-test scores between the two classes (control and experiment) have a homogeneous variance, allowing further tests can be carried out. The next test is the normality test as shown in Table 6.

Table3. *Normality Test Results of Control and Experimental Class*

One-Sample Kolmogorov-Smirnov Test

		Kontrol	Eksperimen
N		27	27
Normal Parameters[a,b]	Mean	9,81	17,81
	Std. Deviation	5,407	6,343
Most Extreme Differences	Absolute	,143	,192
	Positive	,143	,192
	Negative	-,104	-,126
Kolmogorov-Smirnov Z		,744	,998
Asymp. Sig. (2-tailed)		,638	,272

a. Test distribution is Normal.
b. Calculated from data.

The results of the Kolmogorov-Smirnov normality test on the difference between the control class and the experimental class obtained a Z value of 0.744 (Control Class) and

0.998 (Experiment Class), respectively, with a significance value of 0.638 (Control Class) and 0.272 (Experimental Class). The two significance values of each test are greater than

α (0.05).This means that the two data, namely the control class and the experimental class, are spread according to the normal distribution. This result subsequently led to parametric test (t test).

What follows is the paired t-testofpre-test dan post-test aimed at investigating the product effectiveness.

Table4. *Independent t-test Results of Control and Experimental Class*

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Selisih Hasil	Equal variances assumed	,117	,734	-4,987	52	,000	-8,000	1,604	-11,219	-4,781
	Equal variances not assumed			-4,987	50,728	,000	-8,000	1,604	-11,221	-4,779

The results of the t-test on the independent data of the difference in value between the control class and the experimental class obtained a t-value of -4,987 with a significance value of 0,000.The significance value is smaller than α value (0.05).This means that there is a significant difference in the average values between the control class and the experimental class. The negative sign on the t-value indicates that the average of experimental class is higher than that of the control class. To determine the relative effectiveness of project-based learning coupled with student worksheets on students' creative thinking levels, the relative effectiveness level is calculated using the following formula:

$$ER = \frac{MX_1 - MX_2}{\frac{(MX_1 + MX_2)}{2}} \times 100\%$$

(Masyhud,2016;257)

where:

ER :relative effectiveness of a product compared to another

MX_1 : average scores of experimental class

MX_2 : average scores of control class

Prior to determining the relative effectiveness, it was essential to determine MX1 and MX2 by using the scores from both classes. For this purpose, the following formula was employed:

$$ER = \frac{17{,}81 - 9{,}81}{\frac{(17{,}81 + 9{,}81)}{2}} \times 100\%$$

$$= \frac{8{,}00}{13{,}81} \times 100\% = 57{,}91\%$$

After the calculations were carried out, the results were consulted to the interpretation criteria of the relative effectiveness test. Then the value of 57.91% was obtained in the range of 41% - 60%, which implied that the effectiveness was moderate in experimental class.

The results of observations and interviews with teachers and students also showed a positive response to the use of project-based learning coupled with student worksheets in Geometry learning. This is shown by the results of interviews, where students voiced positive responses to learn using the student worksheets based on project-based learning. They mentioned that there were multiple enrichment questions that helped them increase their skills. With the worksheets students had more opportunities to exchange ideas and discuss problems solving problems. The findings implied that the ability to think creatively is closely related to learning outcomes, so that the higher the level of creative thinking skills, the higher the learning outcomes students get.

CONCLUSION AND SUGGESTION

Based on the results of the research and discussion that has been described, several things can be concluded as follows. First, the development of Mathematics student worksheets through project-based learning for Geometry has gone through several stages referring to the Borg & Gall development method as quoted in Masyud, (2016). The procedure consists of 10 stages, but only 8 stages are carried out. Second, the application of project-based learning Mathematics student worksheets on space volume material can improve students' creative thinking skills in the

experimental class. The difference between the pre-test and post-test shows significant improvement as evinced by the students' creative thinking skills in the experimental class. This means that there is an average difference between the control and experimental classes after the treatment (post-test). The calculation of relative effectiveness highlights a value of 57.91, which has indicated that the product quality lies within the range of 41%-60%. This has also been corroborated by the research findings in the experimental class taught using the student worksheet.

Based on the above conclusions, the present study proposed the following suggestions for several parties. First, the student worksheets developed can be used as a learning resource for students for their independent learning to improve students' creative abilities at Public Elementary School of BalungLor 03. Second, the findings are also relevant to teachers. The product is deemed useful to improve teachers' knowledge and skills in applying project-based learning. In addition, the school principals can use student worksheets as a resource for day-to-day instruction. School supervisors can employ the worksheet as a resource to diversify and enrich the existing learning methods. Future researchers may gain new insights regarding the preparation of quality learning media and the development of innovative learning for Mathematics subjects. In addition, these researchers can use the student worksheets as input or a reference to develop more interactive learning media.

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