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RESEARCH ARTICLE

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IMPACT OF INTERACTIVE MULTIMEDIA LESSONS ON STUDENTS SCIENCE ACHIEVEMENT

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ABSTRACT

The study investigates the effectiveness of interactive multimedia lessons on Grade 8 students' science achievement. A quasi-experimental pre-test–post-test control group design is employed. The sample consists of 80 Grade 8 students from Shri Avinashilingam Girls Higher Secondary School, Coimbatore, who are randomly assigned to an experimental group ($n = 40$) and a control group ($n = 40$). The experimental group receives interactive multimedia-based instruction, while the control group receives traditional lecture-based instruction. A validated 30-item science achievement test is administered as both pre-test and post-test over a four-week instructional period. Data are analysed using descriptive statistics and an independent samples t -test. Results indicate that the experimental group achieves a significantly higher post-test mean score ($M = 26.8$, $SD = 2.9$) than the control group ($M = 21.4$, $SD = 3.1$), $t(78) = 7.23$, $p < .001$. Pre-test scores of both groups are nearly equivalent, confirming baseline homogeneity. The findings demonstrate that interactive multimedia instruction significantly enhances science achievement, conceptual understanding, and learner engagement among Grade 8 students. The study supports Mayer's Cognitive Theory of Multimedia Learning and provides empirical evidence for integrating multimedia-based instruction in middle school science education.



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I. INTRODUCTION

The rapid advancement of digital technology transforms contemporary education and creates new opportunities for improving teaching and learning processes. One of the most significant innovations is multimedia learning, which integrates text, images, audio narration, animations, videos, and interactive simulations to create a multisensory learning environment [1], [2]. Multimedia instruction aligns with Mayer's Cognitive Theory of Multimedia Learning, which explains that learners understand concepts more effectively when information is presented through both visual and auditory channels [2], [3]. In science education, multimedia learning is particularly valuable because many scientific concepts are abstract, dynamic, and difficult to visualize using traditional instructional methods. Processes such as chemical reactions, cellular functions, energy transfer, and ecological interactions often involve invisible or complex phenomena that students struggle to conceptualize [4], [5]. Interactive multimedia tools, including animations and virtual simulations, allow learners to observe scientific processes, manipulate variables, and receive immediate feedback, thereby supporting deeper conceptual understanding [5], [6]. Previous studies report that multimedia instruction increases student engagement, motivation, and retention of scientific knowledge [7], [8]. Research also indicates improvements in higher-order thinking skills and learner confidence when interactive multimedia is used effectively [9-11]. However, existing studies frequently focus on limited content areas, small sample sizes, or non-experimental designs, and few are conducted in authentic middle school classroom settings [4], [6]. Grade 8 students are at a critical developmental stage, transitioning from concrete to abstract thinking and frequently experiencing scientific misconceptions [12], [5]. Understanding how interactive multimedia affects science achievement at this level is therefore essential. Despite the growing availability of digital tools in schools, educators require evidence-based guidance on whether multimedia instruction leads to measurable improvements in academic performance when compared to traditional lecture-based teaching [1], [10].

This study addresses these gaps by examining the effectiveness of interactive multimedia instruction on Grade 8 students' science achievement using a pre-test–post-test experimental design. By comparing learning outcomes between students taught with interactive multimedia and those taught through traditional teacher-centered methods, the study contributes empirical evidence to the existing body of research and informs instructional practice, curriculum development, and educational policy [9], [10], [6].

Research Question

1. Does interactive multimedia instruction significantly improve the science achievement of Grade 8 students compared to traditional lecture-based instruction?
2. Is there a significant difference in science achievement scores between students taught using interactive multimedia and those taught through traditional teaching methods?

Objectives

1. To determine whether interactive multimedia instruction leads to higher science achievement among Grade 8 students compared to traditional lecture-based teaching.
2. To measure the difference in pre-test and post-test science achievement scores between students taught with multimedia-based instruction and those taught using traditional methods.

Hypothesis

H_1 (Alternative Hypothesis):

Students who receive interactive multimedia instruction will have significantly higher science post-test achievement scores than students who receive traditional lecture-based instruction.

H_0 (Null Hypothesis):

There is no significant difference in science post-test achievement scores between students taught using interactive multimedia instruction and those taught using traditional instruction.

Importance of the study

This study provides empirical evidence on the instructional value of interactive multimedia in middle school science education. The findings support teachers, curriculum developers, and policymakers in making informed decisions about integrating multimedia tools to enhance student learning and achievement [1], [2], [8].

II. THEORETICAL REFERENCE

By [10] conducted a quasi-experimental study to investigate the effects of multimedia instruction on high school physics students' learning outcomes. The study involved 80 students from two comparable classes in a public high school. Students were randomly assigned to either the experimental group ($n = 40$), which received physics lessons enhanced with animations and interactive simulations, or the control group ($n = 40$), which received traditional teacher-centred instruction using textbooks and lectures. Results showed that the experimental group outperformed the control group on post-tests, demonstrating that multimedia facilitates conceptual understanding and problem-solving skills. [9] conducted an experimental study to investigate the effects of animated multimedia lessons on middle school students' understanding of biology concepts, particularly cellular processes. The study involved 100 Grade 8 students from a public middle school. Students were randomly assigned to two groups: the experimental group ($n = 50$), which received animated multimedia lessons including interactive diagrams, narrated videos, and virtual cell models, and the control group ($n = 50$), which received traditional lecture-based instruction supplemented with static diagrams from textbooks. Results indicated that students in the experimental group scored significantly higher on the post-test compared to the control group. The study concluded that animated multimedia instruction not only improves conceptual understanding but also encourages active exploration and engagement, supporting the use of interactive visualizations in middle school science curricula. By [8] conducted a quasi-experimental study to examine the effects of interactive multimedia lessons on middle school students' engagement and motivation in science.

The study involved 60 students aged 13–14 from two sections of a single public middle school. Students were randomly assigned to either the experimental group ($n = 30$), which received interactive multimedia lessons incorporating animations, videos, simulations, and clickable exercises, or the control group ($n = 30$), which received traditional lecture-based instruction using textbooks and whiteboard explanations. Findings indicated that students in the experimental group exhibited significantly higher engagement scores compared to the control group. They were more likely to participate in class discussions, complete assignments, and explore content independently outside the classroom. By [7] conducted an experimental study involving 120 high school students who were divided into two groups: one group received multimedia-enhanced lessons incorporating animations, videos, and interactive exercises, while the control group received traditional textbook-based instruction. Results indicated that students in the multimedia group demonstrated significantly higher levels of interest, attention, and intrinsic motivation compared to the control group. Moreover, increased engagement was positively correlated with improved learning outcomes, including better test scores and retention of material. By [7] concluded that multimedia not only facilitates understanding but also enhances students' active participation, suggesting that motivation is an important mediator in the effectiveness of multimedia learning. By [2] in Cognitive Theory of Multimedia Learning, proposed that individuals learn more effectively when instructional materials combine words and pictures rather than words alone. Mayer's theory is supported by numerous empirical studies. In turn [3] conducted a series of experiments with college students ($n \approx 120$) demonstrating that learners who received lessons incorporating both narration and animation performed significantly better on transfer tests than those who received only verbal explanations.

These results highlight the role of the dual-channel processing system auditory/verbal and visual/pictorial in enhancing retention and reducing cognitive overload.

III METHODOLOGY

III.1 RESEARCH DESIGN, SAMPLE AND PROCEDURE

A quasi-experimental pre-test–post-test control group design is employed to examine the effectiveness of interactive multimedia instruction on Grade 8 students' science achievement [10], [6]. The sample consists of 80 Grade 8 students from Shri Avinashilingam Girls Higher Secondary School, Coimbatore, who are randomly assigned to an experimental group ($n = 40$) and a control group ($n = 40$). The experimental group receives multimedia-based instruction incorporating animations, narrated videos, simulations, and interactive quizzes designed according to multimedia learning principles [1], [2]. The control group receives traditional lecture-based instruction. A validated 30-item science achievement test is used to assess students' learning outcomes [9], [10]. Data are analysed using descriptive statistics and an independent samples t -test to determine significant differences between groups [6].

IV. RESULTS AND DISCUSSIONS

Table 1: Pre-test and Post-test Science Achievement Scores of Experimental and Control Groups.

Group	N	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD
Experimental (Multimedia Instruction)	40	14.5	3.2	26.8	2.9
Control (Traditional Instruction)	40	14.2	3.0	21.4	3.1

Source: Authors, (2026).

Note. N = number of participants; SD = standard deviation.

The table 1 presents the pre-test and post-test mean achievement scores of the experimental and control groups. The pre-test mean scores of the experimental group ($M = 14.5$, $SD = 3.2$) and the control group ($M = 14.2$, $SD = 3.0$) are nearly equal, indicating that both groups were homogeneous in science achievement before the intervention. After the instructional intervention, a noticeable improvement was observed in both groups. However, the experimental group, which received interactive multimedia instruction, showed a substantially higher post-test mean score ($M = 26.8$, $SD = 2.9$) compared to the control group taught through traditional methods ($M = 21.4$, $SD = 3.1$). The greater gain in post-test scores of the experimental group suggests that interactive multimedia lessons were more effective in enhancing students' science achievement than traditional lecture-based instruction. The reduction in standard deviation in the experimental group also indicates more consistent learning outcomes among students exposed to multimedia instruction.

Table 2: t -test Analysis of Post-test Achievement Scores.

Variable	t -value	df	p -value	Interpretation
Post-test scores	7.23	78	$< .001$	Significant

Source: Authors, (2026).

The table 2 shows the results of the independent samples t -test conducted to compare the post-test achievement scores of the experimental and control groups. The obtained t -value of 7.23 is statistically significant at the 0.001 level. Since the p -value is less than 0.05, the difference between the post-test mean scores of the two groups is significant. This indicates that interactive multimedia instruction had a significant effect on students' science achievement compared to traditional teaching methods. The results indicate that the experimental group demonstrates significantly higher post-test achievement scores compared to the control group. These findings confirm that interactive multimedia instruction enhances science achievement among Grade 8 students [9], [10], [11]. The findings support Mayer's Cognitive Theory of Multimedia Learning, which explains that dual-channel processing and reduced cognitive load facilitate meaningful learning [2], [3]. The results are consistent with previous studies reporting improved achievement, engagement, and conceptual understanding through multimedia-based instruction [5], [7], [8], [10].

V. LIMITATIONS

Despite its contributions, the study has several limitations that should be considered when interpreting the findings. The sample size was relatively small and limited to a single school, which may restrict the generalizability of the results to other contexts. Additionally, the study focused only on Grade 8 students and selected science topics, thereby limiting its applicability to other grade levels and subject areas [12]. The duration of the intervention was limited to four weeks, which may not fully capture the long-term impact of multimedia instruction on students' retention and academic performance [11]. Furthermore, the study did not account for individual learner differences such as prior knowledge, learning styles, and digital literacy, which may influence learning outcomes [1]. Another limitation is related to the availability of technological resources and the teacher's proficiency in implementing multimedia instruction, both of which may have influenced the effectiveness of the intervention [6]. These factors should be taken into account in future research and implementation.

VI. RECOMMENDATIONS

Based on the findings of the study, several recommendations are proposed for educational practice and future research. First, teachers should integrate interactive multimedia tools into science instruction to enhance students' conceptual understanding, engagement, and academic achievement [2], [10]. Professional development programs should be organized to train teachers in designing and effectively implementing multimedia-based lessons [1]. Second, educational institutions and policymakers should invest in technological infrastructure and digital resources to support multimedia learning environments. Curriculum developers are encouraged to incorporate multimedia-based instructional strategies into science curricula to promote active and student-centered learning [8], [9]

VII. SCOPE OF THE STUDY

The present study opens several avenues for future research in the field of multimedia-based science education. Future studies may expand the sample size and include students from diverse schools, regions, and socio-economic backgrounds to enhance the generalizability of the findings [10], [6]. Research can also be extended to different grade levels and subject areas to examine whether the effectiveness of interactive multimedia instruction is consistent across various educational contexts [9]. Longitudinal studies are recommended to investigate the long-term effects of multimedia instruction on students' retention, conceptual understanding, and academic achievement over time [11]. In addition, future research may explore the impact of specific multimedia components such as animations, simulations, gamification, and virtual or augmented reality to determine which elements contribute most significantly to learning outcomes [1], [2]. Further studies could also examine the role of learner-related variables such as motivation, cognitive styles, prior knowledge, and digital literacy in influencing the effectiveness of multimedia instruction [8]. Comparative studies between multimedia-based, blended, and fully online learning environments would provide deeper insights into optimal instructional strategies. Moreover, future research may focus on teacher-related factors, including training, technological competence, and instructional design skills, to ensure effective implementation of multimedia tools in classrooms. Such investigations will contribute to the development of more inclusive, adaptive, and technology-enhanced teaching practices in science education.

VIII. CONCLUSIONS

The findings of the present study provide strong empirical evidence that interactive multimedia instruction significantly enhances Grade 8 students' science achievement compared to traditional lecture-based teaching methods. The experimental group demonstrated significantly higher post-test scores than the control group, indicating improved understanding, retention, and application of scientific concepts. The use of multimedia elements such as animations, simulations, and narrated visuals enabled learners to process information through both visual and auditory channels, thereby facilitating meaningful learning [2], [3]. These findings are consistent with previous research indicating that multimedia-based instruction enhances students' academic achievement, engagement, and conceptual understanding [8-10]. The results also support the Cognitive Theory of Multimedia Learning, which emphasizes dual-channel processing and reduced cognitive load as key factors in effective learning [2]. Furthermore, the reduced variability in post-test scores of the experimental group suggests that multimedia instruction promotes more consistent learning outcomes among students. In the context of middle school science education, where learners often struggle with abstract and complex concepts, interactive multimedia provides an effective pedagogical approach that enhances both comprehension and motivation [4], [6]. Overall, the study highlights the importance of integrating multimedia tools into classroom instruction to improve teaching effectiveness and student achievement.

IX AUTHOR'S CONTRIBUTION

Conceptualization: T. Premalatha, Sambath Rani

Methodology: T. Premalatha, Sambath Rani

Investigation: T. Premalatha, Sambath Rani.

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