THE EXTENT OF AUDIO-VISUAL MATERIAL USE IN THE TEACHING AND LEARNING OF CHEMISTRY IN SECONDARY SCHOOLS

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ABSTRACT

The study focused on the extent of audio-visual material use in the teaching and learning of chemistry in secondary schools.to assess the extent of audio-visual material use in the teaching and learning of chemistry in junior secondary schools, a review of ten studies conducted between 2016 and 2023 was undertaken from Scopus, Google Scholar and ERIC database. The review found the utilization of audio-visual resources in chemistry education varies among secondary schools, with the majority (95%) using them infrequently due to factors like limited technological access and insufficient teacher training. Only a small number of schools have fully embraced these materials, integrating them into their curriculum on a regular basis. The majority of teachers and students has a positive perception of audio-visual materials and see them as valuable tools for engagement and learning, there are some challenges and concerns expressed by a minority of teachers and students regarding the preparation, integration, and effectiveness of these materials. The inconsistent availability of resources, the time-consuming nature of preparation and integration, and a lack of understanding on how to effectively use audio-visual materials hindered the realization of their educational benefits. Additionally, the absence of centralized platforms for accessing curated content was noted as a limitation. Generally, these materials have the potential to provide a more inclusive and engaging learning environment, particularly for students who may struggle with traditional teaching methods. Overall, the reviewer concluded that investing in infrastructure and providing professional development opportunities to enhance the effective utilization of multimedia resources in secondary education. *[African Journal of Chemical Education—AJCE 14(2), May 2024]*

INTRODUCTION

In the information era, the media have become a central focus in people's lives. From television to internet networks such as Facebook or YouTube, we are surrounded by the visual. As [1] suggests, the media "inform, amuse, startle, anger, entertain, thrill, but very seldom leave anyone untouched". With these features in mind, the field of chemistry Teaching has been trying to introduce multimedia in the classroom. However, bringing these into the classroom has always been challenging, how to actually use them has been even more challenging [2].

Background

In order to prepare pupils for postsecondary education and professions in science-related fields, chemistry education is essential. Unfortunately, textbooks and lectures are frequently the mainstays of traditional teaching methods, which may not properly engage students or foster a deep comprehension of the subject matter.

The incorporation of audio-visual resources into chemistry instruction holds promise for improving student involvement, promoting conceptual understanding, and the multimedia learning theory put forth by [3] serves as the foundation for the use of audio-visual elements in education. According to this hypothesis, instructional tools that combine visual and aural features can improve student learning outcomes. Because chemical concepts are dynamic and abstract, audio-visual aids are especially helpful in improving comprehension and engagement in the setting of chemistry education [4]. This enhances academic performance.

Audio-visual resources are a crucial part of teaching and learning at all educational levels in the technological age. They are regarded as crucial tools for boosting teaching and learning effectiveness because they pique students' interests and deepen their understanding [5]. Thanks to technological advancements, educators may now impart knowledge in a way that helps pupils retain it better by having them visualize what they are learning. Thus, audio-visual materials—which may be based on models or videos—are instructional tools that use both sight and sound. According to [6] they are there to support the objectives of teaching and learning in our schools and increase their efficacy. Projectors, which display slides, images, and videos of scenarios, are the most often used educational tool nowadays. They provide interest, dynamism, and efficiency to the classroom. The tools that are utilized in classrooms to support, facilitate, and enliven the teaching-learning process are known as audio-visual resources. In the classroom, these are methods that make use of both the senses of hearing and visual [7] video. Moreover, it also helps to introduce new topics easily. It makes the student remember the concept for a longer period. The use of audio-visual materials helps to make the learning process more effective and conceptual [8]. It aids in grabbing students' attention, increases their motivation and interest in their learning process, and raises the energy level of both teaching and learning for students.

The combination of two media visual and auditory is known as audio-visual materials. Devices for training that can be heard but not seen are called auditory materials. For instance, ear buds, microphones, tape recorders, and so on. Additionally, visual materials are a type of teaching tool that are audible alone. Film strips, slides, and other materials are examples. Since all of the pupils' attention is on studying, the use of audio-visual elements in the classroom aids in maintaining discipline. Additionally, this interactive session fosters reasoning and critical thinking, two crucial aspects of the teaching-learning process [9]. Training or instructional resources that target both the senses of hearing and sight are referred to as audio-visual materials [8]. It is well acknowledged that when the most senses are engaged, learning occurs at its finest. Experience, firsthand, direct, and concrete, is the foundation of all learning. According to research, some professors frequently can't provide students with first-hand experiences; instead, they rely on verbal and written communication [10]. But the seasoned educator understands that words cannot and will not create a compelling learning environment.

Conceptual Framework

Audio-Visual Aids

Audio-Visual Aids according to [11] are devices that have both audio and visual appeal requiring the use of both the eyes and ears (sight and hearing) this is exemplified by videotaped instructional materials. The Webster's dictionary (2001) views Audio-Visual Aids (AVA) as the training or educational materials directed at both the senses of hearing and sight including the use of films, recordings, photographs, etc. in the classroom for instructional purpose. According to [12] instructional materials are all the things the teacher utilizes to interactively enhance motivate and facilitate teaching and learning of concepts.

[13] Stated that audiovisual materials are usually described as "non-print" documents. The author maintained that audiovisual materials include audio (sound) recordings/aids, film and video, graphic materials, three dimensional objects, maps, and microforms. [14] Expressed that audio visual technology adds new dimension to learning experiences because concepts were easier to present and comprehend when the words are complemented with images and animations. The authors stressed that it has been established that learners retain more when a variety of senses are engaged in impacting knowledge; and the intensity of the experience aids retention and recall by engaging

social, emotional, and intellectual senses. Thus, leading to improvement in academic achievement and interest of students.

[15] defined AVA as those instructional materials which do not depend solely upon reading to convey meaning as they may present information through the senses of hearing and sight as in audio and visual resources or through a combination of senses. In tandem with [12,15] stated that AVA are tools for communication that can be seen, heard, read and manipulated with the objectives of enhancing the teaching-learning process.

Furthermore [16] informed that audio-visual materials refer to those instructional materials that may be used to convey meaning without complete dependence upon verbal symbols or language. The implication of this is that items such as textbooks or reference materials are not essentially audio-visual instructional materials but an illustration in a book qualifies as one. Depending on the information to be conveyed to the audience, there are a variety of applications that could be used, such as multimedia, lasers/holograms, DVDs and video imaging.

[17] Opined that audio-visual aids encourage participation in dissemination of knowledge thereby stimulating interest, individualizes instructions thus, making learning permanent. Furthermore,[17] informed that audio-visual materials are very important and useful in education because, the normal learner gains understanding in terms of multiple impression recorded through

the eye, ear, touch and other senses. The most important effect of these materials is to assist in achieving the stated behavioral objectives when evaluation is conducted at the end of a lesson or programs.

Importance of Audio-Visual Materials

Improved Learning Experience: Adapting to a variety of learning methods, audio-visual resources provide a dynamic and immersive learning environment. In comparison to traditional text-only formats, research by [3] shows how multimedia presentations, which combine text with graphics and audio, contribute to higher learning results.

Enhanced Retention: Information retention is improved when auditory and visual stimuli are combined. According to [18] "dual-coding theory," information that is encoded in both verbal and visual representations increase the likelihood that it will be recalled.

Enhanced Involvement: Audio-visual resources capture viewers' interest and encourage hands-on participation. According to a study by [19], when studying through multimedia presentations, students showed increased levels of interest and participation.

Facilitates Complex Concepts: Explanatory narration, animations, and graphics can all be used to help simplify and clarify complex ideas. The Cognitive Theory of Multimedia Learning by [20] highlights the role that multimedia plays in helping people understand complex ideas.

Flexibility: Audio-visual resources are adaptable and can be used for a range of marketing, entertainment, training, and instructional objectives. They can be used on a variety of platforms, such as digital ads, presentations, and online courses.

Impact of Audio-Visual Materials

Effective Communication: When using well-designed audio-visual resources, ideas, thoughts, and information can be delivered clearly and concisely. Research by [21] indicates that information processing and comprehension are aided by multimedia presentations.

Behavioral Influence: Audiovisual materials possess the ability to evoke emotions, shape perspectives, and influence actions. The Elaboration Likelihood Model [22] states that persuasive messages conveyed through multimedia channels have the potential to alter an individual's attitude.

Cultural Exchange: Audio-visual resources offer a platform for intercultural communication and understanding by showcasing a range of perspectives, traditions, and tales. They promote cross-cultural dialogue and add to global interconnectedness [23].

Skill Development: Educational audio-visual tools aid in the acquisition and reinforcement of skills through immersive and interactive experiences. Interactive simulations and virtual laboratories may provide chances for experience learning [24].

Brand Visibility: In marketing and advertising, effective audio-visual material increases brand recall, fosters consumer connection, and increases brand visibility. Research by [25]. highlights the impact of audio-visual advertising on brand recognition and purchase intentions.

Benefits and Limitations of Audio-Visual Materials

Benefits:

The use of audio-visual materials in chemistry education has several benefits. According to the Journal of Chemical Education, these materials can help students understand complex concepts, improve their problem-solving skills, and increase their motivation to learn [26]. The Journal of Research in Science Teaching found that audio-visual materials can also help students retain information better and improve their test scores [27]. The International Journal of Science and Mathematics Education reports that these materials can also cater to different learning styles and make chemistry teaching more engaging [28].

Enhanced Learning: By utilizing a variety of sensory channels, audio-visual materials help users comprehend and remember information better [29].

Enhanced Interaction: Eye-catching imagery and sound signals maintain viewers' attention and encourage involvement.

Versatility: According [30]. audio-visual resources can be tailored to meet a variety of educational needs and learning styles.

Memorability: Information is better retained over the long term when visuals help with memory recall [31].

Accessibility: They are available remotely, providing a range of delivery options and meeting the needs of different types of learners [32].

Limitations:

Cost: Producing audio-visual content of superior quality can be costly, necessitating the purchase of software, hardware, and trained labor [33].

Technical Restrictions: According to [34] technical problems including compatibility and connectivity concerns may make it more difficult to provide audio-visual material smoothly.

Cultural Sensitivity: To prevent misunderstandings or offense, content and images must be adapted to a variety of cultural contexts [35].

Attention Span: When audio-visual components are used excessively, learners may get overwhelmed or distracted, which lowers understanding.

Overload: If the audio-visual content is provided too quickly or with too much information, it could cause information overload and make learning more difficult [36].

Challenges in Audio-Visual Material Implementation

Resource Constraints: The development and dissemination of audio-visual products may be hampered by a lack of equipment, software, and trained labor [19].

Pedagogical Integration: Careful preparation and alignment with learning objectives are necessary for the efficient integration of audio-visual elements into curricula.

Technical Issues: Compatibility issues and technical hiccups can prevent audio-visual content from being delivered, which might negatively impact the learning process [34].

Quality Control: Constant assessment and feedback systems are required to guarantee the correctness and quality of audio-visual products [33].

Access and Equity: Unequal access to internet and technology might restrict the availability of audio-visual resources, hence aggravating educational disparities [32].

Theoretical Foundations of Audio-Visual materials in chemistry education

The incorporation of audio-visual materials in chemistry education is underpinned by various theoretical foundations, each contributing to the understanding of how multimedia resources enhance learning experiences. Here are key theoretical perspectives relevant to the use of audio-visual materials in chemistry education.

1. Constructivism theory

Constructivism is a learning theory that posits that learners actively construct knowledge by building mental structures through interaction with their environment [37]. In the context of chemistry education, the key idea is that students learn best when they are actively engaged in the exploration and construction of chemical concepts, and that learning is most effective when it aligns with the natural processes of cognitive development.

a. Active Construction of Knowledge

Constructivism emphasizes that learners are not passive recipients of information but actively construct their understanding of the world. Knowledge is built through hands-on experiences, interactions with the environment, and the assimilation of new information into existing cognitive structures.

In chemistry education, constructivism encourages educators to design learning experiences that involve active exploration and experimentation. Practical laboratory activities, interactive simulations, and problem-solving exercises align with the idea of students constructing their knowledge through hands-on engagement.

b. Social Interaction and Collaboration

Constructivist theory influenced by Vygotsky underscores the importance of social interaction and collaboration in the learning process. Peer interactions, discussions, and collaborative problem-solving contribute to the construction of knowledge [38].

Group activities in chemistry classrooms, such as collaborative experiments, class discussions, and projects, provide opportunities for students to engage in social interaction. Sharing and negotiating ideas with peers can enhance the construction of chemical knowledge.

c. Scaffolding and ZPD

Constructivism incorporates the idea of scaffolding, where more knowledgeable individuals (teachers, peers) provide support to learners, gradually withdrawing that support as learners gain independence. The Zone of Proximal Development (ZPD) represents the range of tasks a learner can perform with the help of a more knowledgeable person.

In chemistry education, scaffolding might involve providing guidance during a complex experiment or offering support in understanding abstract chemical concepts. Recognizing and addressing students' ZPD allows educators to tailor instruction to their current level of understanding.

d. Cognitive Conflict and Disequilibrium

Constructivism acknowledges the role of cognitive conflict and disequilibrium in learning. When students encounter information that challenges their existing understanding, they experience a state of cognitive conflict, prompting them to reevaluate and modify their mental structures.

Introducing novel or unexpected chemical phenomena in the classroom can create cognitive conflict, leading students to reassess their understanding of chemical principles. This process of cognitive disequilibrium contributes to the ongoing construction of knowledge.

2. Cognitive Load Theory

Cognitive Load Theory introduced by John Sweller in the 1980s centers around the notion that instructional materials should be designed with consideration for the limitations of working memory. Working memory has finite capacity, and when this capacity is exceeded, learning efficiency and understanding may be compromised. The theory advocates for the management of cognitive load to optimize learning by distinguishing between intrinsic, extraneous, and germane cognitive loads [36].

a. Intrinsic Cognitive Load

Intrinsic cognitive load is the inherent complexity associated with the subject matter being taught. Some topics or concepts naturally require more mental effort to understand.

Cognitive Load Theory suggests that educators should be aware of the intrinsic complexity of the content. For complex chemistry concepts, such as molecular structures or chemical reactions, instructional design should focus on presenting information in a way that doesn't overwhelm working memory.

b. Extraneous Cognitive Load

Extraneous cognitive load refers to the unnecessary cognitive burden imposed by instructional design elements that do not contribute to learning. This can include irrelevant information or poorly designed presentation formats.

To optimize learning, instructional materials in chemistry education should minimize extraneous cognitive load. Well-organized and visually clear representations of chemical structures, reactions, or processes can help students focus on the essential content without being distracted by irrelevant details.

c. Germane Cognitive Load

Germane cognitive load is the mental effort directly related to the construction of schema and understanding. It represents the cognitive load that contributes positively to learning by fostering the formation of meaningful connections.

While intrinsic and extraneous cognitive loads need to be managed, the goal is to maximize germane cognitive load. In chemistry education, well-designed audio-visual materials can contribute to germane load by facilitating a deeper understanding of chemical concepts. Interactive simulations, for example, allow students to actively engage with the content, promoting the construction of mental models.

3. Multimodal Learning

Multimodal learning, rooted in the understanding that individuals have diverse learning preferences, emphasizes the use of multiple sensory modalities for information processing. In the context of chemistry education, this approach acknowledges that students may benefit from a combination of visual, auditory, and kinesthetic elements in instructional materials, enhancing comprehension and retention.

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a. Diverse Learning Styles

Multimodal learning recognizes that individuals have different learning styles, including visual, auditory, and kinesthetic preferences. Visual learners benefit from images and diagrams, auditory learners from spoken explanations, and kinesthetic learners from hands-on experiences.

In chemistry education, where abstract concepts often require varied approaches, the use of audio-visual materials can cater to different learning styles. Visualizations, animations, and narrated explanations provide a multisensory experience, accommodating the diverse needs of students.

b. Flexible Instructional Design

Multimodal learning encourages instructional designers to create materials that offer flexibility in how information is presented. This flexibility allows learners to access content through their preferred modalities.

Chemistry educators can design lessons and materials that incorporate visual representations of chemical structures, auditory explanations of reactions, and interactive simulations. This flexibility accommodates individual differences in the way students process and understand information.

c. Enhanced Comprehension and Retention

The incorporation of multiple modalities is believed to enhance comprehension and retention by engaging different areas of the brain and reinforcing learning through various channels. In chemistry, where students must grasp abstract concepts, the use of audio-visual materials can enhance understanding. For example, a video demonstration of a chemical reaction coupled with a verbal explanation can provide a more holistic and memorable learning experience.

4. Dual Coding Theory

Dual Coding Theory, proposed by Allan Paivio posits that information is processed through both verbal and visual channels, and presenting information using both codes enhances learning and memory. In the context of chemistry education, this theory emphasizes the effectiveness of combining visual representations with verbal explanations to facilitate a deeper understanding of complex chemical concepts [39].

a. Verbal and Visual Channels

Dual Coding Theory suggests that information can be processed through both verbal (language-based) and visual (image-based) channels. Simultaneous activation of both channels enhances learning and memory. In chemistry education, where abstract concepts often require visualization, the combination of verbal explanations (spoken or written) with visual representations (diagrams, animations) allows students to engage with the material through multiple cognitive channels.

b. Enhanced Memory Retrieval

The theory posits that the use of both verbal and visual codes creates dual traces in memory. This dual coding enhances memory retrieval because information can be accessed through either the verbal or visual channel. When learning about chemical reactions, for example, providing students with both a written explanation and a visual representation allows them to encode the information using dual codes. This increases the likelihood of successful retrieval during assessments or when recalling the information later.

c. Cognitive Efficiency

Dual Coding Theory suggests that presenting information in a way that utilizes both verbal and visual channels is cognitively efficient. It maximizes the cognitive processes involved in learning and understanding. Chemistry educators can design instructional materials that leverage both codes to promote cognitive efficiency. For instance, incorporating visual aids like molecular models alongside verbal explanations helps students build a more robust mental representation of chemical structures and reactions.

5. ***Media Richness Theory***

Media Richness Theory, proposed by [40]. suggests that the choice of communication media should match the complexity of the task. In the context of chemistry education, this theory underscores the effectiveness of rich media, such as audio-visual materials, for conveying complex and nuanced information.

a. Media Richness Hierarchy

Media Richness Theory proposes a hierarchy of media richness, ranging from lean to rich. Lean media (e.g., text-based communication) is suitable for simple tasks, while rich media (e.g., face-to-face communication or audio-visual materials) is more effective for complex and ambiguous tasks.

In chemistry education, where conveying intricate concepts and processes is common, the use of rich media, such as animations, videos, and simulations, aligns with the principles of Media Richness Theory.

b. Complexity of Chemical Information

The theory asserts that rich media is more suitable for conveying complex and ambiguous information. Complex tasks require a higher degree of interaction and feedback, which can be facilitated through richer communication channels. Chemistry involves abstract concepts, molecular structures, and dynamic processes. Rich media, such as 3D visualizations, interactive simulations, and video demonstrations, allows educators to convey these complex chemical details more effectively than static, text-based resources.

c. Facilitating Understanding and Engagement

Rich media is considered effective in facilitating understanding and engagement by providing a more immersive and dynamic experience for learners. In chemistry education, the use of media-rich resources supports better understanding by allowing students to visualize chemical phenomena in real-time. Interactive simulations, for instance, enable students to engage actively with the content, fostering a deeper and more engaging learning experience.

SIGNIFICANCE

Understanding the extent of audio-visual material usage in the teaching and learning of chemistry at the junior secondary level is vital for educators, policymakers, and curriculum developers. This research contributes to the ongoing discourse on effective teaching strategies, providing evidence of the impact of multimedia tools on student learning outcomes and teacher practices.

Improving science education is important for several reasons. Science enables students to comprehend the natural world, cultivate critical thinking skills, advance scientific literacy, and get ready for careers in STEM (Science, Technology, Engineering, and Mathematics) fields.

Audio-visual materials are a significant topic that is covered in this review. Many academic institutions face financial constraints and limited access to state-of-the-art resources. Instructors should try out various improvement strategies in order to have the greatest possible impact on students' learning experiences. This paper emphasizes the value of Audio-visual materials as a means of overcoming resource constraints and enhancing scientific instruction.

Audio-visual materials are also very useful in science education. Using well-designed resources can improve conceptual understanding, foster student engagement, facilitate experiential learning, and present opportunities for inquiry-based learning. This study highlights how important it is to use the best audio-visual resources possible that meet curriculum standards and take into account students' varying learning styles and skills.

GENERAL OBJECTIVE

The primary objective of this research is to assess the extent of audio-visual material use in the teaching and learning of chemistry in junior secondary schools.

Specific objectives

- To determine the current extent of the use of audio-visual materials in chemistry education in secondary schools.
- To investigate the perceptions of teachers and students on Audio-visual materials secondary schools.
- To examine the challenges in accessing Audio-visual materials secondary schools.

Research Questions

- To what extent are audio-visual materials used in the teaching of chemistry in junior secondary schools?
- How do educators perceive the impact of audio-visual materials on student engagement and comprehension?
- What challenges, if any, hinder the effective integration of audio-visual materials in junior secondary school chemistry education?

METHODS

We intend to compile and categories findings that address Audio-Visual materials at the secondary school level in the first section of this article. The reviewers examine earlier study findings from other researchers to increase their significance. In order to accomplish this, Research on strategies and challenge for enhancing science education through Audio-Visual in secondary schools is conducted through online study of the Google Scholar and ERIC databases. When results were reviewed, inclusion and exclusion methods were utilized to weed out studies that didn't meet the research inclusion requirements for secondary school. Results were first filtered for Audio-Visual materials.

A total of forty (40) studies were investigated and examined. Studies that did not suit the title were excluded from the database, totally 7 (seven). Additionally, 6(six) research were deleted for being outdated (out of scope) and 17(seventeen) studies conducted on college and elementary school pupils were rejected. As a result.10 (ten) studies were approved to be analyzed in this review because they comprised some of the factors that affect students toward science

FINDINGS

The first objective is to what extent are audio-visual materials used in the teaching of chemistry in junior secondary schools. The utilization of audio-visual resources in chemistry education varies among secondary schools, with the majority (95%) using them infrequently due to factors like limited technological access and insufficient teacher training. Only a small number of schools have fully embraced these materials, integrating them into their curriculum on a regular basis, including both classroom instruction and laboratory work. Among the available audio-visual resources, videos are the most commonly utilized, regardless of their alignment with the specific lesson being taught.

The second objective is to investigate the perceptions of teachers and students on Audio-visual materials secondary schools. Multiple research studies consistently demonstrate that both educators and students have a positive perception of audio-visual resources within educational settings. These materials are widely recognized as valuable assets that enhance student engagement, understanding, and retention of knowledge, ultimately resulting in improved learning outcomes.

Teachers generally hold a favorable view of audio-visual materials as effective tools for increasing student engagement and comprehension. Around 85% of teachers acknowledge the benefits of audio-visual resources in helping students grasp complex concepts. They appreciate the adaptability and versatility of these materials in catering to diverse learning styles, as well as their ability to capture students' attention more effectively compared to traditional teaching methods. This heightened engagement can lead to improved focus, participation, and overall academic achievements in the classroom.

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According to a study conducted by [41], approximately 90% of students hold a positive perception of audio-visual materials in education. They prefer lessons that incorporate these elements over traditional lectures, perceiving audio-visual materials as more engaging and memorable compared to text-based learning materials. The use of audio-visual resources was found to significantly increase student engagement and motivation, providing opportunities for the development of creative and critical thinking skills (46). Students reported enjoying the use of audio-visual materials and found them more interesting and engaging than conventional materials. These findings align with the perspective of [15], who highlighted that audio-visual aids not only increase motivation but also enhance clarity, make learning more interesting, and facilitate a better understanding of abstract concepts.

However, a few teachers and students expressed negative perceptions and identified challenges associated with the use of audio-visual materials. These challenges include the time-consuming and effort-intensive process of preparing and integrating these materials into teaching and learning. Some teachers and students also struggled to find suitable materials and found it difficult to effectively use standardized audio-visual resources.

In summary, while the majority of students have a positive perception of audio-visual materials and see them as valuable tools for engagement and learning, there are some challenges and concerns expressed by a minority of teachers and students regarding the preparation, integration, and effectiveness of these materials.

Despite these challenges the reviewer found that the use of audio-visual materials was generally perceived as a valuable and effective practice by both teachers and students. Generally, these materials have the potential to provide a more inclusive and engaging learning environment, particularly for students who may struggle with traditional teaching methods.

The third objective is to examine the challenges in accessing Audio-visual materials secondary schools. The research findings indicated that a significant number of teachers faced obstacles when searching for high-quality resources that aligned with their lesson plans. Challenges related to copyright restrictions and limited funding for purchasing educational videos and software were also identified, which is consistent with the findings of [42].

While teachers and students generally had a positive response to audio-visual aids, the inconsistent availability of resources, the time-consuming nature of preparation and integration, difficulties in finding suitable materials, and a lack of understanding on how to effectively use audio-visual materials hindered the realization of their educational benefits. Additionally, the absence of centralized platforms for accessing curated content was noted as a limitation.

The reviewers exploration focused on the technological challenges associated with incorporating audio-visual materials into chemistry instruction. The study emphasized issues such as compatibility with school devices, limitations in internet connectivity, and the need for teacher training. Overall, the reviewer recommended investing in infrastructure and providing professional development opportunities to enhance the effective utilization of multimedia resources in secondary education.

CONCLUSIONS

This review presents several key findings related to the current extent of the use of audio-visual materials in chemistry education in secondary schools; Utilization of audio-visual materials, perceptions of teachers and students on Audio-visual materials and challenges in accessing Audio-visual materials., (95%) of school using Audio-visual materials rarely .Only a small number of schools have fully embraced these materials, integrating them into their curriculum on a regular basis, including both classroom instruction and laboratory work. Among the available audio-visual resources, videos are the most commonly utilized, regardless of their alignment with the specific lesson being taught.

Despite these challenges the reviewer found that the use of audio-visual materials was generally perceived as a valuable and effective practice by both teachers and students. Generally, these materials have the potential to provide a more inclusive and engaging learning environment, particularly for students who may struggle with traditional teaching methods. The reviewer's exploration focused on the technological challenges associated with incorporating audio-visual materials into chemistry instruction. The study emphasized on compatibility with school devices, limitations in internet connectivity, and the need for teacher training. The reviewers put their options on Multimodal Learning in chemistry education recognizes the importance of acknowledging and catering to diverse learning styles. By integrating visual, auditory, and kinesthetic elements into teaching-learning processes, educators can create a more inclusive and effective learning environment, fostering deeper engagement and understanding among students.

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