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Enhancing Student Retention in Science: The Role of Multimedia Integration

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Abstract*—Student retention in science education is important for the student academic success. However, many of them fail to remember their lessons even after a short moment of instruction. Therefore, multimedia integration in teaching science has been introduced, as maybe it can help the students to ease this predicament. Wherefore, this study aims to find out if the utilization of multimedia as an instructional strategy in teaching science would promote better retention among the grade four students than the lecture method approach. A quantitative method through the application of quasi-experiment design was used in the study with equal number of student participants for both control and experimental group. A pre-post-and delayed posttest approach was used in collecting data with a month of interval for delayed posttest. The statistical tools used in the study were frequency, percentage and weighted mean, independent t-test, and the analysis of covariance (ANCOVA). The result revealed that the utilization of multimedia in science class notably implies better retention among the students taught with multimedia, rather than lecture method. Additionally, ANCOVA demonstrates the significant effect of the instructional method on students' retention scores after considering pre-test scores. This indicates that the method of instruction significantly influenced students' capacity to remember information. But only portion of the variation in the student retention scores is attributed to multimedia while the remaining are suggested as influence by the other factors. Therefore, it is recommended that teachers should adopt using multimedia in teaching, as it is a valuable tool for science teachers to boost students' ability to recall and promote deeper learning while considering other factors to fully maximize its utilization for enhance retention in science.*

Keywords— *Mutimedia integration, lecture method, student retention, long-term retention.*

I. INTRODUCTION

Teachers are using different kinds of teaching strategies in the classroom to help students learn. However, even with the best of intentions, most students find it hard to remember their lessons. According to the experiment of a German psychologist, Hermann Ebbinghaus, he revealed after three days, students forget 95% of what they learned in school (Samad., 2021). This signifies a poor retention of learning.

Retention relates to the ability of recalling information, either in short-term or long-term memory. In the so-called Forgetting Curve, discovered by Hermann Ebbinghaus as stated in the article of Colman (2022), it shows that the average learner forgets 70% of the learning they have in 24 hours. This is evident in the accomplishments of Filipino students, as seen in the 2022 Programmed for International Student Assessment, which places the Philippines at 77th place out of 81 participating nations. Additionally, as reported by Ombay (2024), students continuously experienced lag in the three PISA subjects. Furthermore, 78% of the Filipino students failed to reach minimum level of proficiency, this including Science subject.

In terms of the National Achievement Test, as stated by Branzuela, et al. (2023), the results are in congruence with the previous outcomes as all divisions have been consistently lowest in science. Furthermore, a medium school in the Philippines contributes to the poor performance of its division's NAT results. As a matter of fact, when the Division conducted Division Achievement Test, the school got 34.44% average during school 2021-2022, and 30.71% during school year 2022-2023 in science. The results were far lower than the passing average and student retention might be a factor in the poor achievement.

The study of Pei & Wu (2019) stressed out that the manner of the delivery of instruction plays an important role on how students remember learning best. Based on the study of Kamran, et al. (2023), interactive components in teaching may increase the learning outcomes. This has become a famous successful pedagogical approach in enhancing the students' understanding and involvement. According to Choe et al. (2019), the inclusion of different variety of content forms and representations may promote deeper comprehension of difficult topics to the students, improve learning outcomes, and a higher level of contentment in learning.

The integration of multimedia in teaching may positively result in a good retention rate among students. As reported by Mayer (2018), students gain in both learning achievement and motivation when they are engaged with multimedia science learning. This may reinforce the potential of multimedia integration in teaching and learning which could give a better result in the students' education.

The essentiality of conducting a study on student retention in science, particularly through multimedia integration, may potentially enhance the educational outcome and may address the alarming drop-out in STEM fields. Exemplifying high retention rates are salient for the school academic success which could impact good learning among students by

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fostering engagement and mastery of scientific concepts. This study will provide actionable insights that can improve the student's success in science subject. Ultimately, enhancing student retention may not only benefit them academically but to also impact on a more skilled workforce and on the advancement of society.

In contrast, some researchers claim that traditional teaching methods remain effective for better retention as they can foster a sense of community and belonging which is said to be an important aspect of retention. The traditional teaching method has been fundamental in educational settings, which is characterized by direct instruction and lecture-based method design. In the study of Alaagib et.al., (2019), claimed that for the effective retention of foundational knowledge, the traditional lectures were more effective.

The study on student retention in science education is a critical issue, it is due to the current situation that still many students find it hard to remain engaged and achieve academic success. This research intents in exploring the role of multimedia integration as a strategy in enhancing the student retention in their science classes. The utilization of different multimedia tools allows the teachers to create a more stimulating and engaging environment for the students. The use of multimedia in teaching does not only enhance knowledge retention but also foster greater participation and motivation among learners.

In this sense, due to the poor academic achievement shown by the students in science, it is important to find out if incorporating multimedia as instructional strategy could aid in enhancing the student retention in scientific knowledge. Exactly, this is the researcher had been set out to accomplish in this study.

Objectives

This study aims to determines if incorporating multimedia in science class help the grade four student retain more information than the use of lecture method approach. Specifically, it will seek to answer the following questions.

1) What is the socio-demographic profile of the students in terms of gender, age, ethnicity, and students' parents' monthly income?
2) What is the mean difference in the achievement scores of students in science taught with multimedia integrated instruction and those with lecture method approach in the pre-test, and post-test?
3) What is the difference in the mean retention score of students in science class with multimedia integrated instruction and those with lecture method approach?

II. Methodology

This study used quantitative methods through the application of quasi-experiment design. The researcher provided treatment with the integration of multimedia in teaching science content to the respondents that belonged to the experimental group while the control group received instruction with the use of traditional lecture method. This utilizes pre-test, posttest, and retention test as measurement in the students changes in their behavior. The delayed posttest was administered a month after the administration of the posttest to check the retention of learning among the students.

The study catered the fifty-two (52) students in grade four as selected through purposive sampling, where 26 of them were classified as the experimental group while the remaining 26 respondents were categorized as the control group during school year 2024-2025. The respondents were classified according to their demographic profile which includes their age, gender, ethnicity, socio-economic status and their academic prior knowledge through the results of the pre-test. The study does not cover the comparison of the students' retention of learning based on their socio-demographic profiles. Instead, these variables were only used to classify respondents into experimental and control groups to minimize bias caused by individual differences prior to the intervention.

The study used a self-made instrument based on the competency provided in the MATATAG curriculum specifically designed to be used by the grade four students and science teachers, such as to describe in simple terms how the following human body systems work: muscular, skeletal, digestive, circulatory, and respiratory. The content was anchored from the lesson exemplar, quarter 2, week 1 and 2 as developed by Dr. Randel D. Estacio (Quezon City University) and was validated by Dominador D. Mangao (Philippine Normal University - Manila) and Marie Grace S. Cabansag (Philippine Normal University - North Luzon). Furthermore, the instrument underwent an intensive validity process with the help of five experts with a Doctor of Philosophy and a Doctor of Education who specialized in the field of Science and Language and an additional psychometrician assessed the suitability of the instrument to what it intent to measure. Furthermore, thirty (30) identified learners in grade four from the neighboring school where the experiment was conducted were utilized for pilot testing. The reliability test has yielded a Cronbach's alpha coefficient of $\alpha = 0.813$, suggesting that the questionnaire has an acceptable reliability.

The study strictly adhered to the ethical standards. Approved letters of intent, consent and assent forms from the parents of the respondents were secured prior to the conduct of the study. The confidentiality of the respondents' identity and the data gathered were strictly observed, ensuring the data solely for academic purposes were obtained.

Frequency, percentage, and weighted mean were used as the statistical tools for the descriptive part of the sudy, while for the inferential statistics included the used of independent samples t-test. This served to calculate the significant difference between the two groups of samples. The Analysis of Covariance (ANCOVA) was employed to establish the statistical difference in retention.

III. Results and Discussion

The following findings were revealed based on the data collected. Results of the study were presented with corresponding interpretations and discussions.

Students' Socio-demographic Profile

Figure 1 shows the distribution of students by ethnicity and gender across control and experimental groups, with each

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group consisting of 26 students. Both groups have an equal number of 12 males and 14 females, where 21 are Yakans and 5 are Tausugs, ensuring that gender and ethnicity is balanced between them.

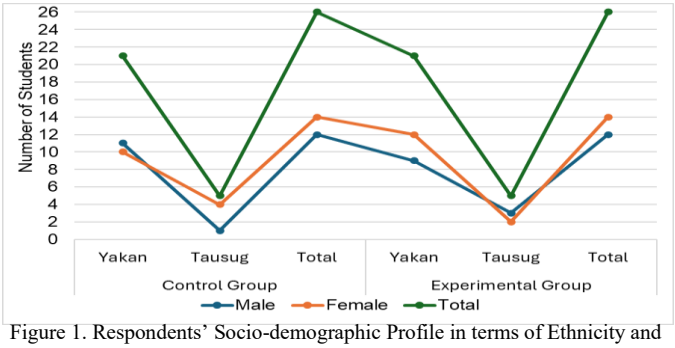

Figure 1. Respondents' Socio-demographic Profile in terms of Ethnicity and Gender Distribution in Control Group and Experimental Group.

In terms of its distribution, among males, the control group comprises 11 Yakans and 1 Tausug, while the experimental group consists of 9 Yakans and 3 Tausugs. For females, the control group has 10 Yakans and 4 Tausugs, whereas the experimental group has 12 Yakans and 2 Tausugs. Since both groups have the same total number of males and females, with slight variations in their ethnic composition within genders, the distribution appears fairly balanced. This minimizes demographic bias, ensuring that any differences in learning outcomes can be attributed to the instructional method rather than ethnicity or gender.

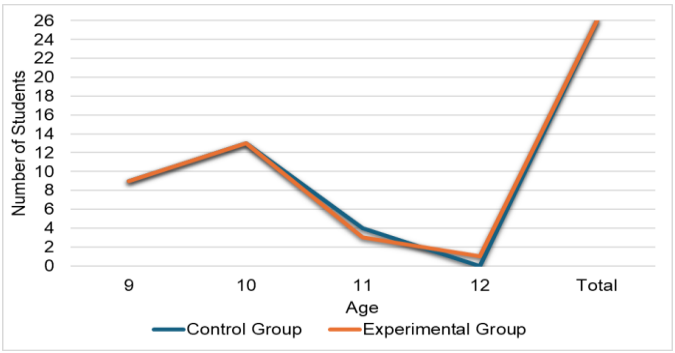

Figure 2. Respondent's Socio-demographic Profile in terms of Age Distribution of Students in the control group and Experimental Group.

Figure 2 presents the distribution of students in control and experimental groups in terms of their age where each of them consists of 26 students. In both groups, the most common age is 10 years, with 13 students (50%) in both the control and experimental groups. The next most frequent age is 9 years, with 9 students (34.6%) in each group. The control group has a slightly higher percentage of students aged 11 (15.4%), while the experimental group has a slightly lower percentage at 11.5%. Additionally, one student (3.8%) in the experimental group is aged 12, while the other has no students aged 12. Consequently, the age distribution is fairly similar between the two groups, suggesting that age does not serve as a significant confounding factor in this study. The groups are balanced in terms of age, ensuring that any observed differences in outcomes can be attributed to the instructional method rather than age differences.

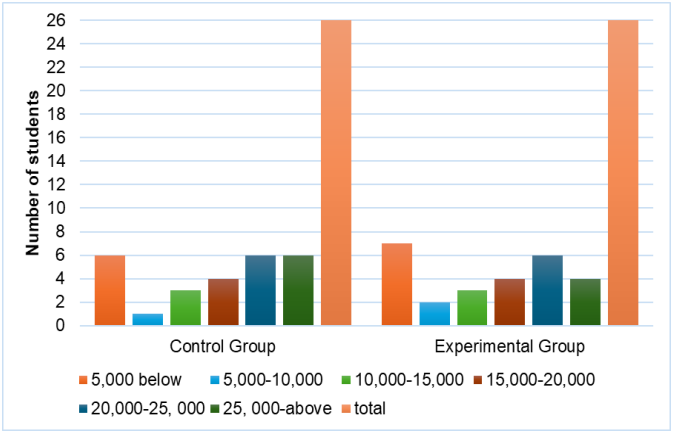

Figure 3. Respondents' Socio-demographic Profile in terms of Monthly Income Distribution in Control Group and Experimental Group.

Figure 3 displays the distribution of students based on their parents' monthly income across control and experimental groups, with each group consisting of 26 students. The income of both groups is evenly represented, with a few notable differences in distribution and concentrations in certain brackets.

The control and experimental groups have identical earnings in three income distribution, such 3 of them gained 10,000-15,000 earning in a month, 4 of them have an income of 15,000-20,000, and 6 students' parents have a monthly income of 20,000-25,000. However, the remaining earning bracket shows a slight disparity in the monthly income of the respondents' parents. The control group has 6 parents earning 5,000 below in a month, while the experimental group has 7 parents. In the 5,000-10,000 brackets, the control group has 1 parent, and the experimental group has 2. Meanwhile, 6 parents in the control group earned above 25,000-above, compared to only 4 in the experimental group. Despite the notable differences between the two groups, such as variations in the monthly income of their parents, both maintain an identical total number of 26 students, ensuring that any observed differences in academic outcomes can be more attributed to the instructional method used rather than to income-related disparities

What is the mean difference in the achievement scores of students in science taught with multimedia integrated instruction and those with lecture method approach in the pre-test, and post-test?

TABLE 1. T-test Results of the Pre-test Achievement Scores among the Control and Experimental Group.

Pretest	Mean	Mean Difference	SD	t	P-value
Control Group	9.65		2.26		
Experimental Group	9.62	0.038	4.73	0.37	.97

Table 1 presents the t-test results of the pre-test scores of the grade four students under control group taught with lecture method approach and the experimental group taught with the

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integration of multimedia in science class. The data show that the t-value was t=0.37 with a probability value (p-value) of p=0.97, which is higher than the alpha level of a=0.05, indicating that the difference is statistically not significant. Given the mean difference of M=0.038 between the control group with the mean of M=9.65 and experimental group with the mean of M=9.62, which is negligible. Therefore, if there's no significant difference in the pre-test score between the two groups, it suggests that they are fairly similar prior to any treatment being applied. This is significant because this indicates that any difference observed in the posttest can be more attributed to the intervention being studied, rather than the pre-existing differences between the groups.

TABLE 2. T-test Results of the Posttest Achievement Scores among the Control and Experimental Group.

Post Test	Mean	Mean Difference	SD	t	P-value
Control Group	12.23	-3.89	3.58	0.37	.003
Experimental Group	16.12		5.32		

Table 2 presents the achievement scores of students who participated in multimedia-integrated instruction compared to those who experienced the lecture method on the posttest results. This shows that the value of t=0.37 and a p value of p=0.003 which is lower than a=0.05. As a result, the group mean for pupils in the control and experimental groups differs considerably. Furthermore, the mean score after the test for the experimental group is M=16.12 which is notably higher than the mean score achieved by the students instructed through the modified lecture method who attained a posttest mean score of M=12.23, resulting in a notably lower mean gain of M=3.89. The average difference observed between the two instructional methods indicates a preference for multimedia-integrated instruction. This indicates that students who engaged with multimedia exhibited more significant learning advancements than their counterparts in the lecture method approach. Moreover, the findings suggest that although multimedia expanded the distribution of scores among pupils, reflecting a broader spectrum of performance results, the adjusted lecture approach led to a more consistent yet diminished overall achievement. This variability indicates that multimedia-integrated instruction could address a range of learning needs, potentially improving engagement and comprehension more effectively than conventional lecture methods.

What is the difference in the mean retention score of students in science class with multimedia integrated instruction and those with lecture method approach?

TABLE 3. T-test Results of the Retention Test Achievement Scores among the Control and Experimental Group.

Retention Test	Mean	Mean Difference	SD	t	P-value
Control Group	11.77		3.993		
Experimental Group	15.27	-3.50	5.896	-2.506	.016

Table 3 illustrates the achievement scores of students who participated in multimedia-integrated instruction compared to those who experienced the lecture method approach during the retention test results. This shows that a t-value of t=-2.506 and a p value of p=0.016 which is lower than a=0.05. Therefore, there is a significant difference in the group mean of the students under control and experimental group. Furthermore, this demonstrates that students who were taught using multimedia-integrated instruction had a higher mean retention score (15.27) compared to those who were taught using the lecture method approach (11.77), with an overall mean difference of 3.50. This suggests that the incorporation of multimedia into the classroom is more beneficial than standard lectures in improving the capacity of pupils to retain information over time. In addition, the fact that the standard deviation was larger in the multimedia group (5.896) compared to the lecture group (3.993) indicates that there was a greater degree of variability in retention. This indicates that some students gained more than others from the multimedia method.

TABLE 4: Summary of Analysis of Covariance (ANCOVA) for Testing Difference in Retention Between the Control and Experimental Groups

Source	Type III Sum of Squares	df	Mean Square	F	P-value
Corrected Model	329.359[a]	2	164.679	7.352	.002
Intercept	492.223	1	492.223	21.974	.000
Pretest	170.109	1	170.109	7.594	.008
Group	160.993	1	160.993	7.187	.010
Error	1097.622	49	22.400		
Total	10931.000	52			
Corrected Total	1426.981	51			

a. R Squared = .231 (Adjusted R Squared = .199)

The results presented in table 4 demonstrate the significant main effect of the instructional method on student retention scores, F (1, 49) = 7.187, p = .010, after considering pretest scores. This indicates that the method of instruction significantly influenced students' capacity to remember information. The pretest scores demonstrated a significant impact on retention, F (1, 49) = 7.594, p = .008, indicating that prior knowledge played a role in retention tests. The overall model demonstrates statistical significance, F (2, 49) = 7.352, p = .002, accounting for 23.1% of the variance (R^2 = .231, Adjusted R^2 = .199) in retention scores. Given that Levene's Test for Equality of Variances (F = 3.798, p = .057) confirms the assumption of homogeneity of variances, the results of the ANCOVA are deemed valid. The null hypothesis has been rejected, indicating that students who received instruction through multimedia integration exhibited notably higher retention scores than their peers who were taught using lecture methods. However, the 0.231 R Squared result indicates that approximately 23.1% of the variance in the retention test can be interpreted by the integration of multimedia in teaching science. The remaining 76.9% of the variance may suggest other factors, such as student motivation, attendance, parental support, and teacher effectiveness, also play crucial roles in the learning process (Comighud, S. M, 2021; Raycahudhari A., et al., 2010).

IV. CONCLUSION

The study demonstrates that integrating multimedia into instructional methods significantly enhances students' learning

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outcomes and retention capabilities compared to traditional lecture-based approaches. The socio-demographic analysis revealed a demographic parity between the control and experimental groups, minimizing potential biases related to gender and ethnicity, and affirming the validity of the findings. Both groups exhibited similar age distributions and income categories, further supporting the comparability of the cohorts.

Pretest scores established that there were no initial differences in academic achievement between the groups, allowing for a clear analysis of the post-intervention results. The independent t-tests conducted on both posttest and retention scores confirmed that students taught through multimedia integration outperformed their counterparts who received traditional lectures. Specifically, the experimental group demonstrated higher mean scores, indicating improved learning and retention, attributed to the engaging and multi-faceted nature of multimedia instruction.

Additionally, ANCOVA results underscored the significant influence of the instructional method on student retention scores, although the R-squared analysis indicated that only a portion of the variance in retention could be accounted for by multimedia integration, suggesting that other factors, such as student motivation, attendance, parental support, and teacher effectiveness, also play crucial roles in the learning process. Overall, this study supports the premise that multimedia-enhanced education can lead to improved academic outcomes, and it encourages the exploration of additional factors that contribute to students' learning experiences and retention capabilities.

V. Other Recommendations

Through the conduct of intervention, assessments, and literature support, the study unravels the potential benefits of integrating multimedia in enhancing the student retention in science. Based on the findings, it is recommended that multimedia-integrated instruction be adopted in teaching Science, as it significantly enhances students' academic performance and retention compared to traditional lecture methods. Teachers should employ the use of multimedia in their class for the students to learn and have a higher retention rate of learning. However, the integration of this in teaching should ensure the accuracy, relevance, and alignment of the multimedia elements to be used with the established learning objectives. This will ultimately help students perform better and achieve better academic retention results. Students should be inspired, encouraged, and informed on the benefits of regular use of multimedia in class to elicit active participation in the interactive discussion and promotion of better learning and knowledge retention among them.

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