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Mathematical Reasoning Ability from Student Learning Independence Side in Problem Based Learning Assisted Ethnomathematical Comics Module

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Abstract

This study aims to analyze the ability of mathematical reasoning in terms of learning independence at problem-based learning with the ethnomathematical comic module. The research population was seventh grade students of SMP Ma'arif Kyai Gading. The technique of selecting the sample cluster is random sampling. VIIA as experimental class with problem-based learning with the ethnomathematics comic modules, VIIB as control class with discovery learning. Data collection used documentation, test and non-test. Analysis of quantitative data using completeness test, average difference test, regression test. Qualitative data analysis using validity test, data reduction, data presentation, conclusion drawing. The results of the study of students with high learning independence achieved indicators of mathematical reasoning ability with few errors, so that they were declared good, students with low learning independence only achieved several indicators of mathematical reasoning ability, so that they were declared less good.

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INTRODUCTION

Mathematics is formed because of human thinking related to ideas, processes, and reasoning. Mathematics subjects need to be given to all students as a basis for improving logical, analytical, systematic, critical thinking skills and the ability to work (Depdiknas, 2006). Therefore, in learning mathematics, it is necessary to have a cognitive attitude that plays a role in efforts to develop students' thinking processes in solving mathematical problems. One of the cognitive attitudes that includes it is the ability to reason mathematically.

Mathematical reasoning ability is the foundation for gaining mathematical knowledge. Reasoning ability is closely related to logical, analytical, and critical thinking patterns. Through good reasoning, a person will be able to draw conclusions or decisions related to his daily life. (Putri, 2019)

However, the problems that occur are that students have not been able to develop mathematical reasoning abilities properly. Where delivered by the mathematics teacher at Ma'arif Kyai Gading students found that it is difficult to solve problems correctly when it presented questions in the form of stories. This shows that students' mathematical reasoning abilities in story problems are still low.

In order for students' mathematical reasoning abilities to be better, an attitude is needed where students no longer rely on information or subject matter provided by the teacher but the students themselves are able to seek from other sources, this attitude is independent learning in finding reasons from various basic knowledge to make the right decisions (Chotimah, dkk, 2018).

To achieve this, teachers can apply innovations in learning where the teacher's role is only as a facilitator and motivator. One of the models recommended by the 2013 curriculum is the Problem Based Learning model. Referring to the formulation of Kwan (2009), that "PBL is an instructional method that challenges students to learn, work together in groups to find solutions to the real problems".

Various real problems that exist in students' lives can be raised as learning problems in Mathematics to find solutions. Learning mathematics raises local cultural themes is conceptually known as ethnomathematics. Ethnomathematics was introduced by D'Ambrosio, a Brazilian mathematician in 1977, the definition of ethnomathematics according to D'Ambrosio (1985) mathematics is practiced among cultural groups, identified as ethnic groups of national society, labor groups, children of certain age groups, and professional class. Therefore, in learning mathematics, ethnomathematics is needed to bridge between mathematics in real life based on local culture and school mathematics.

However, the problems presented by students at Ma'arif Kyai Gading did not understand about the story, where the story questions were presented only in the form of long texts so that students were bored. In harmony with the students, the mathematics teacher at Ma'arif Kyai Gading also conveyed that in the implementation of learning at school, there were shortcomings and limitations in providing visualization of concrete images of problems that were easily understood by students, this result in the learning being applied not optimally resulting in uneven learning outcomes. achieving by the students. These shortcomings and limitations can be corrected by innovation in the use of local culture-based comic module learning media combined with the PBL model.

Therefore, the comic module can present real problems according to local culture. According to Wahyuningsih (2011) in his research that illustrated comics can foster a positive attitude of students to read and study abstract material on their own accord, students become effective, efficient readers, and have an impact on increasing classical student interest, activity, and learning outcomes.

This study aims to analyze mathematical reasoning abilities in terms of learning independence at problem-based learning assisted by the ethnomathematical comic module.

METHODS

This research used sequential mixed method with design sequential explanatory (Creswell, 2014). The research is done at seven grade SMP Ma'arif Kyai Gading Mranggen in the academic year 2020/2021. The population is seven grade SMP Ma'arif Kyai Gading Mranggen academic year

2020/2021. The sample choices use cluster random sampling technic. There are two clasess is choosen VII A as experiment class using problem-based learning model with comic module etnomatematika, and VII B as control class using discovery learning teaching modele. The two classes learning same topic learning that is comparison.

Quantitative data collection techniques in this study used a student's mathematical reasoning ability test, while qualitative data collection was through observation of the learning implementation of student response questionnaires, student learning independence questionnaires, interviews, and documentation.

Learning tools and research instruments that have been compiled are validated by expert validators to obtain research instruments and learning tools that are suitable for use. Furthermore, the test instrument was conducted to test students' mathematical reasoning abilities in the test class, so that valid items were obtained using validity tests, reliability tests, discriminatory power tests, and difficulty level tests. Both classes were given a mathematical reasoning ability pretest. The pretest data obtained were tested using the independent sample t test to state that there was no difference in the average initial mathematical reasoning ability between the two classes.

Learning begins with giving a learning independence questionnaire to experimental class students, it is to measure the level of learning independence of each student. Furthermore, 6 students were selected, namely 2 students who have high learning independence, 2 students who have moderate learning independence, and 2 students who have low learning independence to then analyze their mathematical reasoning abilities. During the learning process, observations of the implementation of learning were carried out by observers in the experimental class to obtain the data on the level of implementation of learning that had been planned in the lesson plan. At the end of the lesson, students were given a posttest mathematical reasoning abilities to both classes. The results of the posttest of students' mathematical reasoning abilities were triangulated together with the results of teacher interviews with the six qualitative research subjects.

Quantitative data analysis used classical completeness test, average completeness test, average difference test, and regression test. Qualitative data analysis using validity test, data reduction, data presentation in the form of a matrix, and drawing conclusions. Problem based learning assisted by the ethnomathematical comic module is said to be of good quality in this study if it meets the criteria (1) Good learning planning includes learning tools and research instruments that are compiled valid and suitable for use in research, (2) Learning goes well and is able to foster a positive response from students. students, (3) effective learning.

RESULTS AND DISCUSSIONS

The feasibility of the research instruments and learning tools that were compiled was assessed based on the results of validation by expert validators. The eligibility criteria are seen based on the average validity score with a minimum score of 0 and a maximum score of 5. The data recapitulation of the results of the validation of learning devices and the results of the validation of research instruments is shown in the following table.

Table 4.1 The validate data lesson plan

Lesson Plan	Average Score	Category
Sylabus	3.83	Good
Lesson Plan	4.57	Very Good
Etnomatematika Comic Module	4.43	Very Good

Table 4.2 The data result research instrument validation

Teaching Instrument	Average Score	Category
Mathematical Reasoning Ability Test Questions	4.5	Very Good
Student Learning Independence Questionnaire	4.43	Very Good

Based on the two tables, it can be concluded that the categories of average scores of learning devices and research instruments are good and very good.

Testing of students' mathematical reasoning ability test instruments was carried out to obtain valid items using validity tests, reliability tests, discriminatory tests, and difficulty level tests. The number of 12 questions tested, 7 valid questions were obtained. Based on this, the students' mathematical reasoning ability test instrument used consisted of 7 questions with a difficulty level of 1 question in the easy category, 3 questions in the medium category, and 3 questions in the difficult category. Learning tools and research instruments that have been compiled are valid and suitable for use in research.

The implementation of learning is assessed based on the results of student response questionnaires and observations of the implementation of learning. The student response questionnaire that was made to assess aspects of student responses to the problem based learning learning model that was applied got a percentage of 91% in the very positive category, student responses to the ethnomathematical comic module used as a learning medium got a percentage of 91% in the very positive category, student responses about understanding the learning material got a percentage of 93% very positive category, and student interest in participating in learning got a percentage of 92% very positive category.

The recapitulation of the results of observing the implementation of learning at each meeting is presented in the following table.

Table 4.3. The average teaching learning evaluation

Meeting	Average scroe each meeting	Category
1	4.1	Very Good
2	4.2	Very Good
3	4.55	Very Good
4	4.8	Very Good
Rata-rata	4.41	Very Good

Based on the results of these observations, it can be stated that in four meetings, the implementation of learning in general is categorized as very good. So, it was concluded that PBL learning assisted by the Ethnomathematical Comics Module went very well and was able to grow a very positive response from students.

The students' mathematical reasoning ability test was carried out twice, namely before the learning was given a pretest, and after the learning was carried out a posttest was given. The results of the pretest analysis of students' mathematical reasoning abilities before treatment, namely the data were normally distributed and homogeneous, then the two-average similarity test was carried out with an independent sample t test assisted by the SPSS program with the results in the following table.

Table 4.4. The result of the Similarity Test of Two Average Pretest Data

Statistic	Sig. (2-tailed)	Decision
TKPMS	0.951	H_0 accepted

At the 5% significance level, the Sig value is obtained. (2-tailed) = 0.951 = 95.1%. This shows that the value of Sig. (2-tailed) > 0.05 = 5% so that H0 is accepted, then there is no significant difference in the average initial mathematical reasoning ability between the two classes.

After the learning was carried out in the experimental class and the control class, then a posttest of students' mathematical reasoning abilities was carried out. The data obtained were then analyzed by normality test and homogeneity test as a prerequisite test. The calculation of the posttest data normality test was assisted by the SPSS program with the results in the following table.

Table 4.5. Posttest Data Normality Test Calculation Results

Statistic	Asymp. Sig. (2-tailed)	Decsion
TKPMS	0.056^c	H_0 accepted

At the 5% significance level, the Asymp value is obtained. Sig. (2-tailed) = 0.056 = 5.6%. This shows that the value of Asymp. Sig. (2-tailed) > 0.05 = 5% so that H0 is accepted. This means that the residual value is normally distributed.

The calculation of the posttest data homogeneity test was assisted by the SPSS program with the results in the following table.

Table 4.6. Calculation Results of the Posttest Data Homogeneity Test

Statistic	Sig.	Decision
TKPMS	0.088	H_0 accepted

At the 5% significance level, the Sig value is obtained. = 0.088 = 8.8%. This shows that the value of Sig. > 0.05 = 5% so that H0 is accepted. This means that the sample comes from a homogeneous population.

Completeness test of the average mathematical reasoning ability of students in PBL learning assisted by the ethnomathematical comic module.

The average completeness test was carried out to find out whether the average mathematical reasoning ability test results of experimental class students were more than or equal to the KKM, which was 70. The calculation of the average completeness test with one sample t-test assisted by the SPSS program with the results in the following table.

Table 4.7. Calculation Results of the Average Posttest Data Completeness Test

Statistic	Sig. (2-tailed)	Decision
TKPMS	0.000	H_0 declined

At the 5% significance level, the Sig value is obtained. (2-tailed) = 0.000 = 0%. This shows that the value of Sig. (2-tailed) < 0.05 = 5% so H0 is rejected. So, the average mathematical reasoning ability of experimental class students who received PBL learning assisted by the ethnomathematical comic module was 70

Classical completeness test of students' mathematical reasoning abilities in PBL learning assisted by the ethnomathematical comic module.

The criteria for the proportion of classical completeness that are set are at least 75% of students who exceed the KKM. Calculation of classical completeness test with binomial test assisted by SPSS program with results in the following table.

Table 4.8. Results of the Classical Completeness Test Calculation of Posttest Data

Statistic	Exact Sig. (1-tailed)	Decision
TKPMS	0.007	H_0 decline

At the 5% significance level, the Sig value is obtained. = 0.007 = 0.7%. This shows that the value of Exact Sig. (1-tailed) < 0.05 = 5% so H0 is rejected. So, the proportion of classical completeness of mathematical reasoning abilities of experimental class students who received PBL learning assisted by ethnomathematical comic modules was more than 75%, meaning that there were more than 75% of the number of students in the experimental class who scored 70.

The average difference test of students' mathematical reasoning abilities in PBL learning assisted by the ethnomathematical comic module with mathematical reasoning abilities in discovery learning learning.

The average difference test was used to determine whether the mathematical reasoning ability of the experimental class students who received PBL learning assisted by th e ethnomathematical comic module was better than the control class students who received discovery learning. The calculation of the average difference test with the independent sample t test assisted by the SPSS program with the results in the following table.

Table 4.9. Results of the Calculation of the Average Difference Test for Posttest Data

TKPMS	Experiment	Control
N	25	19
Mean	85.84	68.84
Std. Deviation	7.782	10.356

Table 4.10. Results of the Calculation of the Average Difference Test for Posttest Data

Statistic	Sig. (2-tailed)	Decision
TKPMS	0.000	H_0 decline

Based on table 4.10 at a significance level of 5%, the value of Sig. (2-tailed) = 0.000 = 0%. This shows that the value of Sig. (2-tailed) < 0.05 = 5% so H0 is rejected. it is concluded that there is a significant difference in the average mathematical reasoning ability between the two classes. Based on table 4.9, it is found that the average mathematical

reasoning ability of the experimental class students is 85.84, while the average mathematical reasoning ability of the control class students is 68.84. This shows that the average mathematical reasoning ability of the experimental class students who received PBL learning assisted by the ethnomathematical comic module was better than the control class students who received discovery learning.

Based on the average completeness test, classical completeness test and average difference test, it can be concluded that PBL learning assisted by the ethnomathematical comic module is effective.

The effect of student learning independence on students' mathematical reasoning abilities.

This test uses the Simple Linear Regression test, which is to determine the effect of student learning independence on students' mathematical reasoning abilities. As a condition for the Simple Linear Regression test, the Kolmogorov Smirnov normality test, significance test, and linearity test were carried out which resulted that the posttest data of students' mathematical reasoning abilities and the results of the student learning independence questionnaire had residual values that were normally distributed, the data must have a significant regression direction and the data must have a significant regression direction. must be linear. Furthermore, the calculation of the completeness test of simple linear regression assisted by the SPSS program with the results in the following table.

Table 4.11. Calculation Results of Simple Linear Regression Test Data Posttest Students' Mathematical Reasoning Ability and Student Learning Independence Questionnaire Results

Statistic	Sig.	Decision
TKPMS dan AKBS	0.000	H_0 decline

At the 5% significance level, the Sig value is obtained. = 0.000 = 0%. This shows that the value of Sig. <0.05 = 5% so H0 is rejected. This means that there is an influence between student learning independence on students' mathematical reasoning abilities.

Table 4.12. Calculation Results of Simple Linear Regression Test Data Posttest Students' Mathematical Reasoning Ability and Student Learning Independence Questionnaire Results

Summary Model		
Model	R	R Square
1	0.671[a]	0.450

a. Predictors: (Constant), Independent students learning

Based on table 4.12 above, the value of R = 0.671 indicates that there is a positive influence between student learning independence on students' mathematical reasoning abilities. Analysis of determination (R^2) in simple linear regression based on table 4.12. obtained the value of R Square = 0.450 = 45%. This means that student learning independence affects students' mathematical reasoning abilities by 45% and the rest is influenced by other variables that are not included in this study.

Students' mathematical reasoning ability in terms of student learning independence

Students who were selected as research subjects to analyze mathematical reasoning abilities in terms of student learning independence were two students who got the minimum and maximum scores in each category of learning independence.

The results of the analysis are based on indicators of students' mathematical reasoning abilities, the thing that is lacking in students with high learning independence is that students only have deficiencies in writing formula symbols and in grouping types of comparisons that they have mastered well. This was proven at the time of the interview, students with high learning independence could explain confidently correctly. Despite encountering obstacles, students with high learning independence do not easily give up and continue to solve problems in questions and can be solved appropriately. This is in accordance with Aziz's research (2017) Learning independence is an important element, because with independence, student success and achievement will be easier to obtain. Among the forms of student learning independence are self-awareness to study, self-confidence in adjusting their tasks, not imitating friends, not cheating on books during exams and

having a quality personality. Johnston-Wilder & Lee (2010) stated that basically learning independence is a process of developing soft skills which are expected to be able to form positive attitudes towards mathematics including being diligent, confident, working hard, and not easily giving up facing challenges or difficulties in learning mathematics.

Based on the indicators of students' mathematical reasoning abilities, the thing that is most mastered by students with low learning independence is drawing logical conclusions where the questions on these indicators fall into the easy category questions while other indicators still have difficulty. Students with low learning independence are not able to check the truth of statements, prove, and make reasons correctly. Inability is also shown by students in using patterns of relationships to analyze situations or make analogies, generalizations, and make assumptions. Students with low learning independence only provide information about the type of problem solving without doing calculations and finding solutions to problems.

The same thing is also shown when students are asked to provide explanations of existing models, pictures, facts, traits, relationships, or patterns and students are also asked to estimate or suspect answers and the solution process. Even with the same question material, when the pattern of questions is different from the examples that have been discussed, such as things that are usually known to be asked, students with low learning independence have difficulty and cannot solve problems correctly at all. In line with the research of Jumaisyaroh et al., (2015) suggesting that learning independence has not been socialized and developed thoroughly among students, they assume that the teacher is the only source of knowledge, causing students to have dependence on others, especially on the teacher himself. In other words, the student has given up on solving problems caused by the attitude of fighting power in dealing with problems that is very weak and results in non-optimal results.

In line with Suhendri (2015) in his research reveals that one of the factors that influence student learning success is learning independence. In addition, the research of Nuridawani et al. (2015) states that independent learning is an efficient and effective step in maximizing students' abilities without having to depend on teachers, so that the teaching and learning process will be more optimal. If the higher the student's learning independence, the higher the learning success achieved by students, mathematical reasoning ability is one of the supports in the success of learning mathematics. This shows that in addition to influencing learning success, student learning independence also affects mathematical reasoning abilities.

CONCLUSION

Based on the results of research and discussion, the conclusions of this study are students' mathematical reasoning abilities based on learning independence, students with high learning independence can meet all indicators of mathematical reasoning abilities well, the thing that is lacking is writing formula symbols and grouping types of comparisons. Students with low learning independence have not been able to master indicators of mathematical reasoning abilities as a whole and completely. Students are only able to master the indicators of drawing conclusions logically with easy category questions, while in other indicators there are still many shortcomings.

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