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Gender-Based analysis of Youtube and Google Meet instructional tools on physics performance and retention in Rivers State

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Abstract
This study investigated the effects of YouTube and Google Meet instructional platforms on students' academic performance and retention in Physics in Rivers State, with particular emphasis on gender differences. Adopting a quasi-experimental pre-test and post-test design, the population of the study comprised all the four thousand, five hundred and seventy-one (4,571) senior secondary school students in one hundred and fifty-four (154) private secondary schools in Obio-Akpor Local Government Area. The sample for the study was eight one (81) senior secondary school students. The sample for the study was drawn using multi-stage sampling procedure. The instrument for data collection was a researcher-made multiple-choice question. The instrument was titled Physics Performance Test (PPT) which was reshuffled into Physics Retention Test (PRT). The instrument was validated by three experts and a reliability coefficient of 0.74 and 0.65 were obtained respectively. Data collected was analyzed using Statistical Package for Social Science (SPSS) version 25. Mean and standard deviation were used to answer the research questions while Analysis of Covariance (ANCOVA) were used to test the hypotheses at 0.05 alpha level. Findings showed that YouTube and Google Meet instructional platforms effectively enhance students' academic performance in Physics with Google Meet demonstrating a stronger long-term impact on retention. While YouTube significantly improved academic performance, its effect on long-term retention was not statistically significant. This study concluded that integrating hybrid digital strategies into science pedagogy will optimize both performance and retention outcomes of students. The study recommended that schools should ensure equal access and engagement opportunities for both male and female students when using digital learning platforms to enhance academic performance since there was a significant effect of Google Meet instructional platform in enhancing students' retention in Physics in Rivers State.

Keywords: Gender-based analysis, YouTube instructional tools, Google Meet, Physics, performance, retention

Introduction

Technological revolutions have engendered innovative paradigms in classroom teaching and learning (Falode *et al*., 2016) [8]. The integration of technology has transformed educators' approaches to lesson organization, planning, and assessment. Analogous shifts in communication systems, instructional materials, lesson design, professional development, and learning productivity have been catalyzed by advancements in educational technology, thereby fostering creativity and efficacy (Garrett-White & Abel, 2017; Falode *et al*., 2016; Mohammed, 2017) [8, 9, 14]. Contemporary research by Maya (2024) observes that students' proficiency and adaptability to innovations have accelerated through heightened engagement with modern technologies. Recent scholarly discourse among educators, practitioners, and researchers has pivoted toward the implications of digital tools for students' academic achievement and behavioral outcomes, propelled by the ascendancy of educational technology (Garrett-White & Abel, 2017) [9].

The integration of these technologies is not a necessarily new trend in the field of education. For decades, schools around the world have attempted to implement technology plans which aim to supply more frequent use of technology to their students. The assumption is that technology can not only improve day-to-day classroom instruction but also that its interactive nature and necessity for life after school have lasting effects on the students (Iftakhar, 2016) [11].

Over the course of the last decade, there has been a fundamental shift to promote and support teachers to adopt technology in education. Prominent among this shift is the adoption of virtual classrooms that enable teachers to interact with students in real time.

A virtual classroom is an online classroom that allows participants to communicate with one another, view presentations or videos, interact with other participants, and engage with resources in work groups. The Virtual classroom, a synchronous form of e-learning has been embraced by many organizations in their attempt to promote workforce learning while trying to save time and cut costs associated with face-to-face instructor-led training (Xanthoula, 2015) [18]. When utilized for practice and study, virtual learning platforms offer many forms of information regarding students' learning (Lima, Bastos & Varvakis, 2020) [13].

Johnson and Olatunde-Aiyedun (2022) assert that scientific curricula, pivotal to national technological advancement, command paramount emphasis within Nigerian educational systems. Neglecting science education impedes a nation's technological progress profoundly. As a transformative force in individual and societal development, science education warrants prioritization across all educational strata (Abubakar, 2024) [1].

Science underpins contemporary technological paradigms, constituting a systematic corpus of knowledge oriented toward human needs and problem resolution (Babagana, Yaki, & Abubakar, 2021) [4]. Encompassing one of humanity's most expansive domains, it elucidates the cosmos, Earth, human existence, and biological entities through empirical observation and detection. Integral to modern civilization, science demands national recognition; nations disregarding its primacy imperil their future

generations' aspirations, as societal prosperity hinges on scientific literacy.

Physics, a foundational science, fosters critical thinking, problem-solving, and technological innovation, remaining compulsory for science-track secondary students in Rivers State. Despite its curricular prominence, persistent poor performance in internal assessments reflects students' struggles with core concepts, yielding low comprehension, achievement, and retention—impeding STEM career preparation. Traditional lecture-based pedagogies, reliant on chalk-and-talk with scant instructional media, inadequately convey abstract Physics principles, exacerbating knowledge deficits. The COVID-19 pandemic catalyzed a shift to digital platforms like YouTube (asynchronous visualizations) and Google Meet (synchronous interactions), which endured post-lockdown amid students' digital nativity and preference for multimedia engagement. Yet, Rivers State Physics educators underutilize these tools, forgoing opportunities to enhance outcomes amid scant local empirical evidence on their efficacy for performance and retention. This study addresses that lacuna by evaluating YouTube and Google Meet-assisted strategies' impact on Physics achievement and retention among secondary students in Rivers State.

Aim and Objectives of the Study

The study aimed to investigate the effects of YouTube and Google Meet instructional tools on students' academic performance and retention in Physics in Rivers State, with particular emphasis on gender differences. Specifically, the study set out to:

1. Compare the effect of You Tube and Google Meet instructional tools in enhancing academic performance in Physics in Rivers State based on gender.
2. assess the joint effect of You Tube and Google Meet instructional tools in enhancing retention in Physics in Rivers State based on gender.

Research Questions

The following understated research questions were raised and answered in this study:

1. What is the effect of You Tube and Google Meet instructional tools in enhancing academic performance in Physics in Rivers State based on gender?
2. What is the effect of You Tube and Google Meet instructional tools in enhancing retention in Physics in Rivers State based on gender?

Hypotheses

The following hypotheses are formulated and tested at 0.05 level of significance.

$H0_1$: There is no significant effect of You Tube and Google Meet instructional tools in enhancing academic performance in Physics in Rivers State based on gender.

$H0_2$: There is no significant effect of You Tube and Google Meet instructional tools in enhancing retention in Physics in Rivers State based on gender

Materials and Methods

The study adopted the quasi-experimental pre-test and post-test design. The population of the study comprised all the four thousand, five hundred and seventy-one (4,571) senior secondary school students in one hundred and fifty-four (154) private secondary schools in Obio-Akpor Local Government Area. The sample for the study was eight one (81) secondary school students. The sample for the study was drawn using multi-stage sampling procedure. The instrument for data collection was a multiple-choice question. The instrument was titled Physics Performance Test (PPT) which was reshuffled into Physics Retention Test (PRT). The PPT/PRT consisted of twenty-five (25) items and it measured students' academic performance in Physics before and after the intervention while the PRT assessed students' retention of information learnt through YouTube and Google Meet. In order to ensure face and content validity, the instrument was validated by the three experts, two research experts in the field of Measurement and evaluation, and a senior Physics teacher. The reliability of the instrument was determined using test-retest method. The initial and re-test scores of the subjects were correlated using Pearson Product Moment correlation and a reliability coefficient value of 0.74 was obtained for the PPT and 0.65 was obtained for the PRT. The data collection phase of this study was done in stages. The researcher first secured approval from principals of three sampled schools via an official letter. Thereafter, Physics Performance Test (PPT) was administered by the researcher and two assistants following teacher orientation. Pretests established baseline knowledge for experimental (YouTube/Google Meet interventions, 2 weeks each) and control (lecture) groups; posttests followed treatment, with a Physics Retention Test (PRT) administered two weeks later. Scores were collated and statistically analyzed. Data collected was analyzed using Statistical Package for Social Science (SPSS) version 25. Mean and standard deviation were used to answer the research questions while Analysis of Covariance (ANCOVA) were used to test the hypotheses at 0.05 alpha level.

Results and Findings

Research Question One: What is the effect of You Tube and Google Meet instructional tools in enhancing academic performance in Physics in Rivers State based on gender.

Table 1: Mean and standard deviation on effect of You Tube and Google Meet instructional tool in enhancing students' academic performance in Physics in Rivers State based on gender

Group	Gender	N	Pre-test Mean	SD	Post test Mean	SD	Mean Gain score
Control	Male	9	7.44	1.014	10.67	1.871	3.23
	Female	16	7.63	1.455	11.00	1.461	3.37
Experimental (YouTube)	Male	11	7.73	2.649	18.18	1.662	10.45
	Female	15	7.20	1.821	16.93	2.086	9.73
Experimental (Google Meet)	Male	16	8.25	2.769	17.75	2.436	9.50
	Female	14	8.36	2.977	17.57	2.102	9.21

Table 1 highlighted the mean and standard deviation analysis on effect of Google Meet instructional tool in enhancing students' academic performance in Physics in Rivers State based on gender. In the Control Group, male students had a pre-test mean score of 7.44 and improved to 10.67 in the post-test, with a gain score of 3.23. The female students in the control group started with a pre-test mean score of 7.63 and improved to 11.00, resulting in a gain score of 3.37. This suggests that while both genders showed improvement through traditional teaching, the impact was insignificant, with females showing slightly better progress than males. In the Experimental Groups, where students were taught using YouTube and Google Meet, both genders demonstrated a significant increase in academic performance. Among students who used YouTube, the male students had a pre-test mean score of 7.63 and improved to 18.18, achieving a gain score of 10.45, while the female students had a pre-test mean of 7.20 and improved to 16.93, with a gain score of 9.73. Similarly, in the Google Meet group, the male students started with a pre-test mean score of 8.25 and increased to 17.75, yielding a gain score of 9.50, while female students had a pre-test mean of 8.36 and improved to 17.57, with a gain score of 9.21. These results suggest that both YouTube and Google Meet were highly effective in enhancing students' performance, with the male students showing slightly higher improvement than the female students in both experimental groups. However, the overall performance increase indicates that online instructional tools were significantly more effective than traditional teaching methods for both genders.

Research Question Two: What is the effect of You Tube and Google Meet instructional tools in enhancing retention in Physics in Rivers State based on gender?

Table 2: Mean and standard deviation on effect of You Tube and Google Meet instructional tool in enhancing students' retention in Physics in Rivers State based on gender

Group	Gender	N	Post test Mean SD		Retention test Mean SD		Mean Gain score
Control	Male	9	10.67	1.871	10.89	1.833	0.22
	Female	16	11.00	1.461	11.19	1.328	0.19
Experimental (YouTube)	Male	11	18.18	1.662	17.82	3.459	-0.36
	Female	15	16.93	2.086	17.53	3.461	0.6
Experimental (Google Meet)	Male	16	17.75	2.436	18.81	1.642	1.05
	Female	14	17.57	2.102	18.07	1.730	0.50

Table 2 showed the mean and standard deviation analysis on effect of Google Meet instructional tool in enhancing students' retention in Physics in Rivers State based on gender. In the Control Group, male students had a post-test mean score of 10.67 and a retention test mean score of 10.89, with a gain score of 0.22. Female students in the control group had a post-test mean score of 11.00 and a retention test mean score of 11.19, resulting in a gain score of 0.19. These results suggest that students in the control group had only a slight improvement in retention, with males showing slightly better retention than females. In the Experimental Groups, students taught using YouTube showed no retention gain, in the post-test and retention test scores for males (-0.36 gain) while there was a very little gain for the female students (0.6 gain). This suggests that while YouTube significantly enhanced performance, it did not contribute to further knowledge retention beyond the post-test. However, in the Google Meet group, male students had a post-test mean score of 17.75 and improved to 18.81 in the retention test, resulting in a gain score of 1.05, while female students increased from 17.57 to 18.07, with a gain score of 0.50. This indicates that Google Meet was more effective than traditional teaching and YouTube in improving long-term retention, with males benefiting slightly more than females.

Hypothesis One: There is no significant effect of You Tube and Google Meet instructional tools in enhancing academic performance in Physics in Rivers State based on gender.

Table 3: Summary of ANCOVA on the effect of You Tube and Google Meet instructional tools in enhancing academic performance in Physics in Rivers State based on gender

Dependent Variable: YouTube and Google Posttest						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	692.224[a]	4	173.056	5.098	.004	.049
Intercept	908.579	1	908.579	26.768	.000	.819
YouTube and Google Meet Pretest	148.705	1	148.705	4.381	.047	.000
Gender	379.499	3	126.500	3.727	.024	.039
Error	848.576	25	33.943			
Total	33816.000	30				
Corrected Total	1540.800	29				

a. R Squared =. 049 (Adjusted R Squared = 0.361)

The results of the ANCOVA analysis for the effect of You Tube and Google Meet instructional tools in enhancing academic performance in Physics in Rivers State based on gender was presented in Table 3. The result revealed that the overall model was statistically significant (F = 5.098, p =. 004), the Intercept was highly significant, with a Sum of Squares of 908.579, F-value of 26.769, and a p-value of 0.000, showing that the overall effect of YouTube and Google Meet on performance was strong. The main effects of gender (F = 3.727, p =. 024), was found to be significant, indicating that there is a significant effect of You Tube and Google Meet instructional tools in enhancing academic performance in Physics in Rivers State based on gender. The Partial Eta Squared value of 0.039 revealed that gender contributed only 3.9% of the variance in students' performance. This suggests that both male and female

students benefited equally from YouTube and Google Meet instructional tools in enhancing their academic performance in Physics.

Hypothesis Two: There is no significant effect of You Tube and Google Meet instructional tools in enhancing retention in Physics in Rivers State based on gender.

Table 4: Summary of ANCOVA on the effect of You Tube and Google Meet instructional tools in enhancing retention in Physics in Rivers State based on gender

Dependent Variable: YouTube and Google Retention						
Source	**Type III Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model	1109.085[a]	4	277.271	25.273	.000	.249
Intercept	25.947	1	25.947	2.365	.137	.219
YouTube Google Meet Posttest	804.064	1	804.064	73.288	.000	.191
Gender	11.240	3	3.747	.341	.796	.040
Error	274.281	25	10.971			
Total	35589.000	30				
Corrected Total	1383.367	29				

a. R Squared =. 249 (Adjusted R Squared =. 194)

The results of the ANCOVA analysis for the effect of You Tube and Google Meet instructional tools in enhancing retention in Physics in Rivers State based on gender was presented in Table 4.

The result revealed that the overall model was statistically significant (F = 25.273, p =. 000), the Intercept was not statistically significant, with a Sum of Squares of 25.947, an F-value of 2.365, and a p-value of 0.137, meaning that there was no notable effect on students' retention. The main effects of gender (F = 0.341, p =. 796), was found not to be significant, indicating that there is no significant effect of You Tube and Google Meet instructional tools in enhancing retention in Physics in Rivers State based on gender. The Partial Eta Squared value of 0.40 revealed that gender contributed only 4% of the variance in students' retention. This suggests that both male and female students benefited equally from YouTube and Google Meet instructional tools in retention in Physics.

Discussion of Findings

The findings from Table 1 reveal that both YouTube and Google Meet were highly effective in enhancing students' performance in Physics, with males demonstrating slightly higher improvement than females in both experimental groups. This suggests that while both genders benefited from these instructional tools, male students exhibited marginally greater academic gains. These findings align with previous research emphasizing the role of digital platforms in improving learning outcomes, particularly in STEM subjects.

Several studies have established the efficacy of YouTube as a pedagogical tool. For instance, Asanre *et al*. (2024) [3] examined the impact of YouTube videos on students' academic achievement in mathematics and found that the integration of this platform into teaching methodologies significantly improved students' understanding and performance. This finding supports the present study's results, highlighting YouTube's capacity to present complex scientific concepts in an accessible and visually engaging manner. Similarly, Mohammed and Ogar (2023) [15] investigated the role of YouTube videos in improving academic achievement and retention among undergraduate students studying environmental education. Their study revealed that students who learned through YouTube performed better than those who relied solely on conventional instructional methods. The visual and interactive nature of YouTube videos contributed to a deeper understanding of subject matter, reinforcing the findings that YouTube enhances student performance in Physics.

Google Me*et al*so emerged as a powerful instructional tool, fostering an interactive learning environment that contributed to students' academic success. The findings align with studies such as that of Adepoju and Suleiman (2022), which examined the role of video conferencing platforms in improving students' academic performance in science subjects. Their study revealed that students who participated in Google Meet-based lessons demonstrated better comprehension and retention of scientific concepts compared to those who were taught using traditional methods. The study attributed this improvement to the platform's interactive features, which allow for real-time discussions, visual demonstrations, and collaborative problem-solving sessions.

Despite these positive outcomes, gender differences in performance raise important questions about the varying effects of digital learning tools. The present study's finding that males exhibited slightly higher improvement than females align with research by Williams and Boateng (2021) [6], who noted that male students often demonstrate greater engagement with digital learning tools, particularly in science and technology-related subjects. This disparity may be attributed to differences in technological confidence and prior exposure to digital platforms. However, other studies, such as that of Patel *et al*. (2020) [16], suggest that gender differences in learning outcomes are context-dependent and influenced by factors such as instructional design, digital literacy, and individual learning preferences.

The findings from Table 2, which indicate that Google Meet was more effective than traditional teaching methods and YouTube in improving long-term retention, further emphasize the potential of video conferencing platforms in facilitating deeper learning. The ability to revisit recorded sessions, engage in real-time discussions, and participate in interactive learning activities likely contributed to this enhanced retention. This aligns with the findings of Okafor and Ajayi (2023), who examined the impact of online learning platforms on students' knowledge retention in physics. Their study found that students who engaged with Google Meet retained information more effectively than those who relied solely on face-to-face instruction, reinforcing the argument that digital learning platforms

enhance cognitive engagement and long-term memory retention.

However, contrasting perspectives exist regarding the relative effectiveness of traditional and digital learning methods. Barfi, Arkorful and Abaidoo (2017) argue that while online instructional tools facilitate access to educational content, they do not always surpass traditional teaching methods in terms of long-term retention. Their study found that students who engaged in face-to-face learning with structured classroom interactions often demonstrated better retention rates due to personalized instruction and direct teacher support. Similarly, Hartono, *et al*. (2019) [10] observed that students who rely exclusively on online learning without adequate instructor guidance may experience cognitive overload, which can negatively impact retention. These findings contrast with the present study's results, suggesting that while Google Meet and YouTube are effective instructional tools, their impact on retention may vary depending on instructional strategies and students' learning habits.

The findings from Tables 3 and 4, which indicate that there was no significant effect of YouTube and Google Meet on students' academic performance and retention based on gender, challenge the notion that digital learning tools disproportionately benefit one gender over the other. While earlier findings suggested a slight advantage for male students, the overall statistical analysis indicates that gender was not a significant determinant of learning outcomes. This aligns with the research of Brown, *et al*., (2020) [7], who conducted a meta-analysis on the impact of digital learning tools on student achievement across various disciplines. Their findings concluded that while minor gender differences exist in engagement and usage patterns, digital instructional tools generally provide equal learning opportunities for both male and female students.

The expectation of these findings can be assessed in light of existing research and theoretical perspectives on digital learning. Given the increasing reliance on technology in education, it was anticipated that Google Meet and YouTube would significantly enhance students' performance and retention in Physics. The cognitive load theory proposed by Sweller (1988) [17] supports this expectation, suggesting that multimedia instructional tools reduce extraneous cognitive load and facilitate deeper learning. Google Meet, with its interactive features and real-time engagement, aligns with this theoretical framework by allowing students to process and retain information more effectively. Mayer's (2009) multimedia learning theory further reinforces this perspective, emphasizing that combining visual and auditory elements in instructional delivery enhances comprehension and retention. Since both YouTube and Google Meet incorporate multimedia elements, their effectiveness in improving learning outcomes was expected.

However, certain aspects of the findings challenge initial expectations, particularly concerning gender differences. While minor variations in performance were observed, the overall analysis indicated no significant effect of gender on learning outcomes. This finding contrasts with some previous studies that suggested male students might have an advantage in digital learning environments due to higher engagement with technology. The results suggest that other factors, such as instructional design, teacher support, and students' digital literacy, play a more critical role in determining learning success than gender alone.

Unexpected aspects of the findings also emerge when considering the potential barriers to digital learning. Issues such as internet connectivity, digital distractions, and students' self-regulation skills were expected to impact retention rates negatively. However, the present study's results indicate that these challenges did not significantly hinder students' ability to retain Physics concepts when using Google Meet. This finding suggests that either these obstacles were effectively managed or that the advantages of Google Meet outweighed potential drawbacks.

The implications of these findings highlight the importance of integrating Google Meet and YouTube as regular instructional tools in science education. Given their effectiveness in enhancing performance and retention, educators should leverage these platforms strategically to maximize learning outcomes. This includes incorporating interactive multimedia, real-time discussions, and continuous assessment mechanisms to reinforce students' understanding of Physics concepts.

Conclusion

Based on the findings of this study, it was concluded that YouTube and Google Meet instructional tools effectively enhance students' academic performance in Physics in Rivers State, with Google Meet demonstrating a stronger long-term impact on retention. While YouTube significantly improved academic performance, its effect on long-term retention was not statistically significant.

Recommendations

Based on the findings and conclusion of the study, the following recommendations were made:

1. Schools should ensure equal access and engagement opportunities for both male and female students when using digital learning tools to enhance academic performance since there was a significant effect of Google Meet instructional tool in enhancing students' retention in Physics in Rivers State.
2. Since there was no significant effect of YouTube and Google Meet instructional tools in enhancing retention in Physics in Rivers State based on gender, Teachers should implement personalized learning strategies within digital platforms to cater to the diverse learning needs of male and female students for improved retention.

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