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Cognition Of Secondary Students in Using Multimedia To Learn Science (Biology) And Its Impact

[1]Mrs. T. Premalatha, [2]Dr. K. Sambath Rani
[1]Research Scholar, Department of Special Education, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore-43, Tamil Nadu, India
[2]Professor, Department of Special Education, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore-43, Tamil Nadu, India, sambathrani_spl@avinuty.ac.in

Abstract
The use of multimedia in education has proven its importance due to its positive impact on the teaching and learning process. The rationale of the study is to explore the cognition of secondary school students in using multimedia to acquire knowledge, comprehension, and constraints in learning biological science. Exploratory method was adopted. A survey was conducted among 379 students studying in 7 government schools, 3 government aided schools and 5 private schools in Coimbatore district (from sixth to ninth standard) under the age group of eleven, twelve & thirteen years. A self-developed questionnaire consisting of three domains, a) knowledge of using multimedia in learning science, b) understanding the concepts of science by using multimedia, and c) constraints in using multimedia in learning science concepts was used to collect data. Data collected was analyzed quantitatively using descriptives and ANOVA. Findings revealed that the government and government-aided school students faced more constraints in learning the biological concept using multimedia compared to private school students. Also, it was found that higher the age better the knowledge of using Multimedia, and higher the class better the use of Multimedia in learning. Multimedia Assisted Instruction can be used in teaching of biology at secondary school to improve students' learning outcomes. If intervention is given at the earlier part of life better the cognition to use multimedia in acquisition of knowledge and understanding of any concept. The comparison to the age group, type of school, and class of the students is discussed in this study.
Keywords: *Cognition, Biology Learning, Multimedia, Secondary Level, Impact*

provides the students with opportunities to think critically, practice different teaching methods and develop scientific concepts, which facilitate the understanding of the physical environment. In schools,

[1] . INTRODUCTION

The destiny of the Country is shaped in the classrooms. This shape depends upon what the teacher teaches and how it goes on molding it. In other words, the destiny of our youngsters falls on the shoulders of teachers. "A teacher affects eternity; he can never tell where his influence stops." Henry Adams (1905)**.** Education begins as soon as the child is born. At first, it is informal and the child learns from the home environment as the home is their first school. Later education becomes more formal through play dates and preschool. Education is a purposeful and formal activity directed toward achieving a goal. Formal education refers to the discipline concerned with various methods of teaching and learning facts. Education can be thought of as the transmission of accumulated knowledge and values to society. It is designed to transfer the culture, mold behaviour, and direct them toward their eventual societal role. Teaching and learning Science is to develop knowledge and scientific understanding through various research activities that help students explain, evaluate, and build scientific knowledge independently (Duschl, et al., 2007).

Teaching Science in secondary schools can be enriched with some informal activities like nutrition week, science clubs, innovative science products, and exhibitions. These types of activities make the classroom more interactive, and less authoritarian giving children full freedom and facilitating learning more than dictating learning. The way of science learning should empower the learner to know the real facts, the principles, and their application, harmonious with the stage of intellectual development. It helps to become an expert and acknowledge the techniques and procedures that lead to the creation and verification of empirical command and the development of a historical and developmental perspective of science. The underlying query is the media influence learning or how to grasp the supremacy of the profuse media so that information and learning can be more successful, as stated by Kozma and his advocates (Samaras, Giouvanakis, Bousiou, & Tarabanis, 2006). At secondary level, science education

teachers have great influence on children by encouraging interest, by developing talent, and by providing useful factual, conceptual, procedural and meta-cognitive knowledge about the world (Arends, 2004).

2. REVIEW OF LITERATURE

2.1 Instructional Methods in teaching Science

In Science teaching-learning at secondary level, the strategies and techniques used by teachers to deliver content, engage students, and facilitate learning refers to instructional method. It has proven difficult for many instructors to teach subjects relating to science, technology, engineering, and math. Effective students effectively utilise their teachers' knowledge, concepts, and wisdom as well as practise learning materials. Consequently, creating authoritative learners is a key job of teaching. (P Kumari, 2015). The teacher delivers information verbally to students in a structured format. They focus on content delivery and factual knowledge. Traditional method of science teaching is best for large groups but may limit interaction and engagement. The teacher plays a prominent role in providing instructions and focus on clarity for effective teaching. The majority of teachers in science classrooms still use traditional teaching techniques, which have repeatedly presented difficulties for both students and teachers over time. "Biology is one of the Science subjects that occupy a unique position in school curriculum. It is an integral part of science and its importance in the field of science cannot be overemphasized. However, the performance of students in the subject has been appalling. In attempt solve the problem, researchers (such as Ahmed & Abimbola, 2011; Cimer, 2012; Agboghoroma & Oyovwi, 2015; Etobro & Fabinu, 2017) found that many students perceive Biology topics as boring, abstract and too difficult to understand. Also, there is the problem of overcrowded classrooms, and poor teaching methods adopted by teachers (Olaleye, Ajayi, & Oyebola, 2017; Gimba, Hassan, Yaki, & Chado, 2018). Low information literacy level and negative attitude to learning has been found to constitute a serious obstacle to the enhancement of student's learning and are indicators of the necessity for integrating emerging technologies in learning, especially, in the field of Science (Davies & West, 2014; Bawden, 1990). To this effect, technology integration in education is suggested and explored. Several studies have been conducted to examine the impact of integrating multiple media modalities into the curriculum, more particularly in the areas where students have difficulties in their ability to envision and manipulate multi- dimensional information spaces (Jekinson, 2009)". **2.2 Multimedia in Education**

The world where we survive is changing promptly and the educational sector is encountering these transposes, especially in the field of media services. Multimedia is a combination of content, effigy, icon, liveliness, and telegenic elements that have been manipulated electronically to exhibit lively forecasts, having attractive ethics with optical stability (Ivers & Baron, 2010). The use of technology within education supports learners in diversified ways to meet their individual needs of the learners. Multimedia is an interactive media and a powerful tool to present information to the user in an effective way. It combines audio, video, text, and animation. It is a computerized method of presenting information to users. Multimedia is applied in many fields. Education is an important field in which effective teaching and learning occur through multimedia. Each person learns differently and each person is persuaded by something different. The use of Multimedia allows designers to tap into these differences. People remember 20% of what they are seeing, 30% of what they are hearing, 50% of what they are seeing and hearing, and 80% through other interactions. Assimilation allows means for making detectable phenomena that are trivial, massive, rapid, or deliberate to see with the unassisted eye. In addition, they exemplify microscopic or conceptual happenings that cannot be noticed or accomplished directly (Buckley, 2000). Ministry of National Education, (2007) insisted that Teachers should use proper media to draw the attention of students during education, processing difficult and complicated instructing materials into easy and understandable ones, and relapsing non-realistic scientific concepts into tangible ones. The development of learning through multimedia paves new ways where learning becomes easy and happens at school and residence. Huk,(2006) said that Computer-instructional hypermedia information provides different means of supporting 3D background representations. "The power of multimedia lies in the fact that it is multi-sensory, stimulating the many senses of the audience. It is also interactive, enabling the end-users of the application to control the content and flow of information (Vaughan, 1998). This has introduced important changes in our educational system and impacted the way we communicate information to the learners (Neo & Neo, 2000). To improve educational productivity, the teaching staff ought to mainstream technology within education, developing traditional techniques & using new educational methods".

2.3 Multimedia in Teaching Science

Multimedia is an interactive media and a powerful tool to present information to the user in an effective way. Ministry of National Education, (2007) insisted that Teachers should use proper media to draw the attention of students during education, processing difficult and complicated instructing materials into easy and understandable ones, and relapsing non-realistic scientific concepts into tangible ones. The development of learning through multimedia paves new ways where learning becomes easy and happens at school and residence. Huk, (2006) said that Computer-instructional hypermedia information provides different means of supporting 3D background representations. Multimedia can help students learn science by making concepts easier to understand. It also helps students to investigate, explore, solve problem and retain information about science concepts. To improve educational productivity, the teaching staff ought to mainstream technology within education, developing traditional techniques & using new educational methods. Biology according to Taiwo & Emeke (2014) the subject exposes the students to the world of knowledge of self, the immediate and distant environment. Hence, to aid understanding the complex concepts such as is found in Science, Mathematics, Medicine, and Engineering, amongst others, researchers such as Mayer (2005) suggested visual and auditory representation of information.

Therefore, this study explored switching from the traditional teaching approach to one based on computers to determine the impact of computer-based multimedia in learning Biology. The study aims to elicit knowledge, understanding, and constraints among school students while using Multimedia in learning biology concepts at the Secondary level.

2.4 Knowledge of using multimedia in learning Biology concepts

Multimedia in teaching is more constructive for the intellectual development and perspective of pupils in biology than the conventional teaching method. The use of interactive media in educating biology is more enticing and assists students in developing an optimistic outlook toward learning biology, thus upgrading the performance of students. In a previous study, Khoiriah et al. (2016) observed that interactive media-based teaching matter can significantly affect the cognitive knowledge outcome of students.

2.5 Understanding of Biology concepts by using multimedia

According to the teachers working in primary and secondary schools and the teacher candidates, the utilization of Multimedia for educating biology content is related to motivation learning and cognitive activities (Odcházelová, 2015). The application of interactive media allows to vary and escalates the process of learning and leads to better accomplishment. Videos with academic backgrounds can contribute a lot of possibilities for mentees to engage with the lesson. Pupils anywhere in the globe can learn from the course of study lectures accessible through video.

2.6 Constraints faced by students in learning Biology concepts by using multimedia

Lack of faith, lack of expertise, and lack of access to resources are the major constraints faced by students in learning biology. However, television sets, computers, and projectors can be used to provide effective learning opportunities among students at the secondary level. Furthermore, multimedia-enriched teaching strategies to enhance the cognitive, psychomotor, and concretization of abstracts (Adekunle, 2019) can be implemented by the teachers to reduce the constraints. Therefore, it is important that effective professional development and technical support and sufficient time be provided to teachers to enhance teaching and learning using multimedia.

3. THEORETICAL FRAMEWORK

Gupta et al**.** (2012) initiated the utility of a revised form of the Technology-Rich Outcomes-Focused Learning Environment Inventory (TROFLEI) for evaluating students' (705) insight into their class environments in integrated media science classrooms in India. A comparative study was conducted between the use of multimedia in teaching and the traditional method of teaching bio-science among students (N=110) at high school concerning the achievement of students. The findings suggest that the results of biology learning pupils can be upgraded with interactive media integration Ayittey et al. (2015). Karpagam et al. (2009) developed a multimedia package to teach science to students with hearing impairments (N=30) in the secondary grade. The findings suggested that there is no remarkable deviation amidst the mean achievement outcome of the control and experimental batch in the pre-test. However, there is a significant difference between the mean achievement scores of the pre-test and final test of the experimental group. The effect of Multimedia techniques and Conventional methods in Science at Secondary schools (N=100) was analyzed. The result implies that the Multimedia technique was more

effective for girls than boys in developing attitudes toward science. It also implies that the boys and girls in the control group were at the same level in terms of attitude toward science before the treatment (Modi et al. (2021).

Ainus Shofawati et al (2023) aimed to describe the influence of multimedia on students' science literacy in the new normal era and students' responses after learning using interactive multimedia on energy flow materials. A sample of 31 students of seventh std was selected for the study. Results showed that the student's science literacy skills increased by using interactive multimedia. Learning using interactive multimedia improves students learning.

Dubey & Chaturvedi (2018) investigated the impression of a multimedia package on learning science subjects. A total of 60 females with average intelligence were selected for the study; 30 were in the experimental batch, and 30 were in the control batch. Set II of the Science (Biology) Achievement Test (SAT) was conducted after teaching the traditional method and multimedia package to the control batch and experimental batch, respectively; the outcome showed that the female children grouped in the experimental batch considerably benefitted from the multimedia package. The multimedia instructional strategies had a long-term effect on tutoring and studying zoology in senior secondary schools (N= 70). The multimedia package helped to understand and retain the concepts easily (Selvaganesan & Jayachitra, 2021).

Kareem (2018) studied the effect of the usage of Multimedia on students' (N=180) results in learning Biology. The results indicated that there is a statistically remarkable difference between students' achievement and method of instruction. Students taught with technology-aided instructions had preferably good learning outcomes compared with those with the traditional teaching method. The efficacy of multimedia instructional strategies in teaching science on the attainment of VIII std students was studied. A notable connection linking the technical approach and accomplishment in science was observed when the interactive media approach was used for teaching (Rashmi, 2019).

Misba H Sampang (2021) studied the effect of multimedia on the performance of grade 9 science students at MSU-Sulu Laboratory High School. 57 students and 5 teachers were utilized for the study. Findings proved that the use of multimedia highly affects the performance of students in grade 9 science to a very satisfactory level compared to teaching without using multimedia only at a satisfactory level.

Dr.Umesh Chandra Kapri (2017) analyzed the impact on achievement in science subjects of class 9th students using multimedia. 40 students from the 9^{th} standard were the sample for the study. The findings of the study showed that the use of multimedia proved to be better than the conventional direct method of teaching Science. The teaching by multimedia approach was effective therefore not a single student was found to have under extremely low level of achievement in science. So, it is obvious that the multimedia approach is an effective method teaching of science. Implementing science lessons with the use of multimedia may lead to making a difference, which produces students' long-term memories about the concept.

Bishu Kumar Dahal (2015) studied the effect of multimedia in teaching science at the secondary level. A sample of 68 students from grade 10 of two public secondary schools in Lalitpur district were selected for this study. The findings provided strong evidence to support the use of multimedia technology in teaching and learning science among secondary school students.

The existing literature indicates that multimedia approaches have a positive impact on moulding attitudes toward science and learning science concepts effectively. Thus, the study aimed to determine the knowledge, understanding, and constraints of using multimedia in learning Science (Biology) concepts at secondary-level students in inclusive education.

3.1 Purpose of the Study

The main purpose of the present study was to

1. Examine the knowledge of using multimedia by the secondary-level students
2. Find out the level of understanding the biology concepts by the students using Multimedia
3. Find out the constraints faced by students in learning Biology concepts using Multimedia

3.2 Hypothesis

1. There is no significant difference in the proficiency of secondary level students in using multimedia across government, government-aided, and private schools.

2. There is no substantial difference in the knowledge of secondary level students in using multimedia based on age.
3. There is no considerable variation in the level of understanding the biology concepts by the secondary student's by using multimedia.
4. There is no discernible variation in the challenges encountered by the secondary students while learning biology concepts through multimedia

3.3 Significance of the Study

Educationists, researchers, and administrative people are always anxious about introducing multimedia into educational institutions to improve teaching and learning modes. The present study would assist teachers in using diversified resources to improve the student's learning experiences. Also, this would motivate the use of multimedia for the students at secondary schools to make an enjoyable learning environment. This study will divulge the relationship between teaching and learning by accessing multimedia. Also, this will provide information that the use of multimedia facilitates learning science among school children.

3.4 Methodology Sample

The investigator conducted the study in 7 Government Schools, 3 Aided Schools, and 5 Matriculation schools in the Coimbatore district, Tamil Nādu. In this study, the investigator selected a sample of 379 students in 6^{th}, 7^{th}, and 8^{th} std. under the age group of 11,12 and 13 years through the Random Sampling technique. The study adopted an exploratory method. A self-developed questionnaire consisting of three domains, i.e., a) knowledge of using multimedia in learning science, b) understanding the concepts of science by using multimedia, and c) constraints in using multimedia in learning science concepts was distributed among the students. Written consent was taken from the principals of the schools for conducting the study. Collected data were analyzed through SPSS by using descriptive and independent t-tests.

Measures a) Knowledge of using Multimedia in Learning Science

To measure the knowledge on the usage of Multimedia as an effective learning medium for learning science concepts the investigators used 10 items with a 3-point rating scale, 'agree', 'neutral', and 'disagree'.

b) Understanding the concepts of science by using Multimedia

To measure the competitiveness of understanding the Science concepts using Multimedia, the investigators used 10 items with a 3-point rating scale, 'agree', 'neutral', and 'disagree'. **c) Constraints in using multimedia in learning science concepts**

To measure the constraints faced by the students in learning science concepts using multimedia, the investigators used 10 items with a 3-point rating scale, 'agree', 'neutral', and 'disagree'.

4. RESULTS Table 1. Background details of the students

Variables	Levels	Number (%)	Mean (SD)
Age Group	11 years	101(26.72)	12.05 (0.76)
	12 years	157(41.5)	
	13 years	120(31.7)	
Class	VI	114(30.2)	
	VII	159(42.1)	
	VIII	105(27.8)	
Type of School	Private	60(15.9)	
	Government	42(11.1)	
	Aided	276(73)	
Medium of Instruction	English	219(57.9)	
	Tamil	159(42)	

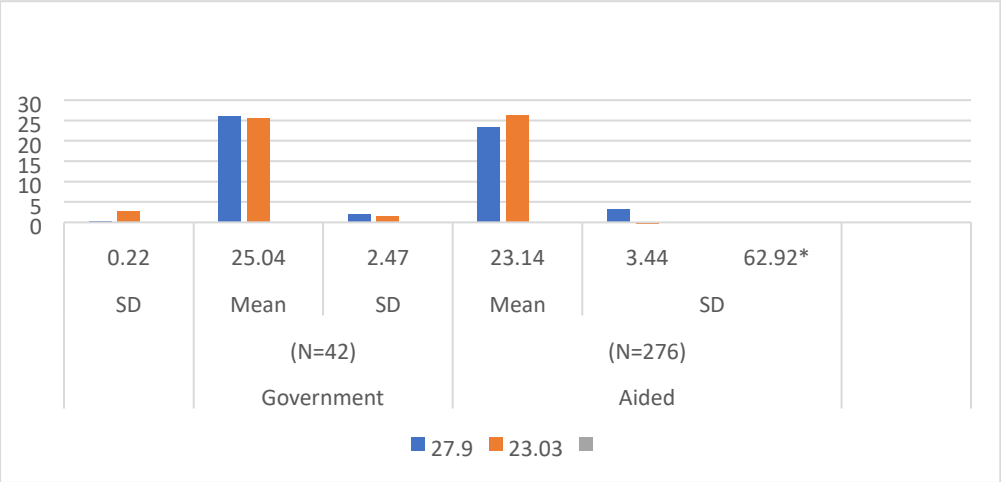
The response rates are presented in Table 1 - 4. The investigator identified in Table 1 that 379 students are studying in various schools, among them 26.72% belong to 11 years of age, 41.5% of them are aged 12 years, and 31.7% are aged 13 years (Mean =12.05, SD=0.76). Out of them, 30.2% were studying in class VI, 42.1% were studying in VII standard and 27.8% were studying in VIII standards. Among them 15.9% were studying in private schools, 11.1% in government schools, and 73% in government-aided

schools. The medium of instruction was English for most of the students (57.9%) while 42% were taught in Tamil.

Table 2. Use of Multimedia in Learning Biology Concepts concerning Age Group

Domains	Age Group						F
	11 Years (N=101)		12 Years (N=157)		13 Years (N=120)		
	Mean	SD	Mean	SD	Mean	SD	
Knowledge of using multimedia	23.90	3.60	23.51	3.48	25.08	3.36	7.19*
Understanding of Biology concepts using multimedia	23.86	3.44	23.77	3.25	25.00	3.07	11.16*
Constraints in learning Biology concepts using multimedia	24.86	2.67	23.11	2.88	23.77	2.66	13.66*

*=Significant at 0.01 level **Figure 1: Use of Multimedia in Learning Biology Concepts concerning Age Group**



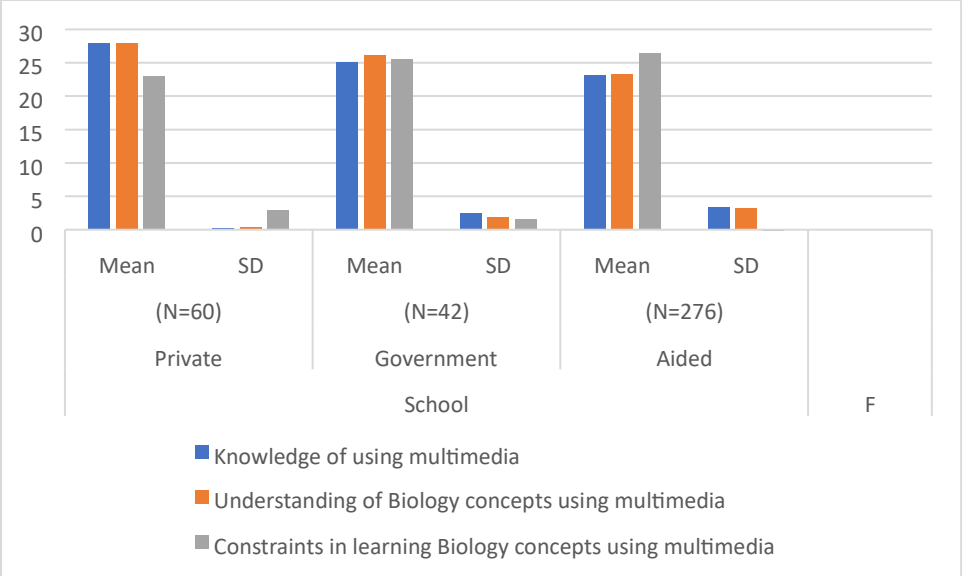
The findings in Table 2 and Figure 1 indicate that the use of Multimedia can be effective in teaching science concepts to students at the secondary level. However, students may face challenges in understanding the concepts if they are not taught to access the information using multimedia during their class. Thus, a one-way ANOVA was conducted to determine the challenges faced by students with 11 years, 12 years, and 13 years of learning biology concepts using multimedia. It was observed that students aged 13 years had better knowledge and understanding of using multimedia, followed by the other two groups. On the other hand, students aged 13 years experienced comparatively fewer constraints than the other two groups while using multimedia. Hence the hypothesis is rejected.

Table 3. Use of Multimedia in Learning Biology Concepts Concerning Type of School

Domains	School						F
	Private (N=60)		Government (N=42)		Aided (N=276)		
	Mean	SD	Mean	SD	Mean	SD	
Knowledge of using multimedia	27.95	0.22	25.04	2.47	23.14	3.44	62.92*
Understanding of Biology concepts using multimedia	27.90	0.35	26.12	1.95	23.30	3.21	74.47*

Constraints in learning Biology concepts using multimedia	23.03	2.84	25.55	1.51	26.41	0.08	56.13*

***=Significant at 0.01 level Figure 2: Use of Multimedia in Learning Biology Concepts Concerning Type of School**



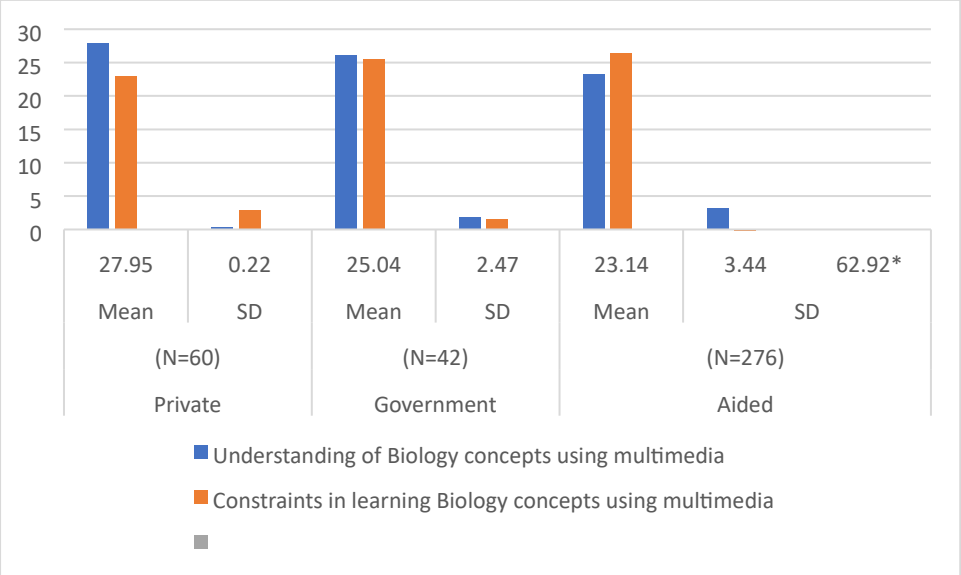
A comparison was made by the investigator in (Table 3 and Figure 2) between the students studying in private, government, and aided schools to determine the challenges of using multimedia while learning biology. It was found that private school students have more knowledge and understanding about Multimedia in learning biology concepts than government school and government-aided school students. The government school students and government-aided school students face more constraints in using Multimedia in learning than the students studying in private schools. As a result, hypothesis is disproven.

Table 4. Use of Multimedia in Learning Biology Concepts Concerning Class

Domains	**Class**						**F**
	Std. VI (N=114)		Std. VII (N=159)		Std. VIII (N=105)		
	Mean	SD	Mean	SD	Mean	SD	
Knowledge of using multimedia	23.40	3.49	23.84	3.40	25.27	3.52	8.60*
Understanding of Biology concepts using multimedia	24.00	3.36	23.83	3.18	25.50	3.28	9.13*
Constraints in learning Biology concepts using multimedia	24.83	2.84	23.16	2.85	23.90	2.60	11.53*

***=Significant at 0.01 level**

Figure 4. Use of Multimedia in Learning Biology Concepts Concerning Class



A comparison was made by the researcher in Table 4 and Figure 3 between the students from VI, VII, and VIII standards of private, government, and government-aided schools in the constraints of the usage of multimedia in learning. It was found that VIII-standard students had fewer constraints in the usage of multimedia in learning biology concepts rather than the other two classes (VI and VII). Multimedia can be used in secondary classes to teach biology to reduce the constraints among the students at the secondary level. Thus, the hypothesis is deemed unsubstantiated.

5. DISCUSSION

The result showed that many students at the secondary level are interested in learning biology through multimedia even though they face constraints. The application of multimedia in teaching improves the efficiency of the learning process (Siagian, et al., 2014).

It also showed that private school students had better knowledge and understanding of multimedia than government and government-aided school students. Students will learn more effectively when teaching and learning are processed through various means (Rahman, 2011). The various aspects of students' views on biology can be changed due to the use of animations and interactive simulations of physical phenomena in the teaching process. It is possible to stamp out students' viewpoints about the subject and it depends on the interactive multimedia in teaching materials used by the teachers in the class. Brunken et al., (2003) investigated the concept of liver function or any organ system that is easier to understand when students use multimedia graphics and animation than presented only in text.

6. Directions for Future Research

The research can be expanded to other districts or regions to validate findings across diverse educational and cultural settings. The authors direct the use of Multimedia strategies to teach science concepts to children with special needs which incorporates their five senses and enhances their learning. Multimedia can be introduced in secondary and higher secondary schools to teach biology. Science teachers can be trained to attain the needed skills to use multimedia in teaching. Pre-service and In-service training can be given to teachers to use multimedia in teaching and developing multimedia packages.

7. Educational Implications of the Study

Enhancing Access and Equity: The findings reveal significant disparities in the use of multimedia between school types, with government and government-aided schools facing greater challenges. Addressing these gaps could lead to more equitable educational outcomes.

Early Interventions: The study highlights the importance of introducing multimedia-based learning at an earlier stage to build cognitive skills and multimedia literacy, enhancing students' ability to acquire and retain knowledge.

Curriculum and Policy Development: Insights from the study can guide educators and policymakers in designing curricula that effectively integrate multimedia tools, particularly in resource-constrained school environments.

8. **Scope of the Study**

- Provides insights for educators, administrators, and policymakers to improve the integration of multimedia in biology education, especially in resource-limited school environments.
- Highlights the importance of early interventions to enhance multimedia literacy and cognitive skills.

9. **Limitations of the study**

- The study is geographically restricted to Coimbatore district, which may limit the generalizability of the findings.
- The use of a questionnaire-based approach may not capture deeper qualitative insights, such as emotional or behavioral responses to multimedia tools.

10. CONCLUSION

The present study investigated that the use of multimedia in schools has a positive effect on students' learning. The content taught by multimedia is more productive and better comprehended by students. It is more powerful for the mental and attitude development of students than the conventional teaching method. The use of Multimedia in teaching the content is more alluring and helps students to generate scientific and a positive attitude toward learning which in turn improves the performance level of students.

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