

## IMPACT OF MULTIMEDIA-BASED TEACHING ON STUDENTS' ACHIEVEMENT IN MATHEMATICS

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### Abstract

Mathematics plays a vital role in the intellectual development of students, but many face difficulties in understanding abstract concepts due to traditional teaching methods. This study investigates the effectiveness of the multimedia approach in enhancing the mathematical achievement of secondary school students. Using a quasi-experimental design, 80 students were divided into two groups: the Control group (taught using conventional methods) and the Experimental group (taught using multimedia tools such as animations, interactive simulations, and audio-visual presentations). Pre-tests and post-tests were conducted to assess achievement, and an attitude scale measured students' responses toward multimedia learning. The results revealed that students in the Experimental group achieved significantly higher post-test scores compared to the Control group ( $p < 0.01$ ). Moreover, students exposed to multimedia instruction showed improved understanding, retention, and positive attitudes toward mathematics. The study concludes that integrating multimedia into the teaching-learning process enhances students' mathematical performance and motivation, and recommends its broader implementation in classroom practices.

**Key Word:** Mathematical Achievement, Multimedia Approach, Teaching-Learning Process

### 1. Introduction

Mathematics is a foundational subject that plays a crucial role in the intellectual development of students. Despite its importance, many students struggle with understanding mathematical concepts, often due to abstract presentation and lack of engagement. The integration of multimedia in education has opened new possibilities for overcoming such challenges. The multimedia approach, which combines various digital media such as visuals, audio, animations, and interactive applications, can enhance comprehension and stimulate learner interest. This study aims to explore the effectiveness of multimedia approaches in improving students' mathematical achievement at the secondary level.

#### Meaning of Mathematical Achievement:

Mathematical Achievement refers to the level of knowledge, skills, understanding, and performance a person demonstrates in mathematics. It measures how well a student can solve mathematical problems, apply concepts, perform calculations, and think critically in the subject of mathematics.

### Definition of Mathematical Achievement:

"The measurable performance or competency of an individual in mathematics, typically assessed through tests, examinations, or other evaluation methods, reflecting the student's ability to understand concepts, solve problems, and apply mathematical knowledge in various contexts."

Example:

- A student solves algebra problems correctly in a test and scores 85%. This score represents their mathematical achievement.

Importance:

- Helps assess students' understanding of math concepts.
- Indicates areas where students need improvement.
- Guides teachers to improve their teaching methods.

### Multimedia Approach – Meaning and Definition

#### Meaning

The **Multimedia Approach** in education refers to using a combination of different media types such as text, images, audio, animations, and videos to teach concepts. It makes learning more engaging, interactive, and helps students understand complex ideas more easily.

#### Definition

The **Multimedia Approach** is an educational method that integrates multiple forms of media (text, graphics, sound, animation, and video) into the teaching-learning process to make learning more effective, interactive, and easier to understand, especially for difficult or abstract subjects like mathematics.

#### Example in Mathematics

- **Video animation** showing how a geometric theorem works.
- **Interactive simulations** where students can manipulate shapes or variables.
- **Audio explanations** combined with visual diagrams for solving algebra problems.
- **Interactive quizzes** that provide instant feedback.

### Benefits of Multimedia Approach

Benefit	Explanation
Makes learning interesting	Multimedia attracts attention more than traditional lectures.
Supports different learning styles	Visual learners benefit from images and animations, auditory learners from audio explanations.
Facilitates better understanding	Abstract concepts (like fractions, geometry, algebra) become easier with visual demonstrations.
Encourages active learning	Interactive elements make students participate rather than just listen.

### Teaching-Learning Process – Meaning and Definition

#### Meaning:

The **Teaching-Learning Process** is a systematic interaction between the teacher and students where knowledge, skills, and values are transferred. It involves the use of various

methods, materials, and activities that help students understand subjects and develop abilities to apply knowledge in real life.

**Definition:**

The **Teaching-Learning Process** is a planned, purposeful interaction between teachers and learners, where the teacher explains concepts, provides examples, encourages participation, and evaluates students' learning to ensure effective knowledge acquisition and skill development.

**Key Components of the Process:**

Component	Role
Teacher	Acts as a facilitator by explaining concepts, giving examples, guiding students, and providing feedback.
Student	Actively participates by listening, practicing problems, asking questions, and applying the knowledge.
Teaching Methods	Lectures, discussions, practical demonstrations, multimedia use, group activities.
Learning Materials	Textbooks, charts, videos, interactive software, models, multimedia presentations.
Evaluation	Tests, quizzes, assignments, projects, practical demonstrations to assess understanding.

**Example in Mathematics:**

1. **Step 1 – Explanation:** The teacher explains the concept of fractions with examples on the blackboard.
2. **Step 2 – Demonstration:** The teacher uses an animated video showing how to add fractions.
3. **Step 3 – Practice:** Students solve problems in the workbook.
4. **Step 4 – Assessment:** The teacher gives a short quiz to test their understanding.
5. **Step 5 – Feedback:** Teacher discusses common mistakes and correct methods.

**2. Objectives of the Study**

1. To compare the mathematical achievement of students taught using a multimedia approach with those taught using traditional methods.
2. To evaluate the effectiveness of multimedia in enhancing student engagement and understanding of mathematical concepts.
3. To examine students' attitudes toward the use of multimedia in mathematics learning.

**3. Hypotheses of the Study**

**H<sub>0</sub>:** There is no significant difference in the mathematical achievement of students taught through traditional methods and those taught using the multimedia approach.

**H<sub>1</sub>:** Students taught using the multimedia approach will show significantly higher achievement in mathematics than those taught using traditional methods.

**4. Review of Related Literature**

**Shah, Iqbal, and Khan, Muhammad (2015)** examined the effect of using multimedia-aided teaching (MAT) on students' academic achievement and their attitude towards learning at the elementary level, specifically in science education. Multimedia in education

has gained importance because of its positive role in improving the teaching and learning process. In this study, 60 students were randomly divided into two groups: an experimental group and a control group. A pretest-posttest control group design was used. The experimental group was taught using multimedia presentations, while the control group followed traditional teaching methods. The teaching lasted for 20 weeks. Data were collected using valid and reliable questionnaires. Additionally, an Attitude Towards Science Scale (ATSS) was applied to measure students' attitudes before and after the teaching period. The data analysis was performed using an independent sample t-test. The results showed that multimedia-aided teaching was more effective than traditional methods in improving students' academic achievement. Moreover, students taught with multimedia developed a more positive attitude toward science compared to those taught using conventional methods.

**Kumar, R. Raj and Hema, G. (2017)** explored the impact of using multimedia instructional strategies on students' learning and retention in mathematics. Information and Communication Technology (ICT) has become an important part of everyday life, helping in areas such as satellite launches, business management, and social networking. These technologies also help students better understand mathematical concepts and relationships by allowing them to discover and organize knowledge in an interactive way. The study involved 60 students from grade IX, who were randomly divided into two groups: an experimental group of 30 students and a control group of 30 students. The experimental group was taught using multimedia instructional strategies, while the control group received traditional teaching methods. Both groups took a pre-test before the teaching began to assess their starting knowledge. After the teaching period, both groups took a post-test to measure their learning progress. Then, after 20 days, both groups were given a retention test to assess how well they remembered what they learned. The data were analysed using a t-test. The results showed that students in the experimental group who were taught using multimedia retained more knowledge over time compared to the control group. The study concluded that using technological tools in teaching mathematics helps improve students' learning and long-term retention of concepts.

**Oyebola Akinoso (2018)** examined the impact of using multimedia tools on students' performance in secondary school mathematics. Two schools were randomly selected from Educational District V. The students were divided into two groups: an experimental group that used multimedia for learning and a control group that followed traditional teaching methods. A quasi-experimental design was used, and a Mathematics Achievement Test with a reliability coefficient of 0.81 (using KR-20) was applied to measure performance. The data were analysed using ANCOVA. The results showed that, although there was no statistically significant effect of the multimedia treatment on overall mathematics achievement, the experimental group had a higher average achievement score compared to the control group. Additionally, there was no significant relationship between treatment and gender. However, male students had a slightly higher average achievement (mean score of 57.50) compared to female students (mean score of 54.13). Overall, the study concluded that multimedia had a positive influence on students' academic performance in mathematics.

**Abdulrahman, M.D. (2020)** focuses on the use of multimedia tools in the teaching and learning process, particularly in developing countries where access to quality education is a major challenge. The research uses a systematic review method to examine how multimedia technologies help provide better access to education and improve student performance. An extensive search of scientific literature was conducted, and studies were selected based on specific criteria. The review analysed various case studies that looked at the use of multimedia tools in teaching. It focused on the types of multimedia used, their success and limitations, application areas, evaluation methods, the technology involved, and the age groups targeted. The study found that multimedia tools go beyond text and images by including audio, video, animation, and 3-D components. Most multimedia solutions are designed with the educational content and learners in mind. Their success depends on how well the technology is built and matched to the students' needs. In conclusion, multimedia tools are effective in overcoming barriers in education by making learning interactive and accessible, especially in developing countries. The study suggests that future research should focus on designing multimedia solutions that are tailored to the content and the learner to further improve education quality.

**Muhaimin, Lukman Hakim & Juandi, Dadang (2023)** The Role of Learning Media in Learning Mathematics: A Systematic Literature Review. Purpose of the Study: The study examines how learning media supports the teaching and learning of mathematics by improving the process of transferring knowledge from teachers to students, making learning more effective. Research Method: A systematic literature review was conducted using the PRISMA method (Preferred Reporting Items for Systematic Reviews and Meta-Analysis), which includes the steps: identification, screening, eligibility, and inclusion. Researchers collected 113 articles from Scopus, ERIC, and ProQuest databases published in the last 10 years. After applying strict criteria, 12 relevant review articles were selected for analysis. Key Findings: Most studies (9 out of 12) were conducted in Indonesia.

**Khairunnisa Hanan Pratiwi, Robinson Situmorang & Tuti Iriani (2024)** The Potential of Interactive Multimedia with Contextual Teaching and Learning Approaches in Mathematics Learning: A Systematic Literature Review. Purpose of the Study: This research investigates how interactive multimedia combined with the Contextual Teaching and Learning (CTL) approach can improve mathematics learning at the elementary school level. Research Method: A systematic review of 18 relevant studies published from 2013 to 2023 was conducted. Only scientific articles indexed in Scopus Q1–Q4 were considered, while theoretical articles and incomplete studies were excluded.

## **5. Methodology**

### **5.1 Research Design**

A quasi-experimental design with a **pre-test/post-test control group** was used to evaluate the effect of multimedia instruction.

### **5.2 Sample**

The study involved **80 secondary school students** from a government school, divided into two equal groups (Control and Experimental) using simple random sampling.

### **5.3 Tools Used**

- **Mathematical Achievement Test (MAT):** Developed and validated by experts.

- **Lesson Plans:** Traditional and multimedia-based lesson plans covering the same mathematical topics.
- **Attitude Scale:** To assess students' attitudes toward multimedia learning.

#### 5.4 Procedure

- The **control group** received instruction using conventional methods (lecture, textbook).
- The **experimental group** was taught using multimedia tools (PowerPoint, animations, interactive simulations).
- Pre-tests were administered to ensure equivalence.
- After a 4-week teaching period, post-tests and attitude scales were administered.

#### 6. Data Analysis

Statistical techniques such as mean, standard deviation, and **t-test** were applied.

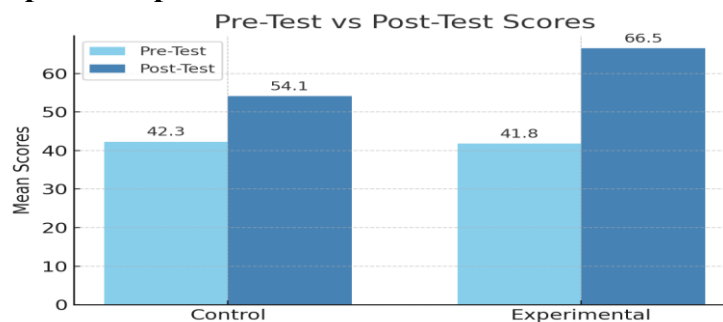
Group	Mean (Pre-Test)	Mean (Post-Test)	SD	t-value	Significance
Control	42.3	54.1	6.5	4.67	p < 0.01
Experimental	41.8	66.5	7.1		

#### Explanation of the Table:

- The **Control group** showed moderate improvement from pre-test to post-test (42.3 → 54.1).
- The **Experimental group**, which received multimedia instruction, showed a greater improvement (41.8 → 66.5).
- The **t-value (4.67)** indicates a statistically significant difference between the post-test scores of the two groups.
- **p < 0.01** suggests that the difference is highly significant at the 1% level, i.e., there's less than a 1% probability that this result is due to chance.

The experimental group showed significantly higher gains, indicating the effectiveness of multimedia instruction.

#### Graphical Representation of Pre-Test and Post-Test Scores



The following bar chart compares the mean scores of students in the Control and Experimental groups before and after instruction. The Experimental group, which received multimedia-based instruction, showed significantly greater improvement in mathematical achievement.

#### 7. Findings

1. The **experimental group** outperformed the control group in the post-test.

2. Students exposed to multimedia showed greater conceptual understanding and retention.
3. Students expressed **positive attitudes** toward the use of multimedia, reporting increased motivation and engagement.

## 8. Discussion

The findings support existing literature that suggests multimedia tools help students visualize and contextualize mathematical problems, thus reducing cognitive load and improving comprehension. The interactivity and variety of media cater to multiple intelligences and learning styles, making abstract concepts more accessible.

## 9. Conclusion

The study concludes that the multimedia approach significantly enhances students' mathematical achievement. It not only improves academic performance but also positively influences learners' attitudes. The results advocate for a broader integration of multimedia into classroom practices, especially in mathematics education.

## 10. Recommendations

- **Curriculum planners** should include multimedia resources in mathematics syllabi.
- **Teachers** should be trained to effectively use multimedia tools.
- **Further research** should explore long-term impacts and scalability across diverse settings.

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