Journal of Education and Practice
ISSN 2222-1735 (Paper) ISSN 2222-288X (Online)
Vol.16, No.8, 2025

Students Understanding of "Biological Processes of Life" and their Classroom Behaviour with Video-Instruction

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Abstract

This study examined the impact of video-based instruction on students` understanding of biological processes and classroom behavior, with consideration for gender, ability levels, and school location in Delta State, Nigeria. Science students find it difficult to understand scientific concepts and perform poorly in sciences, with the application of the dual coding theory that emphasizes mental imagery and the intricate mechanisms of how information is stored in memory, this study focused on the use of videos that would form mental images on the students to teach the biological processes of life topics. The videos as visual aids are meant to assist students in processing and retaining the concepts thought. To achieve this goal, a quasi-experimental design was adopted to compare two groups: one received instruction via videos, while the other was taught using conventional methods. Data were collected over seven weeks using three validated instruments—the Basic Science Ability Test (BSAT), Processes of Life Achievement Test (PLAT), and Classroom Behavior Rating Scale (CBRS). Six topics were covered: digestive, excretory, circulatory, skeletal, respiratory, and nervous systems. Statistical analysis involving means, standard deviations, t-tests, and ANCOVA revealed that students taught using videos achieved significantly higher academic performance and exhibited improved classroom behavior, particularly in rural areas. While high-ability students performed well across both instructional modes, low-ability students showed better outcomes with video instruction. No significant differences were observed based on gender or location. The findings underscore the effectiveness of video-based instruction in enhancing learning outcomes and h positive classroom behavior. It is recommended that video-integrated teaching approaches be adopted to support differentiated instruction, especially for low-achieving students. Additionally, this study findings aligns with the dual coding theory and highlights the need for teacher training programs that build capacity for effective multimedia integration in science education.

Keywords: Video-based instruction, biological-processes of life, Classroom behaviour, Dual coding theory

DOI: 10.7176/JEP/16-8-05

Publication date: July 31st 2025

1. Introduction

Teaching and learning are fundamental components of education, and the emergence of Information and Communication Technology (ICT) along with internet accessibility has significantly impacted various aspects of human life (Bates 2015, Laurillard 2013 & UNESCO 2018). Video Technology in recent times has become a necessity globally, influencing daily lifestyle; and the utilization of videos and related devices has notably revolutionized the educational landscape in developed nations (Fawareh & Jusoh, 2017; Tagoe & Abakah, 2014). This shift has altered the learning approach, with learners no longer reliant solely on traditional paper-based

materials. The internet has facilitated the emergence of videos, enabling learning to occur regardless of geographical constraints or time limitations. The creation of teaching materials is imperative for educators as they can enhance students' learning experiences (Rahmani., 2021).

Teachers play a pivotal role in implementing science-based curricula, ensuring that science students achieve national educational objectives. Recognizing that learners possess unique characteristics with specific learning needs, (Elliot, Kratochwill, Cook, and Travers (2001) emphasized the importance of instructional materials being easily applicable to real-world scenarios. Science teachers are tasked with providing materials and experiences that meet learners' expectations and aid in the learning process. The integration of videos, animations, cartoons, and multimedia has enabled teachers to engage students of varying abilities in innovative ways. In today's digital age, educators are challenged to develop multimedia learning resources to support Technology-enhanced learning (Hasanah et al., 2022), sparking a renewed interest in video-based communication among teachers (Desyandri et al., 2021).

A video is a digital recording or representation of moving visual images, typically accompanied by sound, viewable on a screen. It offers educational content to students regardless of their physical location. (Dinc, 2017; Yilmaz, 2019). Instructional videos not only convey information but also visually demonstrate concepts and place them within a broader context of knowledge. They create an immersive learning environment that aids in knowledge retention and critical thinking development (Mora, 2016). Noetel et al. (2021)) highlighted the role of videos in helping students comprehend course content and engage in interactive learning experiences. Videos have the potential to enhance understanding, retention, and classroom dynamics ((Mora, 2016).

Real-life activities in subjects like Basic Science, Biology, Chemistry, Physics, and Mathematics are brought to life in classrooms through illustrations, demonstrations, and specimens, enhancing student engagement. Technology-based learning models have shown positive outcomes in improving student performance, engagement (Anthony et al., 2019) and motivation levels. Several studies have indicated that educational digital videos enhance students' perceived learning experiences (Bharani et al., 2017 &Bond et al., 2018). Tulinayo, Sentume, and Najjuma (17) discovered a significant positive correlation between students' perceived usefulness of digital learning Technology Ogies and their attitudes towards, capacities for, and intentions to use such Technologies By leveraging videos, students are more motivated to learn, leading to increased interaction compared to traditional classroom settings, thus enhancing the efficiency of teaching and learning (Bharani et al., 2017 &Bond et al., 2018).

Students' performance in the Basic science subject has been low among secondary students in Nigeria (Adeniyi, 2020; Ajewole, 2015; Okebukola, 2017) and the instructional approach is considered a contributing factor (Ekwueme, Ekon, & Ezenwanebife, 2016). It is then perceived that the teaching method employed by the teachers in the field of science may not match the learning preferences of the students of varying abilities, gender, and location (Adeniyi, 2020; Ajewole, 2015). Hence, it is argued that using videos can boost performance and attitude of students. Despite previous findings that videos improve achievements and attitudes more than traditional methods, there still exists a gap and a dearth of knowledge regarding the impact of videos on student engagement and behavior in classrooms during instructional sessions, which is recognized as a justification for this study. There are also some studies with contrary and mixed findings on the use of videos to improve achievements and classroom behaviours of students (Chen et al. 2018; Kim et al. 2019; Patel, 2017; & Sharma et al. 2018) which means more studies are needed for these conflicting arguments. Gaps have also been identified in the use of videos in conjunction with intervening variables such as varying ability levels and gender disparities. This investigation serves as a unique case study conducted in a different location, focused area, and with different intervening variables compared to previous studies. Another justification for this study is the abstract nature of some topics in sciences which makes it difficult for students to comprehend them. Biological processes of life have been identified as topics that are abstract in nature (Mayer, 2008; Singer & Hills, 2015) and require teaching methods that can assist learners to understand them better. Thus, these situations prompted the researcher to investigate the effects of video-based instruction on academic performance and classroom behaviour of junior secondary school high-and low-ability, male and female and rural and urban students in Delta State, Nigeria.

1.1 Research Outline

We commenced by providing a theoretical framework and an all-inclusive literature review and contribution to knowledge in Section. 2. We provide the methodology in section 3, which involves the data collection source, the developed Instruments, in the methodology section followed by the provision of detailed results and discussion in Section 4 and 5 while the concluding part of the work is described in section 6.

2.0 Theoretical Framework

The dual coding theory, also referred to as the theory of mental imagery, delves into the intricate mechanisms of how information is stored in memory (Sadoski & Paivio, 2001). According to this theory, memory is comprised of two distinct mental codes: one verbal and the other nonverbal. The verbal system is characterized by its language-based nature, focusing on words, sentences, and linguistic units, while the nonverbal system stores emotions, visual images, and other non-linguistic representations. The fundamental memory units in the verbal system are known as logogens, whereas in the visual system, they are referred to as "images" (Kuo & Hooper, 2004; Sadoski & Paivio, 2001).

The visual system and linguistic subsystem exhibit unique characteristics in how they process and retain information. In the visual system, images are preserved as cohesive entities with a sense of holistic unity. This means that when we perceive an image, our brain comprehends it as an integrated whole without dissecting its individual components. For instance, when observing a painting, we tend to absorb the entire composition rather than focusing on specific brush strokes or colors. On the contrary, the verbal system encodes information in the form of logogens, which are discrete units akin to words and sentences. This enables us to process language in an organized and sequential manner. For example, upon hearing a sentence, our brain dissects it into individual words, analyses their meanings, and then comprehends the complete message.

Understanding these distinctive characteristics offers insights into how we perceive and interpret the world around us. The theory posits three levels of processing - representational, referential, and associative - occurring within and between the verbal and visual systems (Paivio, 1991). The dual coding theory suggests that when acquiring current information, our brains can encode it through two distinct pathways: verbal and visual. Employing a combination of words and visuals enhances our ability to remember and comprehend information effectively. Educators should focus on strategies to facilitate dual encoding of information in long-term memory. Therefore, when utilizing instructional media such as videos, diagrams, or animations, incorporating both verbal and visual elements can significantly enhance the learning process. This dual approach enables our brains to process information from multiple angles, increasing the likelihood of retention and understanding. Information encoded in both verbal and visual formats, with robust and flexible links between the codes, improves retention, retrieval, and transfer. Dual coding is more likely to occur when the content lends itself to visualization, particularly with concrete concepts like "book" or "biro" that are easier to visualize due to their tangible nature. Conversely, abstract concepts such as "digestion" or "egestion" may require providing learners with prototype images that elucidate the essential characteristics of the concept, aiding in visualization and understanding.

The theoretical framework of the dual coding theory underscores the significance of integrating verbal and visual elements in educational materials to enhance learning outcomes. Research by Marzano, Pickering & Pollock (2001) indicates that instructional videos facilitate the development of non-linguistic representations and improve content learning. Visual aids assist students in processing and retaining learning material, enhancing the development of logogens, and boosting information retention through the incorporation of verbal and visual cues.

3.0 Literature Review:

The literature review reveal that the study of biological processes encompasses various intricate topics, including excretory, circulatory, respiratory, digestive, nutritional, and reproductive systems. These subjects are best comprehended through engaging pedagogical methods rather than rote memorization. Biological processes have been identified as abstract topics (31) that necessitate pedagogical approaches fostering deeper comprehension among learners and use of visuals. The complexity and abstract nature of biological processes such as respiration and photosynthesis pose significant challenges to students in grasping these concepts (Treagust & Duit, 2018)

Struggles in understanding abstract concepts during the teaching-learning process can lead to classroom misbehaviours among students (Fraser 2015; Kim & Kim 2017; Tekkaya & Sungur 2016). To address these challenges, research by Kalas and Redfield (2022) suggests that well-crafted videos can enhance students' comprehension of fundamental biological principles and processes, surpassing the effectiveness of traditional rote memorization and textbooks. Videos have the unique ability to bring lessons to life, making learning more tangible and sparking curiosity among learners. Teachers are encouraged to create their own video content or explore existing applications that provide vivid illustrations, transforming abstract concepts into concrete realities. This approach is particularly vital in local contexts and schools, as studies elsewhere have shown significant improvements in scientific comprehension through video-based instructional materials for teaching biological processes.

Previous studies indicate that videos create a psychosocial learning environment that enhances students' memory retention, logical thinking, knowledge acquisition, motivation, and positive behaviours in classrooms. Mithun and Evan (2018) highlight that video-based teaching enhances learning experiences and outcomes compared to traditional methods, fostering engaging discussions and idea exchanges, leading to improved knowledge retention, motivation, classroom behaviours, and engagement. Hamed (2018) asserts that videos are highly effective teaching tools that enhance classroom behavior and learning outcomes. Similarly, Kay and Kletskin (2017) emphasize that videos improve learning outcomes, engage students, promote active learning, and reduce disruptions in classroom behaviours. However, some researchers have noted contrasting findings, suggesting that excessive reliance on videos for teaching can decrease student engagement, increase indiscipline, distractions, and diminish classroom behaviours (Kirschner & Karpinski, 2010, Roschelle et al. 2016, Turkle 2015). Cuban (2001). Cuban (2001) highlights in his study on the use of computers in classrooms that excessive video usage can lead students to rely more on Technology and less on social and cognitive skills. Roschelle et al. (2016) found that videos cause distractions in the classroom and contribute to increased student misbehaviours.

In conclusion, existing literature indicates poor performance in Basic Science subjects among secondary-level learners, with teaching methods such as conventional approaches being identified as contributing factors. While videos have been recognized for enhancing students' understanding of abstract biological processes and improving classroom behaviours, conflicting research reports exist. This study aims to investigate the impact of videos on enhancing students' comprehension of biological processes and classroom behavior in Delta State, Nigeria, building upon previous literature that identified gaps related to varying abilities, gender, locations, and conflicting results.

4.0 Research Hypotheses:

i. There are no significant differences in the achievement scores of students exposed to lessons on ‘processes of life using conventional versus video-based instructions.

ii. There are no significant differences in the classroom behaviour scores of students exposed to lessons on’ processes of life’ using conventional versus video-based instructions.

iii. There are no significant interactions of method, gender, ability levels and location on achievement of students exposed to conventional versus video-based instruction.

iv. There are no significant interactions of method, gender, ability levels and location on classroom behaviour of students exposed to conventional versus video-based instruction.

5.0 Methodology

The study utilizes a pretest-post-test quasi-experimental research design with two independent variables (video-based strategy and conventional lecture-based strategy) and two dependent variables (academic achievement and classroom behavior).

5.1 Population and Sample

The target population comprises all the 12,342 junior secondary two students in Delta State, Nigeria. A convenience sampling method was employed to procure a sample of 120 students, selecting two intact classes from two staff schools representing urban and rural communities in the state. The sample demographics include sixty-three (63) males and fifty-seven (57) females, sixty-two high ability and fifty-eight low ability students, as well as sixty-four urban and fifty-six rural students. The two staff schools were purposefully selected based on their distinct infrastructure, particularly the presence of electricity to facilitate video projections. One of the staff schools was located in a rural community and the second one was located in a high urban community. Intact classes were utilized for data collection to ensure representation and minimize disruption to the students' academic routine. Excluded were schools that were not staff schools and schools in semi-urbans zones. Staff schools without presence of electricity were also excluded.

5.2 The Instrument validity and reliability

Three research instruments were utilized: the 20-item Basic Science Ability Test (BSAT) for categorizing students based on their abilities, the 20-item Processes of Life Achievement Test (PLAT) for evaluating students' comprehension of processes of life, and Classroom Behavior Rating Scales (CBRS) for assessing students' conduct during lessons. The face validity of PLAT, BSAT, and CBRS were done by professionals in measurement and evaluation, and they also ensure adequate spread of question, the experts examined the

questions to see if they could be used to test the hypotheses. For the content validity of PLAT, a table of specification in (appendix 1) was formulated by the researcher for the PLAT encompassing all six chosen topics in processes of life. The PLAT questions were constructed based on the classification suggested by the Biological Science Curriculum Study (BSCS) similar to the earlier Bloom's taxonomy of Educational Objectives. The BSCS classification questions are based on knowledge, comprehension and application unlike the Bloom's taxonomy which continues after application with analysis, synthesis, and evaluation. The BSCS classification was used in this study because the students are in the Junior secondary school classes. They also checked if the test measured clearly what they intend to measure. Using the table of specification the experts checked to see if the questions were as specified in the table of specification and if they were arranged to conform strictly to the specifications. The comments of the experts were used to produce the final draft for the study. See Appendix 1

In order to establish a reliability of the BSAT items a pilot test was carried out on 30 junior secondary two students in a school which is not part of the schools for the study but had similarities with the treatment and control schools. The Cronbach reliability co-efficient shows the result of the standardized items as 0.679. For the reliability of PLAT, a pilot study was carried out on 30 junior secondary three students who have just completed the Junior Secondary two syllabus containing the topics to be used in this research. Junior secondary two was not used because the students have not been taught the topics intended for this research as at the time of this pilot study. Using the Cronbach alpha, a reliability co-efficient of 0.71 was obtained.

On item analysis, Difficulty index and index of discrimination for PLAT were computed to ascertain the difficulty level of each item in PLAT and the discriminatory power of the items; The difficulty index of an item is calculated by dividing the total number of persons who got the items right by the total number of persons who took the test. The higher the result, the lower the difficulty level, this means the greater the difficulty of an item, the lower its index (Wood & McQuarrie 1999). Based on this, no items were found to be too difficult. On the Index of Discrimination, a good item should discriminate between those who score high on the test and those who score low, the higher the discrimination index, the better the item can determine the difference between those with high test scores and those with low ones. The discrimination index in this work was calculated using the formula:

Di= Hp-Lp/Nlg

Di= discrimination index of item i

H= number of students who got right answers to item i among the top 27%

L= Number of right answers to item i among the bottom 27%.

Nlg = Number of people in the largest group.

The top 27% and bottom 27% who got each item right were used while the middle 46% was not used. The information from table 1 was used to adjudge the discrimination index of each item and based on this, one item was revised due to its low index of discrimination. See appendix 5 for details.

The Fleiss` kappa Inter-rater reliability was employed to establish the reliability of CBRS (0.39 indicating moderate agreement) in this study. The inter-rater reliability measures the degree of agreement between persons scoring a subjective test or rating individuals and is often used when scorers have to observe and rate the actions or behaviours of subjects in a study (Landis & Koch 1977). In the pilot study conducted in this study the ratings of 3 observers who rated 16 students for 5mins each using the information from 10 categories during the 80mins laboratory exercise were pooled and the inter-rater reliability gave a co-efficient of 0.39: details in appendix 2.

5.3 Research procedure

The research procedure spanned 7 weeks during which ethical considerations were adhered to. In the initial week, students undertook the 20-item BSAT to determine their ability levels, For the BSAT, students scoring 60% and above were classified as high ability, while those scoring below 40% were categorized as low ability. The students in the middle ability group who scored between 41% to 59% were not used because of the tendency to fall into either of the high or low ability groups followed by a 20-item PLAT pretest to evaluate their grasp of the content areas.

A 6-week instructional period ensued with one group receiving video-based instruction and the other receiving lecture-based instruction. The video-based instructions were shorts videos shown to the students as the lecture progresses to illustrate the concept to be communicated. The instructors for the video-based instructional

approaches were trained on utilizing the videos during lessons. At the culmination of the seventh week, students completed a post-test using the revised PLAT. Throughout the teaching period, six topics related to processes of life (digestive systems, excretory systems, circulatory systems, skeletal systems, respiratory systems, and nervous systems) were covered, with both classes utilizing the same teaching materials but employing different instructional approaches. Twelve (12) trained research assistants, three for each, observed and rated students' behavior in each class using the CBRS. The average ratings from the research assistants were compared to ascertain which class demonstrated superior behavior during lessons. Incomplete rating sheets were discarded, resulting in a total of sixty-nine accepted ratings.

5.4 Method of Data collection and analysis

Data were collected and analyzed using means and standard deviations, t-tests to identify significant differences between groups, and Analysis of covariance to assess interaction effects. Concerning data normality, given the limited sample size of less than five thousand observations, the Shapiro-Wilk test was employed. The findings indicated a significance level of 0.091 ($p>0.05$), suggesting that the data conforms to a normal distribution, characterized by uniform dispersion. Consequently, the statistical analyses of this study, including the t-test for analysis of hypothesis one and two and the ANCOVA statistics for analysis hypothesis three and four, were performed on the original data without necessitating any transformations.

6.0 Results and Discussion

6.1 Analysis of Hypothesis one

There are no significant differences in the achievement scores of students exposed to lessons on 'processes of life' using conventional versus video-based instructions.

Table 1: independent sample t-test of students in the Video and Conventional Method group

Test	Method	N	Mean	Std. Dev	df	t	Sig(2-tail)	Mean diff	Std.Error diff	Effect size
Post test PLAT	Video	58	13.6897	2.0192						
	Lecture	62	10.5323	2.1782	118	8.219	0.000	3.157	.38414	1.50
Pretest PLAT	Video	58	7.0172	1.7620						
	Lecture	62	6.4032	1.9116	118	1.826	0.070	0.614	.3362	

The table one shows that the comparative analysis of the Process of life achievement tests scores between students taught with videos and those taught with the conventional method revealed no significant difference in pretest means ($t(118) = 1.826$, $p>0.07$) which means the students have similar prior knowledge and achievement before the intervention, and that the post-test difference can be attributed to the treatment. For the post-test, a significant difference ($t(118) = 8.219$, $p<0.001$) was found. The mean achievement score for the video group (13.68) was significantly higher than that of the conventional group (10.53). The effect size ($d=1.50$) indicates a large effect translating to about 36% of the variance in means of students in the two groups and indicates that the use of videos has a noticeable and a dramatic effect on the students' post-test achievement than the use of conventional method. These findings reject the null hypothesis indicating that the video-based instruction is more effective in boosting the minds of students taught lessons on processes of life.

6.2 Analysis of Hypothesis two

There are no significant differences in the classroom behaviour scores of students exposed to lessons on 'processes of life' using conventional versus video-based instructions.

Table 2: Independent sample t-test on classrom behaviour

Method		N	Mean	Std. Dev	df	t	Sig (2-tail	Mean diff	Std error diff	Effect size
PosttestClassroom behaviour	Video	33	20.9091	6.176	67	2.289	0.025	2.992	1.307	
	Lecture	36	17.9167	4.631						0.55
PretestClassroom behaviour	Video	33	13.5152	3.849	67	1.475	0.145	1.126	0.764	
	Lecture	36	12.3889	2.381						

Table 2 shows that the comparative analysis of the classroom behaviour scores between students taught with videos and those taught with the conventional method revealed no significant difference in pretest means (t (67) =1.475, p>0.147) which means the students have similar prior knowledge and achievement before the intervention and that the post-test difference can be attributed to the treatment. For the post-test, a significant difference (t (67) =2.289, p<0.025) was found. The mean behaviour score for the video group (20.9) was significantly higher than that of the conventional group (17.91).

The effect size (d=0.55) indicates a medium effect translating to about 7% of the variance in means of students in the two groups and indicates that about 7% of the difference between the group can be attributed to the treatment.

These findings however reject the null hypothesis indicating that the video-based instruction is more effective in contributing to improved classroom behaviour of students taught lessons on processes of life.

6.3 Analysis of Hypothesis three

There are no significant interactions of method, gender, ability levels and location on achievement of students exposed to conventional versus video-based instruction.

Table 3: Ancova table showing interactions of method with varying ability gender and location.

Dependent Variable: Post test PLAT

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	479.298a	16	29.956	9.041	.000
Intercept	807.070	1	807.070	243.568	.000
PREPLAT	15.515	1	15.515	4.682	.033
Method	175.763	1	175.763	53.044	.000
Gender	5.429	1	5.429	1.638	.203
Location	9.324	1	9.324	2.814	.096
Ability	36.683	1	36.683	11.071	.001
Method * Gender	.761	1	.761	.230	.633
Method * Location	3.557	1	3.557	1.074	.303
Method * Ability	14.394	1	14.394	4.344	.040
Method * Gender * Location	.655	1	.655	.198	.657
Method * Gender * Ability	5.077	1	5.077	1.532	.219
Method * Location * Ability	2.934	1	2.934	.885	.349
Method * Gender * Location * Ability	3.477	1	3.477	1.049	.308
Error	341.294	103	3.314		
Total	18269.000	120			
Corrected Total	820.592	119			

a. R Squared = .584 (Adjusted R Squared = .519)

Table 3 shows a significant main effect of method (p<0.000) indicating high significant differences in the Processes of life achievement scores between students taught using videos and those taught using conventional

methods; a significant two-way effect of method and ability (0.040) suggesting differences in outcomes based on method and ability. Result also shows no significant two-way interactions of method and gender (p>0.633); methods and location (p>0.303). No significant three-way interaction effect: methods, gender, and location (p>0.657); method, gender, and ability (0.219); method, location, and ability (0.349) and no significant four-way interaction effect of method, gender, location, and ability (0.308) on acceptable classroom behaviour of the students during lessons on processes of life. From all the results we can conclude that the method of instruction has a high significant impact on the learning of processes of life in favour of the video group and that ability moderates the effect of method in boosting students learning of processes of life. But no significant interactions between methods and gender or location. Based on the results we reject the null hypothesis for interaction between method and ability but accept the hypothesis for interactions between methods and all the other interacting groups.

6.4 Analysis of Hypothesis four

There are no significant interactions of method, gender, ability levels and location on classroom behaviour of students exposed to conventional versus video-based instruction.

Table 4: Ancova table showing interactions of methods and other variables on classroom behaviour.

Dependent Variable: Post test classroom behaviour

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1124.311a	16	70.269	3.649	.000
Intercept	259.180	1	259.180	13.459	.001
PRECBRS	244.671	1	244.671	12.706	.001
Method	15.270	1	15.270	.793	.377
Method * Gender	36.049	1	36.049	1.872	.177
Method * Location	.056	1	.056	.003	.957
Method * Ability	14.294	1	14.294	.742	.393
Method * Gender * Location	21.321	1	21.321	1.107	.298
Method * Gender * Ability	1.077	1	1.077	.056	.814
Method * Location * Ability	11.620	1	11.620	.603	.441
Method * Gender * Location * Ability	33.258	1	33.258	1.727	.195
Error	1001.341	52	19.257		
Total	27955.000	69			
Corrected Total	2125.652	68			

a. R Squared = .529 (Adjusted R Squared = .384)

Table 4 shows no significant main effect of method (p>0.377) indicating no significant difference in the classroom behaviour between students taught using videos and those taught using conventional methods during lessons on processes of life. Result also shows no significant two-way interactions of method and gender (p>0.177); methods and location(p>0.957); method and ability(p>0.393). no significant three-way effect interactions: methods, gender, and location (p>0.298); method, gender, and ability (0.814); method location and ability (0.441) and no significant four-way interaction effect of method, gender, location, and ability (0.195) on acceptable classroom behaviour of the students during lessons on processes of life.

In conclusion, all the results (p-values >0.05) suggest that the effectiveness of the video-based instruction over the convectional one does not differ significantly across the various subgroups. Based on these results, hypothesis four is rejected meaning there are no significant interactions of method, gender, ability levels and location on classroom behaviour of students exposed to conventional versus video-based instruction

7.0 Discussion

The discovery that the utilization of video-based instruction is more efficacious in enhancing the minds of students taught lessons on processes of life is corroborated by prior researchers who have found that videos aid in improving students' scientific performance (Kalas & Redfield 2022; Mithun & Evan 2018; Kay & Kletskin, 2017). The implication of this finding is that educators and educational authorities should integrate a greater number of videos and multimedia resources when instructing on intricate and abstract scientific topics to junior secondary school students. It is imperative that teachers have access to high-quality video content to utilize during such educational sessions. The educators conducting this research using videos were adequately trained, underscoring the importance of training teachers on the effective utilization of educational videos and providing them with the necessary tools for presenting these videos to students.

Another finding of this study was that video-based instruction was notably more effective in fostering enhanced classroom behaviour among students taught lessons on life processes compared to conventional methods. This aligns with previous research indicating that the use of videos led to improved classroom behavior among students in contrast to traditional lecturing methods (Kay & Kletskin, 2017). However, previous studies suggest that an excessive reliance on videos for teaching can result in diminished student engagement, increased indiscipline, heightened distractions, and deteriorated classroom conduct. (Kirschner & Karpinski, 2010; Roschelle et al. 2016; Turkle 2015). Therefore, teachers should exercise caution and diversify their instructional approaches to prevent monotony or a decline in classroom behavior.

The finding that students of varying ability levels respond differently to conventional versus video-based instruction reinforces previous research emphasizing the significance of considering individual differences in aptitude when selecting instructional methodologies. The mean scores of students in the intersecting groups between method and ability levels indicate that the mean score of the low-ability group under the Conventional method (9.60) was substantially lower than that of the low-ability group under the Video method (13.38); the high-ability video group (13.82) and the high-ability conventional method group (12.22), demonstrating that the conventional method did not enhance the understanding of students in the low-ability group as effectively as in the other groups. This finding is in line with previous research findings (Chen &Wu, 2019, Sadik 2019, and Yang & Wu, 2015).

Lastly, the finding that there are no significant interactions of method, gender, ability levels, and location on the classroom behavior of students exposed to conventional versus video-based instruction is supported by previous research. The implication of this finding is that strategies for managing classroom behavior should be implemented to address the conduct of students in the low-ability groups in addition to employing video instructional strategies, as the study indicates that videos can enhance the performance of students in understanding abstract science concepts such as the biological processes of life.

8. Conclusion

This study examined the impact of video-based instruction on students' understanding and classroom behavior in the teaching of life processes among junior secondary school students in Delta State, Nigeria. The findings provide convincing evidence that integrating videos into science instruction significantly enhances students' comprehension of abstract biological concepts and fosters more positive classroom behavior. Video-based instruction proves effective across gender and geographical location, suggesting its wide applicability and potential for broader adoption. While individual aptitude influenced students' responses to instructional strategies, the absence of significant differences in behavior across gender, ability level, and location supports its universal effectiveness. These results affirm previous research and call for the increased use of educational videos in junior secondary science curricula. Furthermore, educators should implement targeted support strategies to ensure that low-ability students benefit fully from this mode of instruction, thereby promoting equity and deeper learning in science education.

8.1 Recommendation

1. The government and Education authorities are encouraged to facilitate opportunities and provide resources for the effective utilization of videos in teaching complex and abstract scientific concepts to students. The selection of schools in this study was deliberate as they met the electricity requirements for projecting videos, although most schools did not.
2. Educators need to undergo comprehensive training on video usage and projection during instructional

periods. The utilization of videos should extend to other educational levels beyond junior secondary school students.

8.2 Acknowledgement

The authors acknowledge that this work was sponsored by TETFund Nigeria under the Institution Based Research Funding in *batch 9, 2024 IBR, TETF/CE/DR&D/COE/MOSOGAR/IBR 2024.*

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