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Computer Assisted Instruction (CAI) With Animation in Biology Curriculum Delivery: A Panacea for Students Achievement and Motivation

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Abstract: *Students derive enjoyment from learning when it incorporates engaging activities, particularly when the level of abstraction is kept to a minimum. Utilizing information and ICT tools in educational settings serves as one approach to achieving this goal. Therefore, this research explores the efficacy of CAI featuring animation in the delivery of Biology curriculum, aiming to enhance student achievement and motivation. Employing a non-randomized experimental design with pretest and posttest measures, the study targeted a population of 9,780 SSII Biology Students across 222 government-owned secondary schools in Delta South Senatorial District, Delta State, Nigeria. A sample of 207 SSII students was selected from four secondary schools using simple random sampling techniques, facilitated by balloting with replacement. The study utilized the Biology Achievement Test (BAT) and Computer Animation Instructional Package (CAIP) as research instruments, both validated by three experts in Science Education and Measurement and Evaluation to ensure face and content validity aligned with the study's objectives. The reliability of the BAT instrument was assessed through administration to 30 biology students, yielding a reliability coefficient of 0.81 using the Kudar-Richardson formula 21. Both the experimental and Non-intervention groups underwent administration of the BAT instrument, with the intervention group subjected to biology curriculum through CAI animation, while the Non-intervention group received instruction without animation. Data analysis employed descriptive statistics (mean and st.d) alongside inferential statistics, specifically t-tests at a critical value of 0.05. The study's primary findings highlight a substantial disparity in achievement between students subjected to biology curriculum with CAI animation paralleled to those without animation, with the former showing higher performance. Additionally, a notable gender disparity emerged, favoring female students in the group subjected to biology curriculum with CAI animation. The study acclaims, among other measures, the development of additional biology software packages employing CAI with animation for integration into Nigerian school curricula, calling for collaboration among government bodies, educators, and school administrators to facilitate this endeavor.*
Keywords: computer-assisted instructional, animation, curriculum, achievement, motivation.

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INTRODUCTION

The study of Biology delves into the realm of life sciences, exploring the intricacies of living organisms, encompassing their structure, functions, and interactions within their ecosystems. It spans various disciplines including Botany, Geology, Evolutionary Genetics, Conservation, Zoology, Physiology, Medicine, and Molecular Biology. Proficiency in Biology equips students with fundamental scientific principles, enabling them to tackle a myriad of everyday challenges and fostering a deeper thought of the natural world. Adam, lammed, and Ayodele (2022) underscore the standing of teaching Biology, citing its significance on both individual and national levels. They emphasize how the study of Biology cultivates essential skills and values in learners, such as critical thinking, creativity, objectivity, curiosity, and appreciation for aesthetics (FRN 2014).

The intention of educational instruction and curriculum implementation across various levels is to instill genuine values and foster attitudes conducive to individual growth and national advancement in Nigeria. Oyovwi (2018) asserts that the worth of any education system, regardless of its level, hinges on the content of its curriculum and the adeptness of its delivery. Therefore, a well-designed and effectively delivered curriculum is essential for students to acquire the requisite skills, abilities, and competencies. Modernizing pedagogical approaches by integrating online technologies and computer-assisted instruction featuring animation can significantly contribute to the realization of a nation's educational aspirations.

The Biology curriculum for Senior Secondary Schools in Nigeria is structured around four objectives derived from the National Policy of Education (FRN 2014). These objectives are designed to prepare students to attain:

i. Sufficient laboratory and field competencies.
ii. Significant and applicable understanding.
iii. Capability to employ scientific knowledge in daily life concerning personal and communal health plus agriculture.
iv. Rational and effective scientific perspectives.

The policy also stipulated that the government must take requisite measures to ensure that instruction becomes hands-on, activity-oriented, problem-solving, experimental, and supported by information technology to fully achieve the objectives of education in Nigeria and propel the national economy forward. This aligns with the growing necessity for a technologically-driven society in the contemporary information age of the 21st century. Given the crucial nature and significance of biology in comparison to other fields, Hamid (2008) observed its underperformance at the secondary school level.

Tackling the root cause of this underperformance has turn out to be an urgent concern for researchers. Oyovwi (2021) highlighted that students' inability to grasp the curriculum content in biology contributes to their poor performance, while others attributed this issue to dynamics such as teachers' inadequate qualifications, lack of instructional materials, subpar quality of science instruction, overcrowded classrooms, overloaded biology syllabi, and insufficient or unsuitable science equipment (Ekwuevugbe & Oyovwi, 2022; Nckyambaje, Bikorimana & Nsanganwimans, 2021).

Several scholars, notably Oyovwi (2021) and Eyamekware & Oyovwi (2023), have advocated for the execution of novel ideas, student-centered strategies that can positively impact learning outcomes, in contrast to the old-style lecture-based approach that has long prevailed in classrooms. Adebanjo (2021) describes the conservative lecture method as a old-style approach where teachers convey information to students through verbal presentations, which has been linked to subpar academic performance.

The incorporation of CAI featuring animation into the educational system has been recommended owing to the recent information revolution and the proliferation of technological knowledge, which has facilitated the attainment of curriculum delivery objectives. Computer animation enhances learning by providing a tangible and enduring educational experience, letting students to engage visually and auditory. According to Ayupratiwi et al. (2021), students are particularly responsive to audiovisual stimuli paralleled to other forms of instructional delivery. This approach not only improves students' comprehension of the material but also stimulates their concentration and motivation levels.

Potential advantages of computer-based instruction incorporating animation encompass:
1. Visual Aids: Utilizing animation facilitates the elucidation of intricate concepts through visual representations, enhancing comprehension.
2. Engaging Capacity: It fosters higher levels of engagement paralleled to conservative teaching methods, thereby enhancing the enjoyment of learning.
3. Personalization: It affords the opportunity for individualized learning experiences, allowing learners to progress at their own pace, review content, and receive immediate feedback.
4. Retention: Instruction incorporating animation can result in improved information retention, as learners are more inclined to remember visuals paralleled to textual content.
5. Accessibility: With passage allowed from any location with an internet connection or computer, it facilitates ease of entree to learning study aids.

Nonetheless, CAI featuring animation holds promise in enriching the learning journey and enhancing outcomes for learners. Moreover, it possesses the capacity to accomplish the following:

1. Enhance Understanding: Computer animations in Biology curriculum aid comprehension of intricate biological phenomena by rendering them dynamic and within reach. They effectively depict time-related events like cell division.
2. Interactive Learning: Interactive computer animations foster participation, motivation, and interest in the subject.
3. Improve Retention: Animation enhances content retention, activating multiple senses for better recall over time.
4. Foster Collaboration: Streaming biology-based computer animations fosters discussion and debate among students, enhancing critical thinking.
5. Save Costs and Time: Substituting laboratory experiments with computer animation saves time and reduces expenses, allowing students to explore other subject areas.
6. Easy Access: Internet-based animation content is readily available, within reach to anyone with internet connectivity, and can be utilized for educational purposes through open-educational resources.

The recompences of computer-assisted instruction with animation are crucial in education, enhancing comprehension, fostering interactive and collaborative learning, promoting information retention, saving time, and ensuring easy openness. Despite these benefits, its utilization remains limited in Nigerian secondary schools, with scant empirical studies on its effects in biology education.

This study aims to explore the impression of CAI with animation in delivering the biology curriculum, aiming to enhance student achievement and motivation in Ughelli South, Delta State, Nigeria. Academic achievement encompasses successful completion of tasks such as exams, assignments, and projects, measured by grades and test scores, alongside the acquisition of knowledge, critical thinking, problem-solving skills, and real-world application. It plays a critical part in determining students' future educational and career prospects.

Motivation, conversely, acts as a lashing force propelling individuals towards their goals, stemming from personal values, rewards, recognition, sense of purpose, and passion. It is indispensable for success across various domains, including academics, career, relationships, health, and personal growth.

The term "sex" refers to the categorization of students into male and female within an educational environment. Studies indicate that sex, serving as a moderating variable or factor, can impact the achievement and motivation of students, as certain teaching strategies may bolster academic performance for males while others may benefit females.

Statement of the Problem

The performance and drive of students in Biology pose ongoing challenges for educators, academics, and education stakeholders. This issue is often attributed to various teaching methodologies employed by biology instructors. Recent literature highlights innovative

approaches, including concept mapping, cooperative learning, guided discovery, questioning, and demonstration, as effective means of boosting student achievement. However, there is a notable gap regarding the utilization of CAI with animation to enhance biology curriculum delivery.

Therefore, the research question at hand is: "Can the implementation of CAI improve student achievement and motivation in biology curriculum delivery?"

Research Questions

The following research questions guided the study;

1. Are there variances in achievement scores between biology scholars with computer-assisted instruction featuring animation and those without?
2. Are there differences in motivation scores between biology scholars with CAI featuring animation and those without?
3. Do achievement scores differ between male and female biology scholars with CAI featuring animation?
4. Do motivation scores differ between male and female biology scholars with CAI featuring animation?

Hypotheses:

Null hypotheses tested at a 0.05 critical value:

1. There is no substantial disparity in achievement scores between biology scholars using CAI with animation and those without.
2. There is no substantial disparity in motivation scores between biology scholars using CAI with animation and those without.
3. There is no substantial disparity in achievement scores between male and female biology scholars using CAI with animation.
4. There is no substantial disparity in motivation scores between male and female biology scholars using CAI with animation.

Study Purpose:

The study investigates the impact of CAI featuring animation on students' achievement and motivation in biology. Specifically, it examines:

1. Differences in mean achievement scores between biology scholars with CAI featuring animation and those without.
2. Differences in mean motivation scores between biology scholars with CAI featuring animation and those without.
3. Differences in mean achievement scores between male and female biology scholars with CAI featuring animation.
4. Differences in mean motivation scores between male and female biology scholars with CAI featuring animation.

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Theoretical Framework of the Study

This study is grounded in Baddelay's Dual-Coding Theory of Multimedia Learning (2002), which posits that during multimedia learning, the brain concurrently processes two distinct forms of information: auditory (hearing) and visual (seeing) stimuli. The theory suggests that humans possess two working memory systems: one verbal and the other visual. It emphasizes that optimal learning occurs when both channels (verbal and visual) are engaged simultaneously during the intellectual growth, rather than overloading one at the expense of the other.

Baddelay and Hitch proposed a theory of parallel processing, wherein effective working memory capacity is augmented by integrating auditory and visual working memory, rather than relying solely on one or the other. This integration is exemplified in computer animations, where narration (sound) elucidates visual imagery within the learning package. Information may enter a learner's cognitive system through two channels: auditory (hearing) and visual (seeing). In a technologically supported learning setting, information may be presented audibly, entering through the ears, while visual representations such as written words, images, and animations are processed through the eyes. Learners attend to relevant auditory and visual inputs and further process them in working memory, utilizing the verbal Articulatory loop and the visual/spatial sketch pad, respectively.

Consequently, learners are not necessarily overwhelmed or burdened by multimodal instruction; rather, it can be advantageous. The observation that items presented both visually and verbally are better retained underscores the essence of the dual-coding theory.

RESEARCH METHODOLOGY

In this study, a non-randomized experimental research design was used, utilizing pretest, post-test, and Non-intervention group methodologies. Intact classes were selected to ensure stability and facilitate class description.

Population, Sample and Sampling Technique

The study population comprises 9,780 SSII Biology students across all 222 government-owned Secondary Schools in the Delta State Senatorial District of Delta State, Nigeria.
The sample for the study comprises 207 SS II students selected from four Secondary Schools. The sample was drawn using a random sampling technique with replacement through balloting.

Research Instrument

The study employed two main tools: the Biology Achievement Test (BAT) and the Computer Animation Instruction Package (CAIP). To assess student achievement, the BAT was utilized. This test, developed by the researcher, comprises 50 multiple-choice questions focusing on the concepts of respiration and circulation in humans.

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Validity of the Instrument

The instruments for this study were validated by seasoned experts in Science Education (Biology) and Measurement and Evaluation from Delta State University, Abraka. Their extensive experience played a crucial role in evaluating the face and content validity of the instruments, ensuring alignment with the study's objectives.

Reliability of the Instrument

The BAT was piloted with 30 Biology students from a school in Ughelli South Local Government Area of Delta State, who were not part of the sampled schools for the main study. The pilot test fallouts were assessed using the Kudar-Richardson formula 21 (K21), known for its suitability in evaluating reliability in multiple-choice option test items.

After analysis, a reliability index of 0.81 was obtained, meeting the established standard recommended by Taherdoost (2016). A reliability value of 0.70 and above indicates high reliability, demonstrating that the test accurately measures the intended characteristics. Therefore, the BAT is considered reliable and appropriate for use in this study.

Method of Data Analysis

The inquiry posed by the research will be addressed using descriptive statistics, which include calculations of the mean and standard deviation (St.d). Additionally, the hypotheses will undergo testing utilizing t-test statistics at a critical value of 0.05.

PRESENTATION OF RESULTS

Research Question 1

Are there variances in achievement scores between biology scholars with computer-assisted instruction featuring animation and those without?

Table 1: Mean and St.d of Pretest and Post-test Achievement Scores of Students Subjected to Biology Curriculum using CAI with Animation and those without Animation

Group	N	Pretest		Post test		Mean Difference
		Mean	ST.D	Mean	ST.D	
CAI with animation	126	21.25	9.07	54.29	11.08	34.91
CAI without animation	81	22.78	8.71	48.25	10.97	24.62

Table 1 displays the pretest mean achievement score of 21.25, with a st.d of 9.07, for students who underwent the biology curriculum using CAI with animation, and a pretest mean achievement score of 22.78, with a st.d of 8.71, for students without animation. The analysis divulges that both groups had similar levels of achievement prior to the commencement of treatment. Furthermore, the table illustrates a posttest mean achievement score of 54.29, with a

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st.d of 11.08, for students subjected to the biology curriculum using CAI with animation, and a posttest mean achievement score of 48.26, with a st.d of 10.97, for students without animation. Notably, students subjected to CAI with animation exhibited a higher mean difference of 34.91 paralleled to their counterparts without animation, who had a mean difference of 24.62.

Hypotheses 1 (Ho_1)
There is no substantial disparity in achievement scores between biology scholars using CAI with animation and those without.

Table 2: t- test Comparison of Posttest scores of Students subjected to Biology Curriculum using CAI with Animation and those without Animation

Group	N	$\bar{X}$	ST.D	Df	T-cal	Sig (2-tail)	Decision
CAI with Animation	126	59.29	11.08	3.36	7.26	0.00	Rejected
CAI without Animation	81	48.25	10.97				

Table 2 indicates a notable discrepancy in the posttest mean achievement score between students who experienced the biology curriculum with CAI featuring animation and those who did not, with a critical value of P(0.000) < 0.05. Consequently, the hypothesis is invalidated. Consequently, a significant disparity is observed in the mean achievement scores of biology students subjected to the curriculum with CAI animation paralleled to those without animation, favoring the former.

Research Question 2
Are there differences in motivation scores between biology scholars with computer-assisted instruction featuring animation and those without?

Table 3: Mean and St.d of Pretest and Posttest Motivation scores of Students subjected to Biology Curriculum using CAI with Animation and those without Animation

Group	N	Pretest		Post test		Mean Difference
		Mean	st.d	Mean	st.d	
CAI with animation	126	19.3	7.08	43.21	10.09	18.61
CAI without animation	81	21.4	6.64	39.45	9.86	16.50

Table 3 displays the pretest mean motivation score for students involved in the biology curriculum with CAI animation, recorded at 19.3 with a standard deviation of 7.08, and for students without animation, recorded at 21.4 with a standard deviation of 6.64. The analysis divulges that both groups demonstrated nearly identical levels of motivation before the treatment began. Additionally, the table presents a posttest mean motivation score of 43.21 with a standard deviation of 10.09 for students subjected to the biology curriculum with CAI animation, and a posttest score of 39.45 with a standard deviation of 9.86 for students without

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animation. Notably, students subjected to the biology curriculum with CAI animation achieved a higher mean score of 18.61 compared to their counterparts without animation, resulting in a mean difference of 16.50.

Research Hypothesis 2

There is no substantial disparity in motivation scores between biology scholars using CAI with animation and those without.

Table 4: t-test Comparison of Posttest Motivation score of Biology Students subjected to Biology Curriculum using CAI with Animation and those without Animation.

Group		N	$\bar{X}$	St.d	Df	T-cal	Sig (2-tail)	Decision
CAI with Animation		126	43.21	10.09	198	8.251	0.000	Rejected
CAI without Animation		81	39.45	9.86				

Table 4 indicates a notable discrepancy in the posttest motivation mean scores between students who experienced the biology curriculum with CAI featuring animation and those who did not, with a critical value of $P(0.000) < 0.05$. Consequently, the hypothesis is invalidated, suggesting a substantial disparity in the motivation mean scores favoring students subjected to the curriculum with CAI animation.

Research Question 3

Do achievement scores differ between male and female biology scholars with computer-assisted instruction featuring animation?

Table 5: Mean and St.d score of Male and Female Students subjected to Biology Curriculum using CAI with Animation

Variable	N	Pretest		Post test		Mean Difference
		Mean	st.d	Mean	ST.D	
Male	58	12.01	2.14	17.21	4.11	5.03
Female	68	11.85	3.70	18.30	4.00	6.42

Table 5 displays the pretest mean and st.d for male students, which were 12.01 and 2.14 respectively, while for female students, they were 11.85 and 3.70 respectively. Additionally, the table presents the posttest mean achievement scores for male students as 17.21 with a st.d of 4.11, and for female students as 18.30 with a st.d of 4.00. The mean achievement gain for male and female students was reported as 5.03 and 6.42 respectively. According to the analysis, female students demonstrated significantly higher achievement levels paralleled to male students when subjected to the biology curriculum with CAI featuring animation.

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Research Hypothesis 3

There is no substantial disparity in achievement scores between male and female biology scholars using CAI with animation.

Table 6: t-test of Difference between the Mean Achievement score of Male and Female Students subjected to Biology Curriculum using CAI with Animation

Variable	N	Mean	St.d	Df	T-cal	T-crit
Male	58	17.21	4.11	95	2.91	1.180
Female	68	18.30	4.00			

Table 6 presents the t-test comparison of posttest mean achievement scores for male and female students who were subjected to the biology curriculum using CAI with animation. The calculated t-value of 2.91 surpasses the critical t-ratio of 1.180. Consequently, the hypothesis is rejected, indicating a significant disparity in the mean achievement between male and female students subjected to the biology curriculum with CAI animation, favoring the female students who attained a mean score of 18.30, paralleled to the male students' mean score of 17.21. Thus, female students achieved notably better than their male counterparts.

Research Question 4

Do motivation scores differ between male and female biology scholars with computer-assisted instruction featuring animation?

Table 7: Mean and St.d of Motivation score of Male and Female Students subjected to Biology Curriculum using CAI with Animation

Variable	N	Pretest		Post test		Mean Achievement
		Mean	st.d	Mean	ST.D	
Male	58	14.10	1.79	18.51	1.76	4.24
Female	68	10.42	1.21	11.61	2.40	1.37

Table 7 illustrates that the pretest mean motivation score and st.d for male students were 14.10 and 1.79, respectively, while for female students, they were 10.42 and 1.21, respectively. In the posttest, male students had a mean motivation score and st.d of 18.51 and 1.76, respectively, while female students had 11.61 and 2.40, respectively. According to the analysis, male students exhibited higher motivation levels than female students when subjected to the biology curriculum with CAI featuring animation.

Research Hypothesis 4

There is no substantial disparity in motivation scores between male and female biology scholars using CAI with animation.

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Table 8: t-test of Difference between the Mean Motivation score of Male and Female students subjected to Biology Curriculum using CAI with Animation

Variable	N	Mean	St.d	Df	T-cal	T-crit
Male	58	18.51	1.76	63	2.419	1.090
Female	68	11.61	2.40			

Table 8 illustrates the t-test comparison of posttest mean motivation scores for male and female students who were subjected to the biology curriculum using CAI with animation. The calculated t-value of 2.419 exceeds the critical t-ratio of 1.090. Consequently, the hypothesis is rejected, indicating a significant disparity in the mean motivation scores between male and female students, favoring male students.

DISCUSSION OF RESULTS

This study focused on assessing the impact of CAI with animation on students' academic achievement and motivation in biology curriculum delivery. The results indicated a significant improvement in students' understanding of biology concepts and academic performance through CAI with animation. Table 1 and 2 demonstrate that students subjected to CAI with animation outperformed those without animation. This aligns with Bettendorff, Lutz, and Breuer's (2015) findings, suggesting that animation enhances engagement and learning outcomes paralleled to static instructional strategies. Similarly, Suh and Lee (2009) highlighted the positive effect of animation-based instruction on visual-spatial skills, while Karukus, Inan, and Flores (2018) found that animation improved learning outcomes for all students, irrespective of learning styles, and boosted student engagement. Oyovwi (2020) emphasized the importance of active student participation in meaningful learning activities.

Furthermore, the study revealed that CAI with animation creates an interactive and engaging learning environment, thereby enhancing student motivation. Motivation plays a pivotal role in influencing student engagement, effort, and persistence in academic activities. Analysis results indicated that male students exhibited higher motivation levels than female students when subjected to CAI with animation. Ayupratiwi et al. (2022) emphasized the impact of audiovisual stimuli on student motivation, leading to improved performance and increased motivation levels.

Moreover, the study found that female students achieved significantly better than male students when subjected to CAI with animation. The hypothesis testing confirmed a substantial disparity in mean achievement scores, with female students achieving higher scores (mean score of 18.30) paralleled to male students (mean score of 17.21). This supports Nwagbo's (2002) observation that female science students value science education as much as their male counterparts. However, this finding contrasts with Zember and Blume's (2011) and Inyang's (2022) research, which reported male students outperforming females in science.

CONCLUSION

In conclusion, the study affirms that CAI with animation serves as a potent tool for imparting biology curriculum concepts, elevating motivation, and enhancing learning outcomes. Through its provision of a more captivating, interactive, and immersive learning milieu, learners can foster a deeper comprehension of the subject matter and become better prepared to apply their knowledge in real-world scenarios.

Recommendations

1. Authorities and school administrators ought to produce additional biology software packages derived from CAI with animation for implementation in Nigerian educational institutions.
2. Educators should undergo training via conferences and seminars to enhance their openness, proficiency, and competence in utilizing computer devices, enabling them to integrate these tools effectively into the teaching and intellectual growth.
3. The incorporation of computer devices into teaching and learning activities should be mandated for both educators and students in Nigerian secondary schools.

REFERENCES

Adam, A.U, Lameed, S; & Ayodele, B.B. (2022).Attaining meaningful learning of ecological concepts: A test of the efficacy of the learning cycle model, Educational Research, 05(04), 18-29.

Adebanjo, A.A. (2021). Improving Students academic achievement in biology using information and communication technology aided instruction. Kill Journal of Social Sciences, 5(4), 317-326

Ajupratiwi, T, Nandiyanto A.B, Kurniawan T and Bilad M.R. (2022). Online learning using audio-visual for elementary school students during the Covid-19 pandemic, ASEAN Journal of Educational Research and Technology 1(2), 125-132.

Bettendorff, J, Lutz, C; & Breuer, J. (2015). Effects of Animation on User Engagement: A Meta-Analysis. Journal of Media Psychology 27(1), 1-12.

Eyamekware, P. & Oyovwi, E.O. (2023). Adopting Questioning Instructional Strategy in Biology Curriculum Delivery to enhance students achievement and interest in Delta Central Senatorial District. International Journal of Research in Education and Sustainable Development 3(9) 25-38.

Federal Republic of Nigeria (2014). National Policy on Education, NERDC Lagos: Federal Government Press.

Inyang, F.N. (2022). The effect of demonstration, guided-discovery and expository instructional methods on senior secondary students achievement in Physics in Ikot Abasi Local Governement Area Nigeria. Jour of Research in Education and Society 13(3), 124-135.

Karakus, T, Inan, F.A, & Flores, R. (2018). Effects of Animation-Based Learning on Learning outcomes and Engagement Among Students with Different Learning Styles. Journal of Educational Computing Research 56(4), 541-561.

Mayer R.E. (2017).Incorporating motivation into multimedia learning. Learning and Instruction, 29, 171-173.

Ndayambaje, J.B, Bikorimana, E. & Nsanganwimana F. (2021). Factors contributing to the students poor performance in Biology subjects: A Case Study of ordinary level in rural secondary schools of Rwamagana district. GSC Biological and Pharmaceutical Science, 15(3), 249-261.

Oyovwi, E.O. (2018). Impact of recessed economy on Science curriculum implementation in Nigeria secondary schools. Delsu Journal of Educational Research and Development. 17(1), 74-87.

Oyovwi, E.O. (2021). Effects of Concept-mapping and Inquiry Strategies in teaching difficult curriculum concepts in biology on students academic achievement and retention. International Journal of Biosciences 18(258-267).

Suh Y, & Lee H. (2019). The Effects of Computer-Assisted Instruction with Animation on Visual-Spatial Skill Development: A Meta-Analysis Computers and Education 139, 145-158.

Zember, M.J & Blume, L.B. (2011). Gender and academia achievement Retrived 18(7) 2018 www.education.com/refernce/article/gendertoacademytoachievement.