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The Effectiveness of Multimedia in the Learning and Simplification of Reproduction Topic in Science

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ABSTRACT

The purpose of this study is to investigate the effectiveness of multimedia in the learning and simplification (LnS) of reproduction of form 1 science and their influence towards students' science achievement. A total of 42 form 1 students from one of the schools in Kota Kinabalu were selected as respondents in this study. This study uses a quasi-experimental approach. This research using a pre-test and post-test design with only one group of respondents. This design involves administered a pre-test, then exposing them to an intervention of LnS using multimedia, and then measuring them again on the post-test. The pre-test and post-test scores will be collected and analyzed using the SPSS version 29 application. Data will be analyzed using descriptive and paired sample t-test methods. The results showed a significance Mean difference of 13.59 between pre-test and post-test. It was concluded that multimedia-based learning used in LnS enhanced better students' academic achievements in the topic of reproduction.

Keywords: multimedia-based learning, reproduction, effectiveness.



INTRODUCTION

A student's academic path has always included a crucial component of science instruction. The use of multimedia technologies in scientific instruction and learning has received more attention in recent years. The use of multimedia in scientific instruction provides one opportunity to deliver challenging ideas in a fun and participatory way. Multimedia has risen in popularity as LnS tool in recent years. With the development of technology, multimedia has improved in affordability and accessibility, giving teachers additional options for using it in the classroom.

According to Davies and West (2014), low information literacy and a negative perspective towards learning have been found to be significant barriers to improving students' learning and are signs of the need to implement modern technology into education, particularly in the field of science. In particular, multimedia has proven to be an effective tool for students to learn complex subjects as science and biology.

This research is important in increasing students' interest, facilitating understanding, and encouraging participation of the students. Multimedia can enrich the learning experience with the use of interesting images, videos, animations, and audio. This can increase students' interest in learning and help them be actively involved in learning. Besides, multimedia can convey information in a more visual and interactive way. This helps students understand difficult concepts through clearer and more concrete representations. In the use of multimedia, there are opportunities for students to interact with learning content through interactive exercises or simulations. This can encourage active participation and involvement in the learning process. Science subjects are said to be difficult to understand, boring and less interested by most students because of its abstractness.

PROBLEM STATEMENT

The performance of students in science is becoming more and more a concern, especially for teachers and parents. The students' poor performance has been linked to a poor attitude toward learning, poor facilities, crowded classrooms, a lack of appropriate and acceptable science equipment, and students' weak foundational backgrounds. Students' fear of science courses and the false notion that science is a challenging subject are further issues. Most school laboratories are in poor condition, making it challenging to apply new techniques and experiments. The use of multimedia learning, however, offers some optimism as it appears to be reversing the problem (Mohafa et al., 2022).

The LnS are a complicated process with numerous factors that influence its success. One of these factors is the teacher's technique of delivery and practises in the classroom. The science curriculum should teach students how to understand essential scientific ideas and how to solve issues using scientific inquiry techniques. The research conducted is focused on students' difficulties in the topic of reproduction in science subjects in Form one. Previous studies have shown that students have difficulty learning the topic of reproduction (Wahyuni et al., 2019; Hakan, 2013). The human reproductive system is a concept that deals with daily life context. It is one of the challenging



concepts for students (Hakan, 2013). According to Alice (2021), the ability of a teacher to illustrate and represent the concept of reproduction in animals in such a way that students understand plays an important role in biology instruction.

According to Maigoro et al. (2017), pre-conception construction error in students is typically brought on by their peers, environment, family, and teachers who failed to adequately explain the concept at earlier levels of education. It can also be brought on by the language of instruction and ineffective past instruction. Every student has a unique capacity for learning. According to Dalyono (2015), this is because uncertainty in the learning process prevents students from achieving their full potential. According to Bahar and Polat (2007), students' behaviour, attitude, skill, knowledge, physical condition, and learning needs have a significant impact on how they carry out certain learning tasks.

The perception among many students that science is a dull, abstract, and overly challenging subject needs to be corrected. Therefore, it is necessary to investigate the impact of switching from the traditional, long-standing "talk and chalk" method to a multimedia-supported computer-based teaching strategy on students' attitudes toward and involvement with science (Mohafa et al., 2022).

Therefore, this study was conducted to determine the effectiveness of multimedia-based learning in science subjects, especially in the topic of reproduction. This method can attract students' interest to continue learning in class because it can make the learning and simplification process more interactive. In order to stimulate the brain, the used of visuals, video, and animations are necessary in conjunction with text. Students pay more attention and remember more. Therefore, the objectives of this study are as follows:

- 1. To investigate the mean difference in academic achievement in the topic of reproduction before and after the intervention of multimedia-based learning.
- 2. To investigate the effectiveness of multimedia-based learning on the students' academic achievement towards the topic of reproduction.

LITERATURE REVIEW

Cognitive Theory of Multimedia Learning (CTML) is the main theory discussed in this study since it aims to determine the effectiveness of multimedia-based learning on Form One students' academic performance.

Previous Studies

Wahyuni et al. (2019) aimed to identify the causes of difficulties for high school students in understanding the concepts of the Human Reproductive System. The results indicated that while students found the topic interesting, many considered it quite difficult to learn. The study concluded that student learning difficulties in the Human Reproductive System were influenced by various factors, including students themselves, teachers, and textbooks, and provided insights into addressing these difficulties.



Dahal (2021) on the effect of multimedia in teaching Science at secondary level indicated that the group using multimedia projectors had significantly better achievement compared to the group without multimedia projectors. The literature review highlighted the usefulness of interactive multimedia courseware and its ability to match to different learning styles and backgrounds. The results of the study indicated that the experimental group using multimedia had higher post-test scores compared to the control group. The attitudes of science teachers toward ICT as instructional materials were also explored. The study concluded that multimedia, when used effectively, can enhance learning outcomes in science education.

Wahab et al. (2020) aims to look at the effectiveness of ICT use among students in the state of Terengganu in conjunction with the advent of the industrial revolution 4.0. The findings of this study indicate that there is no significant difference in the level of understanding of IR 4.0 based on gender and school location factors. The study also found that there was no significant difference in the use of ICT as a medium of learning based on school location. However, there is a significant correlation between the understanding of IR 4.0 on the use of ICT in learning. Therefore, it can be concluded that students in Terengganu state ICT as a means of gaining and sharing knowledge as well as the medium of learning today.

Puspitasari et al. (2019) aimed to find out the effectiveness of the multimedia interactive for human reproduction system learning. The result of the study shows that the multimedia interactive was qualified and effective to enhance the students' learning outcome in the course of system human reproduction. Zazali and Nasir (2022) aimed to see the effectiveness of the use of interactive multimedia to increase the use of teaching aids in preschool children's learning and help improve children's comprehension and concentration during LnS sessions. The result of the study shows that the use of multimedia-assisted teaching aids is able to increase the effectiveness of the use of interactive multimedia teaching aids in children's learning.

Kiflee et al. (2020) showed that of multimedia as well as the effectiveness in the use of multimedia in learning is at a high level. Besides that, there is also a significant relationship between perceptions and effectiveness of the use of multimedia. As a result, the influence of perceptions has contributed towards the effectiveness of the use of multimedia in the teaching and learning of gifted students. Kapi et al. (2017) compared three multimedia applications which are Greenfoot, Visualization Makes Array Easy (VAE), and e-Tajweed, in terms of their effectiveness for teaching and learning. The study focuses on three key elements mainly the constructivist approach, integration of formal and informal activities, and integration of social learning. The study concludes that multimedia education tools, such as Greenfoot, VAE, and e-Tajweed, are effective in supporting teaching and learning processes. They offer a variety of approaches to engage students, promote self-learning, and improve learning outcomes.

Kapri (2017) found that teaching science through the use of multimedia is more effective than using the traditional direct technique. No student was found to have an exceptionally poor level of achievement in science as a result of the multimedia approach to teaching, proving that this strategy is an effective way to teach science. Implementing science lessons with the use of multimedia could make a difference and help students memorise the concept for a long time. A study by



Selvaganesan and Jayachithra (2021) found that learning using multimedia is efficient, encourages achievement in zoology among students in the XI standard, and helps in maintaining the strength of retention over time. It increases students' interest in what they are learning and will make it easier for them to understand the concepts.

Cognitive Theory of Multimedia Learning (CTML)

Mayer's multimedia learning theory developed from research into text and illustrations and experiments that suggested that illustrations with integrated text improved learning effectiveness (Mayer, 1989). The Cognitive Theory of Multimedia Learning (CTML) is a theoretical framework developed by Richard Mayer that aims to explain how individuals process and learn from multimedia materials. CTML integrates principles from cognitive psychology and multimedia learning research to provide guidelines for designing effective instructional multimedia. According to CTML, there are three main cognitive processes involved in multimedia learning which are selecting, organizing, and integrating information: (i) Selecting process involves selecting relevant information from the multimedia environment. The student focuses on specific elements such as text, images, animations, or audio. It is important to minimize cognitive load during the selection process by avoiding extraneous or distracting elements that may overload the student's cognitive capacity, (ii) Organizing process occurs once relevant information is selected, students need to mentally organize it in a coherent and meaningful way. CTML emphasizes the importance of presenting information in a spatially and temporally integrated manner. According to the principle of spatial contiguity, relevant words and images should be displayed close to one another on the screen to help in the student's mental integration of the material. In order to make it easier for students to relate the information, temporal contiguity proposes that similar words and pictures be provided at the same time rather than one after another, and (iii) Integrating process involves mentally connecting and integrating the selected and organized information with the student's prior knowledge. CTML emphasizes the importance of promoting meaningful learning by fostering connections between new information and existing cognitive schemas. Providing explicit cues, such as verbal explanations or visual highlighting, can support the learner in making these connections.

Conceptual Framework

A conceptual framework is a framework that believes best explains the natural progression of the phenomenon under investigation. It is linked to the conceptions, empirical study, and essential theories for advancing and systemizing expertise. It is the description of how the research problem will be investigated. The conceptual framework describes the relationship between a primary concept from a statistical perspective as shown in Figure 1. According to the conceptual framework, LnS using multimedia-based learning will represent the independent variable while student achievement in the topic of reproduction represents the dependent variable.

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Figure 1. Research Conceptual Framework

METHODOLOGY

The researcher used a pretest-post-posttest design in this research. In this design, the researcher measures the students' achievement levels before and after a specific intervention or treatment. In this study, a researcher used two types of tests which are pre-test and post-test that will be administered to the students. By comparing the pretest and posttest scores, the researcher can evaluate whether the intervention had an impact on student achievement. The next step will be to collect data using a quantitative approach. The requirements of the specified research questions can be satisfied by this strategy by providing accurate information.

Research Design

According to Yadav (2023), the strategy or framework utilized to carry out a research study is known as the research design. It includes setting out the overall approach and methods that will be applied to data collection and analysis in order to answer research questions or test hypotheses. The purpose of this study was to determine the effects of multimedia instruction on Form 1 students' performance in the topic of reproduction at SMK X. The researcher used a pretest-post-posttest design in this research. In this design, the researcher measures the students' achievement levels before and after a specific intervention or treatment. In this study, a researcher used two types of tests which are pre-test and post-test that will be administered to the students. By comparing the pretest and posttest scores, the researcher can evaluate whether the intervention had an impact on student achievement. The next step will be to collect data using a quantitative approach. The requirements of the specified research questions can be satisfied by this strategy by providing accurate information. The flow of research is shown in Figure 2.





Figure 2. Research design

Research Sample

The participants in this study consisted of 42 students from one of the secondary schools in Kota Kinabalu Sabah, while the sample is from one class of Form 1 students at the school.

Research Instrumentation

The research instrument used in this study is in the form of a pre-test and a post-test. The test is based on the syllabus of science subjects of Form one which is in the topic of reproduction. The level of difficulty of the test is in accordance with the level of the student's ability, which is easy, medium, and difficult. The constructed test contains 45 objective questions. Each question will be given a mark of 1 mark and the percentage of the whole test is 100%. Each student will be allocated one hour to answer the test individually. The pre-test will be administered before the use of multimedia in learning while the post-test will be administered after the use of multimedia in learning the topic of reproduction.

Through this instrument, the researcher will be able to compare student achievement before and after intervention in the topic of reproduction and be able to determine whether the use of multimedia is effective in improving student achievement in the topic of reproduction. In this study, the tests that will be done to measure the achievement of the respondents are the pre-test and the post-test. The questions in both sets of tests are multiple choices question. The researcher has constructed 45 objective questions based on Bloom's Taxonomy which involves four levels namely remembering, understanding, applying, and analyzing.

Validity and Reliability

Validity is the extent to which an instrument can measure something that is to be measured.



According to Santhiya (2015), validity is one of the most important criteria and should be considered when evaluating the test. The purpose of test item validity is to determine whether an issue can distinguish between groups in the assessed elements based on group differences. It is a critical aspect of research and ensures that the data collected is accurate, relevant, and appropriate for the research objectives. In other words, a valid instrument accurately captures the construct or concept it is supposed to represent. The discrimination index used to separate participants with high ability levels from those with low ability levels indicates the validity of the question. The discrimination index of the questions, which is calculated using the difference in the proportion of answers from each group indicates the validity of the question (Sudaryono et al., 2019).

Reliability of an instrument refers to the consistency, stability, and repeatability of its measurements or scores. In other words, a reliable instrument should produce consistent results when administered under the same conditions to the same group of participants. High reliability is essential for ensuring that the instrument accurately captures the true score of the construct being measured and minimizes random error or measurement noise. In this study, the research method used is Internal Consistency. This method is used to test the consistency between the items in the instrument. For example, a test that measures science knowledge can be used to test internal reliability by using coefficients such as Cronbach's alpha. Higher values indicate higher reliability. The alpha coefficient range and its strength of association are shown in Table 1.

Table 1. Alpha Coefficient Range and Strength of Association					
Alpha Coefficient Range Strength of Association					
<0.6	Poor				
0.6 to <0.7	Moderate				
0.7 to < 0.8	Good				
0.8 to <0.9	Very good				
0.9	Excellent				

Sources: Nawi et al. (2020)

Pilot Test

A pilot test, also known as a pilot study, is a small-scale preliminary study conducted before the main research project to assess the feasibility, design, and logistics of the study. The primary purpose of a pilot test is to identify and rectify any potential issues, refine research methods, and make necessary adjustments before conducting the full-scale study. In this study, the researcher has conducted a pilot study on students from the same school, which are from Form 1 students of SMK X. A total of 40 students have responded to this pilot study. This pilot study aims to obtain the validity and reliability of the items in the test questions. In this study, the findings of the pilot study will be analyzed using the SPSS application version 28. The Discrimination Index (ID) and the Facility Index (IF) of this pilot study will also be conducted using Microsoft Excel to determine the quality of the test.



Table 2 shows the reliability of the pretest item which has an alpha value of 0.903. According to Nawi et al. (2020), items that have a Cronbach Alpha (α) value of 0.9 above are excellent. This shows that these items can be used in real studies. Cronbach's alpha provides a coefficient that ranges between 0 and 1. The value of α indicates the degree of internal consistency of the items. If α is close to 1, it suggests high internal consistency, meaning that the items are highly correlated, and the scale is reliable in measuring the intended construct. If α is close to 0, it indicates low internal consistency, implying that the items do not correlate well, and the scale may not be an effective measure of the construct.

Table 2. Reliability Statistics of the Test Items				
Cronbach's Alpha	Cronbach's Alpha based on	N of items		
-	Standardized Items			
.903	.904	45		
.903	.904	45		

Table 3 shows normality test analysis by skewness and kurtosis value. According to Fah et al. (2019), if the data has value range in -1 to +1 is considered acceptable for normality.

Table 3. Test of Normality by Skewness and Kurtosis value						
	N Statistic	Ske	wness	Kurtosis		
		Statistic	Std. Error	Statistic	Std. Error	
Total Score	40	.367	.374	804	.733	
Valid N	40					

Data Analysis

In this study, the descriptive analysis and paired sample t-test were used by the researcher to analyze the data obtained. The detail is shown in Table 4.

Table 4. Method of Analysis						
Hypothesis	Method of Analysis					
There is no significant difference between the	Descriptive analysis					
mean score of pre-test and post-test						
achievement of Form One students in the topic						
of reproduction.						
Multimedia-based learning is not effective in	Paired sample t-test					
improving student academic achievement in						
the topic of reproduction.						



RESULT

This study was conducted at one of a secondary school in Kota Kinabalu, Malaysia. The participants involved in the study were 42 students from a single Form 1 classroom at the school. The sample population consisted of 18 male students and 24 female students. Figure 3 shows the distribution of pre-test grades among 42 respondents. Based on the pie chart, there were no respondents who scored grades A or B. Most of the respondents scored either D (48%) or E (45%). While there is a smaller percentage that scored C (7%). In summary, in this pre-test there were 23 (55%) respondents who passed the pre-test while there were 19 (45%) students who failed in the pre-test.



Figure 3. Percentage and Sum of Pre-test Grade

Figure 4 shows the distribution of post-test grade among 42 respondents. Based on the pie chart, the largest group (16 respondents) scored an A, indicating a strong understanding of the reproduction topic. Five respondents scored B, eleven respondents scored C, nine respondents scored D, and only one respondent scored an E, demonstrating minimal understanding. There is a significant improvement in grades across the board. In the pre-test, most respondents scored D (48%) or an E (45%), whereas in the post-test, most respondents scored C (26%) or higher (A: 38% and B: 12%). The biggest gains were seen in grades A, B, and C. The number of students scoring A increased from 0 to 16 (38%), B from 0 to 5 (12%), and C from 3 (7%) to 11 (26%). While there was a decrease in the number of students scoring D (from 20 to 9) and E (from 19 to 1).





Figure 4. Percentage and Sum of Post-test Grade

Analysis of Normality

According to Fah et al. (2019), the Kolmogorov-Smirnov test is appropriate for testing normality of data distribution with sample sizes larger than 50 individuals. The Shapiro-Wilk normality test is preferable for sample sizes below 50 individuals. The Kolmogorov-Smirnov normality test is used to assess whether the difference between the observed data distribution and the theoretical normal distribution is small enough and occurs by chance. If the variation is minor and occurs randomly, hence, the data distribution is viewed as normal. If the difference is significant, it can be inferred that the difference is not random but a result of potential sampling error. Hence, the data distribution is considered abnormal. These tests are used to assess whether a data set is likely to have come from a normally distributed population. The Shapiro-Wilk normality test is more appropriate to test the normality of the data since the sample size is 42 (<50). Table 5 shows the result of two normality tests, the Kolmogorov-Smirnov and the Shapiro-Wilk tests.

Table 5. Normality Tests of Pre-test and Post-test by Shapiro-Wilk						
	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pre-test	.160	42	.009	.970	42	.323
Post-test	.130	42	.071	.942	42	.035

The value of Sig. (.323) for pre-test is higher than the significance value (alpha = .05), therefore the value indicate that the distribution of data is normally distributed. While the value of Sig. (.035) for the post-test is less than the significance value (alpha = .05), therefore the value indicate that the data is abnormal. However, a skewness value between -1 and +1 is excellent, while a value between -2 and +2 is normally acceptable. Values that exceed -2 and +2 are considered as



significant indicators of abnormality. Table 6 below showed a descriptive analysis of pre-test and post-test. The skewness value for post-test is -.110 within the normal range of -1 to 1. Thus, this value indicates that the data is normally distributed.

	Table 6. Descriptive Analy	ists of Pre-test and Post-1	test	
		Descriptives		
			Statistic	Std. Error
PRE-TEST	Mean		16.81	.65
	95% Confidence Interval	for lower bound	15.51	
	Mean	Upper bound	18.11	
	5% Trimmed Mean		16.84	
	Median		18.00	
	Variance		17.52	
	Std. Deviation		4.19	
	Minimum		8	
	Maximum		25	
	Range		17	
	Interquartile Range		6	
	Skewness		28	.37
	Kurtosis		60	.717
POST-TEST	Mean		30.40	1.29
	95% Confidence Interval	for lower bound	27.81	
	Mean	Upper bound	33.00	
	5% Trimmed Mean		30.53	
	Median		29.50	
	Variance		8.33	
	Std. Deviation		69.32	
	Minimum		13	
	Maximum		43	
	Range		30	
	Interquartile Range		16	
	Skewness		11	.37
	Kurtosis		-1.17	.72

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Analysis of Mean Difference between Pre-test and Post-test

The hypothesis testing aimed to identify the relationship between the variables studied. The significance level set for this study is $\alpha = 0.05$. Based on the data that has been conducted, the researcher determines whether there is a significant difference in the pre-test and post-test academic achievement in the topic of reproduction. If the probability values (P-values) obtained from SPSS is P<0.05, then H₀ will be rejected. On the other hand, H₀ will be accepted if the Pvalue obtained is P>0.05. Table 7 below shows the Mean value for pre-test and post-test.



Table 7. Mean Value for Pre-test and Post-test				
	Mean	Ν	Std. Deviation	Std. Error Mean
Pre-Test	16.81	42	4.186	.646
Post-Test	30.40	42	8.326	1.285

The results of the data that have been obtained shows that there is a mean difference between student achievement in the pre-test and post-test. Based on the study sample (n=42), data analysis shows that the post-test (Mean= 30.40, n=42) is higher than the pre-test (Mean=16.81, n=42). The higher mean value of the post-test explains that the group has an improvement in terms of understanding in the topic of reproduction after using multimedia-based learning. The significance difference of 13.59 suggest that the null hypothesis stating that the multimedia-based learning is not effective in improving student academic achievement in the topic of reproduction was rejected. This means that there is a significant difference between pre-test and post-test mean score.

This result is in line with the study that have been done by Selvaganesan and Jayachithra (2021) that it was found that there is a significant difference between the experimental and control group of the post-test with respect to learning of zoology. The mean pre-test score of the experimental group was found to be 20.45 with a standard deviation (SD) of 4.00. The mean post-test score of the experimental group was 38.03 with an SD of 3.22. These results indicate that the mean post-test score (38.03) is significantly higher than the mean pre-test score (20.45) in the context of learning zoology. Thus, the study can be concluded that there is a significant difference between the pre-test and post-test scores of the experimental group with respect to their learning of zoology.

Other than that, the study that had been done by Kiat et al. (2020) also found out that students who undergo multimedia learning get higher scores than the control group in learning. The mean pretest score of the experimental group was 33.325 while the mean post-test score of the experimental group was 70.995. The study concludes that the higher average scores achieved demonstrate that a media-rich approach to learning enhances student comprehension and retention.

Analysis of the Effectiveness of Multimedia-Based Learning in Improving Student Academic Achievement

The study employed a pre-test and post-test design to assess the impact of the intervention. The researcher administered a 45-question test to all respondents before the intervention. The first data collection was conducted using a pre-test, where the researcher distributed a test consisting of 45 questions before the intervention. The pre-test results showed that none of the respondents achieved grades A or B. Three respondents scored C, 20 respondents scored D, and the remaining 19 respondents failed the pre-test.

The second data collection was conducted using a post-test, where the researcher distributed the same set of 45 questions after the intervention. The post-test results indicated a significant improvement whereby 16 respondents scored grade A, five respondents scored B, 11 respondents scored C, and nine respondents scored D. The number of respondents who failed the test decreased dramatically from 19 to 1.



The analysis of pre-test and post-test scores, as shown in Table 8, yielded a significant P-value of 0.000. This P-value, which is less than the commonly accepted threshold of 0.05 (P < 0.05), therefore, the null hypothesis can be rejected. In other words, the results indicate a statistically significant difference between the pre-test and post-test scores.

	Table 8. Paired Sample Test for Pre-test and Post-Test							
	Paired Differences							
	95% Confidence							
	Interval of the							
			Std. Difference					Sig. (2-
		Std. Dev	Error	Lower	Upper			tailed)
	Mean		Mean			t	df	
Pair 1								
Pretest-	-13.595	6.847	1.057	-15.729	-11.462	-12.868	41	.000
Posttest								

The increase in post-test scores may be caused by a few factors. The study that has been done by Selvaganesan and Jayachithra (2021) found that multimedia learning boosts the academic performance of the Grade 11 zoology students. In addition, it was observed that multimedia learning is more effective in enabling knowledge retention after a longer time in comparison to the control group. It also enhances the level of students' participation in the learning process, which in turn enhances ease in understanding the concepts taught.

The study of Akinbadewa and Sofowora (2020) also revealed that students exhibited positive attitudes towards multimedia instructional learning packages, perceiving Biology as more interesting, creative, and activity based. Additionally, students demonstrated increased confidence in answering Biology questions after utilizing the packages. Thus, the multimedia packages enhance students' perception of Biology, improve their attitude towards the subject, and ultimately result in higher learning outcomes.

DISCUSSION

Mean Difference between Pre-test and Post-test

The results of the data that have been obtained shows that there is a mean difference between student achievement in the pre-test and post-test. Based on the study sample (n=42), data analysis shows that the post-test (Mean= 30.40, n=42) is higher than the pre-test (Mean=16.81, n=42). The higher mean value of the post-test explains that the group has an improvement in terms of understanding in the topic of reproduction after using multimedia-based learning. The significance difference of 13.59 suggest that the null hypothesis (H01) of the study is rejected. This means that there is a significant difference between pre-test and post-test mean score.



This result is in line with the study that have been done by Selvaganesan and Jayachithra (2021) that there is a significant difference between the experimental and control group of the post-test with respect to learning of zoology. The mean pre-test score of the experimental group was found to be 20.45 with a standard deviation (SD) of 4.00. The mean post-test score of the experimental group was 38.03 with an SD of 3.22. These results indicate that the mean post-test score (38.03) is significantly higher than the mean pre-test score (20.45) in the context of learning zoology. Thus, the study can be concluded that there is a significant difference between the pre-test and post-test scores of the experimental group with respect to their learning of zoology.

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Effectiveness of Multimedia-Based Learning in Improving Student Academic Achievement

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The analysis of pre-test and post-test scores, as shown in Table 4.6, yielded a significant P-value of 0.000. This P-value, which is less than the commonly accepted threshold of 0.05 (P < 0.05), therefore, the null hypothesis can be rejected. In other words, the results indicate a statistically significant difference between the pre-test and post-test scores.

The increase in post-test scores may be caused by a few factors. The study that has been done by Selvaganesan and Jayachithra (2021) on the effectiveness of multimedia strategies in learning science found that multimedia learning boosts the academic performance of the Grade 11 zoology students. In addition, it was observed that multimedia learning is more effective in enabling knowledge retention after a longer time in comparison to the control group. It also enhances the level of students' participation in the learning process, which in turn enhances ease in understanding the concepts taught.



The study of Akinbadewa and Sofowora (2020) also revealed that students exhibited positive attitudes towards multimedia instructional learning packages, perceiving Biology as more interesting, creative, and activity based. Additionally, students demonstrated increased confidence in answering Biology questions after utilizing the packages. Thus, the multimedia packages enhance students' perception of Biology, improve their attitude towards the subject, and ultimately result in higher learning outcomes.

CONCLUSION

Overall, the research showed that multimedia is an effective way of helping students understand theories in science since concepts taught in science subjects are usually abstract. This can be proclaimed as an effective approach to increase learners' achievement not only in scientific subjects but also in other subjects in which graphic images and interactions facilitate learning. Furthermore, studies focusing on effective multimedia usage in LnS and preparation of teachers for multimedia integration can prepare educators to get the best out of multimedia fully. In sum, this research work reveals that multimedia-based learning is effective in contributing a positive change towards students' learning and teaching environment as well as making learning a more interesting affair in the learning of sciences.

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Conflict of Interest

The authors declare that there is no conflict of interest during the progress of the study.

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