AD EDUXIAN JOURNAL
A Quarterly Multidisciplinary Blind Peer Reviewed & Refereed Online International Journal
Google Scholar Indexing IF:3.125(IIFS)
Vol (2), Issue (2), May-July 2025 *ISSN: 3048-7951*

Use of Audio-Visual Aids for Effective Teaching of Biological Science: A Systematic Review

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DOI: https://doi-ds.org/doilink/08.2025-41199581/ADEDJ/V2/I2/MSBSG

Review: 08/07/2025 **Acceptance: 20/07/2025** **Publication:14/08/2025**

ABSTRACT
The teaching and learning of biological science are a multifaceted process that requires effective tools to enhance understanding. To simplify this complexity, the use of audio-visual aids has emerged as an essential component in modern education. The recent advances in technology have revolutionized the way subjects like biological science are taught and learned. Audio-visual aids, including videos, animations, diagrams, and interactive tools, have proven to be invaluable in engaging students and facilitating the absorption of complex scientific concepts. These aids make learning more dynamic and interactive, thus improving the overall teaching-learning experience. In particular, they cater to diverse learning styles, offering visual and auditory inputs that reinforce theoretical knowledge and foster better comprehension. This paper explores the various types of audio-visual aids that can be utilized in the teaching of biological science, emphasizing their role in enhancing student engagement, promoting conceptual understanding, and improving retention. The paper also discusses how these tools can be effectively integrated into the classroom to support teachers in delivering high-quality education in biological sciences.
Keywords: Audio-Visual Aids, Effective Teaching, Biological Science.

Introduction

The integration of technology into education, particularly in developing countries like India, has become a vital force in enhancing the teaching and learning process. This technological shift is helping create more engaging, efficient, and effective learning environments, especially in the context of science and technology education. Over time, technological advancements have revolutionized various sectors, including education, by introducing new methods and tools that go beyond the traditional "chalk and talk" teaching approach (Ockta et al., 2024; Umar et al., 2023). One such innovative tool that has gained prominence is the use of audio-visual aids. These aids, which combine both sight and sound, include images, videos, animations, diagrams, and sound recordings, and are increasingly recognized for their significant contribution to the educational experience.

In educational literature Audio-visual aids serve to enrich the teaching process, providing a dynamic and multisensory approach that helps students better engage with complex subjects. According to Kinder, these aids make the learning experience more "concrete, realistic, and dynamic," thereby stimulating students' interest and improving their understanding (Tairu et al., 2018). In fact, research suggests that students remember a substantial portion of what they see and do—up to 80%—compared to the 10% of what they hear and read (Doosuur & Mwuese, 2013). Audio-visual aids are effective tools for communication with both people and students. They enhance and support traditional teaching methods, helping to maintain students' attention and engagement throughout the lesson. According to Indrayanti and Romadhon (2023), This underscores the importance of incorporating audio-visual materials into the curriculum, particularly for subjects like biology, where the visualization of abstract concepts and processes is crucial for understanding.

In the biological sciences, the role of audio-visual aids becomes even more critical. Biological concepts such as cellular structures, molecular processes, ecosystems e.t.c. can be abstract and difficult to grasp through verbal explanations alone. Audio-visual materials, such as 3D models, animations, and video simulations, allow students to visualize processes like cell division, protein synthesis, and the circulatory system in ways that are both accurate and engaging (Agada, 2021). These tools bridge the gap between theoretical knowledge and practical application, fostering deeper comprehension and long-term retention. As Eraikhuemen and Enogie (2017) highlight, the use of combined media—text, visuals, and sound—provides a richer, more immersive learning experience that encourages active participation and critical thinking. Moreover, the integration of technology and audio-visual aids supports personalized learning and real-time problem-solving, particularly in STEM (Science, Technology, Engineering, and Mathematics) education. By offering interactive platforms and advanced simulations, educators can cater to the diverse learning needs of students, ensuring that even the most complex concepts are accessible. As Gould and Roffey-Barentsen (2018) emphasize, a significant portion of learning—83%—occurs through sight, reinforcing the critical role of visual aids in facilitating understanding and memory retention.

Meaning of audio-visual aids: Audio-visual aids refer to any educational materials that combine both visual and auditory elements (like films, photos, recordings) to enhance learning. These tools support students by providing a richer, more engaging learning experience and helping them grasp concepts in a more vivid, concrete way than through words alone.

According to the Webster dictionary, audio-visual aids is defined as “training or educational material directed at the both the senses of hearing and the sense of sight, films, recordings, photographs, etc. used in classroom instructions, library collections or the likes”.

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According to Crow & Crow – "Audio-visual aids gives learners the opportunity to benefit from vicarious experiences with people events, objects, ad cause and effect relationship."

According to E. C. Daint – "Audio-visual aids means that complete material, which helps to understand the written or oral subject matter in class room or in other teaching situations".

Types of audio-visual aids

Audio visual aids can be classified in various manners. But the following classification in very popular and commonly used.

Audio aids- by the use of this type of its the student gains knowledge through the sense of hearing. The important aids under this head are the following-

a) **Science Broadcast**: A form of broadcast that focuses on conveying scientific information to the public, often through television or radio programs. These broadcasts aim to educate listeners or viewers about various scientific topics, discoveries, and research.
b) **Tape Recording**: A method of recording sound using magnetic tape. This was a popular format for recording music, interviews, and other audio before digital technologies like CDs and MP3s became widespread.
c) **Radio**: A medium used for transmitting audio signals, typically broadcast over the airwaves. Radio allows people to listen to music, news, and entertainment, as well as educational content. It has been a key tool for mass communication for decades.
d) **Headphone**: A personal audio device worn over or in the ears to listen to audio content. Headphones can be wired or wireless and are used for various purposes, including listening to music, making calls, or for immersive experiences like gaming or virtual reality.
e) **Lingua Phone**: The term "lingua phone" isn't as common as the others. It may be a misspelling or a variation of "linguaphone," which was a brand of language-learning devices and materials. Linguaphone systems were used for teaching languages through audio recordings, often in conjunction with books or other learning materials.

Visual aids - visual aids as the word denotes involves the use of the sense of sight. therefore, such aids which can be appreciated and understood by seeing only, are called visual aids. The important aids under this head are the following-

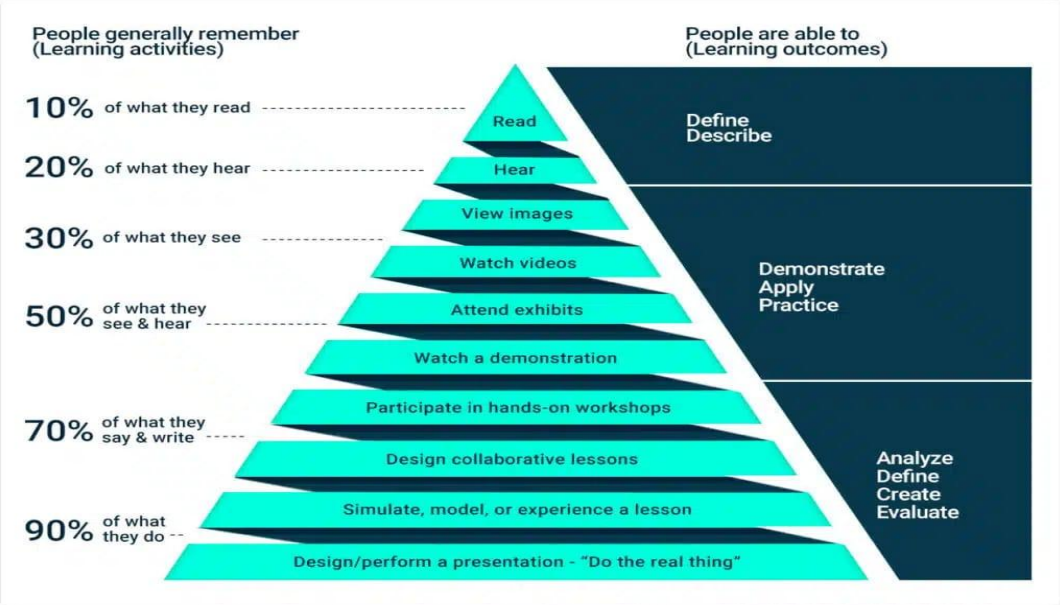
a) **Bulletin Board**: A flat surface used for posting notices, announcements, or other information. Bulletin boards are typically found in schools, offices, and public spaces and are used to display important messages, upcoming events, or educational materials. They can be made of cork, fabric, or other materials, and items can be pinned or tacked onto the surface.
b) **Chalk Board or Black Board**: A smooth, dark-colored board on which information can be written using chalk. This traditional teaching tool is used in classrooms for writing notes, explaining concepts, and drawing diagrams. A blackboard is typically made of slate or a similar material, and the white or colored chalk provides high contrast for visibility.
c) **Charts, Pictures, and Models**: These are visual aids used to enhance learning and presentation. **Charts** can be graphs, diagrams, or tables that represent data or concepts visually. **Pictures** can help illustrate ideas or provide context to textual information. **Models** are physical or digital representations of objects, systems, or processes, used to make abstract concepts more concrete or understandable, such as a globe for geography or a skeletal model for biology.
d) **Motion Picture, Film Strips, and Slides**: These are visual media used for presentations and education:**Motion Picture**: A sequence of moving images that are shown in rapid succession to create the illusion of motion. Movies and videos are examples of motion pictures and are widely used for educational and entertainment purposes.**Film Strips**: A series of still images on a strip of film that is projected one by one using a projector. Film strips were commonly used in classrooms for teaching before digital technologies became more widespread. **Slides** A single image or photo on a small, transparent film, typically viewed using a slide projector. Slides were often used for presentations in education and business before the widespread adoption of digital projectors.

Audio visual aids - in the use of these aids, the eyes and ears work together. The child sees with his eyes and listen with his ears and tries to memorize the teaching point. The important aids under this head are the following-

a) **Optical Aids**: These are devices that enhance vision or allow the user to see things more clearly. Optical aids are often used in education and presentations to make objects, images, or text more visible. Examples include magnifying glasses, projectors, microscopes, and telescopes. In the context of teaching, optical aids can include overhead projectors or slide projectors that project images or text onto a screen for a larger audience.
b) **Television**: Television is an electronic system used for transmitting moving images and sound to display broadcasts, including news, entertainment, and educational content. It's one of the most influential forms of mass media. Educational television programs, for instance, have been used to teach a variety of subjects from science to history.
c) **Picture**: A visual representation of something, typically a still image, such as a photograph, drawing, or painting. In education, pictures are used to enhance lessons, provide visual context, and make learning more engaging. For example, a picture of a plant helps in biology classes to teach about its parts.
d) **T.V.**: This is simply an abbreviation for **television**, as explained above. It refers to the medium used for transmitting moving images and sound for entertainment, information, and education.
e) **Video**: Video refers to moving images that are typically accompanied by sound, recorded or streamed. Videos can be recorded on various devices like cameras or smartphones and played on television, computers, or mobile devices. Videos are

used for entertainment, but also widely for educational purposes, with instructional videos or documentaries being common tools in classrooms and training environments.

Edgar Dale Model of Learning -Dale's Cone of Experience is a visual model consisting of eleven stages, beginning with concrete experiences at the bottom and becoming progressively more abstract as it reaches the top. Dale also notes that the arrangement of the cone is based on the level of abstraction and the number of senses engaged, rather than difficulty. The experiences at each stage can be combined and are interconnected, promoting more meaningful learning.



Edgar Dale Model of Learning

One of the key principles in selecting and using teaching strategies is that the more senses involved in learning, the more effective and impactful the learning experience will be. However, this does not imply that concrete experiences are the only valuable methods for educators to use when transferring knowledge to learners. As mentioned earlier, the experiences at each stage of the Cone of Experience can be combined and are interrelated, so it is essential to strike a balance between concrete and abstract experiences. This balance is necessary to meet the diverse needs of learners across all developmental domains and to support their overall growth.

The generalization of the Cone of Experience presented above is only a starting point. To fully grasp the concept, it is important to explore each component of the cone in more depth, as Educational Technology is fundamentally based on this model. By examining each stage, from concrete to abstract, we can better understand the various elements of the cone and how they contribute to the broader purpose of educational technology.

Research objectives:

The following research questions are raised to guide the study

1. To study the audio-visual aids in biological sciences in historical perspective.
2. To study the use of audio-visual aids in biological sciences.

Research methodology

The researcher's work for reviewing the literature focused on the use of audio-visual aids in biological sciences. Only one database (Google Scholar) was used to search for relevant documents from 2020 to 2024, particularly emphasis recent research papers. The following keywords were used in English: "audio-visual aids" and "biological science." The search process was thorough, leading to a strong collection of intervention strategies. Both open-access and non-open-access documents were reviewed, but only open-access documents were considered for this paper. Initially, studies were selected based on their titles, but in cases where titles did not provide sufficient information, the researcher examined the abstracts. If the abstract was also insufficient, the entire article or research paper was reviewed. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were used to improve the reporting of systematic reviews and meta-analyses, and also to critically appraise published systematic reviews.

Objective 1: To study the audio-visual aids in biological sciences in historical perspective.

For achieving this objective, I have gone through the one literature websites Google Scholar regarding the survey of this study has been conducted on the use of audio-visual aids in biological sciences**.**

Nurzaman, Dewi H. H. R., Budiana H.R., and Silvana H. (2020) conducted a study entitled 'Teaching Aids in Learning Communication: The Introduction of the Animals Concept to Students with Visual Impairments in Biology Lessons.' The

sample included students with visual impairments at SLBN A Wyata Guna Bandung. The research method used in this study was the descriptive method. The findings indicate that visual aids such as tables, pictures, and PowerPoint presentations are commonly used in biology lessons to support students' understanding; however, they pose significant challenges for students with visual impairments. Many teaching aids, especially those that explain material about animals, rely heavily on visual content, which may not be accessible to these students. Therefore, it is essential to explore alternative or adaptive teaching aids that can ensure all students, regardless of their visual ability, can fully engage with the material and benefit from the learning experience.

Satyaprakasha C.V. & Sudhanshu Y. (2022) conducted a study on the 'Effect of Multimedia Teaching on Achievement in Biology.' Two sections of 9th standard students, consisting of 38 and 39 students respectively, from Samhitha High School, Kurabrahalli, Bangalore, were chosen as the sample. An experimental study was conducted, and the findings show that multimedia teaching has proven to be an effective approach in enhancing students' achievement in biology, particularly in the areas of knowledge, understanding, application, and overall performance, when compared to traditional methods. The use of multimedia tools significantly supported students' learning, making the educational experience more engaging and interactive. The study highlights the potential of multimedia teaching to improve educational outcomes for all students, regardless of gender, in the subject of biology.

Halima H. (2023) conducted a study entitled 'Audio-Visual Aids as Tools for Improved Teaching and Learning of Biology in Nigerian Secondary Schools.' The methodology used in this study was qualitative research. The conclusion of the study is that audio-visual aids play a crucial role in the teaching and learning process, making it more engaging and effective. When used correctly, these aids enhance students' understanding and improve teachers' ability to achieve desired learning outcomes. The integration of audio-visual aids can motivate students, increase their attention levels, and foster deeper comprehension. Additionally, these aids support the development of students' intellectual capacity by providing dynamic, interactive content that appeals to different learning styles. Ultimately, the use of audio-visual aids contributes significantly to creating a more effective and stimulating learning environment.

Asia N., Kinda J., & Edward J. (2024) conducted a study on the development of learning video media in biology subjects with a sample size of 31 students from class XI Mathematics Science. The methodology used was a development research method. The findings indicated that learning videos offer students the flexibility to learn at their own pace and revisit content as needed, allowing them to deepen their conceptual understanding while catering to diverse learning styles.

Arfi, J., Wahyuri, A. S., Gusril, Rasyid, W., & Ockta, Y. (2024) conducted a study on developing engaging audio-visual learning media for basic locomotor patterns through play-based activities for early learners, with a sample size from State Elementary School 13 Tanjung Beringin. The findings indicate that the media has proven to be an effective tool for teaching physical education, particularly in the area of locomotor motion. The results of this study provide valuable solutions for educators and prospective educators to address the challenges posed by limited facilities and infrastructure in schools. By leveraging available technology, educators can present engaging and dynamic learning materials that align with educational goals, ensuring a more impactful and accessible learning experience for students.

Ndoh N.U. & Umbugadu M. (2024) conducted a study entitled 'Multimedia Instructional Materials in Teaching Basic Science Concepts for Students with Hearing Impairment.' The sample size consisted of sixty (60) students, and a descriptive survey design method was used. The findings of this study highlight the significant benefits of using multimedia instructiona/l materials for teaching science concepts, particularly for students with hearing impairments. These students showed improved performance in science examinations when multimedia tools were incorporated into lessons. Moreover, the use of multimedia not only enhances the learning experience for these students but also reduces the stress on interpreters, providing them with more effective teaching resources.

Sadiq M., Khairuddin, & Khairunna (2024) conducted a study entitled 'The Influence of Contextual Teaching and Learning Audio-Visual Media Learning Models on Student Learning Outcomes on Digestive System Material in Class XI at Private High School PAB 8 Saentis Medan.' The population in this study consisted of all students from Class XI Science 3 and Class XI Science 4. The research method used was the experimental method, with a quasi-experimental design and a non-equivalent control group design. The research shows that the Contextual Teaching and Learning (CTL) model, combined with audio-visual media, has a positive impact on Biology learning outcomes for digestive system material in Class XI Science students at PAB 8 Saentis Medan Private High School. The results indicate that students in the experimental class, which used the CTL model with audio-visual media, performed better than those in the control class, demonstrating the effectiveness of this teaching approach in improving learning outcomes.

Mahmood I., Bukhari S.K.U.S., & Bahoo R. (2024) conducted a study entitled 'Effectiveness of Visual Aids in Teaching English at the Secondary School Level.' The population of this study consisted of 440 students, with a sample size of 30 students selected from District Bahawalnagar. The research method used was an experimental design. The study highlights the effectiveness of using visual aids in teaching English, as students taught with this method showed significant improvement in their achievement. The findings suggest that the visual aids approach is superior to traditional lecture methods in helping students achieve better learning outcomes. Additionally, the study demonstrates that, prior to the intervention, both groups were at a similar level of English

proficiency, emphasizing that the challenge of teaching English can be transformed into an opportunity when visual aids are incorporated. Therefore, integrating visual aids into the teaching process can be a valuable strategy for enhancing student achievement

Allayban et al. (2024) conducted a study entitled 'Lights, Camera, Learning: A Comparative Study Between Video Visual Aids and Traditional Visual Aids on Grade 11 STEM Students' Academic Performance in Earth Science.' The study focused on Grade 11 STEM students in Earth Science and used a quasi-experimental design, specifically a pretest-posttest non-equivalent comparison group design. The study reveals that the use of both video and traditional visual aids did not result in improved academic performance among Grade 11 STEM students in Earth Science. While technology may boost engagement, it does not necessarily enhance learning outcomes. The findings emphasize the importance of evaluating teaching methods and content quality, suggesting that technology should be used purposefully and with consideration of its context to truly benefit the learning experience. This raises important questions about the broader implications of technology integration in the classroom, as it does not always lead to positive outcomes

Kassa M.M. et al. (2024) conducted a study on the 'Effect of Using Multimedia and Dynamic Classroom Integrated Instruction on Grade 11 Students' Biology Academic Achievement.' A total of 94 secondary school students participated in the study as the sample size. An experimental research design, specifically a non-equivalent, quasi-experimental design, was used. The findings showed that the experimental group exhibited significant improvement in biology achievement from the pre-test to the post-test, as well as compared to the control group. Additionally, students with different learning styles (VAK) benefited equally from multimedia and dynamic classroom integrated instruction (DCII), with no significant differences found in achievement between the groups. The use of multimedia tools, such as videos, simulations, and animations, enhanced student engagement and active participation, leading to more effective learning compared to conventional teaching methods.

In conclusion, the integration of audio-visual aids in education represents a transformative shift in teaching and learning. These aids enhance students' understanding of complex biological concepts, foster deeper engagement, and improve academic achievement. By leveraging the power of technology and multi-sensory learning tools, educators can create more dynamic, accessible, and effective learning environments. This is particularly crucial in developing countries, where the use of innovative educational technologies can help bridge the gap between traditional teaching methods and modern, globally competitive education. As technology continues to advance, the role of audio-visual aids in education will only grow, paving the way for a more interactive, inclusive, and comprehensive learning experience that prepares students for the challenges of the future.

Objective 2- To study and understand the meaning, characteristics, types, and use of audio-visual aids in biological sciences.

1. Audio Aids in Biological Science - Audio aids are tools that primarily use sound to convey information. These tools can help explain biological concepts and make complex ideas more engaging and accessible through auditory means.The important aids under this head are the following -

a) **Podcasts and Audio Recordings:**Podcasts are audio-based content that often includes interviews, discussions, or deep dives into biological topics. These are useful for learning about biology when you are on the go, as they allow you to listen to experts discuss subjects such as genetics, evolution, ecology, or medical advancements.

b) **Audiobooks:**Audiobooks are narrated versions of textbooks or popular science books. They are beneficial for auditory learners or when visual reading isn't possible (e.g., while commuting).

c) **Audio Guides:**Audio guides provide pre-recorded audio information and are commonly used in museums, zoos, or botanical gardens. These guides explain biological concepts related to the exhibits, helping visitors understand the science behind various organisms or ecological phenomena.

2. Visual Aids in Biological Science- Visual aids use images, diagrams, videos, and other visual media to convey information. These aids are often used to explain complex biological processes that may be difficult to understand through text alone.

a) **Infographics:** Infographics combine graphics, charts, and text to present information in a visually appealing and easily digestible format. These are often used to simplify complex biological data.It is easy to understand with an**example,**an infographic showing the process of photosynthesis or a flowchart of the human digestive system.

b) **Videos and Films:** Videos and films combine images and motion to demonstrate biological processes in action. These can be used in classrooms, online platforms, or documentaries.It is easy to understand with an**example,** A documentary on the human genome or an animation showing how blood circulates through the heart.

c) **Diagrams and Charts:** Diagrams and charts are static, but they effectively show relationships between biological elements, such as the structure of cells, the classification of species, or ecological food chains.It is easy to understand with a **example**Diagrams of the cell structure or the life cycle of a butterfly.

d) **Smartboards and Interactive Whiteboards:**These are digital whiteboards that allow for interactive teaching. In biological science, they can be used to explore diagrams, molecular structures, or even simulations of biological processes.It is easy to understand with an**example,**A smartboard showing a molecular structure of DNA, where the teacher can interactively manipulate and zoom in on different components.

1. **Virtual Reality (VR) & Augmented Reality (AR):** VR and AR combine digital elements with the real world, providing immersive learning experiences. These technologies are increasingly used in biological science education to allow students to explore biological systems in a more hands-on way.It is easy to understand with a example A VR simulation that lets students explore the human circulatory system or AR apps that overlay information on biological specimens.

3. Audio-Visual Aids in Biological Science-Audio-visual aidscombine both sound and visual elements to create an immersive and multi-sensory learning experience. These aids are particularly powerful because they engage both auditory and visual senses, helping learners understand complex biological concepts in a more holistic way.

a) **Educational Videos and Documentaries**: These combine sound (narration, interviews, sound effects) with visuals (animations, live-action footage, graphs) to present biological content in an engaging way. Educational videos often break down complex processes into digestible parts. It is easy to understand with an**example**A video showing the stages of human embryonic development, with a narrator explaining each phase.

b) **Animated Diagrams and 3D Models:** These animations combine visuals and sound to provide dynamic, engaging explanations of biological processes. Animations allow for clear visual depictions of processes that occur at microscopic or molecular levels. It is easy to understand with an**example,** 3D animation explaining the process of mitosis, with accompanying audio narration that describes each phase of cell division.

c) **Interactive e-learning Platforms:** These platforms integrate audio, video, and interactive elements to teach biological science. Students can click through interactive content, watch videos, and listen to explanations while engaging with quizzes and exercises. It is easy to understand with an**example,** an interactive online course that explains genetics, allowing students to explore genetic sequences while listening to expert commentary.

d) **Virtual and Augmented Reality in Biological Simulations:** VR and AR can provide a fully immersive experience, where the learner can interact with biological systems, with both visual and auditory cues guiding the experience.It is easy to understand with a **example,** A VR simulation where students can "walk" through a human body and hear descriptions of the organs, blood flow, and the nervous system.

e) **Interactive Presentations:** These are multimedia presentations that combine slides, video, sound, and text to explain biological topics. Presentations are often used in classrooms or seminars to support lectures. It is easy to understand with an e**xample, A** PowerPoint presentation on the human immune system, with embedded video clips of white blood cells attacking pathogens, accompanied by voiceover narration.

Outcome and Discussion

The study reveals that multimedia tools, including videos, simulations, and animations, significantly enhance student engagement and comprehension in biological science. These resources cater to diverse learning styles and allow students to learn at their own pace, resulting in improved understanding and academic performance. The integration of the Contextual Teaching and Learning (CTL) model with audio-visual media further reinforced this improvement, demonstrating its effectiveness in teaching complex biological concepts. While multimedia tools effectively boosted student engagement, the study also found that technology alone does not guarantee improved learning outcomes in all contexts. This was particularly evident in the Earth Science group, where video and traditional visual aids did not result in enhanced academic performance. This highlights the importance of thoughtfully selecting and integrating teaching methods and content to maximize the benefits of multimedia tools. Additionally, the study addressed the challenges faced by students with visual impairments, as many biology teaching aids rely heavily on visual content. However, multimedia aids provided inclusive and interactive learning experiences, overcoming these barriers and supporting a wider range of learning needs. Overall, the findings confirm that multimedia teaching is an effective strategy for enhancing biology education, improving knowledge, understanding, application, and performance for all students, regardless of learning style or disability. Furthermore, the benefits of audio-visual materials extend beyond just enhancing comprehension. They also contribute to improving academic achievement. Students who engage with visual aids often show better retention of knowledge, which translates into higher academic performance (Allwell& Sam-Kayode, 2022). As students gain a clearer understanding of biological processes and systems, they are better equipped to develop critical science process skills, ultimately leading to more successful outcomes in education (Sulthon, 2016).

CONCLUSION

This literature review examined the use of audio-visual aids in the teaching and learning of biological science. The integration of traditional teaching methods with modern technological tools has proven to be an effective approach in enhancing the learning experience. Audio-visual aids, freely accessible through various platforms, can significantly enrich the teaching of biological science by making complex concepts more understandable and engaging for students. The use of these tools, when applied creatively and effectively by knowledgeable educators, can transform biological science instruction into a more interactive and student-cantered process. As technology continues to evolve, it is evident that its integration into the classroom has made a substantial impact on how biological science is taught, fostering a more dynamic and efficient learning environment. The continual development and application of such tools are vital in shaping the future of biological science .

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