

Improving Physics Learning Outcomes through M-Learning with Articulate Storyline: A Quasi-Experimental Study

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Abstract: The purpose of this study was to investigate the effectiveness of using Articulate Storyline-based M-learning in improving the learning outcomes of 10th grade MIPA 3 students at MA Swasta Allu Bangkala, with a focus on Energy Sources material. This study used an experimental design with a One Group Pretest-Posttest design. The study population consisted of 82 students, and data were collected using learning outcome tests along with appropriate teaching instruments and modules. Descriptive analysis and the N-Gain test were used to evaluate the data, while the Mann-Whitney test was used to test the significance of the difference between the pretest and posttest scores. The results showed that the average pretest score was 30.00, which was very low, while the average posttest score increased to 48.18, which was low. The Mann-Whitney test showed a significant difference with an Asymp. Sig (2-tailed) value of 0.001, which is smaller than the significance level of 0.05, indicating an increase in student learning outcomes after using Articulate Storyline-based learning media. This study provides valuable insights into the potential use of M-learning tools, particularly Articulate Storyline, in improving student learning outcomes. This study demonstrates the effectiveness of digital learning media in the classroom and provides a basis for further research on the integration of these tools in educational settings to improve student engagement and understanding. The novelty of this study lies in the application of Articulate Storyline in the Indonesian educational context. This study contributes to the development of research on M-learning and digital learning media, demonstrating the potential of these tools in improving student performance, particularly in Indonesia. This study provides a new perspective on the role of digital learning tools in improving educational outcomes.

Keywords: Articulate Storyline, Learning Outcomes, M-Learning and Digital Learning Media

A. Introduction

Education is a conscious and planned effort to create a learning environment and learning process that enables students to actively develop their potential.

Technological advances in education pose challenges for students and teachers as they must compete to keep up with the changes that occur. At the same time, educators will be able to impart meaning to students if they can understand the world from the students' perspective. If they want to change students' behavior, they must first change students' beliefs and views.

Classroom learning for students certainly goes through an appropriate educational process. The use of technology to achieve optimal learning objectives so that the expected learning outcomes can be achieved. However, the reality in the field shows that the implementation of learning experiences obstacles that cause learning to be ineffective in achieving the expected results. The use of technology with learning media is very important in the world of education to improve learning outcomes. When using M-learning learning media assisted by the Articulate Storyline application, students can truly understand what will be taught in physics by using the *Articulate Storyline* application to help students easily understand the material and concepts of physics (Criollo-C et al., 2021) (Calvani et al., 2008).

The Articulate Storyline learning media (Fombona et al., 2020) is a learning medium specifically designed to package learning. The Articulate Storyline application is an E-learning software tool that functions to help build interactive (learning) content. Interactive learning media based on Articulate Storyline is considered very suitable for supporting teaching and learning activities in the classroom and for independent learning (Behera, 2013) (Glasserman-Morales et al., 2024). This was proven by observations at Allu Private Madrasah, where it was found that students still used textbooks and took notes in their books in a monotonous manner during the learning process. An interview with one of the physics teachers at the madrasah revealed that students were not interested in using textbooks, even though WhatsApp was used as a medium for sharing material with students. As a result, students appear passive and bored because using textbooks makes them less focused when learning physics, which leads to very low learning outcomes (Khasib et al., 2023) (Pratiwi et al., 2023). Given these issues, teachers need to make efforts to use a variety of media that are tailored to the students' conditions. Media plays a very important role in the learning process to achieve optimal results (Astuti et al., 2024).

Ultimately, the use of learning media can support and enhance the appeal of learning. Therefore, teachers need to develop learning media that suits the conditions of students in the classroom. This study on the effectiveness of using M-learning learning media based on the Articulate Storyline application will be used to facilitate the teaching process and make teaching more lively and exciting. In addition, students will not misuse Articulate Storyline and it can be useful in the teaching and learning process. (Jethro et al., 2012). Based on this, we are interested in conducting research with the title: Improving Physics Learning Outcomes through M-Learning with Articulate Storyline: A Quasi-Experimental Study

B. Methods

This research is classified as experimental research with a *One Group Pre-test-Post Test Design*. The population used in this study were students in class X MIPA 3 at MA Allu Bangkala, consisting of three classes with a total of 82 students. The research instruments used were Learning Achievement Tests and teaching modules. Furthermore, the data analysis technique used descriptive analysis and *N-Gain* test analysis to see the effectiveness of this study.

The data analysis techniques used were descriptive statistical analysis and inferential analysis. In this study, the descriptive analysis showed that the hypothetical mean value obtained by the researcher was 50, obtained from $\mu = \frac{1}{2} (X_{\max} + X_{\min})$, while the hypothetical standard deviation value was 16.67, obtained from $\sigma = \frac{1}{6} (X_{\max} - X_{\min})$, where $X_{\max}$ is 100 and $X_{\min}$ is 0. Meanwhile, the inferential analyses used are 1) data normality test; 2) hypothesis testing; and 3) testing the effectiveness of the learning media used. 1) Normality Test, to perform parametric statistical tests on quantitative data, the main requirement is that the data must have a normal distribution. To prove whether the data has a normal distribution or not, a normality test using the Liliefors test is required. In decision making, compare L_{hitung} with L_{tabel} using the Liliefors test critical value table with a significance level of $\alpha = 5\%$. If $L_{hitung} \leq L_{tabel}$, then the sample distribution is normal, and if $L_{hitung} > L_{tabel}$, then the sample is not normally distributed. 2) Hypothesis testing. If the data is not normally distributed, then the *Mann-Whitney* test is used to perform the hypothesis test using *IBM SPSS v.26*. The *Mann-Whitney* test is a non-parametric non- t test used to test for differences between two independent populations (Mariana & Hidayanto, 2022). The *Mann-Whitney* test is an alternative when the assumption of population normality is not met, and the data does not have a normal distribution. 2) Effectiveness Test. The effectiveness test with *N-Gain* was used to test how effective the use of *M-learning* learning media based on the *Articulate Storyline* application was. This effectiveness test is used to answer the formulation or hypothesis in this study. The *N-Gain* test is performed when there is a significant difference between the average *pre-test* and *post-test* scores through an independent sample *t-test* (Sugiyono, 2013).

C. Results and Discussion

Results

The type of research used in this study was an experimental method using a *One Group Pre-Test Post-Test Design*. In this study, there were 3 meetings using only one class, namely class X MIPA 3 MA Swasta Allu with 22 students who were given treatment using *M-Learning* Learning Media Based on the *Articulate Storyline* Application on Energy Source Material. The *pre-test* and *post-test* each consisted of 20 multiple-choice questions to measure the students' learning outcomes. The findings of the students'

learning outcomes before and after using the *Articulate Storyline* Application-Based M-Learning Media are as follows:

Descriptive Statistical Analysis

Overview of the learning outcomes of students in Class X MIPA 3 at MA Allu Bangkala before using the Articulate Storyline application-based M-learning media

Based on the results of the study conducted in class X MIPA 3 at MA Allu Bangkala, the researcher collected data through student learning outcome test questions. The results of the student learning outcome tests can be seen in the following table:

Table 1. Frequency Distribution of Pre-test Learning Outcomes

Xi	Fi
20	2
25	5
30	10
35	3
40	1
50	1

Based on Table 1 above, the learning outcome test results of grade X MIPA 3 students at MA Allu Bangkala were used as a reference in processing descriptive analysis using the *IBM SPSS* program, as shown below:

Table 2. Results of descriptive analysis of pre-test learning outcomes of students
Descriptive Statistics

	N	Min	Maximum	Mean	Standard Deviation
Pre-Test	22	20	50	30.00	6.547
Valid N (listwise)	22				

Based on the descriptive analysis in Table 4.2, it shows that the maximum or highest score obtained by students is 50, while the minimum or lowest score obtained by students is 20, with an average score of 30.00 and a standard deviation of 6.547. The *pre-test* scores of student learning outcomes can be shown in the frequency distribution table or based on the categorization in Table 3.3, as shown in the following table:

Table 3. Categorization of Student Learning Outcomes (Pre-test Results)

Interval	Frequency	%	Categorization
$X < 33.33$	17	77	Low
$33.33 \leq X < 66.67$	5	23	Moderate
$X \geq 66.67$	0	0	High
Total	22	100%	Low

Based on Table 3 above, it shows that of the 22 students who participated in this study, 77% were low and 23% were categorized as moderate. The data is then illustrated in the following histogram or bar chart:

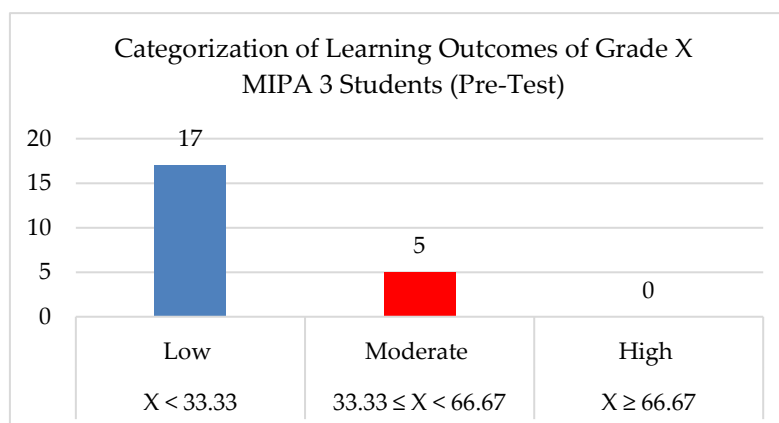


Figure 1. Diagram categorizing student learning outcomes (*pre-test* scores)

The diagram shows that the frequency of low *pre-test* learning outcomes is in the range of $X < 33.33$, which means that 17 students are in the very low category.

Overview of the learning outcomes of students in Class X MIPA 3 at MA Allu Bangkala before using the Articulate Storyline application-based M-learning media

Based on the research conducted in Class X MIPA 3 at MA Allu Bangkala, the researcher collected data through student learning outcome test questions. The results of the student learning outcome tests can be seen in the following table:

Table 4. Frequency distribution of *post-test* learning outcomes

X_i	F_i
25	2
30	3
35	1
40	1
45	4
50	4
55	1
60	1
65	1
70	3
75	1

Based on Table 4 above, the learning outcome test results of grade X MIPA 3 students at MA Allu Bangkala were used as a reference in processing descriptive analysis using the IBM SPSS program, as shown below.

Table 5. Descriptive analysis results of the *post-test* learning outcomes of students

Descriptive Statistics					
	N	Min	Maximum	Mean	Standard Deviation
Post-Test	22	25	75	48.18	15.395
Valid N (listwise)	22				

Based on the descriptive analysis in Table 5, it shows that the maximum or highest score obtained by students is 75, while the minimum or lowest score obtained by students is 25, with an average score of 48.18 and a standard deviation of 15.395. The *post-test* scores of student learning outcomes can be shown in the frequency distribution table or based on the categorization in Table 3.3, as can be seen in the following table:

Table 6. Categorization of Student Learning Outcomes (*Post-test* Results)

Interval	Frequency	%	Categorization
$X < 33.33$	5	23	Low
$33.33 \leq X < 66.67$	13	59	Medium
$X \geq 66.67$	4	18	High
Total	22	100	Moderate

Based on Table 6 above, it shows that of the 22 students who participated in this study, 23% were low, 59% were categorized as medium, and 18% were in the high category. The data is then illustrated in the following histogram or bar chart:

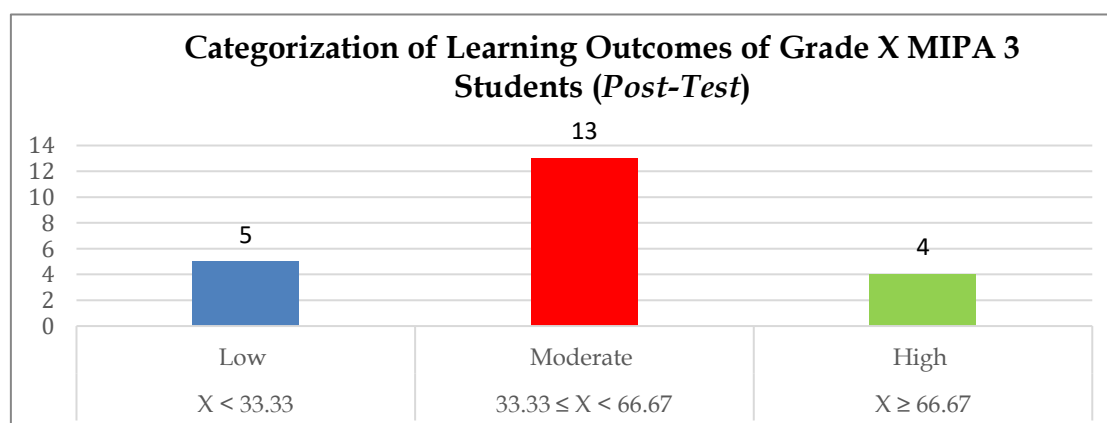


Figure 2. Categorization diagram of student learning outcomes (*pre-test* scores)

The diagram shows that the frequency of high *post-test* learning outcomes is in the range of $33.33 \leq X < 66.67$, which means it falls into the moderate category, with 13 students.

Inferential Analysis

Normality Test

A normality test was conducted to determine whether the physics learning outcome data obtained, both from the *pre-test* and *post-test* scores, were normally distributed or not. In this study, data normality testing was conducted using the Liliefors test at a significance level of $\alpha = 0.05$. The results of the normality test calculations in this study using *IBM SPSS* are as follows:

Table 7. Results of the Normality Test for Learning Achievement Tests

Tests of Normality						
	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
PreTest	.273	22	.000	.863	22	.006
PostTest	.135	22	.200*	.941	22	.204

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Based on Table 7, the significance value for the *Pre-Test* is 0.001 and for the *Post-Test* is 0.200. If the significance value is greater than 0.05 ($\text{sig} > 0.05$), then it can be said that the data is normally distributed. Conversely, if the significance value is less than 0.05 ($\text{sig} < 0.05$), then the data is not normally distributed. Thus, it can be concluded that the *Pre-Test* data is not normally distributed, while the *Post-Test* data is normally distributed. Therefore, we proceed with a *non-parametric* test because the data is not normally distributed.

In addition to *IBM SPSS* analysis, normality testing can also be performed manually using the Liliefors test. The results of the Liliefors normality test for student learning data before treatment obtained a calculated value of $L_{(0)} = 0.279$ and $L_{(table)} (\alpha = 0.05; n = 22) = 0.190$, so it can be concluded that $L_{(0)} > L_{(table)}$. This indicates that the data is not normally distributed. Meanwhile, for the data after treatment, $L_{(0)} = 0.135$ was obtained at a significance level of 0.05, so it can be concluded that $L_{(0)} < L_{(table)}$. This indicates that the data is normally distributed.

Hypothesis Test

The analysis prerequisite test shows that the learning outcome data before treatment is not normally distributed, so the test is continued using a non-parametric statistical test. The test used is the *Mann-Whitney* test (U) at a significance level of $\alpha = 0.05$.

Based on the calculation results, the value obtained was $Z_{\text{calculated}} = 3.962$ and $Z_{\text{table}} = 1.96$. These results show that $Z_{(\text{calculated})} > Z_{(\text{table})}$, so it can be concluded that H_0 is rejected and H_1 is accepted. This shows that there is a difference between the learning

outcomes of students before using the *Articulate Storyline* application-based *M-Learning* learning media on the Energy Sources material for Grade X MIPA 3 at MA Allu Bangkala. The following is the analysis using *IBM SPSS v.26*:

Table 8. Mann-Whitney Analysis using IBM SPSS v.26

Ranks				
	Group	N	Mean Rank	Sum of Ranks
Score	Pretest	22	14.95	329.00
	Posttest	22	30.05	661.00
	Total	44		
Test Statistics ^a				
			Value	
	Mann-Whitney U		76,000	
	Wilcoxon W		329,000	
	Z		-3.962	
	Asymp. Sig. (2-tailed)		.000	
a. Grouping Variable: Group				

From the table above, the *Asymp. Sig (2-tailed)* value shows a number of 0.001. The *Asymp. Sig (2-tailed)* value is smaller than the significance level of 0.05, so H_0 is rejected and H_1 is accepted. This indicates that there is a difference between the learning outcomes of students before using the *Articulate Storyline*-based *M-Learning* educational media on the subject of energy sources in Grade X MIPA 3 at MA Allu Bangkala.

Effectiveness Test

The N-Gain calculation was used to determine the effectiveness of using the *Articulate Storyline* application-based *M-Learning* media to improve the learning outcomes of Grade X MIPA 3 students at MA Allu Bangkala. The *N-Gain* test analysis was conducted manually, and the results are as follows

Table 9. Manual N-Gain Results

No.	Pre-Test	Post-Test	Post-Pre	Ideal Score (100-Pre)	N-Gain	Category
1	30	30	0	70	0.00	Low
2	30	25	-5	70	-0.07	Low
3	25	30	5	75	0.07	Low
4	35	25	-10	65	-0.15	Low
5	20	30	10	80	0.13	Low
6	25	45	20	75	0.27	Low
7	30	70	40	70	0.57	Low
8	30	65	35	70	0.50	Low
9	25	45	20	75	0.27	Low
10	30	45	15	70	0.21	Low
11	30	70	40	70	0.57	Moderate
12	35	50	15	65	0.23	Low

No.	Pre-Test	Post-Test	Post-Pre	Ideal Score (100-Pre)	N-Gain	Category
13	30	50	20	70	0.29	Low
14	25	70	45	75	0.60	Moderate
15	30	75	45	70	0.64	Moderate
16	35	55	20	65	0.31	Moderate
17	30	60	30	70	0.43	Moderate
18	30	50	20	70	0.29	Low
19	50	50	0	50	0.00	Low
20	25	45	20	75	0.27	Low
21	20	40	20	80	0.25	Low
22	40	35	-5	60	-0.08	Low
Average	30	48.18	18.18	70	0.25	Low

These results can also be verified using the IBM SPSS program. The results can be seen in the following table.

Table 10. IBM SPSS Program N-Gain Results

Descriptive Statistics					
	N	Min	Maximum	Mean	Standard Deviation
N-Gain	22	-.15	.64	.2533	.23276
Valid N (listwise)	22				

The results of the *N-Gain* test on student learning outcomes are shown in the frequency distribution table or based on categorization can be seen in the following table.

Table 11. Categorization of the N-Gain test results

Interval	Frequency	%	Categorization
$g > 0.70$	0	0	High
$0.7 > g \geq 0.3$	5	23	Moderate
$g < 0.29$	17	77	Low
Number	22	100	

Based on the results of the *N-Gain* test calculations that have been carried out, the Gain index value or the average value before and after the treatment was given was 0.25, which is in the low category. Therefore, it can be concluded that the effectiveness of using *M-Learning* learning media based on the *Articulate Storyline* application to improve the learning outcomes of grade X MIPA 3 students at MA Allu Bangkala is still in the low category.

Discussion

In this study, the researcher observed the difference in learning outcomes of students in class X MIPA 3 at MA Allu Bangkala before (*pre-test*) and after (*post-test*) being taught using the *Articulate Storyline* application-based *M-learning* media.

An overview of the differences in student learning outcomes before (*pre-test*) and after (*post-test*) being taught using *M-learning* learning media based on the *Articulate Storyline* application for students in Class X MIPA 3 MA Allu Bangkala

The research results obtained show that there is a difference in student learning outcomes before and after being given treatment in the form of *M-learning* learning media. This can be seen from the difference in maximum and average scores obtained from the *pre-test* and *post-test* data. To prove this, an analysis was carried out manually and using the *SPSS Statistics version 26 for Windows* program.

Based on the research results and analysis conducted, the learning outcomes of the 22 students who participated in this study obtained average scores before being given the treatment, which was in the low category. This average was then broken down into several categories according to the analysis results obtained, namely in the very low and low categories. This condition was caused by the fact that students were only taught using the lecture method or using a conventional learning model and the absence of *M-learning* media based on the *Articulate Storyline* application that was previously used in the learning process.

The results of the analysis of the students' learning outcomes after the treatment showed an average for each indicator. All indicators were in the very low, low, medium, and high categories. Students in the very low category were still unfamiliar with the treatment given in this study. Students in the low category were those who had improved from the very low category to the low category, as were students in the moderate category. Then, students who were in the high category were due to the fact that, according to them, the use of *Articulate Storyline*-based *M-Learning* had a positive impact on student learning outcomes even though they had not been able to fully adapt to the treatment given (Wulansari & Prapanca, 2024) (Febrianti & Alrianingrum, 2021).

This is because the use of *Articulate Storyline*-based *M-Learning* is still relatively simple and similar to regular PowerPoint presentations, coupled with a lack of creativity among educators in the learning process. In the independent curriculum learning process, active learning is required for students. This is also supported by research conducted by Ozuorcun (Ozuorcun & Tabak, 2012), which states that there are several shortcomings in the teaching and learning process, both in terms of time and implementation, and that the use of KPS aspects is limited to questions and is not used as an approach. Therefore, in the learning process, learning outcomes must be practiced repeatedly in order to achieve the learning objectives (Nurdiansah et al., 2021) (Agarwal & Pandey, 2013) (Georgiev et al., 2004).

Based on the descriptive analysis results, the average between the *pretest* and *posttest* was 30.00 and 48.18. This shows that the learning outcomes of students in class X

MIPA 3 at MA Allu Bangkala after being given treatment (*post-test*) and before (*pre-test*) applying the *M-learning* learning media based on the *Articulate Storyline* application provided better learning outcomes compared to students before being given treatment. This is in line with the research conducted by Ahmad Raihan (2022) that *Mobile Learning* media can improve student learning outcomes if the media is used properly and correctly according to their needs, it will affect student learning outcomes (Raihan, 2022) (Pratiwi et al., 2023).

After conducting a descriptive analysis, an inferential analysis was performed, which included normality tests, hypothesis tests, and effectiveness tests. The data underwent normality testing to determine whether it was normally distributed or not. The *Lilliefors Significance Correction* test at a level of $\alpha = 0.05$ was used as the normality test in this study. Based on the Lilliefors test using the *SPSS Statistics version 26 for Windows* program, the *pretest* data obtained a value of 0.001 and the *posttest* data obtained a value of 0.20. The significance value for the *pretest* data obtained was less than 0.05 ($\text{sig} < 0.05$), so it can be concluded that the test scores of the students' learning outcomes before the treatment was applied were not normally distributed, and after the treatment was given, they were normally distributed because the significance value for the *post-test* data obtained was greater than 0.05 ($\text{sig} > 0.05$).

After testing normality, hypothesis testing was then carried out using non-parametric methods because one of the data sets was not normally distributed. The results of hypothesis testing using the *Mann Whitney* test showed that there was a difference in the learning outcomes of students before and after being taught using *M-learning* learning media based on the *Articulate Storyline* application in class X MIPA 3 at MA Allu Bangkala. This is also in line with research conducted by Nurhidayah (Nurhidayah et al., 2025) (Akhililia et al., 2024) which showed that based on statistical test results, there was a difference in learning outcomes between students who used m-learning and those who did not (Rahmawati & Mukminan, 2017).

Overview of the Use of *M-Learning* Educational Media Based on the *Articulate Storyline* Application in Grade X MIPA 3 at MA Allu Bangkala

The results of the study indicate that student learning outcomes improved after being given treatment in the form of using *Articulate Storyline* application-based *M-learning* learning media. However, based on the *N-Gain* test analysis, the improvement was not very significant. Therefore, it can be concluded that the use of *Articulate Storyline* application-based *M-learning* learning media in improving student learning outcomes is in the low category.

The *N-Gain* test calculation results show that the *average N-Gain* score before and after being given treatment in the form of using *Articulate Storyline* application-based *M-learning* learning media is in the low category. However, there were students who did

not maximize the use of the learning media, so that some of them were less active in their groups and did not fully maximize their responsibilities as group members.

This was because the difference between the pretest scores before and after the treatment was not significantly different. The low physics learning outcomes of students before the implementation of *Articulate Storyline* multimedia were caused by several factors. One of them was the lack of motivation and interest in learning physics among students (Yolanda et al., 2022) (Arkorful & Abaidoo, 2015).

In addition, another factor that caused low learning outcomes among students before the treatment was the inappropriate learning methods used by educators, which caused students to tend to be passive during lessons and dominated by educators (Daryanes et al., 2023). Furthermore, the results of this analysis are supported by the initial observation that students rarely engage in learning with *M-learning* media, resulting in students not being accustomed to the learning process using *M-learning* media based on the *Articulate Storyline* application. This is in line with the research by Arkorful et al. (Arkorful & Abaidoo, 2015), which states that learning media is a tool that can be used to convey learning messages. Educators must design this multimedia-based learning effectively and create a relaxed, comfortable, and friendly atmosphere to encourage students to engage in the learning process. (S (Kurniasari et al., 2025).

D. Conclusions

The conclusion of the research conducted is that the use of M-Learning educational media based on *Articulate Storyline* has an impact on the learning outcomes of students in class X MIPA 3 at MA Swasta Allu. Before the implementation of the learning media, the average learning outcome score of the students was 30.00, which was in the low category. This shows that the students' initial ability in the material taught, namely energy sources (), was still at a very limited level, indicating the need for improvement in the learning methods applied. After implementing the *Articulate Storyline*-based M-Learning learning media, the average learning outcome score of students increased to 48.18, which is in the moderate category. Although there was a significant increase, these results indicate that despite the changes, the effectiveness of using this learning media in improving student learning outcomes is still relatively low. This indicates that although there has been progress, there is still much room for improvement in the application of learning technology.

The results of statistical analysis using the Mann-Whitney test show a significant difference between students' learning outcomes before and after the implementation of learning media. The *Asymp. Sig (2-tailed)* value obtained was 0.001, which is less than 0.05, indicating that this difference did not occur by chance and showing that the use of *Articulate Storyline*-based M-Learning learning media had an effect on improving student learning outcomes. The effectiveness of using *Articulate Storyline*-

based M-Learning learning media in energy source material in class X MIPA 3 is still in the low category, which means that even though there has been an improvement, further development is still needed to increase the effectiveness of this learning media in achieving more optimal results. This study contributes to the development of technology-based learning media, with the hope of continuing to improve the quality of education in the future.

This study has several limitations. First, the sample was limited to students in class X MIPA 3 at MA Swasta Allu, which may not be representative of the broader student population, limiting the generalizability of the findings. Second, the intervention period was relatively short, which may not have allowed enough time for students to fully engage with and internalize the material, thus affecting the long-term impact on learning outcomes. Third, the study did not include a control group, making it difficult to definitively attribute the observed changes in learning outcomes to the Articulate Storyline-based media, rather than other external factors. Additionally, the novelty effect of using new technology could have influenced students' enthusiasm, potentially skewing the results temporarily. Lastly, the research did not explore the sustainability of the learning outcomes over a longer period, which is crucial for assessing the true effectiveness of the intervention.

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