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Students' Mathematical Reasoning Ability and Self-Efficacy Viewed from the Application of Problem Based Learning and Contextual Teaching and Learning Models Assisted

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ABSTRACT

The aim of this research is to reveal; (1) the significant influence of PBL and CTL models assisted by interactive media on students' mathematical reasoning abilities, (2) the interaction between KAM and the application of learning models on students' mathematical reasoning abilities, (3) the significant influence of the application of PBL and CTL models assisted by interactive media on self-efficacy students, (4) knowing the interaction between students' initial mathematics abilities and learning models on students' self-efficacy. Quasi experiment is applied, especially counter balanced design with instruments: (1) test of students' initial mathematical abilities, (2) test of students' mathematical reasoning abilities, (3) self-efficacy questionnaire. Infrential data uses covariance analysis (ANCOVA). The research results showed that: (1) The two experimental classes taught using the PBL (Problem Based Learning) model and the CTL (Contextual Teaching and Learning) model assisted by interactive media had a significant influence on students' mathematical reasoning abilities. (2) There is an interaction between initial mathematics abilities (KAM) and the learning model used on students' mathematical reasoning abilities. (3) The two experimental classes taught using the PBL (Problem Based Learning) model and the CTL (Contextual Teaching and Learning) model assisted by interactive media have a significant influence on student self-efficacy. (4) There is an interaction between initial mathematics abilities (KAM) and the learning model used on student self-efficacy.

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INTRODUCTION

There are two vital aspects that students, especially university students, must have in the process of understanding mathematics material, namely mathematical reasoning abilities and students' self-efficacy (confidence). These two things are very significant: first, mathematical reasoning abilities are considered very important because they are closely related to the ability to think logically, analytically and critically. There are 4 indicators of mathematical reasoning ability used in this research, namely (1) Students are able to make conjectures; (2) Students are able to provide explanations using models, facts, properties and relationships; (3) Students' ability to estimate answers and process solutions; and (4) Students' ability to use patterns and relationships to analyze mathematical situations to ensure the validity of the answers/arguments that have been given.

Second, self-efficacy is very important because it is a student's sense of confidence in himself, whether he is able to complete problems, assignments and questions in lessons or not. There are 6 indicators of self-efficacy in this research according to references in previous research conducted by Sugiati (2021), namely as follows, (1) Magnitude/Level (level of difficulty of the problem) consisting of, (a) Having an optimistic view in doing lessons and task; and (b) Feel confident that you can carry out and complete the task. (2) Strength

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(resilience) consists of, (a) Commitment in completing assigned tasks; (b) Persistence in completing assigned tasks. (3) Generality (breadth) consists of, (a) Responding to different situations well and positively; (b) Make life experiences a way to achieve success.

Based on observations (preliminary research) at a state university in Mandailing Natal Regency in the Basic Mathematics course, especially the three-variable system of linear equations (SPLTV) material, it is known that students' mathematical reasoning abilities are still low, showing that more than 40% of students scored below 70. This means that they still don't understand the concepts of the System of Three Variable Linear Equations (SPLTV) that have been presented, they still lack the ability to formulate mathematical problem conjectures, they are not used to the ability to think analogically, and the ability to connect with new problems to be solved still needs to be strengthened.

Then, the results of observations in the field also revealed that the majority of students had low self-efficacy. This was conveyed by the lecturer in charge of the Basic Mathematics course at this state university who stated that the majority of students during lectures in class tend to be passive, not confident, unable to convey the logic of a mathematical answer they have made, less active in conveying good ideas orally. and writing, and embarrassed to ask questions when studying.

To overcome this problem, there are two learning models that are quite effective, namely Problem Based Learning (PBL: problem-based learning) and Contextual Teaching And Leaning (CTL: contextual learning) with the help of interactive media. PBL is a learning process that emphasizes problem solving activities where students actively solve problems or seek answers to problems given and in this context, the role of educators is that of mediator and facilitator encouraging students to construct and solve problems actively (Yulianti & Gunawan, 2019). Nasution, M.D & Oktaviani, W (2020) emphasized that PBL can also improve students' problem solving abilities. Panggabean (2015) states that students are expected to develop more, because if done individually they will not develop significantly. Prasetia, Akrim, and Sulasmi (2022) stated that collaborative group learning which is usually applied in PBL helps the teaching and learning process to be better. Irvan & Muslihuddin (2020) argue that the PBL learning model can improve students' critical thinking abilities. The stages of the PBL learning model applied in this research are 5 steps referring to Sugiati (2021), (1) Orientation to the problem; (2) Organizing students to learn; (3) Guiding individual/group investigations; (4) Develop and present work results; and (5) Analyze and evaluate the problem solving process.

Meanwhile, CTL according to Ritonga (2021a) is a learning system that aims to stimulate the brain to be able to assemble and realize patterns into meaningful forms. Ngalimun (2014) revealed that CTL is what encourages students to be able to logically connect the material studied with concrete examples that exist in real world everyday life. Indicators for assessing students in CTL include: (1) projects/activities and reports; (2) homework; (3) quiz; (4) works

RESEARCH METHOD

The results of the Initial Mathematics Ability (KAM) test from the two experimental classes, namely experimental class 1 in the Tadris Science Study Program and experimental class 2, namely in Tadris Bilology, are experimental class 1, namely getting a minimum score of 33, a maximum score of 82, with a mean score of 62.61, and standard deviation 16.256. Then in experimental class 2, the minimum value was 33, the maximum value was 81, the mean value was 61.00, and the standard deviation was 15.510. There were 4 students with initial mathematics ability with high criteria, 22 students with medium criteria for initial mathematics ability, and 7 students with low criteria for initial mathematics ability.

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The results of the mathematical reasoning ability scores of students (KPM) who were treated with the PBL model assisted by interactive media with a minimum score of 60, a maximum score of 98, a mean score of 82.89 and a standard deviation of 11.478. Then the mathematical reasoning ability scores of students who were treated with the CTL model assisted by interactive media with a minimum score of 66, a maximum score of 96, a mean of 86.93 and a standard deviation of 8.084.

The results of the student self-efficacy questionnaire in experimental class 1 who were treated with the PBL model assisted by interactive media obtained a minimum score of 75, a maximum score of 98, with an average of 86.50 and the standard deviation was 8.686. The self-efficacy value of students in experimental class 2 who were treated with the CTL model assisted by interactive media obtained a minimum score of 77, a maximum score of 98, with an average of 89.53, and the standard deviation was 6.621. In detail, the results of the PBL model assisted by interactive media and CTL assisted by interactive media show that the number of students who have self-efficacy in the good category is 9 people with a percentage of 27.27% and the number of students who have self-efficacy in the very good category is 24 people with a percentage of 72.73%. . Then the number of students who have self-efficacy is categorized as insufficient and sufficient, namely none or 0%.

The KAM test results of students in classes treated with the PBL model assisted by interactive media have a significant value of 0.103> 0.05 and the KAM of students in classes treated with the CTL model assisted with interactive media has a significant value of 0.140> 0.05. The results of the homogeneity of variance test carried out with Levene statistics on KAM resulted in the significance value of KAM for the two experimental classes, namely 0.535 > 0.05, which means H0 was accepted. This shows that the variance in each class is acceptable and shows that both classes have homogeneous data variations.

The results of the KPM normality test using the Kolmogorov-Smirnov technique in both classes resulted in the PBL model assisted by interactive media, namely 0.142 > 0005. The results of the mathematical reasoning ability of the experimental class treated with the CTL model assisted by interactive media were 0.200 > 0.05. This means that the PBL model assisted by interactive media and the CTL model assisted by interactive media are acceptable. So it can be stated that the test data in the two experimental classes have normal distribution data. The homogeneity test results of the variance of the two classes of student KPM test score data between the experimental classes are 0.053. These results indicate that the significance value of students' mathematical reasoning abilities is > 0.05, so H0 which states there is no difference in variance between classes can be accepted. This shows that the test data on students' mathematical reasoning abilities in the experimental class who were treated with the PBL model assisted by interactive media and CTL assisted by interactive media had homogeneous data variance.

The normality test results using Kolmogorov Smirnov in both experimental classes with the PBL model assisted by interactive media was 0.065 and the CTL model assisted by interactive media was 0.200. The significance value of the two classes shows > 0.05. This shows that H0 which states that the data is normally distributed for both classes is acceptable. This means that the self-efficacy questionnaire data for the experimental class that was treated with the PBL model assisted by interactive media and the CTL model assisted by interactive media has data that is normally distributed. Homogeneity test results on the student self-efficacy questionnaire is 0.059> 0.05, which states that there is no difference in variance between classes. The data is accepted. This states that the two student self-efficacy questionnaire data in experimental class 1 and experimental 2 have homogeneous data variance.

ANCOVA Test Results

From table 1, it can be seen that there is a significant influence between the PBL model assisted by interactive media and the CTL model assisted by interactive media on students' mathematical reasoning

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abilities. By ignoring the influence of KAM and looking at the class, it can be seen that the significance value is 0.000 < 0.05 which states that H0 is rejected. Based on these results, it can be concluded that at the 95% confidence level there is a significant influence between the defender models

Table 1. Two Factor ANCOVA Data Calculation Results with

Single Covariate on Mathematical Reasoning Ability

Tests of Between-Subjects Effects					
Dependent Variable: KPM					
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	3283.379[a]	28	117.264	90.785	.000
Intercept	216049.358	1	216049.358	167264.019	.000
KAM	2841.116	21	135.291	104.742	.000
Kelas	232.071	1	232.071	179.668	.000
KAM * Kelas	308.429	6	51.405	39.797	.002
Error	5.167	4	1.292		
Total	240186.000	33			
Corrected Total	3288.545	32			
a. R Squared = .998 (Adjusted R Squared = .987)					

Source: From SPSS 23 data processing results

To see the influence of initial mathematics ability (KAM) and different learning models simultaneously, it can be seen in column 1 of the table above, namely Corrected Model. It can be seen that the significance value is 0.000. The value 0.000 <0.05 indicates that H0 is rejected. This states that at the 95% confidence level, the KAM PBL model assisted by interactive media and the CTL model assisted by interactive media simultaneously influence students' mathematical reasoning abilities.

Meanwhile, based on table 2, it can be seen that there is a significant influence between the PBL model assisted by interactive media and CTL assisted by interactive media on student self-efficacy. By ignoring the influence of KAM and looking at the class, it can be seen that the significance value is 0.002<0.05 which states that H0 is rejected. Based on these results, it can be concluded that at the 95% confidence level there is a significant influence between the learning model applied on student self-efficacy.

Table 2. Results of Two Factor ANCOVA Data Calculations with a Single Covariate on Student Self-Efficacy

Tests of Between-Subjects Effects					
Dependent Variable: SE					
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1964.848[a]	28	70.173	42.104	.001
Intercept	232516.546	1	232516.546	139509.928	.000
KAM	1796.567	21	85.551	51.330	.001
KELAS	87.500	1	87.500	52.500	.002
KAM * KELAS	93.000	6	15.500	9.300	.025
Error	6.667	4	1.667		
Total	256820.000	33			
Corrected Total	1971.515	32			
a. R Squared = .997 (Adjusted R Squared = .973)					

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To see the influence of initial mathematics ability (KAM) and different learning models simultaneously, it can be seen in column 1 of the table above, namely Corrected Model. It can be seen that the significance value is 0.001. The value 0.001 < 0.05 which states that H0 is rejected. This states that at a 95% confidence level, the KAM PBL model assisted by interactive media and CTL assisted by interactive media simultaneously influence student self-efficacy.

RESULTS AND DISCUSSION

The KAM test was carried out by giving a series of questions containing basic knowledge related to Mathematics involving research objects, namely 33 students who were divided into two classes, namely experimental class 1 which consisted of 18 students and experimental class 2 which consisted of 15 students. The results of the KAM test given revealed that on average students were divided into 3 categories, namely the low category, the medium category and the high category. The KAM test was also carried out in previous research, which was the starting point for checking and measuring the extent of students' mathematical abilities, before being given any treatment or treatment (Ritonga, 2021b; Sugiati, 2021).

The existence of treatment by applying the PBL model assisted by interactive media and the CTL model assisted by interactive media to students in the experimental class has an impact on positive results in the form of learning outcomes which tend to increase compared to before being given treatment with the two PBL and CTL learning models assisted by interactive media. These results are actually almost similar to previous research by Ritonga (2021b) which both examined PBL and CTL on KPM. The difference with this research is the use of interactive media in the learning process. And almost the same as research by Azis (2016), only different in the assessment of authenticity (previous research), the use of interactive media (this latest research).

Apart from mathematical reasoning ability (KPM), Self-efficacy is also a significant factor that leads a student to successfully solve the mathematical problems they face. Because, Self-Efficacy is a belief in each individual that helps motivate and move whether or not that person is able to compiling, organizing, implementing and applying the abilities and skills possessed, in this case the ability and skills to solve mathematical problems.

The finding of increased student self-efficacy after being given PBL and CTL model treatment assisted by interactive media is proof that PBL and CTL have a positive relationship to help build student self-efficacy in learning mathematics, in this case especially the Basic Mathematics course. Even though this research is not exactly the same as previous research (Ridaningrum et al., 2020; Sartika, 2017; Sugiati, 2021), at least it equally proves that positive PBL and CTL learning models help both pupils and students to have good self-efficacy in study Mathematics material. For more clarity, a comprehensive summary can be seen in the following table.

Table 3. Research Results

Kelas	Kemampuan Awal Matematika		Kemampuan Penalaran Matematis		*Self Efficacy*	
	Jumlah Hasil Skor Total	Rata-rata	Jumlah Hasil Skor Total	Rata-rata	Jumlah Hasil Skor Total	Rata-rata
Eksperimen 1 (Model PBL)	1.127	62,61	1.492	82,89	1.557	86,50
Eksperimen 2 (Model CTL)	915	61,00	1.304	86,93	1.343	89,53

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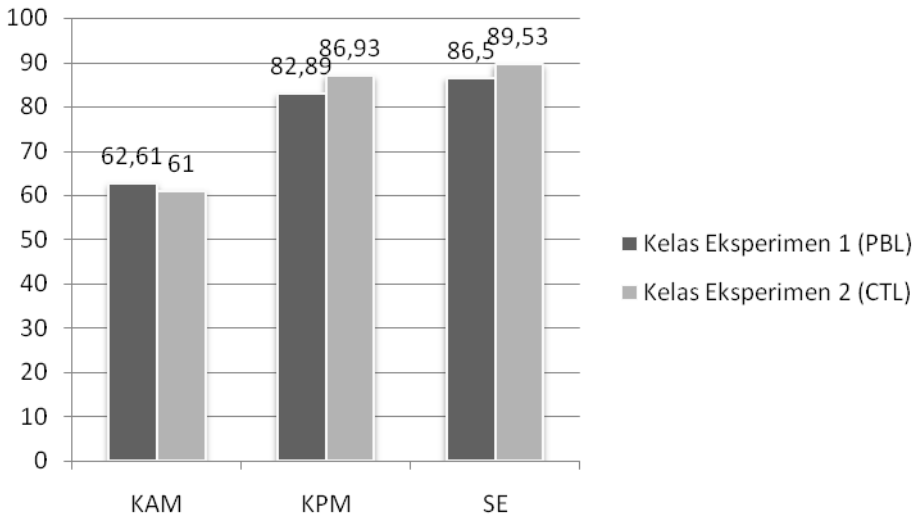
Referring to table 3 above, it can be concluded that in Experimental Class 1's Initial Mathematics Ability (KAM) the average score for students' mathematical abilities was higher, namely an average score of 62.61 compared to the KAM results for experimental class 2, namely an average of 61. 00. Meanwhile, the KPM in experimental class 2 was higher, namely an average of 86.93, compared to the KPM in experimental class 1, namely an average of only 82.89. In this case, experimental class 1 uses the PBL model while experimental class 2 uses the CTL model. This means that experimental class 2 uses the CTL model better than experimental class 1 which applies the PBL model.

Graph 1. Influence and interaction of KAM, PBL and CTL models assisted by Interactive Media for KPM and SE



Then the self-efficacy score in experimental class 2 with an average of 89.53 was higher than the score in experimental class 1 which only averaged 86.50. This means that the CTL model applied in experimental class 2 is better than the PBL model applied in experimental class 1 in an effort to increase student self-efficacy.

The conclusion is that in this research the CTL model is more dominant, or in other words, that the CTL model is better than the PBL model in improving students' mathematical reasoning abilities and self-efficacy.

CONCLUSION

From the results of the data analysis processed and analyzed in the previous chapter, the following conclusions can be drawn. (1) The two experimental classes taught using the PBL (Problem Based Learning) model and the CTL (Contextual Teaching and Learning) model assisted by interactive media have a significant influence on students' mathematical reasoning abilities. (2) there is an interaction between initial mathematics abilities (KAM) and the learning model used on students' mathematical reasoning abilities. (3) The two experimental classes taught using the PBL (Problem Based Learning) model and the CTL (Contextual Teaching and Learning) model assisted by interactive media have a significant influence on student self-efficacy. (4) There is an interaction between initial mathematics abilities (KAM) and the learning model used on student self-efficacy.

Relevant suggestions after carrying out this research are as follows; (1) Learning with the PBL and CTL models assisted by interactive media can be expanded in application, not limited to Basic Mathematics courses on Systems of Three Variable Linear Equations (SPLTV), but also applied in other courses and materials with the aim of creating a learning atmosphere that provides students with opportunities to express ideas and sharpen mathematical reasoning skills, (2) PBL and CTL models assisted by interactive media become an innovative alternative so that students learn by focusing on solving problems with the help of interactive and interesting media technology, (3) It is hoped that future research will not only be limited to using two independent variables and bound as has been applied in this research, but also combining in-depth interviews regarding student conditions, lecturer perceptions and the condition of institutional infrastructure with a combination of quantitative and qualitative research or mixed methods to explore more in-depth and comprehensive research (comprehensive).

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