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The students' mathematical critical and creative thinking ability in double-loop problem solving learning

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Abstract. The purpose of the study is to examine whether or not there is an increase in students' critical and creative thinking skills using double-loop problem solving (DLPS) learning compared to ordinary learning. The method of this research is a quantitative method, with a pretest-posttest design. The population of this study involved all class VIII students in one of the Cimahi Junior High Schools, while the sample selected by two classes VIII consisted of the experimental class namely students who received DLPS learning and control classes namely students who received ordinary learning. The technique of processing N-gain scores using IBM-24 SPSS software. The results of this study are 1) increasing the ability of mathematical creative thinking of students who use DLPS learning better than students who use ordinary learning and 2) increasing the ability of mathematical critical thinking students who use DLPS learning is no better than students who use ordinary learning. In general it can be concluded that DLPS learning can improve students' creative mathematical thinking skills but have not been able to improve students' mathematical critical thinking skills, especially in junior high school.

1. Introduction

This research is based on the problems raised by Siregar [1] which hit mathematics education in Indonesia from junior high to tertiary level, among others: students are still weak in analyzing questions, students are still weak in relating the things needed to solve problems, students are still having difficulties in using mathematical symbols and students / students are not accustomed to dealing with non-routine questions. Correspondingly, Tresnawati, Hidayat and Rohaeti [2] revealed that critical thinking skills still tend to be low, because students still tend not to succeed in correctly answering the problems of the non-routine questions given. Both of these problems have similarities, namely students / students still have not managed to answer or are accustomed to facing non-routine questions. The results of subsequent studies Siregar, Darhim and Asih [3] also suggest that students are still weak in understanding problems when faced with the problem of critical and creative thinking, a very basic obstacle because of the inability to understand problems. Though mathematics in general is a way of thinking someone in solving problems faced in everyday life. The inability is biased because the factors of students do not yet have mathematical creative reasoning. In line with the opinion of Bergqvist and Lithner [4] which states that " the mathematical creative reasoning is one of the reasoning processes that a person undertakes in solving problems through non-routine procedures". This is made clear by Inch's statement, that critical thinking is a vital skill in today's society, enabling a situation, problem, question, or phenomenal to arrive at a viable hypothesis or conclusion [5]. The creative thinking ability referred to in this research is an ability in mathematics which includes fluency, flexibility, authenticity and elaboration. In line with research Dilla, Hidayat and Rohaeti [6]



which states creative thinking skills include fluency, flexibility, authenticity and elaboration. Whereas according to Anita [7] critical thinking ability is an ability in which the ability to think creatively is also developed. So that critical thinking skills can be possessed by students when students have the ability to think creatively, because the ability to think creatively is part of the ability to think critically.

Learning solutions offered to overcome critical thinking skills as well as creative thinking skills, namely learning that is able to train students in solving problems by identifying and detecting problems given and evaluating temporary solutions so that students are trained in dealing with the problems at hand. One lesson that applies this method is Double-Loop Problem Solving (DLPS) learning. According to Reflani [8], the stages of the Double - Loop Problem Solving learning model are: 1) Identifying the problem is not just the symptoms; 2) Detect causal causes (directly) and apply a temporary solution; 3) Evaluating successes and temporary solutions; 4) Decide whether root problem analysis is needed or not. At the stage of identifying the problem, students are trained to think critically because it is not just a problem that is identified but that is not a symptom such as questioning the possibilities of the direction the problem is given. While the stage of detecting causal causes and implementing a temporary solution, students are required to think creatively in detecting causes so as to design related solutions according to the students' own knowledge. Therefore, DLPS learning makes students trained to deal with problems even if the problem is non-routine. So that it can be estimated that the problem expressed by Siregar et al [3] namely "the still weak students in understanding problems when facing critical and creative thinking problems, the very basic obstacles due to the inability to understand problems", can be overcome with DLPS learning. If the problem of students in dealing with critical and creative mathematical problems has been resolved, human resources will be more qualified. This is contrary to opinion Setiawan and Sari [9], mathematics education has an important role in the effort to create quality human resources as capital for the development process. The purpose of this article was compiled to express the hypothesis that the increase in critical and creative thinking skills of junior high school students using DLPS learning was better than junior high school students who used ordinary learning.

2. Method

The method in this study is a quantitative method, where before treatment the students are given questions about mathematical critical and creative abilities (pretest) and after treatment students are given questions about mathematical critical and creative abilities (posttest). The population in this study were all eighth grade students in one of the Cimahi Junior High Schools. The sample was chosen as many as two classes namely class VIII-A as the experimental class using the Double-Loop Problem Solving (DLPS) learning model and class VIII-B as the control class using the normal learning model.

Data processing techniques for calculating the increase are used scores of critical and creative thinking skills obtained later in the N-Gain test, following the formula N-Gain according to Hake in Wiyono [10] as follows:

$$\text{Indeks gain } (g) = \frac{\text{posttest score} - \text{pretest score}}{\text{maximum ideal score} - \text{pretest score}}$$

Then the results are used for the calculation of the normality test, homogeneity test and t-test or t'-test or the Mann Whitney test with the help of IBM-24 SPSS software.

3. Result and Discussion

3.1. Data Analysis N-Gain Critical Thinking Ability

3.1.1. Normality Test

Based on the n-gain score obtained from the pretest-posttest that have been done, then analyzed using several tests including normality test with a significance level .05. the hypothesis used in the normality used in the normality test is a follows:

H_0 : Samples come from populations that are normally distributed

H_1 : Samples come from populations that are not normally distributed

The testing criteria according to Ruseffendi [11], namely:

If Sig. > 0.05 then H_0 is accepted

The calculation results of the normality test from the N-gain score of critical thinking skills using the IBM-24 SPSS, as follows:

Table 1. N-Gain Data Normality Test

Class	<i>Kolmogorov-Smirnov</i>		
	Statistic	Df	Sig.
Experiment	0.118	39	0.190
Control	0.130	40	0.087

Seen from Table 1. Sig. is obtained the experiment class is $0.190 > 0.05$ then H_0 is accepted and Sig. the control class is $0.087 > 0.05$ so H_0 is accepted. Means that the two class are samples derived from the population with normal distribution. Then proceed with the homogeneity test.

3.1.2. Homogeneity Test

Based on the results of the normality test, the next test is homogeneity in order find out whether the variance of the classes is homogeneous or not. This homogeneity test refers to the significance level 0.05. The hypothesis used in the homogeneity test is as follows:

H_0 : Population variance scores both classes are homogeneous

H_1 : Population variances scores both classes are not homogeneous

The testing criteria according to Ruseffendi [11], namely:

If Sig. > 0.05 then H_0 is accepted

The results of the homogeneity test calculation from the N-gain score critical thinking skills using IBM SPSS-24, as follows:

Table 2. Homogeneity Test

Class	N	Sig.
Experiment	39	0.919
Control	40	

Seen from Table 2. It is obtained that N-sig. equal to $0.919 > 0.05$ then H_0 is accepted. Means that the population variance scores both classes are homogeneous. So that the t-test is then carried out.

3.1.3. Test the Two Mean Difference

Based on the normality test and homogeneity test, then the two-mean difference test is carried out, the t-test uses a significance level of 0.05. The statistical hypothesis is as follows:

H_0 : $\mu_1 \leq \mu_2$ (improvement of mathematical critical thinking skills of students using DLPS learning is not better or the same as students who use ordinary learning)

H_1 : $\mu_1 > \mu_2$ (improvement of students' mathematical critical thinking skills using DLPS learning is better than students who use ordinary learning)

The testing criteria according to Ruseffendi [11], namely:

If Sig. > 0.05 then H_0 is accepted

The results of t-test calculations from the N-gain score critical thinking skills using the IBM SPSS-24 as follows:

Table 3. Independent sample t-test

T	Df	Sig. (2-tailed)
0.217	77	0.829

Seen from Table 3. obtained N-sig. (2-tailed) equal to $\frac{0.829}{2} = 0.415 > 0.05$ then H_0 is accepted. It means that the improvement of mathematical critical thinking skills of students using DLPS learning is not better or the same as students who use ordinary learning. This is because students are still not left up in the learning process that requires students to express their ideas in solving or solving problems given so students still need time to master critical thinking skills. In line with the conclusions of the research results Rochmad, Agoestanto and Kurniasih [12] which explains that the strategy stage of critical thinking is longer than the critical thinking stage.

2. Data Analysis Creative Thinking Ability

2.1. Normality Test

Based on the n-gain score obtained from the pretest-posttest that have been done, then analyzed using several tests including normality test with a significance level .05. The hypothesis used in the normality used in the normality test is a follows:

H_0 : Samples come from populations that are normally distributed

H_1 : Samples come from populations that are not normally distributed

The testing criteria according to Ruseffendi [11], namely:

If Sig. > 0.05 then H_0 is accepted

The calculation results of the normality test from the N-gain score of creative thinking skills using the IBM-24 SPSS, as follows:

Table 4. Normalitas Test Data N-Gain

Class	<i>Kolmogorov-Smirnov</i>		
	Statistic	Df	Sig.
Experiment	0.144	39	0.039
Control	0.216	40	0.000

Seen from Table 4. Sig. is obtained the experimental class is $0.039 < 0.05$ so H_0 is rejected and Sig. the control class is $0.000 < 0.05$ so H_0 is rejected. Means that the two classes are samples originating from populations not normally distributed. Then followed by a non-parametric test, the Mann Whitney test.

2.2. Mann Whitney Test

Based on the normality test stating that the two classes are not normally distributed, then the nonparametric test, the Mann Whitney test, is carried out using a significance level of 0.05. The statistical hypothesis is as follows:

H_0 : $m_1 \leq m_2$ (improvement of mathematical creative thinking ability of students using DLPS learning is not better or the same as students who use ordinary learning)

H_1 : $m_1 > m_2$ (improvement of students' creative mathematical thinking skills using DLPS learning is better than students who use ordinary learning)

The testing criteria according to Ruseffendi [11], namely:

If Sig. > 0.05 then H_0 is accepted

The results of the Mann Whitney test calculation from the N-gain score of mathematical creative thinking ability using the IBM-24 SPSS, as follows:

Table 5. Mann Whitney Test

Class	N	Asymp. Sig. (2-tailed)
Experiment	39	0.019
Control	40	

Seen from Table 5. is obtained N-sig. (2-tailed) of $\frac{0.019}{2} = 0.0095 < 0.05$ then H_0 is rejected. It means that the increase in mathematical creative thinking skills of students using DLPS learning is no better than students who use ordinary learning. This is because students who use DLPS learning have experience in solving problems or in other words have deep memories of the basic concepts of the material that becomes a problem so that their creative thinking ability has increased compared to students who use ordinary learning. The creative thinking requires sufficient initial knowledge/experience so that it has several possible strategies or ideas that can be raised. So that it can be concluded that creative thinking skills can be improved properly provided it is supported by the students' initial knowledge/experience [4,13-15].

4. Conclusion

Based on the results and discussion of the study, two conclusions were obtained as follows 1) Increased mathematical critical thinking skills of students who use DLPS learning are not better or the same as students who use ordinary learning; 2) Increasing the ability of mathematical creative thinking of students who use DLPS learning is better than students who use ordinary learning. In general, it can be concluded while from the research that has been done, DLPS learning can improve students' creative mathematical thinking skills but have not been able to improve students' mathematical critical thinking skills, especially in junior high school.

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References

- [1] Siregar I 2016 Masalah Pembelajaran Pembuktian Matematika Bagi Mahasiswa Di Indonesia *Mosharafa J. Pendidik. Mat.* **5** 315–324
- [2] Tresnawati, Hidayat W and Rohaeti E E 2017 Kemampuan Berpikir Kritis Matematis dan Kepercayaan Diri Siswa SMA *J. Res. Math. Learn. Educ.* **2** 116–122
- [3] Siregar I, Darhim and Asih E C M 2018 Analisis kesulitan siswa smp menghadapi soal berpikir kritis dan kreatif matematis *Symmetry (Basel)*. **3** 82–92
- [4] Hidayat W, Wahyudin and Prabawanto S 2018 Improving students' creative mathematical reasoning ability students through adversity quotient and argument driven inquiry learning *J. Phys. Conf. Ser.* **948**
- [5] Nurfauziah P and Sari V T A 2018 Penerapan Bahan Ajar Trigonometri dengan Model Matematika Knisley untuk Meningkatkan Kemampuan Berpikir Kritis Matematik *AKSIOMA* **7** 356–362
- [6] Dilla S C, Hidayat W and Rohaeti E E 2018 Faktor Gender dan Resiliensi dalam Pencapaian Kemampuan Berpikir Kreatif Matematis Siswa SMA *J. Medives J. Math. Educ. IKIP Veteran Semarang* **2** 129–136
- [7] Anita I W 2015 Pengaruh Motivasi Belajar Ditinjau Dari Jenis Kelamin Terhadap Kemampuan

- Berpikir Kritis Matematis *P2M STKIP Siliwangi* **2** 246–251
- [8] Isrok'atun and Rosmala A 2018 *Model-Model Pembelajaran Matematika* ed B S Fatmawati (Bandung: PT Bumi Aksara)
 - [9] Setiawan W and Sari V T A 2019 The effectiveness of cognitive conflict on the concept of differential *J. Phys. Conf. Ser.* **1157** 1–6
 - [10] Wiyono; 2013 Pembelajaran Matematika Model Concept Attainment Meningkatkan Kemampuan Pemecahan Masalah Materi Segitiga *J. Educ. Res. Eval.* **2** 50–54
 - [11] Ruseffendi H E T 2010 *Statistik Dasar untuk Penelitian Pendidikan* (Semarang: IKIP Semarang Press)
 - [12] Rochmad, Agoestanto A and Kurniasih A W 2016 Analisis Time-Line dan Berpikir Kritis dalam Pemecahan Masalah Matematika pada Pembelajaran Kooperatif Resiprokal *Kreano J. Mat. Kreat. - Inov.* **7** 217–231
 - [13] Hidayat W and Aripin U 2019 The improvement of students' mathematical understanding ability influenced from argument-driven inquiry learning *J. Phys. Conf. Ser.* **1157** 32085.
 - [14] Hidayat W, Wahyudin W and Prabawanto S 2018 The mathematical argumentation ability and adversity quotient (AQ) of pre-service mathematics teacher *J. Math. Educ.* **9** 239–48.
 - [15] Hendriana H, Rohaeti E E and Hidayat W 2017 Metaphorical Thinking Learning and Junior High School Teachers' Mathematical Questioning Ability *J. Math. Educ.* **8** 55-64.