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Development of Teaching Modules Based on Panai Malay Ethnomathematics to Improve Students' Critical Thinking Skills

https://doi.org/10.31004/jele.v10i3.945

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A B S T R A C T

This study aims to determine "how the development of teaching modules based on Panai Malay ethnomathematics can improve students' critical thinking skills." This study is a development study using the ADDIE development model. The subjects of this study were 11th grade students at Madrasah Aliyah Swasta al Washliyah Marbau. Data was collected using tests. The development of ethnomathematics-based teaching modules to enhance students' critical thinking skills is the problem addressed in this study. This study aims to test students' critical thinking skills in solving problems in learning the system of two-variable equations and to obtain results from normality tests, homogeneity tests, and hypothesis tests that influence teaching critical thinking skills to students at the Al Washliyah Marbau Private Madrasah Aliyah in North Labuhanbatu Regency.

Keywords: *Student Worksheets, Ethnomathematics, Critical Thinking.*

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INTRODUCTION

Education will then be a development in accordance with the development of the times, and thus the resulting human resources must also be of high quality as well as being able to solve problems, think creatively, be systematic, and critical. One of the abilities that must be possessed is the ability to think critically. Facioné (2011) states that the ability to think critically is self-control and self-regarding to determining something that makes an inference, evaluation, set analysis, and interpretation or presentation through consideration carried out or believed. Then Astrid Chandra Sari, Nurul Ilmiah, and Intan Yuli Lestari (2021) berpendapat that students' ability to analyze and evaluate information to determine whether the information is reliable and can be used to draw valid conclusions. A way with the opinion of Acep Pebrianto, Gugun Gunawan, Ribka Yohana, and Adi Nurjaman (2019) who berpendapat that berpikir critically matematis menekankan pada penyelesaian masalah melalui proses berpikir sendiri, menganalisis pembahasan, menemukan ide-ide dengan bukti untuk setiap makna, dan memutuskan apa yang harus diyakini dan apa yang harus dilakukan. This is the process berpikir that develops pola berpikir logis (Tarwiyani, 2021). And also, a student's critical thinking ability can only think critically or reason at a higher level if he carefully examines his experiences, assesses his knowledge and ideas, and weighs his arguments beforehand. Critical thinking is an important skill that students have because it can be used to solve problems and be considered in making decisions to solve problems in everyday life and is also very important in education, namely mathematics. The ability tersebut can be dikembangkan by learning mathematics (Nurdyansyah, 2018).

Matematika memiliki the highest throne in science because matematika is a perkembangan of science and teknologi (Shara et al., 2019). Apart from that, mathematics is a complex science and can develop different skills or abilities of a person. Due to the

kompleksitas of mathematics, students must have the ability to think critically about mathematics. The statement tersebut approved oleh Permendikbud (2016) nomor 21 which is tentang content standard of Basic and Middle Education which states that the content of mathematics subjects contains kompetensi to show a critical attitude serta educate. So, from the above understanding, the ability to think critically is an individual's competence in concluding information to be used as material for consideration until they reach the right decision. Remembering the importance of mathematics in everyday life, students need to have the nature of liking and high interest in mathematics (Suanto et al., 2022).

However, the reality that occurs in the field is the opposite of the expected situation, namely the low ability of high school students in Indonesia in terms of critical mathematical thinking. Where students have not been able to conclude information from a problem to get the right decision as expected. This is evidenced by the problems that occur in the students of MAS Al Washliyah Marbau as well as the opposite of the situation that occurs, supported by the students' bad attitude towards mathematics which is considered difficult and hard to understand, which is in line with Ayubi's opinion (2018) that most students understand and assume that mathematics is wrong. Mathematics is a difficult lesson; it can be seen from the beginning of the lesson that students are already complaining that they can't do it, they don't pay attention to the lesson, there are even students who annoy other students so they can't focus on studying. When students are given a question, students immediately fill it in without writing what they need to know and ask. Based on the findings of research results, Frida Marta Argare, Simo Rangkir, Tetty Natalia Sipayung, and Aprilita Sianturi (2018) from research data conducted at SMP Negeri 5 Akses stated that out of 30 students, 40% were able to understand and do well. 13% were able to understand and menyelesaikan the soal with strategy but the calculations were wrong, and 20% of students understood and menyelesaikan the soal but did not use the correct strategy. And the rest are still having difficulty working on the software that has not been made (Utami et al., 2018).

Student learning outcomes are low due to the aspek of students' critical thinking in mathematics which has long been involved in mathematics lessons and is not disclosed. Students find it difficult to come up with new ideas in the lesson they receive from the teacher and are not given the opportunity to rethink, evaluate, and analyze ('Aini et al., 2024). Oleh karena itu, peneliti mengambil salah satu materi matematika untuk dianalisis, yaitu materi persamaan linier tiga variabel. Materi Sistem Persamaan Linier Tiga Variabel (SPLTV) merupakan salah satu materi di kelas X semester dua. In completing this SPLTV question, students are expected to be able to understand the problem, analyze the question, and do the question in the right way so that students can conclude precisely what is being asked. From the way that students will work in solving the masalah tersebut, it will definitely produce a penyelesaian that is berbeda, and because of that perbedaan, each student will also definitely be berbeda in relation to some students' critical thinking in menyelesaikan soal pecahan (Cahya & Siregar, 2023).

In the research of Fauziah Hidayat, Padillah Akbar, and Martin Bernard (2019), namely *Analysis of the Ability to Think Critically in Mathematics and Independently Learn High School Students towards SPLDV Materials*, they state that the ability to think critically of students is entirely in their kategori rendah because students are menyelesaikan the soal instrument where only 1 person can menyelesaikan the soal. Then in the research of Angga Andriawan Asti Saru Setiawati, Indah Puspita Sari, and Siti Chotim (2018), namely *Analysis of Critical Thinking Ability in Mathematics of Junior High School Students in Pythagorean Subjects*, they stated that the critical thinking ability of students was in the low category because of the four indicators, only the percentage of one indicator reached 61%, and the percentage of the other three indicators only reached 61%. In this way, it can be said that the changes that occur are different depending on the metode and the learning strategies used by teachers as well as the readiness and ability of each student (Latifa, 2023). Based on the statement above, the research aims to assess the students' ability to think critically in mathematics at SPLDV without any previous treatment (Sugiyono, 2019). With this research, it can give mathematics teachers an

idea to be able to design learning activities that can develop and train students how to think critically.

METHOD

This research uses the metode penelitian research and development, or is known as Research and Development (R&D). Arifin & Nurdyansyah (2018) state that research activities are carried out to obtain information about user needs (needs assessment), while development activities are carried out to produce media or learning devices. Research was carried out to produce products in the form of teaching materials based on the Melyu Panai culture. This research uses the ADDIE development model. Noviyanti & Gamaputra (2020) state that the model of the research stage of ADDIE development consists of five stages, namely the analysis stage, the design stage (design), the development stage (development), the implementation stage (implementation), and the evaluation stage (evaluation). The ADDIE development model is used as a reference in designing a module. This research was carried out at Al Washliyah Marbau Private Madrasah Aliyah. The types of data used are qualitative and quantitative. Data collection is carried out through tests given to students. To memperoleh data on students' mathematical critical thinking skills, an assessment is conducted on students' answers to each item of the problem (Berliana Nur Oktaviana et al., 2023).

The data collected comes from the pretest value and the posttest value and is then compared accordingly to the purposes using technical analysis of inferential statistical data: (1) Normality test, which is the first step in analyzing data in a perfect specific way. To test this normality, we use a program derived from SPSS 16.0 for Windows software. The test uses SPSS according to the One-Sample Kolmogorov-Smirnov test using a significance level of 5% or 0.05. If $P_{(value)} \geq 0.05$ then the consequence is normal, whereas if $P_{(value)} < 0.05$ then the results are not normal. (2) Homogeneity test, is a test of whether or not the variances of two or more distribution items are the same. Homogeneity test is carried out with the help of the SPSS 16.0 program which comes from the Windows software using Univariate Analysis of Variance, using the significance level of 5% or 0.05. If $P_{(value)} \geq 0.05$ then the results are homogeneous, whereas if $P_{(value)} < 0.05$ then the result is not homogeneous. (3) Hypothesis test, an inferential statistical analysis used to test the effects of the hypothesis in the research by using the t-test in the SPSS 16.0 application derived from the Word application. Once the results of the prerequisite tests carried out are proven that all the data processed have normal results as well as homogeneity, then it can be continued by using a hypothesis testing t-test system. Hypothesis testing is carried out to find out whether the hypothesis given can be accepted or, on the contrary, rejected. Conditions for taking a decision: if sig. ≥ 0.05 then H_0 can be accepted and H_1 rejected, and if sig. < 0.05 then H_0 will be rejected and H_1 will be accepted (Faulina et al., 2025).

FINDINGS AND DISCUSSION

Before the writer carries out the Normality Test, the Homogeneity Test, and the Hypothesis Test, the writer will report up to the final values, where these final values are the result of research carried out by the writer in one of the schools in North Sumatra, namely in Madrasah Aliyah Private Al Washliyah Marbau, Kabupaten North Labuhanbatu. These values are from 40 students in two classes. The writer will provide class codes where the experimental class is given code 1 and the control class is given code 2.

Table 1. Final Value of Experimental Class and Control Class

Experimental Class	Control Class	Code Experimental Class	Code Control Class
85	77	1	2
90	72	1	2
91	75	1	2
79	72	1	2
97	81	1	2

84	76	1	2
83	76	1	2
85	77	1	2
90	80	1	2
90	78	1	2
86	82	1	2
84	89	1	2
82	75	1	2
84	72	1	2
83	75	1	2
85	72	1	2
90	81	1	2
81	76	1	2
85	76	1	2
87	80	1	2

Normality Test

The normality test is used to find out whether the collected data has a normal distribution or not. The criteria used are that the data is said to be normal if the significance value (P-value) on the output of the One-Sample Kolmogorov-Smirnov test is greater than the determined alpha, namely 0.05 (P-value ≥ 0.05) (Suparni, 2020). The following are the results of the One-Sample Kolmogorov-Smirnov test with the help of the SPSS 16.0 application from Windows, as shown in the following table.

Table 2. Normality tets

One-Sample Kolmogorov-Smirnov Test

		Unstandardized Residual
N		20
Normal Parameters[a]	Mean	.0000000
	Std. Deviation	4.01316569
Most Extreme Differences	Absolute	.187
	Positive	.187
	Negative	-.133
Kolmogorov-Smirnov Z		.837
Asymp. Sig. (2-tailed)		.485

a. Test distribution is Normal.

According ... ware from Window ... retest treatment and ... has a normal distrib ... ce is 0.485 > 0.05, so it can be concluded that the residuals are normally distributed.

Homogeneity Test

The homogeneity test is used to find out whether the variances of several distributions are the same or not. This test was carried out using the help of the SPSS 16.0 application from Windows. With the testing criteria, if the significance value is greater than 0.05, then it can be said that the variance of the two data sets is the same. The following is the proof that the two data sets have the same variance.

Table 3. Test Results of Homogeneity of Variance for the Research Subjects

Test of Homogeneity of Variances

Hasil Belajar Baris dan deret

Levene Statistic	df1	df2	Sig.
.026	1	38	.872

Based on th ... gnificance value is 0.872. Beca ... the pretest and posttest values ...

Hypothesis Test

Hypothesis testing is a statistical method used to test the truth of a hypothesis or assumption about a population based on a sample of data. Hypothesis testing helps in making decisions about whether the hypothesis used can be accepted or rejected based on the evidence provided. The following are the results of the hypothesis test shown in the table below.

Table 4. Hypothesis Test of Research Subjects – Paired Samples Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre Test	86.0500	20	4.19868	.93885
	Posttest	77.1000	20	4.20401	.94004

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Pre Test & Posttest	20	.298	.202

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	Pre Test - Posttest	8.95000	4.97864	1.11326	6.61993	11.28007	8.039	19	.000

Based on the results of the hypothesis test above, it can be seen that the significance value is approximately 0.000. Because the significance value is smaller than 0.05 (Sig. < 0.005 < 0.05), it indicates that there is a significant difference between the initial variable and the final variable. This shows that there is a meaningful influence from the behavior and the treatment given to each variable.

The results of this research using the Problem-Based Learning model to develop logical or critical mathematical thinking in students on the subject of the System of Two-Variable Linear Equations show that students' learning achievement has improved after being given treatment. Based on the research data and analysis obtained from value comparisons, the final scores (n) show that the experimental class had 20 students and the control class also had 20 students. The experimental class obtained an average score of 86.05, while the control class had an average score of 77.01.

Furthermore, inferential statistical analysis based on the hypothesis test using SPSS 16.0 from Windows resulted in a significance of 0.000 using a significance level of 0.05. Since the hypothesis test shows that $0.000 < 0.05$, H_0 is rejected and H_1 is accepted.

As a result, it can be concluded that there is an effect from using the Malay Panai Culture-based learning model on students' critical mathematical thinking abilities in the subject of the System of Two-Variable Linear Equations in the class.

CONCLUSION

The development of Mathematics and Mathematics teaching modules using the Problem-Based Learning method effectively improves students' critical thinking skills regarding the subject matter of the system of two-variable equations in class XI Madrasah Aliyah Swasta Al Washliyah Marbau. The average learning outcome (mean) in the experimental class is 86.05, while the control class has an average score of 77.01, indicating an improvement in learning outcomes after the treatment. Furthermore, the hypothesis test using SPSS 16.0 resulted in a significance value of $0.000 < 0.05$, leading to the rejection of H_0 and acceptance of H_1. This demonstrates that the application of the Discovery Learning model significantly influences and improves students' critical thinking and learning outcomes in the subject of Sequences and Arithmetic Series in class XII at Al Washliyah Private Madrasah, Marbau, North Labuhanbatu Regency.

ACKNOWLEDGEMENTS

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