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Influence of Audio Visual Media Based on Project Based Learning (PjBL) on Students' Mathematical Reasoning Ability at College ERIA Medan High School

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Abstrak

Penelitian ini membahas tentang pengaruh media audio visual berbasis pembelajaran *Project Based Learning (PjBL)* terhadap penalaran matematis siswa di SMA Perguruan ERIA Medan. Sampel penelitian siswa kelas XI IPS-2 berjumlah 30 siswa. Teknik pengambilan sampel *Purposive Sampel* dengan desain penelitian menggunakan *Pre-Experimental Desain (nondesain).* Dalam desain penelitian ini hanya menggunakan satu kelas, yaitu kelas eksperimen dalam proses pembelajaran diberikan perlakuan dengan menggunakan media pembelajaran audio visual berbasis *Project Based Learning (PjBL).* Teknik pengumpulan data menggunakan angket respon siswa dan tes penalaran matematis, tes berisi 3 soal uraian yang sudah divalidasi ahli. Analisis data menggunakan uji deskriptif, uji normalitas, uji homogenitas, dan uji hipotesis. Pengujian hipotesis menggunakan uji regresi linier sederhana. Hasil penelitian menunjukan bahwa persamaan Y = 19,892 – 0,310X, dengant_{hitung}= 10.359 dan nilai signifikansi = 0,000 diperoleh nilai$t_{hitung} > t_{tabel}$ yaitu 10.359>2,0484 dengan taraf signifikansi kurang dari $\propto$ = 0,05. Besar persen pengaruh dilihat dari tabel koefisien korelasi pada nilai *R square*(R^2). Dari hasil perhitungan diperoleh nilai $R^2 = 0{,}793$ menunjukkan bahwa media audio visual berbasis *Project Based Learning (PjBL)* terhadap penalaran matematis siswa SMA perguruan ERIA Medan berpengaruh positif dengan persentasese besar 79,3% termasuk katagori tinggi. Sementara perolehan respon siswa sebesar 82,3%. Sehingga dapat dinyatakan pembelajaran menggunakan media audio visual berbasis *Project Based Learning (PjBL)* mendapat respon positif.

Abstract

This study discusses the influence of audio-visual media based on *Project Based Learning (PjBL)* learning towards the students' mathematical reasoning at SMA Perguruan ERIA Medan. With the objectives. The research sample of class XI IPS-2 students consisted of 30 students. The sample technique was *Purposive Sample* with the type of *Pre-Experimental Design (non-desaign)* research. In this research design, only one class is used, namely the experimental class. In the learning process, treatment is given using audio-visual learning media based on Project Based Learning (PjBL). The data collection technique used the students' response questionnaire and mathematical reasoning test, the test contained 3 essay questions that had been validated by experts. Data analysis used desciptive tests, normality tests, homogeneity test, and hypothesis test. Hypothesis testing used a simple linier regression test. The results of the study showed that the equation Y = 19,892 – 0,310X, with t_{count}= 10.359 and significance value = 0.000 obtained the value of $t_{count} > t_{table}$ which is 10.359>2,0484 with a significance level of less than $\propto$ = 0,05. The percentage of the influence can be seen from the correlation coefficient table at the R *Square* value (R^2). From the calculation results obtained the value of $R^2 = 0{,}793$ indicating that audio-visual media based on *Project Based Learning (PjBL)* towards the students' mathematical reasoning of SMA Perguruan Eria Medan has a positive effect with a percentage of 79,3% including the high category. While acquisition of the students'responses was 82,3%. So, it can be stated that learning using audio-visual media based on *Project Based Learning (PjBL)* gets a positive response.

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Introduction

Mathematics learning is learning that requires concepts in solving mathematical problems. So students need a creative mindset and mathematical reasoning skills. According to Konita et al., (2019) stated that mathematical reasoning is the ability to analyze, generalize, synthesize/integrate, provide appropriate reasons and solve non-routine problems. Students who have good reasoning skills will easily understand mathematical material and vice versa, students with low mathematical reasoning skills will find it difficult to understand mathematical material. One of the things that affects students' low mathematical reasoning is learning that only focuses on teaching materials and textbooks and the lack of use of media in learning so that students feel bored and bored more easily during the learning process. Especially mathematics learning. It is not uncommon for students to consider mathematics lessons to be boring and saturated learning which results in low students' mathematical reasoning.

Where in improving mathematical reasoning there are several indicators that are the benchmarks for its improvement, namely: (1) presenting mathematical statements through writing, pictures, sketches or diagrams, (2) submitting conjectures, (3) providing reasons for several solutions, (4) checking the validity of an argument, (5) drawing conclusions or making generalizations (Romadhina et al., 2019). One thing that can encourage interest in learning and improve mathematical reasoning is the use of media in the learning process. Learning media itself is an important component in the teaching process that can be used by educators properly as a tool to deliver material so that it can be understood by students. Therefore, educators as facilitators must be more creative and innovative in selecting learning media that are appropriate to the material to be delivered.

According to Umaroh et al., (2020) it is stated that students will find it easier to understand mathematical concepts if they are accustomed to using their reasoning skills in making independent estimates, so that student learning outcomes can also improve. In line with that, educators must improve their ability to use varied and creative learning media that are technology-based, so that they can generate student activity and encourage student interest in learning. One way to improve mathematical reasoning and encourage student interest in learning is by using learning media. In line with Nurhidayah et al., (2022) in the learning process, learning media are needed that can motivate students to continue learning and ask questions from what they do not yet know in order to provide maximum results as expected.

The media that can be applied in the learning process, especially mathematics learning, is audiovisual media. According to Dian et al., (2021), Audio Visual media is a modern instructional media that is in accordance with the development of the times (advancement of science and technology) including media that can be seen and heard at the same time. So that it attracts attention, interest in

learning and can be more easily understood by students. In addition to the use of interactive and innovative learning media, the use of appropriate and varied learning models can also make it easier for students to understand the learning material presented, foster interest and mathematical reasoning in students. So that it triggers learning to be effective and efficient. One of them is the Project Based Learning (PJBL).

According to Octariani & Rambe, (2018) Project Based Learning is an innovative learning model that involves project work where students work independently or in groups in constructing their learning and implementing it in real products. The syntax of Project Based Learning (PjBL) according to the Ministry of Education and Culture, 2014 in Manasikana, et al (2022:45) includes (1) Determining basic questions (start with essential questions), (2) Preparing project plans (design project), (3) Preparing a schedule (create schedule), (3) Monitoring students and (4) Project progress (monitoring the students and progress of the project), (5) Assessing the outcome (assess the outcome), and (6) Evaluation of experience (evaluation the experience). By creating audiovisual learning media that collaborates with the Project Based Learning (PjBL) learning model, educators also prepare project assignments which must be completed according to the specified deadline. So that the material delivered by educators through audiovisual videos can be directly implemented by students to find out whether learning objectives have been achieved.

Facts in the field based on researcher observations on observations when teachers teach in class and researcher interviews with educators who are mathematics teachers and students at SMA Perguruan ERIA Medan, the learning process still uses the lecture method and seems monotonous and there is no use of interactive and innovative learning media so that it results in a sense of boredom and boredom so that it inhibits students' reasoning ability in understanding the material. Based on the explanation of the problems above, the researcher is interested in studying how the Influence of Audio Visual Media Based on Project Based Learning (PJBL) on Students' Mathematical Reasoning. This study aims to determine the extent to which the use of audiovisual media based on the Project Based Learning (PjBL) Model influences the mathematical reasoning of class XI IPS-2 students at SMA Perguruan ERIA Medan. And to find out how students respond to the use of audiovisual learning media based on the Project Based Learning (PjBL).

Method

This type of research is quantitative. The research method is Pre-Experimental Design (non-design) in the sense that there is no control class. With the research design is One-Shot Case Study research, which only involves one class, namely the experimental class, where the experimental class in the learning process is given treatment using audio-visual learning media based on Project Based Learning (PjBL). The population of the study was all students of class XI of High School College Eria Medan with a total of 106 students. The sampling technique used in this study was purposive sampling by looking at the

criteria of the four classes, namely class XI IPA-1, XI IPA-2, XI IPS-1, and XI IPS-2 by giving an initial test to measure students' mathematical reasoning, which meets the criteria as a sample, namely class XI IPS-2. The test given contains 2 mathematical reasoning questions that have been validated by experts. The test is given with conventional learning and the assessment is carried out on an ordinal scale. Where the results of the initial ability test are also used as pre-test scores.

The data collection technique in this study was to use a mathematical reasoning test instrument to measure students' mathematical reasoning. By giving students a mathematical reasoning test. The test given contains three descriptive questions that have been validated by experts with an instrument assessment grid based on students' mathematical reasoning indicators to determine the increase in students' mathematical reasoning from before and after treatment. In addition to using the test instrument, data collection from this study also used a student response questionnaire containing ten questions about learning using audio visuals based on Project Based Learning (PjBL).

After the initial ability or pre-test score of the students was known at the first meeting, then at the next meeting the students were given learning using audio-visual media based on Project Based Learning (PjBL). At the last meeting, students were given a post-test in the form of three descriptive questions with the material of algebraic function derivatives, to determine the extent of students' mathematical reasoning after being given treatment with learning using audio-visual media based on Project Based Learning (PjBL). At the same time, a student response questionnaire was also given to determine whether learning using audio-visual media based on Project Based Learning (PjBL) received a positive response or not from students with measurements using a Likert scale.

Research Results and Discussion

Research Results

Results of Students (*Preetest)* and (*Posttest)* Mathematical Reasoning

After the calculations were carried out, the results of the analysis of the pretest values of mathematical reasoning for the experimental class were as follows:

Table 1. Students Mathematical Reasoning Test Results

No	Amount of students		Obtaining Results		KKM Value	Catagory
	Preetest	Posttest	Score	Value		
1	3	0	8	40	75	Incomplete
2	2	0	9	45	75	Incomplete
3	4	0	10	50	75	Incomplete
4	4	0	11	55	75	Incomplete
5	4	0	12	60	75	Incomplete
6	4	4	13	65	75	Incomplete
7	3	3	15	75	75	Complete
8	5	4	15	75	75	Complete
9	2	7	16	80	75	Complete
10	0	3	17	85	75	Complete
11	0	6	18	90	75	Complete

12	0	0	19	95	75	Complete
13	0	3	20	100	75	Complete
Amount of Students Complete *Preetest*					**7**	
% Average					**23,33**	
Amount of Students Complete *Posttest*					**23**	
% Average					**76,66**	

Table 1. shows that the results of the posttest were twenty three students who passed the mathematical reasoning criteria with a percentage of 76.66%, while the pretest results were seven students who passed the mathematical reasoning criteria with a percentage of 23.33%. This shows that the posttest results are higher than the pretest results with a percentage difference of 53.33%. Based on the data obtained from the pre-test and post-test results, students' mathematical reasoning abilities can be seen in the comparison histogram as follows:

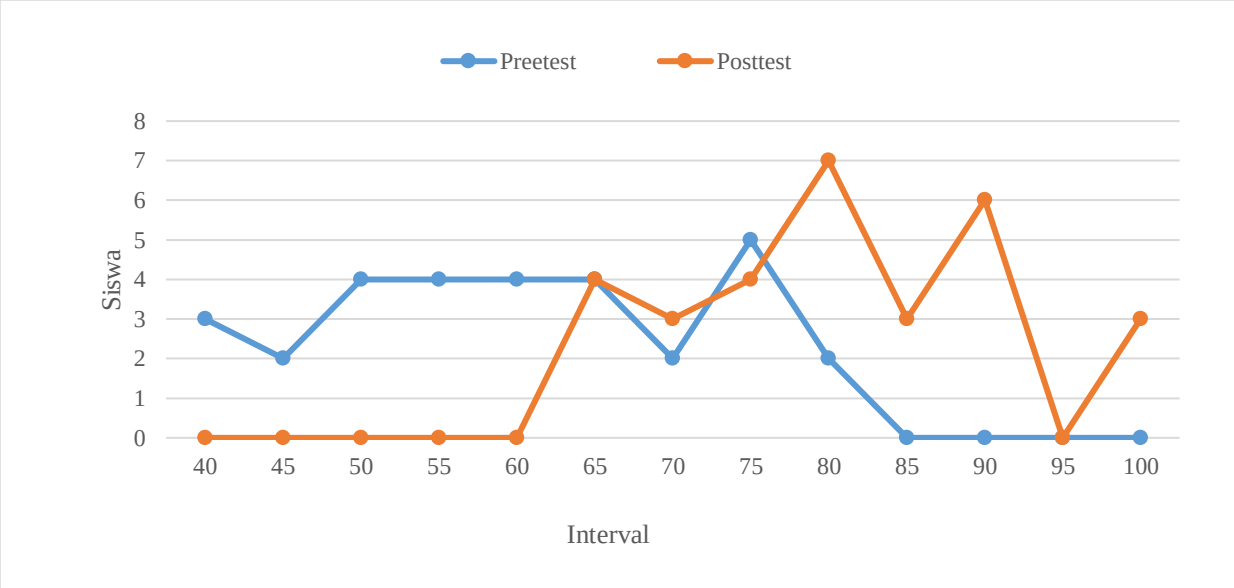

Figure 1. Comparison of Studens Mathematical Reasoning Test Results.

From the results of the calculations that have been done, Figure 1 shows the results of students' mathematical reasoning after learning using audio-visual media based on Project Based Learning (PjBL) is higher than during conventional learning. With an average result of 23.33% for learning using audio-visual media based on Project Based Learning (PjBL) and an average result of 76.66% for conventional learning. This shows a difference in increase of 53.33%.

Descriptive Statistical Test Results *Preetest* and *Posttest*

After testing, the results of the analysis of the pre-test and post-test values of mathematical reasoning of students in the experimental class were as follows:

Table 2. StatistikDeskriptif*Preetest* dan *Posttest* Siswa

Statistic	Experimental Class	
	Pree-test	***Post-test***
Amount of Studens	30	30
Maximum Value	80	100
Minimum Value	40	65
Mean	60,17	80,83
Standar deviasi	12,281	10,429
Varians	150,833	108,764

Based on table 2 above, it shows the measure of centralization of the pretest and posttest results of mathematical reasoning of experimental class students with a maximum value of 80 for the pretest and a maximum value of 100 for the posttest, a minimum value of 40 for the pretest and a minimum value of 65 for the posttest, the average value of students' mathematical reasoning from the pretest results is 60.17 and the average value from the posttest results is 80.83.

In the size of the distribution of data from the pre-test and post-test results of students' mathematical reasoning, there are differences in standard deviation and variance. The standard deviation for the results of the pre-test of students' mathematical reasoning is 12.281 and the variance for the results of the pre-test of students' mathematical reasoning is 150.833. While the standard deviation for the results of the post-test of mathematical reasoning is 10.429 and the variance for the results of the post-test of students' mathematical reasoning is 108.764.

Obtaining Student Response Results for Learning Using Audio Visual Media Based on Project Based Learning (PjBL)

The researcher calculated the results of the questionnaire responses from students to learning using audio-visual media based on project-based learning. The calculation was done using Ms. Excel. The calculation results obtained 82.33%. It can be concluded that learning using audio-visual media based on project-based learning received a positive response from respondents. The formula used in calculating student responses is as follows:

$$RS = \frac{JSPI}{n} x100\%$$

Source: (Fitriyani Hali, 2021)

Information:

RS = Respon Siswa

JSPI = Jumlah Skor Perolehan Item

n = Maximal Score

From the calculation results can be categorized into the following criteria:

Table 3. Category of Student Achievement

Interval	Category
85% - 100%	Very Positive
70% - 85%	Positive
50% - 70%	Less Positive
0% -50%	Negative

Source:(Fitriyani Hali, 2021)

Prerequisite Test Results

1. Normality Test *Preetest* and *Posttest* Students Mathematical Reasoning

The normality test is conducted to determine whether the data used is normally distributed or not Murwani, (2001) in Nuryadi et al., (2017:83), because it will be used in hypothesis testing. While the normality test is conducted using the test Shapiro-Wilk.

Table 4. Normality Test *Preetest* and *Posttest* Mathematical Reasoning

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
nilaipreetest	.120	30	.200*	.946	30	.133
nilai posttest	.132	30	.194	.940	30	.091

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Based on table 4, it is known that the pretest significance value is 0.133 > 0.05 and the posttest significance value is 0.91 > 0.05. So it can be stated that both pretest and posttest data of students' mathematical reasoning conducted by the researcher are normally distributed.

2. Homogeneity Test of Pretest and Posttest of Mathematical Reasoning

The homogeneity test was carried out using the pretest and posttest values simultaneously with the help of SPSS 22, the following results were obtained:

Table 5. Homogeneity Test of Pretest and Posttest of Mathematical Reasoning

Test of Homogeneity of Variances

Penalaran			
Levence Statistic	df1	df2	Sig
1.285	1	58	.262

Table 5 shows the results of the pretest and posttest homogeneity test obtained a significance value of 0.262 > 0.05. Thus, it can be interpreted that the results of the pretest and post-test of mathematical reasoning ability in the experimental class have the same variance.

Hypotgesis Test

After the Prerequisite Test is fulfilled, a hypothesis test is then carried out in this study to prove the truth of the proposed hypothesis. The hypothesis proposed by the researcher is Audio Visual Media Based on Project Based Learning (PjBL) on Mathematical Reasoning of Class XI IPS-2 Students at SMA Perguruan ERIA Medan. Previously, a hypothesis test was carried out on the pretest and posttest

values of students' mathematical reasoning to determine the percentage increase in students' mathematical reasoning before and after treatment in the experimental class. This hypothesis test was carried out using a simple linear regression analysis test. The simple linear regression formula used is as follows:

$$Y = a + b_1X_1 + b_2X_2 + e$$

Source: Suhendra, (2021)

Based on the calculation results, the following data was obtained:

Table 6. Simple Linear Regression Analysis of Mathematical Reasoning Pretest and Posttest

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.891[a]	.793	.786	.395

a. Predictors: (Constant), Preetest

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	16.769	1	16.769	107.300	.000[b]
	Residual	4.376	28	.156		
	Total	21.145	29			

a. Dependent Variable: Posttest

b. Predictors: (Constant), Preetest

Based on table 6, it is known that the sig value is 0.000 <0.05 and the coefficient of determination (R Square) value is . It can be concluded that it is rejected and accepted, meaning that there is a contribution or large influence given by audio-visual media based on the project-based learning model (X) on students' mathematical reasoning (Y) of 79.3%, including in the high category.

t-Test Results

The following are the results of the calculation with the t-test to see whether there is a partial influence given by the independent variable to the dependent variable. The calculation was carried out using SPSS version 22.

Table 7. Hypothesis Testing With t-Test

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	19.892	.367		54.230	.000
	Preetest	-.310	.030	-.891	10.359	.000

a. Dependent Variable: Posttest

Based on table 7, it is known that the partial influence of the independent variable (X) on the dependent variable (Y) obtained a Sig value of 0.000 < 0.05 with = 2.0484. So it can be stated as rejected and accepted, meaning that there is an influence of audio-visual media on mathematical reasoning.

Discussion

Based on the results above, it is known that audio-visual media based on project-based learning has a significant influence in improving students' mathematical reasoning. The results obtained by learning using audio-visual media based on project-based learning show a greater increase compared to conventional learning.

This is because students who receive treatment using audio-visual media based on project-based learning understand better in solving problems related to mathematical reasoning. By asking questions from the problems that have been made which aim to help students solve the problem. So that students can better understand how the initial steps are to solve the problem and also the next steps until the problem is solved. Audio-visual media can help students develop their mathematical reasoning so that they can solve better problems. The use of media in learning greatly helps teachers to convey learning materials and can increase the effectiveness, efficiency and also the attraction of students in the ongoing learning process and can improve students' mathematical reasoning. In line with according to Junaidi (2019) in Wulandari et al., (2023) the use of learning media at the teaching orientation stage greatly helps the effectiveness of the learning process and the delivery of messages and lesson content so that learning objectives are achieved.

Audio-visual media is a learning media that presents audio and visual elements simultaneously so that students get messages or information from visualizations in the form of words or images that are equipped with sound. The sound can be in the form of a visual explanation that is displayed, dialogue or just a sound effect such as music. According to Dian et al., (2021) with the use of audio-visual media in the teaching and learning process, among others: teaching will attract more students' attention so that it can foster learning motivation, teaching materials will have clearer meanings so that they can be understood by students and allow students to master teaching objectives better, teaching methods will be more varied, not just verbal communication through the utterance of words by the teacher, so that students do not feel bored and educators do not run out of energy, students do more learning activities.

Based on the results of this study, it also provides an influence on each indicator of mathematical reasoning (Romadhina et al., 2019). As in the first indicator, namely solving problems using a way of presenting mathematical statements through writing, pictures, sketches or diagrams. This can be seen through the answers of students who are able to examine questions in the form of written stories or diagrams. In the second indicator, students are expected to be able to express their guesses. This can be seen through the details of students' answers in making guesses as a way of solving the

problems given. In the third indicator, namely solving problems by providing reasons for several solutions. This can be seen from students' answers which not only state one way, but can be more than one way. In the fourth indicator, students can solve problems using a way of checking the validity of an argument from several solutions that have been made previously. In the fifth indicator, namely solving problems by drawing conclusions or generalizing. So that you can find the right answer. This can be seen from the end of the student's answer by concluding the results of the answers that have been obtained.

However, it should be noted that in the use of audio-visual media in learning, guidance from a teacher is still needed to direct students in the learning process and provide constructive feedback. This study also has limitations, namely (1) The use of moving audio-visual media based on the Project Based Learning (PjBL) Model (2) The material applied is the derivative of algebraic functions in the sub-chapter on the properties of derivatives of algebraic functions in class XI IPS-2 at SMA Perguruan ERIA Medan (3) This study uses the Pre-Experimental Design technique (non-design) with no control class and (4) Indicators to determine students' mathematical reasoning can be seen in (1) Presenting mathematical statements through writing, pictures, sketches or diagrams; (2) Submitting conjectures; (3) Providing reasons for several solutions; (4) Checking the validity of an argument; (5) Drawing conclusions or making generalizations (Romadhina et al., 2019).

Conclusion

Based on the discussion above, it can be concluded that there is an influence of audio-visual media based on project based learning (PjBL) on students' mathematical reasoning. In the results of the analysis of the initial value (pretest) of mathematical reasoning of experimental class students is smaller than the posttest value after being treated with audio-visual media based on project based learning (PjBL). This shows that audio-visual media based on project based learning (PjBL) has a positive influence on students' mathematical reasoning, especially on the material of algebraic function derivatives. The percentage of the resulting influence is 79.3%. In addition to providing an increase in mathematical reasoning values, audio-visual media based on project based learning (PjBL) also received a positive response from students of 82.33%.

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