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Animation and Infographics Instructional Strategies On The Engagement, Performance And Retention Of Secondary School Biology Students In Rivers State

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ABSTRACT
This research examined how secondary school biology students in the obio akpor local government area of Rivers State responded to animation and infographics as teaching tactics in terms of engagement, performance, and retention. Nine research questions and nine hypotheses were developed as the study's guiding principles. The study used a pre-test post-test non-equivalent control quasi-experimental research design. In Rivers State's Obio-Akpor Local Government Area, there are twenty-three (23) public senior secondary schools. 186 senior secondary year two (SS 2) Biology students from the Obio-Akpor Local Government area of Rivers State were selected for the study's sample using simple random and selective selection from three whole classes. Three tests—the Biology Performance Test (BPT), the Biology Retention Test (BRT), and the Biology Students' Engagement Questionnaire (BSEQ)—were used to obtain the data. Analysis of Covariance (ANCOVA) was utilised to test the hypotheses at the 0.05 level of significance while Mean, Standard Deviation were employed to analyse the data and provide answers to the research questions. The results revealed that There is significant dissimilarity among students taught utilising animation, utilising infographics and utilising discussion method in their performance in biology, there is significant dissimilarity among students taught utilising animation utilising infographics and utilising discussion method in their retention in biology, there is significant dissimilarity on the influence of gender on performance there is significant dissimilarity on the influence of gender on retention, there is significant joint effects of animation, infographic, discussion teaching method and gender on performance, there is significant joint effect on animation, infographics, discussion teaching strategy and gender on retention, there is significant dissimilarity on effects of animation infographics and discussion as a teaching strategy on the engagement of biology students, there is no significant dissimilarity on influence of gender on the engagement of biology students and there is significant joint effect of animation, infographics, discussion teaching method and gender on the engagement of biology students. According to the study's recommendations, the government should do more to encourage teachers to incorporate animation in their biology lessons.
Keywords: Animation And Infographics, Instructional Strategies, Engagement, Performance And Retention

INTRODUCTION

Recent years have seen a rise in the utilisation of animations and other types of dynamic visualisation in the educational setting. Over a decade of research has shown animations' efficacy and established a

connection between animations and specific types of learning (Höffler & Leutner, 2007). There are more factors that influence the efficiency of animation in the classroom (Berney & Betrancourt, 2016).

Science and technology are at the heart of contemporary life because of the widespread advancements made possible by utilising scientific knowledge, concepts, laws, theories, and principles (Nwafor, 2017). Independently verifiable information, or the capacity to actively explore and critically assess such knowledge, is the ultimate objective of scientific research. Therefore, science may be either a field of study, a process, or a skill set. Senior high school curricula in Nigeria encompass a wide range of scientific disciplines, including chemistry, physics, animal husbandry, geography, mathematics, agricultural science, computer science, economics, health science, and biology. When utilised effectively, animation and information graphics in the classroom create a learning environment that aids students' academic progress, making education the most potent instrument for a country's economic, social, technological, and political development. Steward (2002) claims that animated teaching materials are rapidly gaining attention as one of the most controversial issues in contemporary education. This view of animation as just a kind of entertainment has sadly persisted, as Okon (2008) notes in his study on the utilisation of animation in the classroom. He continued by saying that everyone can see that animation is helpful in the classroom, and that it has essentially replaced all other forms of instruction as the gold standard.

In congruent with Frank (2006), the employment of multiple senses in a perceptual context (learning environment) leads to better learning and retention upshots. When utilised properly, animation may provide students access to concepts like process, substance, event, object, change in time, speed, and space that were previously out of reach. However, the process of animation itself acts as a springboard for students to engage in a broad variety of learning activities; the attention that the notion of animation tends to attract is not the end purpose. They are the foundation of conceptual cognition, allowing for clearer communication and faster comprehension. utilising animation in the classroom may benefit educators in more ways than one. The incorporation of audio, text, multicoloured images, graphics, motion, light, and other special effects provides learners (students) with numerous and exceptional opportunities to build their capacity for high-quality learning and to increase their ability to be highly innovative in thought and practise.

The instructional strategy is imperative because it encourages student engagement in the learning process via four main characteristics: knowledge sharing (the teacher draws upon students' prior knowledge of the subject), sharing ability (the teacher encourages students to apply their knowledge, share with one another, and correct one another), mediation (the teacher mediates and directs learning), and mediation and facilitation (students and teacher collaborate to so When we talk about animation instructional technique, we are referring to a subset of pedagogical methods that makes utilisation of visual aids like cartoons, graphics, and animations to get a point over to students. Animation captures a sequence of drawings or poses for puppets or models to make a film seem to move. Animated films, in congruent with academics, are those that depict the movement of drawn (or simulated) objects in motion. When utilised in the classroom, animations provide a visual help. In congruent with Sanchez, Canas, and Novak (2010), an instructional animation is one that actively seeks to educate its audience. Digital media formats like the animated Graphics Interchange Format (GIF), Flash animation, and digital video join the likes of flip books, movie film, and video cassettes as mediums for recording animation. Showing animated films now requires state-of-the-art equipment, such digital cameras, computers, or projectors. Another common method of creating animated movies is stop-motion animation, which may utilisation anything from paper cut-outs and puppets to clay figures and three-dimensional items. When showing a sequence of pictures rapidly one after another, the frame rate is usually 24, 25, 30, or 60 frames per second. Utilising animation in the classroom may help students learn more effectively and remember what they have learned over the long run since it engages more of their senses. Several studies have indicated that the utilisation of teaching approaches utilising animated media boosts students' success and retention in a range of academic subjects.

In the classroom, infographics are becoming more popular as a means of presenting and conveying information. Infographics are a promising, effective, and helpful tool for a variety of purposes, including but not limited to data display, idea explanation, presentation simplification, connection mapping, trend illustration, and conveying essential insights. In keeping with the multisensory and multimodal approach, they make utilisation of both words and pictures. They help to transform massive volumes of information into a comprehensible picture. Infographics are popular in many fields, including education, since they help students and others quickly absorb complicated concepts via the utilisation of visually appealing representations of that information. It allows for faster communication of information. If implemented methodically, it may help students learn to work together, retain information, and take an active role in their own education. For educational purposes, information graphics are useful since they improve content comprehension and interpretation for audiences of all types (Basco, 2020).

However, biology students have often performed poorly. . Many issues have been established via study; one of them is the fact that certain topics are tough both for teachers and their pupils. Some examples comprise the fields of genetics, ecology, and nervous system integration. Further study has indicated that textbooks are predominantly utilised to teach many of these areas. This is why it is common for teachers to skim over subjects like genetics, which is notoriously difficult to introduce to students. Numerous investigations on this topic attest to the fact that learning genetics is difficult. This is perhaps because genetics is an intangible field whose underlying processes (including cell division, fertilisation, and germination) are not immediately apparent to the human eye. Despite Biology's obvious importance and relevance, it seems that most students do not have much (if any) competent, usable understanding of the topic. There are not enough good biology teachers, there are not enough biology texts, there exist not enough power, and there are not enough functional science labs. Adebayo and Oladele (2016) state that the lack of available Biology laboratories is the most crucial of these concerns. Today, one of the few universal truths in the world is the proverb practise makes perfect.

Therefore, Because of this, it is crucial to move the emphasis of research on instructional techniques in Biology education towards innovative methods of teaching. Students who are having difficulty in Biology classes may benefit from utilising animated media and info-graphics in the classroom as they provide a realistic alternative to hands-on experience and give students an extra boost in their success in the subject.

Statement of the Problem

The purpose of science education is to familiarise students with scientific nature (facts, principles, and ideas), procedures, attitudes, and professional scientist-level abilities. The utilisation of technologies and/or media to guarantee maximal cognitive growth or progress of pupils is crucial to the success of any educational organisation in today's current era of sophisticated technology. It is impossible to overstate the advantages of utilising ICT in teaching and learning. (2017) Fomsi & Orduah). It gives a tangible foundation for the understanding of abstract topics as studies have demonstrated that the utilisation of ICT as an intellectual multi-tool that is flexible to pupils' demands may greatly improve learning quality (Nwafor & Okoi, 2016; Furo, 2015; Gambari & Yusuf, 2017; Samuel, 2018). Teachers and students need to have access to and utilise ICT if Nigeria is to catch up to other developed nations (Fomsi & Orduah, 2017).

The goal of Basic Sciences education is to prepare students to grasp fundamental concepts correctly and to apply them. Additionally, it aims to foster the attitudes and abilities necessary for future scientific endeavours. To attain these goals, collaborative learning actions and active involvement are essential, and good Basic Sciences education depends on functional instructional media (Oni, 2014; Osokoya, 2013; Samuel, 2017).

A person's attitude towards a certain thing or action is said to be their interest. This implies that a youngster will get interested in anything or action they find appealing or interesting. As an upshot, in a classroom setting, a student will only pay attention to a lesson if the teaching is engaging for them (Nwachukwu, 2013; Danjuma, 2015).

Although ICT has nearly completely permeated every sector in Nigeria, Fomsi & Orduah (2017) found that the education sector has been the slowest to embrace it. However, the purpose of this research is to

investigate how the instructional tactics of animation and infographics affect the performance and retention of biology students in secondary schools in Rivers State.

Aim and Objectives of the Study

The aim of the study is to investigate the effect of animation and infographics as instructional strategies on the engagement, performance and retention of secondary school Biology students in Rivers State. However, the specific objectives of the study are to:

1. Determine the dissimilarity exists among the performance of students taught biology utilising animation, those taught utilising infographics and those taught utilising discussion teaching method?
2. Find out the dissimilarity exist in the retention of students taught biology utilising animations those thoughts utilising infographics and those thoughts utilising discussion method?
3. Establish the dissimilarity among the performance of female and male biology students?
4. Investigate the dissimilarity among the retention of female and male students in biology?
5. Determine the joint effect of animation, infographics, discussion teaching strategy and gender on performance?
6. Find out the joint effect of animation, infographics, discussion teaching strategy and gender on retention of students in biology?
7. Determine the effect of animation, infographics and discussion as a teaching strategy on the engagement of biology students.
8. Find out the influence of gender on the engagement of biology students.
9. Find out the joint effects of animation infographics discussion teaching strategy and gender on the engagement of biology school students.

Research Questions

The following research questions were drawn to guide the study

1. What dissimilarity exists in the performance of students taught biology utilising animation, those taught utilising infographics and those taught utilising discussion teaching method?
2. What dissimilarity exist in the retention of students taught biology utilising animations those thoughts utilising infographics and those thoughts utilising discussion method?
3. What is the dissimilarity among the performance of female and male biology students?
4. What is the dissimilarity among the retention of female and male students in biology?
5. What is the joint effect of animation, infographics, discussion teaching strategy and gender on performance?
6. What is the joint effect of animation, infographics, discussion teaching strategy and gender on retention of students in biology?
7. What dissimilarity in engagement exist among students taught biology utilising animation infographics and discussion teaching strategy?
8. What is the dissimilarity among the engagement of female and male students in biology?
9. What dissimilarity in engagement as a joint effect of animation, infographics, discussion teaching strategy and gender?

LITERATURE REVIEW

Conceptual Framework

Extent Technical and Vocational Education contribute to Employability Skills

Due to its capacity for imaginative or creative thought and ability to concretize abstract temporal notions, animation is substantially better at portraying ideas that comprise changes over time (Rias & Zaman, 2019). In line with Bada, et al. (2018), the purpose of animated films is to provide more information and outside assistance for mental recreations, allowing the pupil to execute greater levels of subjective handling.

In a similar vein, Akor (2016) highlighted that the usage of animation in the classroom serves to pique pupils' interests, inspire them to study, and increase their level of autonomous and personal responsibility for their education likewise their capacity for higher-order thinking and creative problem-solving. Iravani

and Delfechresh (2019) also highlighted how the adaptability of learning via animation allows for a wider range of stimuli, growing the pupils' engagement in learning and, as an upshot, their academic attainment, interest, and retention—all of which are imperative factors in any educational system. Gupta and Lata (2014) found that animation improved pupils' scientific performance more effectively than traditional lecture methods. Low academic attainment, in line with Ogundokun and Adeyemo (2017), is associated with a drop in the availability of instructional resources in schools.

Types of animations

Despite the fact that there are other animation genres that may be employed in our lectures, the examiner only discussed the three most prevalent styles of animation. These kinds are appropriate for utilisation in technology education and visual communication courses they are the: **Traditional animation also** known as cell animation as the individual frames in a conventionally animated film are really pictures of original artwork. The most animated movie of the 20th century might employ this as its primary production method. Secondly is the **Full animation** described as the process of creating top-notch conventionally animated movies with consistent usage, intricate artwork, and discernible movement. And lastly the c**omputer animation which** refers to digital images that can be produced digitally. It emphasises visual manipulation in which objects and characters move and interact. Computer animation is defined by Bancroft and Keane (2006:87) as a programme that employs animation software to produce and replicate individual frames. The utility of animation software programmes like Mice and Animor is well established.

The advantages of utilising animation in tutoring Biology pupils.

Learning about a variety of subjects via animation might benefit pupils. Animation films help pupils' grasp of abstract concepts. With a range of media technologies, utilising animation on computers has gotten simpler, and it is a useful approach for pupils to impart cultural material.

1. **Facilitating understanding of subjects**

The utilisation of animation when presenting material that needs visuals to accompany the text to help with subject matter learning in a particular and constrained situation has a better impact.

2. **Enhancing listening comprehension**

Pupils' listening comprehension improved when they got real images from real videos and when they saw cartoons.

3. **Enhancing and facilitating immediate and delayed attainment in the Biology classroom**

To help pupils retain more difficult and sophisticated information than they learned via instructions, computer-generated animation is more successful than static visuals.

Constraints facing tutors in utilising animation in secondary schools

When presenting any multimedia programme or animated film, instructors often struggle. The following sentences are the examiner's summaries of them:

1. **Overcrowded classes**

Tutors' biggest challenge in public secondary schools is dealing with overcrowded classrooms. The instructor loses control of the class when there are 60 pupils in the class. Naturally, this issue causes pupils to misinterpret the lesson itself and decreases their opportunity to raise any lesson-related questions.

2. **Equipment's problems**

Most public schools lack modern technology comprising PCs, LCDs, headphones, Android phones, and other items. Additionally, instructors are unable to convey the content itself in a location or space that is appropriate. Additionally, the Gaza Strip has erratic electric current both during and after the conflict, and many schools lack an appropriate remedy for this issue.

3. **Training teachers:**

Many instructors are unable to employ modern tools like an Android, LCD, or projector, therefore they must continue to deliver their lessons in the old-fashioned manner. Training programmes may help to address this issue.

The Concept of Info graphics

The phrases information and graphics combine to produce the phrase info graphics. In English-language periodicals, it first appeared in 1960. Info graphics are graphic visual representations of information, facts, or knowledge designed to display them quickly and clearly (Newsom & Haynes, 2004; Naparin & Saad, 2017).

As opposed to this, Krum (2014) described info graphics as a kind of graphic design that blends text, illustrations, pictures, and data visualisations. In line with Damyanov and Tsankov (2018), it might also refer to a visual depiction of facts, information, or knowledge. It is an information graphic, which presents facts in an easily comprehensible visual manner. Thus, an infographic is a collection of visuals, images, diagrams, or charts with little to no text to help readers better understand the subject matter.

Types of Info graphics

Infographics have been categorised into six major categories owing to their complexity, comprising static, zooming, clickable, animated, video, and interactive (Krum, 2014).

Concept of Retention

The capacity to remember what one has learnt is known as retention. It happens when knowledge is stored in memory. As an upshot, effective coding of incoming learning or information creates an index that can be accessed, allowing for retention without the need for complex search techniques, which makes it harder to recall the knowledge (Krapp, 2005). Kumar (2008) outlined four techniques for assessing retention. These comprise recognition, reconstruction, recall or reproduction, relearning or saving method (which involves estimating the number of trials required to learn materials initially and noting the savings of trials when relearning it later), and saving technique.

Concept of engagement

The goal of education is to support students' learning and growth in order to provide them with the knowledge and skills they need to lead fulfilled lives.

student participation is necessary to achieve the educational objective. According to a 2018 Gallup study titled School Engagement Is More Than Just Talk, engaged children are 4.5 times more likely to feel optimistic about the future than their actively disengaged peers and are 2.5 times more likely to report that they perform well in class and earn excellent grades. According to a different Gallup study, student engagement significantly improves students' success. In terms of how effectively they prepared students for the future, schools with high student engagement scored better than those with low participation.

How to Measure Student Engagement

Just as it is difficult to define, student participation is challenging to measure. To measure an engaged student's performance, it must first be defined. Ben Johnson, a tutor and author, provides one piece of feedback, noting that actively engaged students pay attention, take notes, listen, ask questions, interact, respond to inquiries, and react.

To formally measure their participation, it is possible to survey the students. It is a great idea to poll college students in the midst of the semester, according to PhysPort, a branch of the American Association of Physics Tutors.

How to Increase student Engagement

1. Nurture Interactions
2. Create Meaningful Work
3. Foster Autonomy

Concept of Instructional Strategy

Tutors utilise tutoring techniques, often called instructional strategies, to present course information in ways that keep pupils interested and practising various skill sets. Depending on the unit subject, grade

level, class size, and available resources in the classroom, a tutor may utilisation a variety of tutoring methods.

List of Instructional Strategies

10. **Differentiated Instruction**: This promotes learning while enabling instructors to adapt classes to the diversity of ability levels in a class. Tutors keep an eye on pupils and utilisation formative assessment techniques to ensure that lessons may be tailored to each pupil's skill and ability levels as necessary.
11. **Active Learning**: Active learning integrates components of project-based and inquiry-based learning to enable pupils to follow their own learning pathways, which promotes pupil agency in the learning process. Think-pair-share exercises and kinesthetic learning environments are examples of active learning activities.
12. **Project-Based Learning experiences:** By giving students the opportunity to actively engage in learning about a topic over time, this may encourage the development of a deep understanding. Project-based learning may also bring together a variety of skills and abilities as students work alone or cooperatively to develop a movie, book, or website (Mahmud, 2010).
13. **Inquiry-Based Learning**: This emphasises how important sound thinking and questioning strategies are to the learning process. The most important concerns that must be addressed in order for students to understand a given topic are identified, and they then continue to acquire information, develop hypotheses, participate in activities, and look for answers in an open-ended environment.
14. **Blended Learning**: Because of this, students may complete part of their learning individually online and some of it in a conventional classroom environment. This approach combines the advantages of both learning styles to create a balanced learning environment that gives students the flexibility to study on their own schedule and the opportunity to interact with others in person to reinforce what they have learned.
15. **Flipped class rooms invert the traditional tutoring model**: In flipped classroom, pupils are assigned pre-learning prior to class so that problem-solving, individual feedback, and pupil cooperation may take place during that time. With prior preparation for the lesson and more targeted help and feedback from instructors and peers, flipping a classroom may enable pupils to make greater progress during class time.
16. **Cooperative Learning:** this promotes grouping pupils into smaller groups so that they may collaborate and communicate with one another. To encourage teamwork, communication, and social skills, tutors might purposefully establish groups out of pupils with dissimilar ability levels and learning preferences (Mahmud, 2010).

The concept of academic performance

The degree to which a pupil, instructor, or institution has met its educational objectives is known as academic accomplishment, sometimes known as academic performance, as previously stated. Academic performance of pupils is continuously examined in order to spot any pupil whose performance is likely to upshot in academic failure early on.

academic performance is utilised to assess a person's capacity to retain, adapt to, evaluate, and communicate what has been learned. Academic performance refers to the visible and imperative aspect of a pupil's command of a skill or body of knowledge.

The most common method of evaluating a pupil's academic progress is via exams created by the instructor or via standardised assessments, which are often known as external examinations in Nigeria (Kpolovie et al.).

Concept of Biology

Biology is the branch of science that examines how living things interact with one another and their surroundings.

The scientific study of life is known as biology. It is a natural science with a wide range of applications, yet it contains a number of resonant themes that unite it as a single, cohesive topic (Cambell, 2014). I.e., every creature consists of cells that process genetic information that may be passed on to future generations. The diversity of life on Earth, which first appeared more than 3.7 billion years ago, is enormous. The many kinds of life, from prokaryotic species like bacteria and archaea to eukaryotic organisms like protists, fungi, plants, and animals, have been the subject of study and classification by biologists.

Theoretical Framework

The Dual Coding Theory Of Visualisation And The Cognitive Theory Of Multimedia Learning

The Dual Coding Theory of Visualisation serves as the theoretical foundation for this investigation. The underlying premise of dual coding theory is that words and outside images stimulate the coding system additively (Paivio, 1986). Additionally, the likelihood of retrieval rises when information is dual-coded. The dual coding hypothesis further postulates that words and images trigger various types of mental processing.

The Cognitive Theory of Multimedia Learning (CTML) by (Paivio, 1986; Baddeley, 1986, 1999; Chandler & Sweller, 1991; Mayer, 1999a, 1999b).

The fundamental tenet of multimedia learning is that words and visuals combined can teach us more profoundly than words alone can. This fundamental idea might provide an explanation for why so many individuals find YouTube videos to be a useful resource for learning new hobbies or talents.

These notions served as the framework for our investigation. Because the expertise and tools needed in the early days of computers were in short supply, there has not been much study or design work done on the usage of animated film in Nigeria (Onansanya, Shehu, Iwokwagh, & Soetan, 2018). Thankfully, there is affordable, user-friendly software accessible now that makes it easier to produce animated film. Macromedia Creative Suite and Cinema 4D are two examples of such software programmes. These programmes allow for the construction of visuals and the animated film of procedures even in three dimensions.

METHODOLOGY

The study utilised a quasi-experimental research design. The non-equivalent pre-test and post-test control group methodology was used. Instead of randomly assigning partakers to experimental and control groups, quasi-experiments rely on pre-existing or unbroken groupings (Nworgu, 2015). Partakers were not randomly randomised to groups; rather, treatment condition was given to two intact groups that had previously been formed. We choose this layout since it would not mess with our classroom setup or our lesson plans at all! As an upshot, studies relied on unbroken courses rather than randomly assigning partakers.

The twenty three (23) public senior secondary schools in Obio/Akpor Local Government Area of Rivers State, Nigeria make up the investigation population. According to the Rivers State Secondary Schools Board, Planning, Research, and Statistics Department, Port Harcourt, Rivers State - RSSSB, 2021

A random sampling procedure was utilised to choose three secondary schools. In order to conduct the experiments, we strategically placed the three secondary institutions into the respective groups (Experimental group I, Experimental group II, and control group). Purposeful allocation took into account factors such school type (government institutions), gender makeup (mixed schools), availability of information and communication technology (ICT), and pupils' prior experience with mobile devices.

The Biology Performance Test (BPT), Biology Retention Test (BRT), and Biology Pupils' Engagement Questionnaire (BPEQ) was employed as data gathering tools. The examiner created the 25-item Biology Performance Test (BPT), a multiple-choice exam. The topics presented to the pupils in this study will serve as the basis for the 25-item multiple-choice examinations. The Biology Retention Test (BRT) will employ the elements from the Biology Performance Test (BPT) but reshuffled to assess pupils' biology retention skills. The twenty-five (25) multiple-choice, objective exam questions on the Biology

Performance exam (BPT) and Biology Retention Test (BRT) have alternatives from A to D. Each question carries four (4) points, giving a total score of 100 percent; however, any erroneous feedback receives a score of zero

Two components, A and B, make up the Biology Pupils' Engagement Questionnaire (BPEQ). The partaker was asked to provide demographic information in Section A, and section B had twenty (20) items on a four (4)-point scale divided into two clusters. The first cluster asked about the level of pupil engagement with computer animation, and the second cluster asked about the level of pupil engagement with infographics. In order to allow pupils to identify their degree of engagement, the Biology Pupils' Engagement Questionnaire (BPEQ) will be graded on a four-point scale of strongly agree - SA, agree -A, disagree -D, and severely disagree -SD

The University of Port Harcourt's measurement and evaluation specialists, one biology instructor, and the examiners' supervisors verified the biology performance test (BPT), biology retention test (BRT), and biology pupils' engagement questionnaire (BSEQ). This enabled the researcher to obtain a critical assessment of the instrument in terms of appropriateness and adequacy. The suggestions from these experts was used to improve the content of the instrument before administration. Twenty (20) SS 2 pupils from a secondary school with a similar homogeneous culture to the study region will take the Biology Performance Test (BPT) and Biology Retention Test (BRT). The Kudder Richardson Formular (KR-21) was utilised to approximate the reliability co-efficient of the instrument owing to the upshots of the Biology Performance Test (BPT) and Biology Retention Test (BRT) scores that were acquired from a trial testing exercise conducted with twenty (20) pupils.

Additionally, the elements from the Biology Pupils' Engagement Questionnaire (BSEQ) will undergo testing. Twenty (20) SS2 pupils from the same secondary school in Rivers state will get the Biology Pupils' Engagement Questionnaire (BSEQ). With the utilisation of Cronbach Alpha, the upshots from the Biology Pupils' Engagement Questionnaire (BSEQ) trial testing exercise, which comprised twenty (20) pupils, was utilised to assess the instrument's reliability co-efficient. While ANCOVA and the z-test was utilised to evaluate the hypotheses at the 0.05 level of significance, standard deviation and mean was employed to answer the research questions.

RESULTS

Research Question 1: *What dissimilarity exists among the performance of students taught biology utilising animation, those taught utilising infographics and those taught utilising discussion teaching method?*

Table 4.1: Standard deviation and mean of performance of SS2 Biology students taught with animation and those taught with infographics in Obio-Akpo L.G.A

Methods		**Pretest**		**Posttest**		
	N	Mean	Std	Mean	Std	Gain Scores
Animation	60	29.33	3.94	65.13	10.03	35.80
Infographics	61	29.25	7.21	57.64	9.42	28.39
Discussion	65	28.55	6.59	54.80	11.44	26.25

In line with Table 4.1, there are dissimilarities in how biology is taught to students utilising animation, infographics, and conversation methods. A mean gain of 35.80 was achieved by students who were taught utilising animation, compared to 28.39 for those who were taught utilising infographics and 26.25 for those who were taught utilising the discussion technique. This suggests that there is a dissimilarity in the performance of SS2 Biology students in Obio-Akpo L.G.A. who were taught utilising animation, infographics, and conversation as opposed to those who were taught utilising discussion and animation.

Research Question 2: *What dissimilarity exist in the retention of students taught biology utilising animations those thoughts utilising infographics and those thoughts utilising discussion method?*

Table 4.2: Standard deviation and mean of the effect of animation infographics and discussion as a teaching strategy on retention.

Methods		**Posttest**		**Retention**		
	N	Mean	Std	Mean	Std	Gain Scores
Animation	60	65.13	10.03	77.53	12.35	12.40
Infographics	61	57.64	9.42	70.43	10.54	12.78
Discussion	65	54.80	11.44	63.69	13.06	8.89

Table 4.2 displays the impact of conversation, animation, and infographics as a teaching approach on retention. Students taught utilising animation saw a mean gain of 12.40, while those taught utilising infographics had a mean gain of 12.78 and those taught utilising the conversation technique experienced a mean gain of 8.89. This suggests that students learn more well when utilising animation and infographics.

Research Question 3: *What is the dissimilarity among the performance of female and male biology students?*

Table 4.3: Standard deviation and mean of influence of gender on performance

Gender		**Pretest**		**Posttest**		
	N	Mean	Std	Mean	Std	Mean gain
Male	85	29.41	5.85	56.59	9.03	27.18
Female	101	28.71	6.28	64.15	12.39	32.44

Table 4.3 shows the impact of gender on performance; male students gained an average of 27.18 points, while female students gained an average of 32.44 points. In conclusion, female pupils outperformed their male peers in academic performance.

Research Question 4: *What is the dissimilarity among the retention of female and male students in biology?*

Table 4.4: Standard deviation and mean of influence of gender on retention

Gender		**Pretest**		**Posttest**		
	N	Mean	Std	Mean	Std	Mean gain
Male	85	56.59	9.03	67.39	14.89	10.80
Female	101	64.15	12.39	72.87	11.19	11.72

Table 4.4 shows the effect of gender on retention; male students gained an average of 10.80 credits, while female students gained an average of 11.72 credits. In conclusion, female pupils outperformed their male peers in academic performance.

Research Question 5: *What is the joint effect of animation, infographics, discussion teaching strategy and gender on performance?*

Table 4.5: Standard deviation and mean of joint effect of animation, infographics, discussion teaching strategy and gender on performance.

Methods	Gender		Pretest	posttest	Mean gain
Computer Animation	Male	Mean	28.31	59.23	30.92
		N	26	26	
		Std. Deviation	4.51	6.88	
	Female	Mean	30.12	69.65	39.53
		N	34	34	
		Std. Deviation	3.30	9.79	
Infographics	Male	Mean	30.21	57.10	26.90
		N	29	29	
		Std. Deviation	7.14	7.70	
	Female	Mean	28.38	58.13	29.75
		N	32	32	
		Std. Deviation	7.28	10.85	
Discussion Method	Male	Mean	29.60	53.80	24.20
		N	30	30	
		Std. Deviation	5.52	11.12	
	Female	Mean	27.66	55.68	28.00
		N	35	35	
		Std. Deviation	7.35	11.82	

Table 4.5 shows the combined impact of gender, animation, infographics, debate teaching strategies, and performance. When taught utilising animation, female and male students received mean gains of 30.92 and 39.53 respectively, while female and male students received mean gains of 26.90 and 29.75 when instructed utilising infographics, and 24.20 and 28.00 when instructed utilising the discussion method. Compared to female and male students in the control group, female and male students in the experimental groups did better.

Research Question 6: *What is the joint effect of animation, infographics, discussion teaching strategy and gender on retention of students in biology?*

Methods	Gender		posttest	Retention	Mean gain
Computer Animation	Male	Mean	59.23	73.08	13.85
		N	26	26	
		Std.	6.88	14.95	
	Female	Mean	69.65	80.94	11.29
		N	34	34	
		Std.	9.79	8.70	
Infographics	Male	Mean	57.10	70.62	13.52
		N	29	29	
		Std.	7.70	12.62	
	Female	Mean	58.13	70.25	12.13
		N	32	32	
		Std.	10.85	8.44	
Discussion Method	Male	Mean	53.80	59.33	5.53
		N	30	30	
		Std.	11.12	13.77	
	Female	Mean	55.66	67.43	11.77
		N	35	35	
		Std.	11.82	11.32	

Table 4.6 shows the combined impact of gender, animation, infographics, discussion teaching strategies, and retention. When utilising animation to teach, female and male students, respectively, gained an average of 13.85 and 11.29 points; when utilising infographics to teach, they gained an average of 13.52 and 12.13 points; and when utilising discussion methods to teach, they gained an average of 5.53 and 11.77 points. When this gender is compared, male experiment partakers recalled information better than the control group, while female infographic partakers kept information better than discussion-based experiment partakers. But female pupils who utilisation the talk technique remember more than those who utilisation animation.

Research Question 7: *What dissimilarity in engagement exists among students taught biology utilising animation, infographics and discussion teaching strategy?*

Table 4.7: Standard deviation and mean of dissimilarity in engagement that exists among students taught biology utilising animation, infographics and discussion teaching strategy

Methods		**Pre-engagement**		**Post-engagement**		**Mean gain**
	N	Mean	Std	Mean	Std	
Animation	60	40.45	2.84	55.28	6.08	14.83
Infographics	61	38.93	3.05	56.11	6.45	17.18
Discussion	65	48.87	13.28	59.61	13.40	10.74

Table 4.7 displays the variance in student partaking across biology classes that utilisation animation, infographics, and discussion-based teaching methods. Students taught utilising animation saw a mean gain of 14.83, whereas those taught utilising infographics experienced a mean gain of 17.18 and those taught utilising the conversation technique experienced a mean gain of 10.74. This suggests that students were more actively engaged in the classroom when taught utilising animation and infographics.

Research Question 8: *What is the dissimilarity among the engagement of female and male students in biology?*

Table 4.8: Standard deviation and mean of dissimilarity among the engagement of female and male students in biology.

Gender		**Pre-engagement**		**Post-engagement**		**Mean Gain**
	N	Mean	Std	Mean	Std	
Male	85	38.47	3.17	53.47	6.48	15.00
Female	101	46.62	10.98	60.10	10.62	13.48

In line with Table 4.8, male students improved on average by 15.00 points, while female students improved on average by 13.48 points. In conclusion, male students showed higher levels of involvement than their male peers.

Research Question 9: *What dissimilarity in engagement as a joint effect of animation, infographics, discussion teaching strategy and gender?*

Table 4.9: Standard deviation and mean of dissimilarity in engagement as a joint effect of animation, infographics, discussion teaching strategy and gender

Methods	Gender		Pre-engagement	Post-engagement	Mean gain
Computer Animation	Male	Mean	42.15	57.08	14.92
		N	26	26	
		Std.	1.78	3.11	
	Female	Mean	39.15	53.91	14.76
		N	34	34	
		Std.	2.83	7.37	
Infographics	Male	Mean	37.34	54.59	17.24
		N	29	29	
		Std.	2.54	6.71	
	Female	Mean	40.38	57.50	17.13
		N	32	32	
		Std.	2.77	5.99	
Discussion Method	Male	Mean	36.37	49.27	12.90
		N	30	30	
		Std.	1.45	6.22	
	Female	Mean	59.60	68.49	8.88
		N	35	35	
			8.59	11.39	

Table 4.9 shows the impact of animation, infographics, discussion teaching strategies, and gender on dissimilarities in involvement. The mean gains for female and male students utilising animation were 14.92 and 14.76, respectively, while the mean gains for female and male students utilising infographics were 17.24 and 17.13, and the mean gains for female and male students utilising the discussion method were 12.90 and 8.88, respectively. Female and male students in the experimental groups showed higher levels of engagement when compared to female and male students in the control group.

DISCUSSION OF FINDINGS

Table 4.1 presents the upshots of an investigation comparing the achievement of pupils taught biology by animation, infographics, and the traditional approach of classroom discussion. The upshots show that utilising animation and infographics in the classroom is an excellent way to improve pupils' performance in Biology, especially when compared to the more traditional Discussion approach. Teaching SS2 Biology with animation, infographics, or discussion in Obio-Akpo ensued in substantially different upshots for pupils, as shown in Table 4.10. Specifically, animation had a much larger impact on pupil performance than the other two approaches combined, while infographics had a larger impact on pupil performance than the discussion approach. Conclusion: Compared to utilising infographics and having pupils debate the material, utilising application animation to teach Biology improved pupils' performance much higher. Animation and infographics provide a more engaging and immersive learning environment than traditional methods of instruction. There was a noticeable increase in the kids' level of cooperation towards their education. The pupils' interest in the exercises enhanced and they offered a tonne of queries which reflected their interest in the learning hence bringing boost in their academic achievement in learning of Biology. This study's upshots corroborate those of Atsumbe and Ajunwa (2018), who found that utilising animation to teach Basic Electricity enhanced pupils' abilities. Owing to the upshots, it seems that employing animation to explain the fundamentals of electricity was effective. Teachers in the pre-treatment era had a hard time getting their pupils interested in the material, so they instead relied on rote memorization. Making utilisation of cartoons and charts as a teaching tool Pupils' ability to work

together to study Biology improves as an upshot of their exposure to the subject. By lowering cognitive load and memory, animation and infographics utilised in biology classrooms may help pupils learn more and do better. These upshots corroborate those of earlier studies conducted by Abilock and Williams (2014) and Lamb and Jhonson (2014), who found that infographics are able to effectively convey even the most complex concepts to pupils through the utilisation of visuals like graphs with bars, pie charts, zoom boxes, histograms, symbols, line graphs, tree diagrams, and images.

Table 4.2 displays the upshots, showing that the utilisation of visual aids like animation and infographics may increase pupils' memory of biological information. Table 4.11 demonstrates that at Obio-Akpo L.G.A., there exist a statistically substantial difference in the retention rates of SS2 Biology pupils taught utilising the three different teaching styles. The upshots showed that the experimental groups' Biology pupils learned more on average than the control group's Biology pupils. This study demonstrated the pupils taught Biology learn more profoundly from words and visuals than pupils in control group. The significance of this upshot stems from the inference that the instructional methods utilised by the experimental groups improved learner encoding, leading to higher levels of confidence and drive. When utilising animation as a teaching method, pupils learn more quickly and become more invested in the subject matter because of the visual, auditory, and visual elements that comprise the medium. The collaborative aspect of the experimental groups encourages pupils to utilisation creative and logical approaches to issue resolution. Animation and infographics help pupils think more logically, which in turn leads to more creative problem-solving. The utilisation of animation and infographics in Biology education facilitates skill development and the acquisition and retention of knowledge. Ayediun (2020) found that utilising cartoons to educate about climate change upsurge pupils' understanding, retention, and engagement with the issue, and our upshots corroborate those upshots. Alqudah, et al. (2019), Lamb and Johnson (2014), Eissa (2014), and Simiciklas (2012) all agree that infographics improve and enhance pupil retention because they allow for simple comparison of information, make data meaningful by providing analogies, examples, and themes, and are easy to publish, distribute, and store via social media.

Table 4.3 reveals that when comparing male and female pupils' understanding rates, the female pupils fared better. There exist a big gap in the group work of male and female pupils. In congruent with the data in table 4.12, the hypothesis that the teaching styles have a substantial effect on the performance of male and female pupils is correct. Female pupils must have paid more attention and been more invested in the course than male pupils, since only then could they have outperformed their male counterparts. This lends credence to the upshots of Usama and Abdulaziz (2021), who discovered that SI was more helpful for the education of female pupils while AI was more useful for the education of male pupils. This research suggests that the success of students in Biology classes varies in congruent with their gender.

In congruent with Table 4.4, female pupils remembered more information than male pupils. There exist no statistically substantial difference in retention rates between male and female pupils in Biology, as shown in Table 4.13. This suggests employment of these strategies in teaching upsurge learning and retention more in females than in males. Pupils of both sexes benefit from the utilisation of instructional methods while learning and teaching biological ideas. One possible explanation for this disparity is that female pupils, given their position as active partakers in the classroom, seem to have a greater capacity for sustained attention than male pupils.

Table 4.5 displays the statistical analysis of the data and shows that both male and female pupils in the experimental groups outperformed their counterparts in the control group. This indicates a gender-by-group interaction effect. Pupil performance varied substantially by animation, infographics, discussion approach, and gender, as shown in Table 4.14. Pupils achieved higher upshots because they were more emotionally invested in the subject matter and because the material was more directly applicable to their lives via the utilisation of visual, auditory, and kinaesthetic cues. Improving pupils' Biology grades requires a combination of visual aids like animation and infographics and auditory ones like instructor discussion.

Compared to the control group, male students in the experiment kept more information after seeing the infographics, while female pupils in the infographics group recalled more information after viewing the

discussion group. Female pupils in the conversation group do better in terms of memory retention than those in the animation group. Both the teaching strategy and the pupils' gender influence how much information they remember from Biology class. An important part of any educational approach, method, or technique aimed at helping boys and girls reach their full potentials is ensuring that pupils retain important information. Table 4.15 confirmed that animation, infographics, discussion teaching strategy, and gender all have a substantial joint effect on retention. Therefore, it is crucial not just in Rivers state but in Nigeria as a whole to utilisation suitable teaching technique and methods i.e. animation, infographics, and discussion method to guarantee high quality education and the success of millions of male and female pupils.

In congruent with Table 4.7, pupils were more interested in animation and infographics than in a traditional discussion-based Biology course. When utilised in the classroom, animations and infographics assist pupil's better grasp complex biological ideas via the utilisation of visualisation, visuals, images, and interaction. In terms of pupil interest in biology class, Table 4.16 shows that animated infographics are more effective than classroom discussion. Teaching utilising animations and infographics throughout class boosts pupil's learning and engagement level. The utilisation of visual aids like animations and infographics in the biology classroom increases pupil interest and comprehension of course material. The utilisation of animation and informative images created a stimulating setting in which pupils could study Biology. This upshot is consistent with those of Ayediun (2020) and Türkay (2016), who similarly found that whiteboard animations have a positive effect on retention and engagement, likewise with some earlier research showing that utilising animations to teach about climate change was effective in raising pupils' knowledge, retention, and interest in the topic.

The upshots in Table 4.8 demonstrated at engagement level, male pupils were engaged more than their male peers. This suggests that while teaching Biology in the classroom, male pupils enjoy the lesson more than female pupils, leading to more partaking in class activities. This may have a similar beneficial effect on the academic performance and retention of male pupils with regards to studying Biology, likewise on their grasp of scientific topics and communication capacity via improved visual thinking skills. In congruent with Table 4.17, there exist no statistically substantial difference in the effect of gender on the interest levels of biology pupils. Male pupils' much greater engagement level may have been the upshot of their partaking in more classroom activities.

Table 4.9 presents the upshots of an investigation showing that the control group pupils were more engaged than the experimental group pupils, both male and female. Table 4.18 also shows that there exist a strong interactive impact between animation, infographics, the discussion mode of instruction, and pupils' genders in regards to their interest in biology lessons. The upshots suggest the pedagogical approaches are gender-neutral, making them suitable for utilisation in institutions that welcome pupils of both sexes. The eye-catching nature of animation and infographics may have had a role in this upshot by capturing pupils' interest and keeping it. Because of their focus on the learner and their incorporation of memory and strategy monitoring, infographics and animation hold great promise for advancing the aims and objectives of Biology teaching. Infographics and animation are two methods for capturing the attention of pupils. Learning utilising infographics and animation is more interactive and focused on the pupil than classroom discussion. The simplicity and speedy communication capabilities of visual representations allow them to be instantly engaged by pupil. The upshots also show that the utilisation of these techniques in the classroom upsurge pupil interest in the experimental group while decreasing it in the control group. The upshots of this research demonstrated that pupils were highly engaged after exposure to the therapy, which improved the quality of interactive information and helped pupils better visualise complex ideas. When pupils are able to visualise concepts with easily, they are better able to build concrete mental representations. Learners may utilisation the developed schemes to aid in long-term memory storage. Moreover, pupils find that visualising the principles presented in class helps them recall the material far more effectively.

CONCLUSION

Observations led to the following conclusions:

1. Students who utilised animation and infographics outperformed those who utilised the conversation technique in Biology.
2. Compared to students exposed to the conversation technique, those exposed to animation and infographics remembered biology concepts more well. Students who were female did better than those who were male.
3. Female pupils outperformed their male counterparts in academic performance.
4. In the experimental groups, both female and male students outperformed female and male students.
In the control group, students
5. In the trial, male students recalled information better than both the control group and the female
When utilising infographics, students recalled more information than when utilising the conversation method. However, female pupils who utilisation the conversation technique remember more than those who utilisation animation.
6. Animation and infographics upsurge student engagement in the classroom.
7. Male students showed higher levels of involvement than their male peers.
8. In the experimental groups, both female and male students showed more engagement than male student women in the control group

RECOMMENDATIONS

The following suggestions are given in light of the investigation's upshots.

1. The government should encourage teachers more to employ animation and infographics to enhance the successful delivery of biology instruction in senior high schools
2. For the Nigerian secondary educational system, the government should develop and execute special ICT policies on animation.
3. The government should provide sufficient animation and infographics packages to educators and students.
4. The government should provide instructors technical assistance and training opportunities via workshops and in-service instruction.
5. Information graphics and animation Schools should promote instructional materials for teaching and studying biology.

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