Advances in Social Sciences Research Journal – Vol. 12, No. 12
Publication Date: December 16, 2025
DOI:10.14738/assrj.1212.19698.
Amoah, J. E. M. (2025). Using Audio-Visual Aids to Improve the Concept of Dentition in Second Year Science Students at Mfantsipim School. *Advances in Social Sciences Research Journal*, *12(12).* 59-80.

Using Audio-Visual Aids to Improve the Concept of Dentition in Second Year Science Students at Mfantsipim School

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ABSTRACT

This action research investigated the effects in using audio-visual materials on the academic performance of second year science students of Mfantsipim School in the concept dentition in humans. An action research design was used with a sample of 43 students. The main instruments for data gathering were tests (pre-test and post-test) The pre-test results revealed generally low performance, with a mean score of 10.77, whereas after the intervention with audio-visual aids (videos, diagrams, interactive presentations), the post-test mean rose significantly to 16.63. A paired-samples t-test showed that this improvement was statistically significant ($t(42) = 15.842$, $p = 2.54 \times 10^{-19} < 0.05$), confirming that the intervention impacted positively on student achievement. The results further demonstrated that fewer students scored in the lower scores after the intervention, while more attained higher marks (including scores of 26–30, which was absent in the pre-test). The findings suggest that the use of audio-visual materials not only enhanced comprehension and retention but also fostered greater student engagement and interest in science learning. It was recommended that, biology teachers should adopt audio-visual materials in teaching complex topics. Whilst, regular workshops should be organized to train teachers in the effective use of technology in teaching.

Keywords: biology, dentition, audio-visual aids, information communication technology

BACKGROUND TO THE STUDY

Science education is crucial for the holistic development of learners, students need a strong understanding of human biology (Tareen, Tareen & Nazmine, 2021) [1]. A key topic within this field is dentition, which refers to the development, arrangement, and classification of teeth. Understanding dentition is vital for students studying nutrition, health, and hygiene, as it directly impacts food consumption, digestion, and overall well-being.

In Ghana, the biology curriculum for Senior High School's contains the concept of dentition and same is also introduced in the Integrated Science curriculum. This includes sub-strands such as the types of teeth (incisors, canines, premolars, molars), their functions, the dental formula, the stages of human dentition (milk teeth and permanent teeth), and the importance of oral hygiene (Bekoe & Eshun, 2013) [2]. For science students, who often pursue careers in catering, nutrition, and health sciences, mastering this topic is not only academically important but also practically relevant.

Many students, struggle to understand and retain information related to dentition. Traditional teaching methods, such as lectures and textbook reading, often fail to make the topic relatable and engaging (Abarghouie, Omid & Ghadami, 2020) [3]. As a result, students demonstrate poor

performance, low enthusiasm, and a lack of deeper understanding. This situation calls for a more innovative approach to teaching that addresses the diverse learning needs and preferences of students.

One promising solution is the use of audio-visual aids, which are educational tools that incorporate both visual and auditory elements (Akram, Malik & Malik, 2012) [4]. These aids include animated videos, diagrams, dental models, Power point presentations, and interactive digital resources. They can effectively bring the concept of dentition to life, allowing students to see the structure of teeth, observe the process of tooth development, and listen to explanatory content that reinforces their learning (Manu, Ampomah, Akyina & Antwi, 2024) [5]. Audio-visual tools help transform abstract topics into concrete, observable phenomena, thereby enhancing student engagement and comprehension (Manu et al., 2024) [5].

Over the years, there has been a significant shift in educational pedagogy from teacher-centred approaches to learner-centred and activity-based methods (Kumi-Yeboah, Kim, Mohammed, & Amponsah, 2025) [6]. In previous decades, science education in Ghana and many other parts of the world heavily relied on rote learning, memorization, and theoretical explanations, with minimal emphasis on practical or visual support (Amankwah-Amoah, 2016) [7]. For instance, concepts such as dentition were often taught using chalkboard illustrations and textbook definitions, which provided limited opportunities for students to visualize the real-life applications of what they were studying.

As educational theories like constructivism gained importance, the focus began to shift toward active learning, where students construct knowledge through interaction with materials, visuals, and real-life scenarios (Treve, 2024) [8]. This transition led to a recognition of the importance of teaching aids and multimedia resources in the classroom. Audio-visual tools became increasingly relevant, especially with the advent of digital technology, projectors, and online educational content (Tawiah, Opoku, & Addai-Mensah, 2024) [9]. In the context of teaching dentition, educators have started using dental models, charts, and video demonstrations to help students understand the function and placement of different teeth. This shift has been supported by curriculum planners and science educators who advocate for integrating Information and Communication Technology (ICT) into teaching (Ofosu-Asare, 2024) [10]. However, despite these advancements, there is still a gap in the widespread use of these tools, particularly in resource-constrained schools or classes where teachers may lack training or access to relevant materials (Cullen, Mallet & Murphy, 2019) [11].

Numerous studies have shown that audio-visual aids significantly in enhancing learning outcomes, particularly in science education. Mayer's (2005) [12] Cognitive Theory of Multimedia Learning suggests that when learners receive information through both visual and auditory channels, they process and retain it more effectively than they would with words alone. This theory supports the idea that complex concepts, such as the structure and functions of human teeth, are better understood when learners are exposed to both images and narration simultaneously.

Research conducted by Ojo (2017) [13] on the use of instructional media in science classrooms in Nigeria revealed that students exposed to visual and audio resources performed significantly better on assessments than those taught through traditional methods. Similarly, Boateng

(2023) [14] examined the role of audio-visual aids in Ghanaian Senior High Schools and found a positive correlation between the use of these tools and student performance in biology and integrated science. Additionally, Agyei, Jita, and Jita (2019) [15], in their study on the effects of multimedia teaching on science understanding in selected Ghanaian Senior High Schools (SHSs), emphasized that students taught using videos and animations developed a deeper conceptual understanding and showed greater enthusiasm for learning. Collectively, these studies affirm the effectiveness of audio-visual aids in enhancing student engagement, conceptual clarity, and academic achievement.

Despite this evidence, many schools, including Mfantsipim School, have yet to fully integrate these tools into their science instruction. Many science teachers continue to depend heavily on traditional lecture-based methods, which do not cater for students with visual or auditory learning preferences. This contributes to low retention of content, misconceptions, and poor performance in assessments.

The primary gap this study seeks to address is the limited use of audio-visual aids in teaching science topics such as dentition at the senior high school level, particularly to science classes. Thus, there is the need for a study to investigate how such resources can be practically and effectively utilized in specific classroom contexts.

Statement of the Problem

The practical teaching and learning of scientific concepts, such as human dentition, remains a challenge in many Senior High Schools in Ghana (Ampiah, 2008[16]; Korli, 2023) [17]. Despite the importance of this topic within the biology curriculum (particularly in relation to health, nutrition, and hygiene) many students struggle to understand the structure, functions, and classification of teeth. Observations and preliminary assessments conducted in Second Year science students at Mfantsipim School reveal consistently low performance on the topics related to human dentition. Students often perceive the topic as abstract and difficult to relate to, resulting in limited retention and application of knowledge (Ahorlu,2013) [18].

A review of existing literature suggests that the use of audio-visual aids such as animated videos, diagrams, and digital simulations can enhance student engagement and improve academic performance in science-related subjects. Research conducted by Mayer (2005) [12] and Boateng (2023) [14] indicates that when learners are exposed to content through multiple sensory channels (both visual and auditory), they are better able to understand and retain complex information. However, much of the existing literature is general and does not provide targeted insights into how these tools specifically affect the teaching of biology topics like dentition.

Lack of specific, context-relevant research creates a gap between theory and practice. Although the benefits of audio-visual resources are well-documented, their integration into the teaching of specific scientific concepts remains inconsistent, particularly in resource-constrained schools. Teachers often lack training, access to appropriate materials, or confidence in using educational technology (Ofosu-Asare, 2024) [10]. As a result, students miss the opportunity to engage in more interactive and effective forms of learning.

This action research aims to address the gap by exploring how audio-visual aids can improve students' understanding and improve performance regarding the concept of dentition in humans. The study focuses on a specific group: Second Year science students at Mfantsipim School. It seeks to generate practical insights that can inform teaching strategies, curriculum implementation, and future research. This research responds to a genuine educational need and aligns with broader efforts to enhance science education through innovative, learner-centred approaches.

Research Questions

1. What is the performance of students prior to the use of audio-visual aids in teaching the concept of dentition in humans?
2. How would the use of audio-visual aids impact the performance of students in the concept of dentition?

LITERATURE REVIEW

The Concept of Dentition in Humans

Dentition is the formation and health of teeth as they grow in the mouth. In humans, it involves teeth type, its differentiation, as well as the sequence and timing of their longevity over a lifetime. According to Carney, Keels, Divaris, Casey & Cashion (2024) [19], human dentition can be grouped into two primary dentitions: the primary (deciduous, milk teeth) and the permanent (adult) dentition. The change from primary to permanent dentition is part of an important biological process that is generally initiated in early childhood (around six years old), and continues until the early teenage years (Donnell, Johnston & Foley, 2021) [20]. This is the process that in the curriculum of human biology is quite important, since it is the one that connects our anatomy with personal hygiene and growth.

Based on their shape and function, human teeth are categorized into four major types. These are incisors, canines, premolars and molars. Incisors are for cutting, canines for tearing, and premolars and molars for grinding food (Stepovic, Vulovic, Bankovic, Misic & Vojinovic, 2023) [21]. Each variety has a particular function in the mechanical digestion of food and their location causes good fragmentation of food before swallowing. The study of these functional differences helps students appreciate the complexity and specialization within the human digestive system (Oudkerk et al., 2023) [22]. The knowledge of dentition also supports learning in topics such as nutrition, oral hygiene, and overall body health.

The dental formula is a common way to represent the number and arrangement of teeth in mammals. In humans, the permanent dental formula is typically written as two incisors, one canine, two premolars, and three molars on each side of both the upper and lower jaws (Gudinho & Weksler, 2021) [23]. According to Overskott, Markholm, Sehic & Khan (2024) [24], understanding this formula allows students to systematically identify and count teeth, facilitating structured learning. It also helps learners to differentiate between human dentition and that of other animals, highlighting evolutionary adaptations and feeding habits.

Moreover, the structure of a tooth is another important concept in the study of dentition. A typical tooth consists of the crown, neck, and root, with layers such as enamel, dentine, pulp, and cementum providing protection and support for nerve and blood supply (Brand, Isselhard & Smith, 2023) [25]. These anatomical features are essential to understanding how teeth

function and respond to disease or damage. For students in the science programme, such knowledge is especially relevant for promoting proper oral hygiene and preventive health practices, which are applicable not only to their personal well-being but also to their future roles as health advocates within their families, schools, and communities.

Understanding dentition goes beyond the biological function and also touches on developmental stages and dental care. Research by Wambier, Chibinski, Wambier, Lima Navarro & Banerjee (2023) [26] suggests that early education on dentition can prevent dental conditions such as cavities, gum disease, and tooth loss. By learning about dentition, students become more aware of the importance of diet, brushing, flossing, and regular dental visits. In school settings, incorporating dentition into the biology curriculum prepares students not only for exams but also for making informed decisions about their health and well-being (Rachmawati & Rahman, 2025; Maragha, 2024) [27].

The concept of dentition in humans provides a foundation for learning about both biological structure and function. It also connects with health education and lifestyle practices, making it an essential topic for students in disciplines such as Home Economics. A clear understanding of dentition supports broader learning in biology and equips learners with the knowledge needed to care for their oral health throughout life.

Students' Difficulties and Misconceptions in Learning Dentition

Learning about dentition in humans may seem easy, but for many students, it can be a confusing and hard topic. Studies by Overskott et al. (2024) [24] have shown that students often struggle to fully understand the types, structure, and functions of teeth, especially when they are introduced using technical language or abstract diagrams. According to Ma, Yang, Li, Ma & Li (2025) [28], biology topics that relate to internal structures or involve unfamiliar scientific terms often become difficult for students to grasp, particularly when they lack real-life examples or practical exposure.

One common difficulty students face is identifying and remembering the different types of teeth and their functions. Incisors, canines, premolars, and molars may sound easy in theory, but in practice, students often mix them up, especially when they do not get to see them closely or compare their differences (Cohen, Fitzpatrick & Huie, 2024) [29]. A study by Clauss, Fritz & Hummel (2023) [30] revealed that many students cannot correctly match each type of tooth with its role in digestion, mainly because they have not been given a chance to engage with visual or physical representations of the mouth. Without that hands-on or visual learning, these terms become nothing more than definitions to memorize.

Another major challenge is with the dental formula. Although it is designed to make the arrangement of teeth easier to understand, many students find it confusing and mechanical (Monterubbianesi, Tosco, Vitiello, Orilis, Frasccastoro, Putignano & Orsin, 2022) [31]. Students often fail to connect the formula to their actual mouths, so it becomes a disconnected math-like expression rather than a tool for learning (Monterubbianesi et al., 2022) [31]. For instance, in the study by Opoku, Salu, Azornu & Komesuor (2024) [32], a significant number of junior and senior high school students misinterpreted the dental formula and believed it represented the total number of teeth instead of the number on each side of the jaw. This shows a gap in the way the concept is introduced and taught.

Students also develop misconceptions about when and how teeth grow. Some think all adult teeth come in at once or believe that milk teeth are replaced randomly (Gupta & Rai, 2021) [33]. A study by Spaveras & Antoniadou (2023) [34] indicated that some students even believed permanent teeth could grow back once removed. These misunderstandings show that learners are sometimes missing key developmental concepts, which are essential to understanding human growth and change. It also suggests that everyday experiences, myths, or lack of clear teaching can influence what students believe about their own bodies (Spaveras & Antoniadou, 2023) [34].

Again, students rarely make the connection between dentition and their own dental care practices. Many see it as just another biology topic to pass exams, without realizing its importance to their personal health (Beh & Ho, 2024) [35]. As observed by Kourouma (2024) [36] students often fail to relate lessons on teeth to brushing techniques, diet, or dental visits. This disconnect points to the need for teaching methods that are more relatable and practical, allowing students to see the real-world value of what they are learning.

On the whole, the difficulties students face when learning about dentition often arise from the way the topic is presented, as it may be too abstract, too theoretical, or disconnected from their personal experiences. Misconceptions and confusion are common when students do not have access to visual materials, models, or everyday examples. To improve understanding, it is important for teachers to use strategies that bring the lesson closer to home such as using videos, diagrams, or even peer observations so that learners not only understand dentition but also see its role in their daily lives.

The Use of Audio-Visual Materials in Education:

Audio-visual (AV) materials refer to teaching tools that combine both sound and visual elements to enhance the learning process. Agarwal and Bain (2024) [37] revealed that, in science education, these materials are used to simplify complex ideas, spark interest, and support better retention of content. According to Amos, Eghan and Oppong (2022) [38], AV materials engage more senses at once, which makes learning more effective compared to just reading or listening. In the classroom, audio-visual tools help to bring lessons to life, especially for topics that are difficult to explain with words alone, like the structure and function of human teeth (Kwaffo, 2020) [39]. There are different types of audio-visual materials, each with its own strengths and uses. These can be grouped into three main categories: audio materials, visual materials, and combined audio-visual materials.

Audio Materials:

These include tools that focus mainly on sound. Examples are recorded lectures, educational podcasts, radio programs, and voice-over explanations. These materials help students who learn better by listening, and they are useful for revising lessons or introducing new concepts (Adom, Mensah, Kuttin, Derrick & Nyamekye, 2021) [40]. For instance, an audio recording explaining the function of molars and premolars can be helpful for students to listen to while revising at home.

Visual Materials:

These are materials that rely only on what students can see. Examples include charts, diagrams, drawings, posters, models, flashcards, and pictures. In teaching dentition, a labelled diagram of

a tooth or a dental formula chart can be used to visually explain key concepts. These tools make it easier for students to identify the parts of the tooth and understand the arrangement of different types of teeth (Darkwa & Agyei, 2021) [41].

Audio-Visual (AV) Materials:

These include resources that combine both sound and visuals. Examples are videos, animations, PowerPoint presentations, slide shows with narration, and interactive software. These are especially effective in science education because they show movement, colour, and sound all at once (Kwegyiriba, Mensah & Ewusi, 2022) [42]. For example, a video showing how food is chewed, broken down by teeth, and passed through the digestive system can make learning memorable and fun.

Teachers may choose different types of AV materials depending on the topic, classroom setting, and the needs of their students (Romiszowski, 2024) [43]. It is also important to match the material with the lesson objective (Felder & Brent, 2024) [44]. When used well, audio-visual materials make learning more interactive and enjoyable, especially in subjects like biology where real-life processes are often invisible or hard to imagine (Romiszowski, 2024) [43].

In conclusion, audio-visual materials play a vital role in modern teaching, and their different types give teachers flexible options for delivering lessons. Whether it is a simple chart, a voice recording, or a detailed animation, these materials help students understand better and stay engaged. For a topic like dentition, which involves physical structure, movement, and function, AV tools are not just helpful however, they are essential

METHODOLOGY

Research Design

A research design is a structured plan for investigating a scientific issue which is tailored to a specific research problem (Thomas, Martin, Etnier & Silverman, 2023) [45]. It is an essential component of research which serves as a guide for data collection, measurement, and analysis (Kumar & Praveenakumar, 2025) [46]. The design specifies whether there is an intervention and what that intervention entails. The nature of comparisons to be made, the method, timing data collection and the setting in which the data collection is done are the hallmarks of every good research work.

The research design in this study was action research. This is because, action research is a problem-solving approach focused on addressing immediate issues in specific contexts (De Oliveira, 2023) [47]. This study was conducted at Mfantsipim School. The action research design was chosen because it targets a specific academic challenge, aiming to address it by implementing audio-visual aids as an intervention. The main aim of the study was to determine how the use of audio-visual materials could improve the performance of Second Year science students in the concept of dentition at Mfantsipim School.

Research Population

According to Ganesha and Aithal (2022) [48], a research population is a distinct group of individuals targeted in a study. There are two types of population in research and these are; Target population which refers to the entire group of individuals to which the researcher is interested in generalizing the conclusion. The next type is the accessible population which is

the population in research to which the researcher can apply his/her conclusion. The accessible population is also known as the study population.

In this study, the target population were all second-year science students at Mfantsipim School. However, the accessible population in this study consists of form two science one students at Mfantsipim School. The class comprised of 43 students with an average age of 17 years.

Sample Size and Sampling Technique

Bekele & Ago (2022) [49] defined sample as the selected elements (objects or people) chosen for a study. The individuals selected to form the sample were from the larger group, the population. In this study, the sample size for the intervention was the Second-Year science one class at Mfantsipim School, consisting of 43 students. A judgmental sampling method was used to select the sample from the population. This approach was chosen because the researcher taught this particular class and therefore had sufficient knowledge about the students' academic performance in biology.

Research Instrument

According to Appiagyei, Fenyi and Awogya (2022) [50], a research instrument is a tool or device used by researchers to collect, measure, and analyse. It helps gather the information needed to answer research questions or test hypotheses. Examples are questionnaires, interviews, observation, checklists and achievement tests. Afful and Twumasi (2022) [51] stated that, there are four basic instruments used in educational research. They are questionnaire, observations, interviews, and unobtrusive methods. The researcher used observation and achievement test as the main instruments for data collection. The description and the implementation of each of them follows.

Data Gathering Procedure

Informal Observations:

In this study, the researcher carried out unplanned observations of some biology lessons at the beginning of his internship period. The process involved careful listening and observation. The researcher recorded detailed notes of what was observed during each biology lesson. The observed biology lessons provided information on how biology was taught at the school and whether students are involved in the lesson or not. The researcher also noted students' attitudes during biology lessons as well as their performance in class exercises.

Achievement Test Design and Implementation:

In this study, two types of tests - pre-test and post-test - were used to assess students' u understanding of dentition. Both tests were designed to collect data on student performance before and after the use of audio-visual materials in teaching. The pre-test was administered prior to the intervention while the post-test was conducted afterward, allowing for comparison of results to measure the impact of the teaching strategy. These tests also provided quantitative evidence to substantiate the identified learning challenges.

Each test was divided into two parts to help the researcher understand what the students knew. The first part had multiple-choice questions with four possible answers. This format was used because, realistically, students sometimes guess on these kinds of questions. With four options, there is only a 25% chance of getting it right by luck (Resbiantoro & Setiani, 2022) [52].

The second part asked students to write out their answers in an essay form. This showed the researcher whether students could explain the concepts in their own words and connect different ideas together. While the multiple-choice section revealed what facts students remembered, the essays demonstrated how well they truly understood the material. This combination gave the researcher a complete picture, by showing both what students knew and how well they understood it.

Validity of the Instrument:

In every research work, the validity of the research instruments is a paramount factor to be considered. According to Rudolph, Freeman-Green, Byrne, Savage-Davis, Jones & Thomas-Richmond (2024) [53], validity of an instrument is the ability of the instrument to measure accurately what it is supposed to measure. The researcher implemented several validation methods to ensure the pre-test and post-test accurately measured the intended learning outcomes.

Content validity was established through careful alignment with the prescribed curriculum. The researcher thoroughly reviewed the Second-Year syllabus and consulted relevant textbooks to identify dentition concepts, which includes tooth classification, dental formulas, and oral hygiene practices. The test items were linked to the learning objectives to ensure comprehensive coverage of the topic. Furthermore, two experienced Biology teachers independently reviewed the test questions to verify their relevance and appropriateness for the students. Also, the test items were carefully formulated and also, pilot tested. A preliminary version of the test was administered to five students not participating in the main study, which led to refinements in question wording and instructions. The final version maintained this clarity while effectively covering all critical aspects of human dentition.

Reliability of the Instrument:

The reliability of an instrument in action research pertains to its ability to produce consistent, stable, and repeatable results (Wiafe, Mensah, Mensah, Bangalee & Oosthuizen, 2021[54]; Srem-Sai, Quansah, Frimpong, Hagan & Schack, 2021) [55]. It is a measure of the degree to which the instrument measures the attribute it is supposed to be measuring. This concept is particularly important in ensuring the accuracy of measurements and the dependability of the instrument (Ahmed & Ishtiaq, 2021) [56]. To ensure the reliability of the test questions on improving dentition knowledge through audio-visual methods, the researcher implemented a test-retest method to verify the reliability of both the pre-test and post-test instruments. Also, an intense invigilation was conducted by five colleague interns. Students were allocated a maximum of 60 minutes to complete all test questions, which the researcher determined to be sufficient time.

Intervention Strategy and Implementation

The intervention was carried out over a two-week period, with lessons scheduled for three days each week. Each session lasted for 90 minutes, which was in line with the existing biology periods on the school timetable. The purpose of the intervention was to improve students' understanding and performance on the topic "Dentition in Humans" using audio-visual materials. Tools used included videos on dentition, projected animations, printed diagrams, posters and interactive board activities. This method placed emphasis on engaging, creative, and student-centred teaching while staying within the boundaries of available resources.

Table 1: Intervention over the two-week period

Week One
Day 1: Introduction to Dentition and Types of Teeth
During this session, the students were introduced to the concept of dentition in humans, with the focus on the four major types of teeth. The class began with a 3D animated video that displayed the arrangement of human teeth in the mouth. The researcher paused at intervals to explain key points. The researcher then divided the students into small groups for a "Tooth Puzzle Challenge", where each group received printed images of incisors, canines, premolars, and molars. The students were asked to arrange these on a blank mouth template in the correct anatomical position. For example, a group that correctly positioned the canines between the incisors and premolars was asked to explain the role of the canines in tearing food. This activity fostered teamwork and visual recognition of tooth types.
Day 2: Dental Formula and Tooth Structure
The lesson focused on the dental formula and internal structure of a typical tooth. A slide presentation and projected diagram were used to explain this concept. Students were given individual diagrams to label the enamel, dentine, pulp, and other parts of the tooth. To reinforce learning in a fun way, the researcher conducted a "Tooth Bingo" game. Each group received a bingo card with terms like 'molar', 'enamel', 'plaque', and 'canine'. The teacher read definitions aloud, such as "This tooth is responsible for grinding food", and students marked the correct term on their cards. When a student shouted "Bingo!", they were asked to explain each selected term to confirm their win.
Day 3: Comparison of Dentition in Humans and Animals
At this stage, the lesson compared the dentition of humans with that of herbivores and carnivores. Videos of feeding habits were projected, showing a cow, a lion, and a human eating. Students discussed how tooth structure differs based on diet. Each group was assigned an animal and created a poster showing its dentition. For instance, one group illustrated the flattened molars of a cow and explained their role in grinding plant materials. Presentations were made using these posters.
Week Two
Day 4: Dental Diseases and Oral Hygiene
This lesson addressed common dental diseases and oral care. A video showed a student suffering from tooth decay. The class discussed causes, symptoms, and preventive measures. Students then took part in a "Dentist and Patient" role-play, where they practiced giving and receiving oral hygiene advice. This helped improve appropriate dental habits in a practical, interactive format.
Day 5: Recap and Interactive Revision Game
All previous content was reviewed through a board game called the "Teeth Relay". The class was split into four teams. Each team sent a member to the board to answer questions or label a diagram of a tooth. For example, one question asked a student to "Write the dental formula of an adult human." Another task involved labelling the pulp cavity on a diagram. The next member only proceeded when the previous answer was correct. This encouraged teamwork, speed, and concept recall.
Day 6: Project Work and Evaluation
Students were grouped to produce summaries of what they had learned. Projects included posters, oral presentations, and short skits related to dentition and hygiene. One group presented a poem titled "The Life of a Tooth," which narrated the journey of a tooth from eruption to decay. These were used to assess the effectiveness of the intervention.

Examples of the Images and Posters Used for During the Intervention;

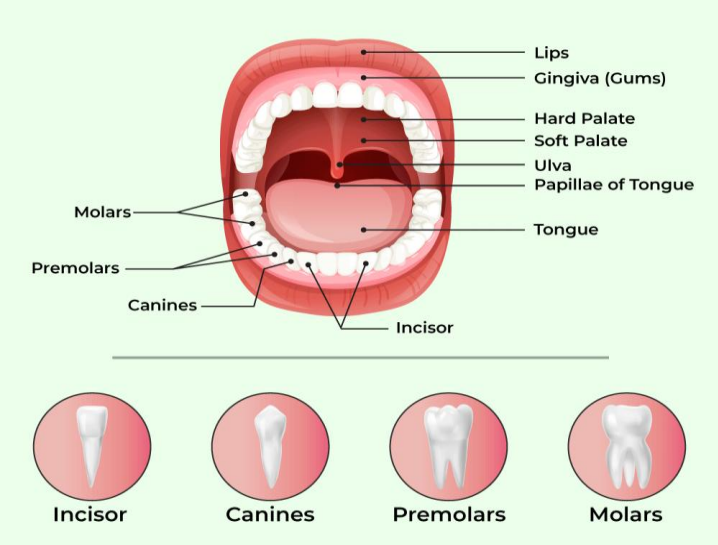

Figure 1: A diagram showing the arrangement of human teeth in the mouth.

Figure 2: A diagram showing the anatomy of the tooth.

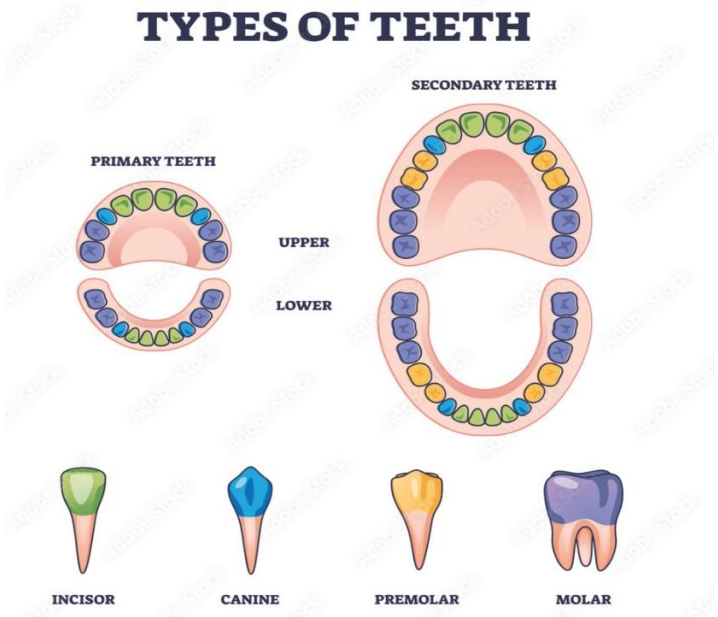

Figure 3: A diagram showing the various structures of the human teeth

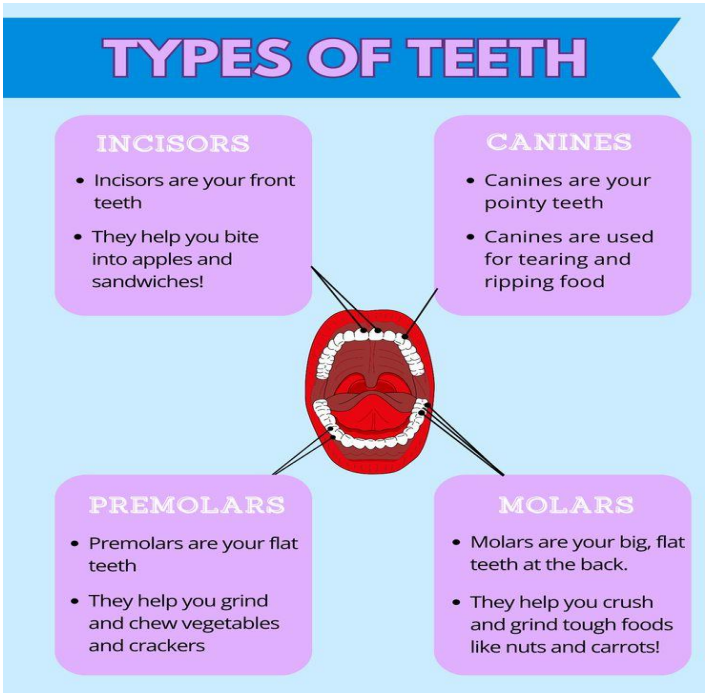

Figure 4: A diagram showing the types of teeth, their description, location in the mouth and their function

Figure 5: A diagram showing a decayed tooth

Post- Intervention Activity

The researcher also conducted a post-test, just like the pre-test for the students to answer questions after the intervention. This was to assess the degree at which students' performance and interest had been aroused with improved performance in the concept of dentition in humans.

Data Analysis Procedure

The numerical data of the pre-test and post-test activities were collated and analysed using descriptive statistics such as the frequency table for better interpretation. The mean scores were compared to determine the effectiveness of the intervention.

RESULTS, ANALYSIS AND DISCUSSIONS

Research Question 1

- What is the performance of students prior to the use of audio-visual aids in teaching the concept of dentition in humans?

In answering this research question, a pre-test was administered to the students to determine their performance before the implementation of the treatment activity. The result from the pre-intervention test is summarized in Figure 6.

Presentation of the Pre-test Results

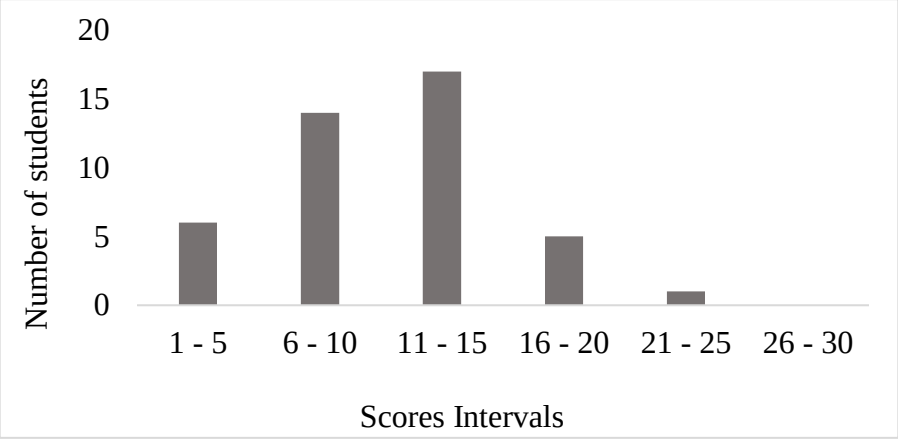

Figure 6: A bar chart showing the distribution of Students' Scores in the Pre-Test on the Concept of Dentition

The purpose of this test was to check how well the students understood the topic of dentition in humans after it had been taught using the traditional method of teaching. This was done to determine whether the traditional method was sufficient on its own or whether there was a need to try a new approach, such as the use of audio-visual materials. The results of the test served as a baseline to help measure any improvement after the new method was introduced. The results of the pre-test are presented in the figure 6.

Interpretation of the Pre-test Data

The bar chart (Figure 6) presents the scores obtained by Second Year Science students of Mfantsipim School in the pre-test on the concept of dentition in humans. The results showed that the highest number of students, 17, had marks within the range of 11–15, which formed the modal class. This was followed by 14 students who scored between 6–10, while 6 students scored within the lowest interval of 1–5. Altogether, these three groups accounted for 37 students, representing about 84% of the total class. Only a few students attained higher scores, with 5 students falling within 16–20, and just 1 student within 21–25. No student scored between 26–30. The distribution indicated that although the topic had already been taught using the traditional method, the majority of students still performed below average, with most scoring less than 15 out of 30. The very low number of students who achieved higher marks and the absence of top scores suggested that the traditional approach did not promote adequate understanding of dentition in humans. This highlighted the need for an alternative instructional strategy, such as the use of audio-visual materials, to better support students' comprehension and improve their performance on the concept.

Research Question 2

- How would the use of audio-visual aids impact the performance of students in the concept of dentition?
- How did the use of audio-visual aids affect the academic performance of Second Year science (2) students in the topic of dentition?

In answering this research question, a post-treatment test was administered to the students to determine their performance and the level of understanding they had gained on the concept of dentition in humans after being taught with audio-visual materials.

Presentation of the Post Test Results:

The purpose of this test was to check how well the students understood the topic of dentition in humans after it had been taught using audio-visual materials. This was done to find out whether the new method of teaching was more effective in helping students learn than the traditional method. The results of the post-test are presented in the figure below (Figure 7).

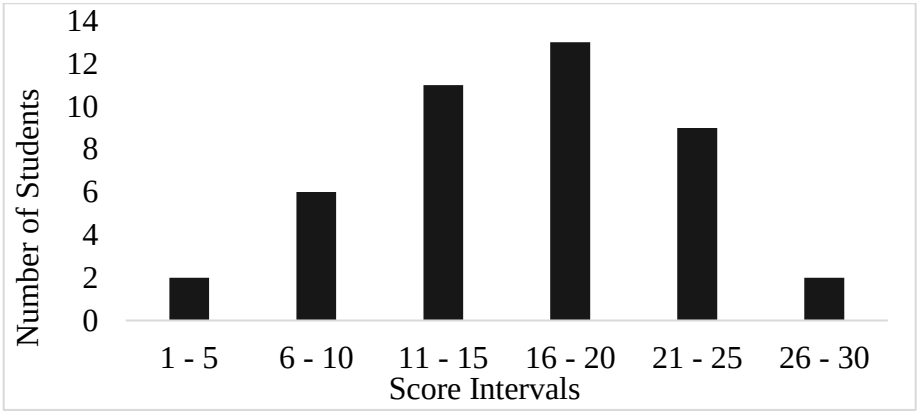

Figure 7: A bar chart showing the distribution of Students' Scores in the Post-Test on the Concept of Dentition

Interpretation of the Post Test Data

The bar chart (Figure 7) presents the scores obtained by Second Year science students of Mfantsipim School in the post-test on the concept of dentition in humans after the use of audio-visual materials. The results showed that the highest number of students, 13, had marks within the range of 16–20, which was the modal class score. This was followed by 11 students who scored between 11–15, while 9 students fell within the interval of 21–25. Only a small number of students, 2 and 6 respectively, scored within the lowest intervals of 1–5 and 6–10, while another 2 students attained the highest interval of 26–30. The distribution indicated that after the intervention, majority of the students scored above average, with some attaining marks greater than 15 out of 30. Compared to the pre-test results, the number of low scorers drastically reduced, while more students moved into the higher score ranges. The presence of students in the top interval of 26–30, which was absent in the pre-test, further demonstrates the effectiveness of the new teaching approach. These results therefore suggest that the use of audio-visual materials enhanced students' understanding of the concept of dentition in humans and significantly improved their overall academic performance.

Comparison of the Pre and Post-tests Results

To provide a clearer picture of the results, a bar chart was drawn to compare the pre-test and post-test scores of the students. Figure 8 presents a visual representation that highlights the differences in performance before and after the intervention.

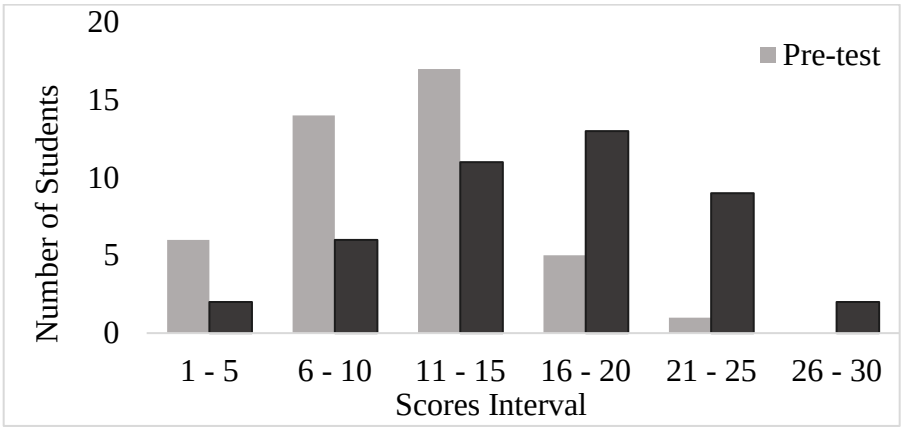

Figure 8: A bar chart showing the Comparison of Students' Pre-test and Post-test Scores

Figure 8 presents the distribution of students' scores in both the pre-test and post-test after the use of audio-visual materials in teaching the concept of dentition in humans. From the results, it is evident that the performance of students in the pre-test was relatively low. Majority of students scored within the ranges of 6–10 and 11–15, with 14 and 17 students respectively falling within these intervals. A considerable number, 6 students, also scored within the lowest interval of 1–5, while only a few attained scores above 15. Specifically, 5 students were within the 16–20 range, just 1 student within the 21–25 range, and none reached the highest interval of 26–30. This shows that before the introduction of audio- visual materials, students generally struggled with the concept, as their scores were largely clustered around the lower and middle intervals.

The post-test results, however, reveal a significant improvement in students' performance after the intervention. Unlike the pre-test, the scores in the post-test shifted markedly from the lower ranges toward the higher ones. The highest number of students, 13, scored within the range of 16–20, followed closely by 9 students in the 21–25 interval. Notably, 2 students were able to achieve scores within the highest interval of 26–30, which had no representation in the pre-test. The number of students in the lowest ranges reduced sharply, with only 2 students in 1–5 and 6 in 6–10. This outcome clearly demonstrates that the use of audio-visual materials had a positive impact, enabling more students to perform better and achieve higher scores.

In summary, the overall trend revealed by the chart is that students' performance improved considerably after the application of audio-visual materials. While the pre-test results showed that students' scores were largely concentrated in the lower and middle ranges, the post-test results indicated a marked shift toward the higher ranges. This provides strong evidence that audio-visual materials were effective in enhancing students' understanding and achievement in the concept of dentition in humans.

t-test Analysis of the Pre and Post Test Results

To determine whether the difference in students' performance between the pre-test and post-test was statistically significant, a t-test analysis was carried out. This test was intended to establish whether the observed improvement was due to the intervention or occurred by chance. The table below (Table 2) shows the paired t-test statistical data comparison on students' scores in the pre and post-test.

Table 2: Paired t-test Statistical Analysis on the Pre-test and Post-test results

Test	Mean	Variance	Observation	Pearson correlation	df	t Stat	P(T<=t) two-tail	t Critical two-tail
Pre	10.767	19.611	43	0.92	42	15.842	2.54E-19	2.018
Post	16.628	32.620	43					

($\alpha = 0.05$)

Interpretation of t-test Data

The paired t-test was conducted to compare the mean scores of students in the pre-test and post-test after the use of audio-visual materials in teaching the concept of dentition in humans. The results show that the mean score increased from 10.77 in the pre-test to 16.63 in the post-test, indicating a marked improvement in students' performance after the intervention. The variance also increased from 19.61 to 32.62, suggesting that while the overall scores improved, there was a wider spread of scores in the post-test compared to the pre-test.

The Pearson correlation coefficient of 0.92 indicates a very strong positive relationship between pre-test and post-test scores. This means that students who performed well in the pre-test generally maintained good performance in the post-test, though with significant improvement.

The calculated t-statistic was 15.842, which is far greater than the critical t-value of 2.018 at a 0.05 significance level with 42 degrees of freedom. Furthermore, the p-value was 2.54×10^{-19}, which is much smaller than the alpha level of 0.05. This means the observed difference between the pre-test and post-test means is statistically significant.

In conclusion, the paired t-test confirms that the use of audio-visual materials had a significant positive effect on students' performance in the concept of dentition in humans. The very low p-value provides strong evidence to reject the null hypothesis that there is no difference between pre-test and post-test scores. Therefore, it can be inferred those audio-visual materials were highly effective in improving students' understanding and academic achievement in this area.

DISCUSSION OF THE FINDINGS

The findings of this action research clearly demonstrate that the use of audio-visual materials significantly improved students' academic performance on the topic dentition in humans. The pre-test results indicated that, majority of students scored below average when the traditional teaching method was used, with as many as 84% of the class obtaining scores below 15 out of 30. This suggested that the conventional approach to teaching dentition did not effectively support learners in grasping the concept. However, after the intervention, the post-test results revealed that most students moved into higher score ranges, with 13 students scoring between 16–20, 9 students scored between 21–25, and 2 attaining the highest score range of 26–30. The

mean score increased significantly from 10.77 in the pre-test to 16.63 in the post-test, and the paired t-test confirmed that this difference was statistically significant. This underscores the positive influence of audio-visual materials on students' learning outcomes.

The findings resonate with earlier studies on the effectiveness of instructional innovations. For instance, Asantewaa (2023) [57] observed that when audio-visual materials were integrated into science lessons, students exhibited improved comprehension and higher test scores compared to peers taught with traditional lecture methods. Similarly, Gyamenah (2024) [58] reported that animations and video demonstrations in teaching photosynthesis helped students overcome common misconceptions and improved their overall grasp of the topic. The present study, therefore, corroborates these findings by showing that audio-visual interventions provide a more engaging and effective medium for teaching science concepts, particularly those that are abstract and difficult to visualize.

The improvement recorded in this study can also be explained through Mayer's (2024) [59] Cognitive Theory of Multimedia Learning, which posits that student learn better when information is presented through both visual and auditory channels rather than through verbal explanations alone. According to Mayer (2024) [59], such dual coding reduces cognitive overload and enhances deeper processing of information. In the context of this research, dentition in humans, which involves abstract processes such as tooth development, eruption, and types of teeth, was made more concrete when learners could see moving images, diagrams, and explanations simultaneously. This aligns with the sharp increase in students' post-test scores after the introduction of audio-visual materials, as compared to the poor performance under the traditional teaching method.

The results also support the conclusions of Akuoma and Juliana (2021) [60] in Nigeria, who noted that the use of video-based instruction in biology classes increased student motivation, participation, and retention of knowledge. In a similar study, Jeptoo and Mogeni (2024) [61] in Kenya found that audio-visual resources significantly enhanced students' critical thinking skills, as learners were able to connect visual representations of biological processes with theoretical concepts. These regional findings confirm that the benefits of audio-visual instruction are not confined to one country but extend across different educational contexts in Africa. The present study adds to this body of evidence by showing similar improvements among Ghanaian students.

Another important observation in this study was those audio-visual materials not only improved performance but also reduced the number of students performing at the lower end of the score range. For example, while 6 students scored between 1–5 in the pre-test, this number dropped to only 2 in the post-test. This suggests that audio-visual materials may particularly benefit struggling learners by providing alternative ways of understanding abstract material. This finding echoes Abdullahi, Amao and Abubakar's (2024) [62] assertion that audio-visual resources make complex concepts more relatable and accessible, thereby fostering inclusive learning where even weaker students are able to make progress.

The present findings also highlight a shift in the learning culture when modern instructional materials are employed. Traditional lecture methods often lead to passive learning, where students merely listen and memorize. In contrast, audio-visual materials stimulate multiple

URL: http://dx.doi.org/10.14738/assrj.1212.19698

senses, creating a more interactive and engaging classroom environment. Studies by Tetteh, Amakye, Asori & Mohammed. (2025) [63] have shown that students taught with audio-visual aids display higher levels of enthusiasm, participation, and curiosity in science lessons. The increased motivation likely contributes to better performance outcomes, as also observed in this study.

In conclusion, this action research establishes that the use of audio-visual materials in teaching dentition in humans significantly improved the academic performance of senior high school students. The results are in line with both local and international studies that consistently emphasize the pedagogical value of multimedia resources in science education. By making abstract concepts more concrete, reducing learning difficulties, and increasing student engagement, audio-visual materials prove to be effective instructional tools. The findings thus provide strong justification for integrating such materials into the teaching of biology and other science subjects at the secondary level. This will not only raise academic achievement but also cultivate greater interest and deeper understanding among students.

CONCLUSION

The study was set out to examine the impact of audio-visual materials on students' performance in the concept of dentition in humans at Mfantsipim School. The results showed that students taught with traditional lecture methods performed poorly and struggled to explain the types, functions, and stages of dentition. However, after the introduction of audio-visual materials, students' performance improved significantly, with the mean score rising from 10.77 to 16.63, and the paired t-test confirming that the difference was statistically significant. These results clearly demonstrate that audio-visual materials make abstract biological concepts more concrete and enhance students' understanding.

It can therefore be concluded that the use of audio-visual materials is an effective instructional approach for improving both academic performance and students' attitudes toward biology. By making lessons more interactive, engaging, and relatable, these tools not only increase comprehension but also foster greater interest and participation. The study affirms the need for teachers and curriculum planners to integrate audio-visual resources into science instruction in order to promote meaningful and lasting learning.

RECOMMENDATIONS

There is the need for continuous training and professional development for teachers to build their competence in the use of audio-visual resources. The Ghana Education Service, in collaboration with Mfantsipim School administrators, should organize workshops and in-service training sessions to equip teachers with the skills needed to effectively integrate these tools into classroom instruction. Such training will not only expose teachers to existing digital resources but also encourage them to create or adapt locally relevant audio-visual materials that suit their specific teaching contexts. Based on the findings of this study, it is again recommended that biology teachers at Mfantsipim School make deliberate efforts to integrate audio-visual materials into the teaching of abstract concepts such as dentition in humans. By incorporating animations, videos, diagrams, and interactive presentations into lessons, teachers can enhance students' comprehension, improve retention, and sustain their interest in learning biology. Adequate provision of resources and infrastructure is also crucial for the effective implementation of this recommendation. The Ministry of Education and school

authorities should ensure that schools are well resourced with projectors, computers, speakers, and reliable electricity to facilitate the use of audio-visual tools. Partnerships with private organizations, local universities, and non-governmental organizations can also be explored to bridge resource gaps and promote the use of innovative teaching strategies in science education. Curriculum planners should also support learner-centred approaches such as the use of audio-visual materials in science education. Incorporating such strategies into curriculum guidelines will encourage teachers to move beyond rote learning and adopt methods that foster deeper understanding and critical thinking. Furthermore, teachers should create opportunities for students to actively participate when audio-visual materials are used, through group discussions, project work, and problem-solving activities. This will encourage collaboration, correct misconceptions, and promote the development of analytical and reasoning skills among learners.

Finally, the study recommends that further research be carried out to examine the effectiveness of audio-visual materials in other biology topics such as genetics, photosynthesis, and cell division, as well as in other strands of science beyond biology. Conducting similar studies across different schools and regions will provide broader evidence to guide educational policy and strengthen the case for integrating audio-visual materials into the teaching and learning of science in Ghana and beyond.

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