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Effect of Instructional Videos on Attitude, Academic Performance and Retention in Digestive System Among Senior Secondary Students in Katsina State Nigeria

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Abstract - This study examined the Effect of Instructional Videos on Attitudes, Academic Performance and Retention in Digestive System among Senior Secondary Students in Katsina State. The study developed six research objectives, answered six research questions, and tested six research hypotheses. The study utilized Quasi-experimental research design. The population of the study covered 3,139 students from 23 secondary schools in Daura Zonal Education Quality Assurance Katsina State Nigeria, Purposive and Cluster Sampling technique were used to sample two schools, with a sample size of 120 students. Two instruments were used for data collection namely Digestive System Performance Test (DSPT) with a reliability coefficient of 0.72., and Digestive System Attitude Questionnaire (DSAQ) with a reliability coefficient of 0.79. The Research questions were answered and analyze using mean and standard deviation, while null hypotheses were tested at p<0.05 level of 'significance using independent sample t-test the findings of the study revealed that significant difference exist in the attitude, academic performance and retention of students taught using instructional videos and those taught using conventional teaching method. Students in the experimental group developed and obtained a significantly high positive attitude, academic performance and retention respectively than students in the control group. It was concluded that Instructional videos enhance students' attitude, academic performance and retention in digestive system concept if use in a right way, Instructional videos helps in enhancing attitude, academic performance and retention in gender as indicated by insignificant gender difference. It was recommended that teachers should be encouraged to teach using Instructional videos so as to enhance students' attitude towards digestive system and improve in academic performance and retention.

Keywords: *Academic Performance, Attitude, Instructional Videos and Retention.*

I. INTRODUCTION

Science is a word derived from Greek word Scientia which means a body of knowledge. Different scholars define science differently according to their perception and understanding of the subject matter. According to Allchin (2020), stated that science can be defined as a systematic pursuit of knowledge about the natural world through observation, experimentation, and critical reasoning, framed by the norms and practices of the scientific community. Allchin (2020) emphasizes that science is not merely a method or a body of knowledge but also a community-driven activity bound by shared norms such as transparency, peer review and replicability. In this view, science is a social endeavor that depends heavily on communal validation processes to authenticate knowledge. Allchin (2020) approach highlights that the credibility of science lies not just in methods but also in the collective trust and ethical practices maintained by the scientific community.

The National Academies of Sciences, Engineering and Medicine (2019) defines science as "the use of evidence to construct testable explanations and predictions of natural phenomena as well as the knowledge generated through this process. This definition underscores two critical elements the reliance on empirical evidence and the predictive capability of scientific theories. Importantly, it reflects a growing understanding that science is not static it involves continuous testing and revision. By emphasizing evidence and prediction, the National Academies stress the dynamic and provisional nature of scientific knowledge, recognizing that scientific conclusions are always subjected to change with new discoveries and improved methodologies. Lederman,

Lederman Antink-meyer (2019) proposed that science is a human endeavor characterized by the generation, validation, and communication of empirical knowledge, mediated by socio-cultural factors and aimed at explaining patterns in the natural world. This modern definition incorporates an important dimension that earlier models largely neglected the socio-cultural context. Lederman and Gess (2019) argue that scientific inquiry cannot be separated from the values, biases, and cultural influences that shape researchers' questions and interpretations. Their view reflects an increasing emphasis in contemporary philosophy of science on recognizing the human elements within scientific practice such as attitude, subjectivity and the influence of social values.

Biology is a challenging subject for many students. Instructional videos which often include virtual labs or interactive models allow students to visualize and experiment with biological phenomena that may be too complex or impractical to observe directly in the classroom. For example, instructional videos in teaching digestive system can give students a deeper understanding of how biological systems work. The use of instructional videos in biology education in Nigeria can have a significant impact on students' academic performance, especially in secondary schools. Biology is a fundamental subject in sciences offered in senior secondary schools, it is an integral science subject that centers on the understanding of living things. Hamzat, Bello and Abimbola (2017) define Biology as a field of science that is presented in theoretical and practical form. The Practical presentations of biological concepts offer students the opportunity to carry out scientific processes in the laboratory and outside the laboratory, which are far different from theoretical presentations of some of its topics. Chavan (2017) stated that biology is enriched with topics like cells, circulatory system, photosynthesis, digestive system, respiratory system, excretive system, organs, and so on. Although there might be problem in teaching these topics due to the unavailability of teaching aids to teach the topics. Campbell and Reece (2018) defines Biology as the scientific study of life, encompassing a wide range of sub-disciplines that explore the structure, function, growth, evolution, distribution and taxonomy of living organisms. This field integrates knowledge from Molecular Biology, Cellular Biology, Genetics, Ecology, and Evolutionary Biology to understand the complex interactions among organisms and their environments. Biology not only examines individual organisms but also the systems and processes that sustain life on earth. As a dynamic and interdisciplinary science, it plays a crucial role in addressing global challenges such as health, conservation, and climate change. Solomon, Berg and Martin (2017) characterize biology as a diverse field that examines living organisms and their interactions, emphasizing the integration of different biological disciplines such as genetics, ecology, and evolution.

Digestive system is a complex network of organs responsible for the ingestion, breakdown, absorption, and elimination of food substances. It comprises the gastrointestinal tract including the mouth, esophagus, stomach, intestines and anus, along with accessory organs such as the liver, pancreas, and gallbladder. Gonzale and Mendez (2020) found that this system facilitates the mechanical and chemical processes that convert food into essential nutrients and energy while expelling waste products. Recent studies emphasize the importance of the gut micro biome in digestion and overall health, highlighting the intricate interplay between diet, digestion, and metabolic processes. Also, Koh De Vadder, Kovatcheva-Datchary and Backhed (2017) defines digestive system as a coordinated assembly of organs and structures that facilitate the processing of food, enabling the conversion of complex nutrients into simpler molecules that can be absorbed into the bloodstream. This system encompasses both the gastrointestinal tract from the oral cavity to the anus and accessory organs such as the liver, pancreas and gallbladder. Recent research has highlighted the critical role of the digestive system in immune function, metabolism, and the maintenance of overall homeostasis. Hargreaves and Lemoine (2021) explain that digestive system is a complex network of organs responsible for the intake, breakdown and absorption of nutrients, as well as the elimination of waste products. In the context of science education, particularly Biology, instructional videos have become a vital pedagogical tool for explaining complex and abstract topics such as the digestive system. They provide concrete visualizations of invisible biological processes that cannot be easily demonstrated through traditional classroom methods. In the study of the digestive system, instructional videos simplify the explanation of complex anatomical and physiological processes such as digestion, absorption, and enzymatic actions. They

help learners visualize the journey of food from ingestion to elimination, thereby enhancing their understanding and engagement (Yusuf & Oyetola, 2023). Through animations, 3D models, and simulations, students can observe organ functions, interactions, and real-life applications, leading to a deeper conceptual grasp. The rapid advancement of technology has significantly transformed educational practices worldwide, particularly with the integration of multimedia tools in the teaching and learning process. Among these innovations, instructional videos have emerged as one of the most effective tools in contemporary education. Instructional videos are structured multimedia presentations designed to facilitate learning by combining visual, audio, and sometimes interactive elements to deliver content in an engaging and comprehensive manner. Their application has become increasingly relevant in the teaching of science subjects, including biology, where visual representation of abstract concepts such as the digestive system is essential. Traditional teaching methods, often dominated by verbal instruction and textbook-based learning, have been found to be insufficient in sustaining student interest, especially in complex subjects. Students frequently struggle to understand and retain abstract biological concepts due to the limitations of conventional teaching approaches. In this context, instructional videos provide an alternative that can enhance learners' comprehension by offering visual simulations and demonstrations that bring theoretical content to life.

Academic performance refers to the extent to which a student meets the learning objectives and requirements of a course or program. According to Ahn and McEachin (2017) academic performance encompasses a variety of indicators, including grades, standardized test scores, and overall academic achievement. This definition highlights the multidimensional nature of academic success, recognizing both qualitative and quantitative measures. Academic performance is influenced is a complex interplay of cognitive, social and factors that affect student outcomes. Johnson, Johnson and Smith (2018) stated that this holistic view acknowledges that it is not solely based on individual capability but is also shaped by external contexts including family background and school environment. Academic performance can be viewed as a reflection of a student's ability to utilize their cognitive and non-cognitive skills to achieve desired academic goals. According to Duckworth and Seligman (2019) found that academic performance underscores the importance of both intelligence and perseverance, suggesting that effective study habits and resilience are essential components of achieving high academic performance. Academic performance is defined as the demonstration of knowledge and skills acquired through educational experiences, typically measured through assessments and examinations. This definition emphasizes the evaluative aspect of academic performance.

Retention plays a crucial role in students' ability to learn and succeed academically. Students whom retain knowledge perform better academically. The ability to remember and make use of past knowledge and experience is known as retention. Retention of learning is the process of storing new information in long-term memory in a format that facilitates easy retrieval. Studies by Kurumeh, Onah and Mohammed (2018) as well as Ajayi and Ogbeba (2017) showed low students retention rate in Nigerian secondary schools. This low retention rate has been attributed to the use of ineffective and inappropriate teaching methods by teachers, which is the lecture method. This lecture method does not help Biology students to retain what is being taught and practiced at a later time. It does not bring about transfer of learning. Retention is the capacity to store and recall information acquired through learning after a specified period to measure student development (Toklucu & Tay, 2017). Aggarwal (2018) identifies four methods of measuring retention. These are; recall or reproduction; relearning or saving method (this involve calculating the number of trials taken to learn materials in the beginning and note down the saving of trials relearning it after some lapse of time); recognition; and reconstruction. A good memory and retention lead to meaningful learning, leading to production of a series of changes within our entire cognitive structure, modifying existing concepts, and forming new linkages between concepts. Yakubu, Samuel, Abdulkadir & Yakubu (2019) defined retention as the ability of students to store, retrieve or recall learning objects after a given period of time. Retention refers to all information still retained or remaining in the memory of each individual who has been through the learning process and can be recalled within a specified time frame (McLeod, 2019). Bawaneh (2019) viewed retention as the extent to which a student acquired and retained concepts, knowledge, and skills during his study of the subject

after being subjected to planned educational experiences. Retention is the ability to retain and consequently remember things experienced or learned by an individual later (Madugu & Yusuf, 2020). They further added that, it is the ability of the students to recall information from short term and long-term memory for the purpose of attaining better academic performance. Khoshsima, Saed & Hakimzadeet (2015) noted that the rationale behind the necessity of previously existed knowledge is that it helps learners solve any misinterpretation and also retain the newly learned information.

Base on the experiences of the researcher as a biology teacher observed that Students are finding it difficult to understand most of Biology Concept using Conventional method that is consistently been used by teachers in our Secondary Schools, the researcher after reviewing several researches find out that using different teaching method like the use of concept instructional video enhance students' Attitude, Academic Performance and retention better than the conventional teaching method. WAEC Chief Examiner's report (WAEC, 2025) indicates that digestive system constitutes an area of difficulty faced by students. It is observed that digestive system usually appears in the compulsory part of the examination. This section might be part of the area contributing to the students' poor performances. This level of dismal performance could be attributed to the abstract nature of the concept, which usually make teachers to teach it using of lecture method. Consequently, student resort to relying on cramming to pass Biology, a situation which drastically affects their academic performance and by extension making it highly difficult for them to retrieve learnt material initially stored through that process. In particular, the WAEC Chief Examiners report (2025) on Biology observed areas of weaknesses to include poor spelling of some technical terms digestive system, poor drawing of some diagram, inability to use technical terms to describe concept of digestive system. This could be due to the observed fact that the teaching of biology in Nigerian secondary schools is being done with the use of chart and diagrams. This implies that students' academic performance, arising from the use of this method of teaching which is not supportive and encouraging is undesirable, in contrast to the collaborative teaching strategy into secondary classroom in other countries which has proved to be effective in improving teaching and learning process. This is one of the reasons motivate the researcher to carry out research on the Effect of instructional videos on Attitude, Academic Performance and Retention in Digestive System among Senior Secondary School Students in Daura ZEQA Katsina State, Nigeria in order to enhance Students' Academic Performance and Retention.

The main purpose of this study is to investigate the effect of instructional videos on attitude, academic performance and retention in digestive system among senior secondary biology students in Daura Zonal Education Quality Assurance (DZEQA). Specifically, the study intends to:

1. Find out the effect of Instructional Videos on Attitude in Digestive System among secondary school students in Daura Zonal Education Quality Assurance Katsina State.
2. Ascertain the effect of Instructional Videos on Academic Performance in Digestive System among secondary school students in Daura Zonal Education Quality Assurance Katsina State.
3. Examine the effect of Instructional Videos on Retention in Digestive System among secondary school students in Daura Zonal Education Quality Assurance Katsina State.

Based on the objectives of the study, the following research questions are raised, to guide the study:

1. What is the difference between the mean attitude scores of the students taught Digestive System using Instructional Videos and their counterparts taught same concept using the conventional method?
2. What is the difference between the mean academic performance scores of the students taught Digestive System using instructional videos and their counterparts taught same concept using conventional method?
3. What is the difference between the mean retention ability scores of the student taught Digestive system using instructional videos and those taught same concept using conventional method?

The following research hypotheses were formulated to guide the study:

H_{01}: There is no significant difference between the mean attitude scores of the students taught Digestive System using instructional videos and those taught same concept using conventional method.

H_{02}: There is no significant difference between the mean academic performance scores of the students taught Digestive System using instructional videos and those taught same concept conventional method.

H_{03}: There is no significant difference between the mean retention scores of the students taught Digestive system using instructional videos and those taught same concept using conventional method.

II. METHODOLOGY

The design of this study is a quasi-experimental design; specifically, pre-test, posttest non-equivalent control group design. The study consisted of two groups; which are: the experimental group (EG) and the Control group (CG). The intact classes were used to avoid threat of selection bias among the students and to avoid rearranging and re-grouping which could disrupt the normal school settings. The population for this study comprised a total number of 3,139 senior secondary school II (SS2) students consisting of 1,804 males and 1,335 females offering Biology in 24 public secondary schools of Katsina Zonal Education Quality Assurance, Katsina State. The sample of the study comprised 120 senior secondary II Biology students made up of 50 males and 70 females from selected public co-educational schools in Katsina Zonal Education Quality Assurance, Katsina State. Purposive and Cluster sampling technique were employed in this study. Purposive and Cluster sampling sampling technique. Where by Experimental school choose purposively, the justification behind this is that the study tries to find out the effectiveness of using instructional videos to teach biology (digestive system) the researcher has to go to school with computer and ICT facilities. The experimental group (EG) was taught using computer assisted Instruction and the control group (CG) was taught using conventional lecture method. Digestive System Performance Test (DSPT) and Digestive System Attitude Questionnaire (DSAQ) was the instruments used to collect data, the instruments were validated by four experts and they have the reliability coefficient value of 0.72 and 0.79 it was obtained using Pearson Product-Moment Correlation (PPMC) and Cronbach's Alpha Coefficient. The instrument has two sections; section A, which contains student's biod-ata and section B, which contains 20 objective questions. The data collected was analyzed using mean, standard deviation and independent sample t-test.

III. RESULTS

H_{01}: There is no significant difference between the mean attitude scores of the students taught Digestive System using instructional videos and those taught same concept using conventional method.

Table 1: Summary of Independent Sample t-test of Attitude Scores of Students in Experimental and Control Groups

Groups	N	Mean	Std. Dev.	Df	t value	p-value	Remark
Experimental	62	54.16	8.352	118	9.570	0.000	Significant
Control	58	39.30	8.652				

Significant at $P \leq 0.05$

Table 1: shows that t = 9.570, p-value = 0.00, df = 118. Since the p-value of 0.00 less than alpha value = 0.05, there is significant difference between the mean attitude scores of the students taught Digestive System using instructional videos and those taught same concept using conventional method. Therefore, the null hypothesis which states that There is no significant difference between the mean attitude scores of the students taught Digestive System using instructional videos and those taught same concept using conventional method is said to be rejected. The alternative hypothesis is retained; there is significant difference between the mean attitude scores of the students taught Digestive System using instructional videos and those taught same concept using conventional method.

H_{02}: There is no significant difference between the mean academic performance scores of the students taught Digestive System using instructional videos and those taught same concept conventional method.

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Table 2: Summary of t-test Analysis of Academic Performance Ability Scores of Secondary School Biology students in the Experimental and Control Groups

Groups	N	Mean	Std. Dev.	Df	t value	p-value	Remark
Experimental	62	49.72	8.111	118	9.593	0.000	Significant
Control	58	37.15	6.015				

Significant at $P \leq 0.05$

Table 2: shows that t = 9.593, p-value = 0.00, df = 118. Since the p-value of 0.00 less than alpha value = 0.05, the null hypothesis which states that there is no significant difference between the mean academic performance scores of the students taught Digestive System using instructional videos and those taught same concept conventional method is said to be rejected. Therefore, there is significant difference between the mean academic performance scores of the students taught Digestive System using instructional videos and those taught same concept conventional method.

H_{03}: There is no significant difference between the mean retention scores of the students taught Digestive system using instructional videos and those taught same concept using conventional method.

Table 3: T-test Analysis of Retention Scores of Students in the Experimental and Control Groups

Groups	N	Mean	Std. Dev.	Df	t value	p-value	Remark
Experimental	62	54.08	8.520	118	8.089	0.000	Significant
Control	58	40.20	10.056				

Significant at $P \leq 0.05$

Table 3: shows that t=8.089, p-value = 0.00, df = 118. Since the p-value of 0.00 less than alpha value = 0.05, there is significant difference between the mean academic performance score of male and female students taught digestive system using instructional videos and those taught the same concept using conventional method. Therefore, the null hypothesis which states that there is no significant difference between the mean academic performance score of male and female students taught digestive system using instructional videos and those taught the same concept using conventional method is said to be retained.

IV. DISCUSSION

The results of data analyzed revealed that there was a significant difference in the attitude scores, mean academic performance, and retention between those taught Digestive system concepts using computer assisted instruction and those taught with conventional method among senior secondary schools in Daura ZEQA Katsina state Nigeria. This may be attributed to the fact that Instructional Videos improves deeper learning when information is presented in both text and Graphics than by text alone. This is in line with that of other researches that reported Instructional Videos has significantly impact on students' attitude, academic performance, and retention.

Finding number one revealed that Students taught digestive system using instructional videos developed higher positive attitude in digestive system than their counterparts without it. This finding agrees with that of Igbonkweakuwu and Cleopas (2025) who's their findings revealed that no significant difference in the mean scores of SS2 students in single-sex and co-education schools in attitude when taught with demonstration, discussion and lecture teaching methods in Biology. These indicated that there was need for students to engage in teaching with Instructional videos. Also, Kala, Maikamba, Isah, and Aisha (2023) Their findings revealed a significant main effect of problem solving instructional strategy and demonstration teaching method on academic achievement and retention of senior secondary school students in Biology. It can be concluded from this study that problem solving instructional strategy and demonstration teaching method used in teaching basic science content has significant main effect on academic achievement, attitude and retention for the entire subject that participated in the study.

Finding number two indicated that students taught with instructional videos performed better than their counterparts. This indicates that Instructional videos boosted student's performance as indicated by welberge theory that identified key variables that influenced students' Performance such as instructional quality and quantity, prior performance and motivation .Haruna, Salisu, Abdullahi and Shuaibu (2025) Whose their findings revealed that revealed significant difference in the academic performance of students exposed to the animated videos strategy and those taught using conventional method. From the findings of the study, it was recommended among others, there is need for Federal and State Ministries of Education to provide computers and projectors for teachers to facilitate their teaching with educational animations. Similarly, Ahakiri (2023) revealed that there was a significance difference between biology students' academic achievement when instructional video was use in teaching biology. The second hypothesis that sought for the influence of availability of instructional videos on students' academic achievement was not significant. It was recommended the teachers teaching biology use instructional videos in teaching biology. Also, Joseph and Josphine (2024) their findings revealed that there was a significance difference between biology students' academic achievement when instructional video was use in teaching biology. The second hypothesis that sought for the influence of availability of instructional videos on students' academic achievement was not significant. It was recommended the teachers teaching biology use instructional videos in teaching biology.

Finding number three revealed that students taught digestive system using instructional videos significantly retain than their counter part. Astin Student Involvement theory of Retention who identified that student learned when they are actively involved. This finding is in line with that of Sunday (2025) who's his findings revealed that the use of YouTube Instructional Video Package improved the mean retention scores of students in physics than the use of Lecture Method. And his recommendations were made that the use of instructional videos should be incorporated into physics instruction on a regular basis and students should be encouraged to use instructional videos as a supplemental resource, in addition to traditional classroom instruction. Also, Kabiru, Hassan and Samaila (2023) His findings of the study show that students exposed to Video Instructional package taught domestic installation has significant effect in the mean outcome scores and retention compared to those taught domestic installation with conventional method. The result concludes that instructional video package enhanced the academic performance and retention of domestic installation Students exposed to instructional video package in both their cognitive and psychomotor performance.

V. CONCLUSION

The study investigated effect of instructional videos on attitude, academic performance and retention in digestive system among senior secondary students in Katsina State Nigeria. The conclusions were drawn from the findings of the study based on the statistical analysis of the data collected. Therefore, it was concluded that; instructional videos have positive impact on students' attitude in digestive system. Therefore, positive attitude towards digestive system can be enhanced significantly by using instructional videos. Students' retention ability of learnt concept in digestive system can be promoted using instructional videos. Therefore, it can be concluded that better retention of learnt concept can be achieved by using instructional videos.

The following findings were revealed based on the results of this study:

1. There is statistically significant difference between the mean attitude scores of students taught Digestive System using instructional videos and those taught same concept using conventional method.
2. The result shows that students in the experimental group with higher mean performed better than those in the control group. This indicates the efficacy of using instructional videos over Conventional method in enhancing the academic performance of secondary school Biology students in digestive system.
3. The result shows that students in the experimental group with higher mean retained better than those in the control group. This indicates the effectiveness of using instructional videos over the Conventional method in aiding retention

ability of secondary school students in Digestive System.

Based on the findings of this study, the following recommendations are made:

1. Biology teachers should frequently employ the use of instructional videos in teaching abstract concepts in Biology like digestive system to promote students' attitude, academic performance and retention.
2. Government at all levels should train teachers by organizing seminars, conferences and workshops on learning how to teach using instructional videos.
3. The Federal and State Government through the Ministries of Education should ensure proper use of instructional videos as well as encourage teachers to use the instructional videos strategy as this research finding revealed that it is more effective in enhancing students' attitude, academic performance and retention ability of students than the conventional lecture method.

REFERENCE

[1] Ahn, J., & McEachin, A. (2017). The Impacts of Accountability on Student Achievement: Evidence from a State-wide Accountability System. *Educational Policy Analysis Archives*, 25(14). https://doi.org/10.14507/epaa.25.2777

[2] Ajayi, T., & Bello, K. (2020). Students' attitudes and academic success: A review of empirical evidence in African schools. Journal of Education and Practice, 45(3), 102–115. https://doi.org/10.1080/jep.2020.45103

[3] Allchin, A. D. (2020). *Teaching the Nature of Science: Perspectives and Resources.* Science Education.

[4] Allchin, D. (2020). Teaching the nature of science: Perspectives and resources. Science Education.

[5] Campbell, N. A. & Reece, J. B. (2018). *Biology* (11th ed.). Pearson

[6] Chavan, R. (2017). Difficulties in Teaching Biology Concepts by Science Teachers At Upper Primary Level. *Aayushi International Interdisciplinary Research Journal*, *3* (8), 10–18.

[7] Duckworth, A. L., & Seligman, M. E. P. (2019). Self-discipline gives girls the edge: Gender in self-discipline, grades, and achievement test scores. *Journal of Educational Psychology,* 93(1), 25-30. https://doi.org/10.1037/0022-0663.93.1.25

[8] Gonzalez, A., & Mendez, M. (2020). The Role of the Gut Microbiome in Human Health and Disease. *Journal of Clinical Gastroenterology, 54*(5), 401-410. https://doi.org/10.1097/MCG.0000000000001154

[9] Hamzat, A., Bello, G., & Abimbola, I. Oscar. (2017). Effects of computer animation instructional package on students' achievement in practical biology. Cypriot Journal of Educational Sciences, 12(4), 218. https://doi.org/10.18844/cjes.v12i4.2932

[10] Hargreaves, D. I., & Lemoine, A. (2021). The human digestive system: A comprehensive overview. *Clinical Gastroenterology and Hepatology*, 19(4), 658-670. https://doi.org/10.1016/j.cgh.2020.07.012

[11] Koh, A., De Vadder, F., Kovatcheva-Datchary, P. & Bäckhed, F. (2017). From Dietary Fiber to Host Physiology: Short-chain Fatty Acids as Key Bacterial Metabolites. *Cell*, 165(6), 1332-1345. https://doi.org/10.1016/j.cell.2016.05.041

[12] Kurumeh, M. S., Onah, F. O. & Mohammed, A. S. (2018). Improving Students' Retention in Junior Secondary School Statistics using Ethno-mathematics Teaching Approach in Obi and Uju Local Government Area of Benue State, Nigeria. *Greener Journal of Educational Research, 2*(3), 54- 62.

[13] Kurumeh, M. S., Onah, F. O. & Mohammed, A. S. (2018). Improving Students' Retention in Junior Secondary School Statistics using Ethno-mathematics Teaching Approach in Obi and Uju Local Government Area of Benue State, Nigeria. *Greener Journal of Educational Research, 2*(3), 54- 62.

[14] Lederman, N. G., & Gess-Newsome, J. (2019). Portals to the public: The role of science education in developing scientifically literate citizens. *Science Education*, 103(1), 1-6.

[15] Lederman, N. G., Lederman, J. S., & Antink-Meyer, A. (2019). Nature of science and scientific inquiry as contexts for the learning of science and achievement of scientific literacy. International Journal of Education in Mathematics, Science and Technology, 7(3), 245–257. https://doi.org/10.18404/ijemst.559318

[16] McLeod, J. J. (2019). The Effects on Student Retention by Implementing Contextualized, Program-Specific Learning Modules in an Online Student Success Course: *A Practice Report. Student Success*, *10*(1), 141-146. https://doi.org/10.5204/ssj.v10i1.1095

[17] National Academies of Sciences, Engineering, and Medicine. (2019). Science and Engineering for Grades Six–Twelve: Investigation and

Design at the Center. *The National* Academies Press. https://doi.org/10.17226/25216

[18] Solomon, E. P., Berg, L. R., & Martin, D. W. (2017). *Biology* (11th ed.). Cengage Learning

[19] Toklucu, S., & Tay, B. (2017). The Effect of Cooperative Learning Method and Systematic Teaching on Students' Achievement and Retention of Knowledge in Social Studies Lesson. *Eurasian Journal of Educational Research,(66)*, 315-334.

[20] Yusuf, M., & Adebayo, T. (2023). The role of student attitude in predicting academic achievement in science subjects. Journal of STEM Education Research, 6(2), 215–229. https://doi.org/10.1007/s41979-023-00152-9.