# EFFECTS OF VIDEO-BASED WEBSITES ON SENIOR SCHOOL STUDENT'S PERFORMANCE IN SELECTED MATHEMATICS CONCEPTS IN KWARA STATE NIGERIA

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**Abstract:** This study investigated the effect of Video-Based Websites on Senior School Students' Performance in Selected Mathematics Concepts in Kwara State. The research utilized a quasi-experimental design, specifically a pretest-posttest, non-randomized, control group design with a 2 x 3 x 4 factorial design. The sample consisted of 30 participants for YouTube, 35 for Vimeo, 45 for Facebook, and 42 in the control group, drawn from JSS II classes in four selected schools. Schools A, B, and C were designated experimental groups, while School C the control group. Intact classes were selected using purposive sampling. Four research questions were formulated and answered, while two hypotheses were tested. Descriptive and inferential statistics were employed to analyze the data using Statistical Product and Service Solution (SPSS) version 20.0 at a significance level of 0.05. The findings revealed a positive effect of YouTube, Vimeo, and Facebook on students' mean performance scores, although no significant difference was observed between these platforms and the conventional teaching method. The study concluded that appropriate video-based websites such as YouTube, Vimeo, and Facebook can enhance learning among secondary school students. It recommended further research to explore the long-term effects of multimedia technology in education and its impact on various subject areas and student populations to gain a deeper understanding of its potential benefits and inform future educational practices.

***Keywords:*** Video-based websites, YouTube, Vimeo, Facebook.

## INTRODUCTION

Mathematics is a critical discipline within Nigeria's education system, yet student performance in this subject has been consistently unsatisfactory, leading to negative outcomes. This poor performance has been associated with stress, frustration, disengagement from class, and a tendency to pursue disciplines or courses that do not require a strong mathematical background (Ajimudin & Mukuna, 2023). This issue is particularly concerning for students interested in science, as they often struggle to meet the standards set by the Joint Admission and Matriculation Board (JAMB) for admission to higher education institutions. Numerous studies have examined various aspects of mathematics education in Nigeria to tackle these challenges. For instance, research has underscored the importance of inclusive education as a superior practice for Nigerian classrooms, recommending a shift in policy towards inclusive education and the training of teachers in inclusive education pedagogies (Ajimudin & Mukuna, 2023).

Studies have also delved into the influence of gender, age, and mathematics anxiety on college students' success in algebra, offering insights into factors that could contribute to underperformance in mathematics (Owolabi & Adejoke, 2014). Entrepreneurial education has emerged as a potential remedy for the educational challenges in Nigeria, with calls for increased investment in entrepreneurial education to nurture entrepreneurial skills and convert challenges into opportunities (Odia & Odia, 2013). Additionally, there are proposals to revamp mathematics education to drive national development, emphasizing the need for innovative approaches and the integration of a think-tank mentality into pre-service teacher training (Tella, 2018). The awareness and utilization of teachable moments in mathematics classrooms have also been scrutinized, examining whether mathematics teachers in Nigeria are cognizant of and effectively employ them as they arise (Akinoso, 2017). Moreover, research has explored the link between cognitive failures in mathematics, mathematics anxiety, and performance in calculus

among pre-service teachers, shedding light on the cognitive aspects that might contribute to subpar performance in mathematics (Awofala & Odogwu, 2017).

Furthermore, studies have investigated the impact of math anxiety on the mathematics performance of senior school students, underscoring the importance of mathematics education for decision-making processes and the necessity for enhancements in the teaching and learning of science, technology, and mathematics (Agnes & Mathew, 2019). The role of key stakeholders, such as the government, teachers, and students, in enhancing science education in Nigeria has also been examined, focusing on the duties and hurdles faced by each stakeholder (Badmus & Omosewo, 2018). Recently, there has been a growing concern about the declining performance of students in mathematics. Several strategies have been suggested to tackle this issue, including restructuring the curriculum, enhancing teaching effectiveness, utilizing student-friendly instructional materials, and implementing methods to reduce mathematics anxiety (Royal, 2022). Additionally, parents have been increasingly investing in private mathematics tutoring for their children (Smith, 2015).

However, despite these efforts, the impact on student performance has been limited. For instance, the 2011 West African Senior Secondary Certificate Examination (WASSCE) results in Nigeria revealed that only 38.93% of the 587,830 candidates who took the May/June 2011 WASSCE achieved a grade of C6 and above in Mathematics (West African Examinations Council, 2011), highlighting the pressing need for innovative approaches to address this issue. One proposed innovation involves departing from the conventional method, which is characterized by individualism and unhealthy competition. In this conventional approach, students study solely to pass examinations and outperform their classmates (Royal, 2022). However, this approach may not encourage a deep understanding of mathematical concepts and may contribute to anxiety and stress among students. Curriculum restructuring is suggested as a potential solution to address these challenges. This would involve revising the existing curriculum to make it more engaging, relevant, and aligned with the needs of students. By incorporating real-life applications and problem-solving tasks, students can develop a deeper understanding of mathematical concepts (Johnson, 2010).

Moreover, teaching effectiveness is crucial for improving student achievement. Teachers need to employ effective instructional strategies that cater to students' diverse learning needs. This may include differentiated instruction, cooperative learning, and technology-enhanced teaching methods (Royal, 2022). The use of student-friendly instructional materials can also enhance student engagement and understanding. These materials should be visually appealing, interactive, and designed to facilitate active learning. Examples include manipulatives, multimedia resources, and online platforms (Royal, 2022).

Furthermore, addressing mathematics anxiety is essential for improving student performance. Various anxiety reduction methods have been proposed, such as relaxation techniques, cognitive-behavioral interventions, and exposure therapy (Brown, 2013). These methods aim to alleviate anxiety symptoms and create a positive learning environment for students. The individualistic environment in education has been found to create gaps between high achievers and low achievers (Johnson et al., 1981). Traditional individualistic efforts have not been successful in addressing this problem. Researchers have proposed using online video-based instructional strategies to address this issue (Johnson et al., 1981). Online video-based instructional strategies utilize video content as the primary medium for delivering educational information and facilitating learning experiences in an online environment (Johnson et al., 1981). These strategies leverage the visual and auditory elements of videos to engage learners, explain complex concepts, demonstrate processes, and provide context in a dynamic and accessible manner (Johnson et al., 1981). Online video-based instructional strategies usage aligns with the advancements in digital technologies and the widespread use of social networking websites and video-based learning websites forums (Pöysä-Tarhonen et al., 2021).

Platforms such as Facebook, Twitter, YouTube, and others have changed the scope and structure of digital media, allowing for the sharing of files, instant conversations, exchanging of videos and images, and contact with others (Pöysä-Tarhonen et al., 2021). In education, video-based learning websites forums such as YouTube, Vimeo, and Metacafe have become popular tools for online learning (Romig & Alves, 2021). These platforms offer high-quality educational videos that can enrich students' learning experiences. Teachers also find these platforms to be textbook alternatives, providing students with the required information. Video-based learning websites forums have been found to impact college students' academic performance significantly. These platforms provide access

to a wide range of information, enhancing students' awareness, imagination, and knowledge exchange (Pöysä-Tarhonen et al., 2021).

Additionally, these platforms facilitate interactive learning, allowing students to ask questions, comment, and engage in discussions with others. Video-based learning websites forums can also improve students' listening, speaking, and writing skills, making them comprehensive tools for capacity building in education. During the COVID-19 pandemic, video-based learning websites forums usage became even more prevalent as students relied on videos to make up for missed lectures and access educational content. These videos can be easily accessed through smartphones, providing students with continuous learning opportunities. The convenience and accessibility of video-based learning websites forums make them valuable resources for students to enhance their learning and academic performance. Hence, this study examines the Effects of Video-Based Websites (VBW) on Senior School Student's Performance and Retention in Selected Mathematics Concepts in Kwara State.

***Statement of the Problem***

Deteriorating achievement of students in mathematics has been of great concern to stakeholders in education such as policymakers, guidance counsellors, parents, and the society at large. The analysis of past achievement patterns in mathematics in Nigeria carried out by Ali (2006) showed that between 2015 and 2022, there was a steady average of 1.7% annual decline in students' $A_1$ to $C_6$ grades of acceptable achievement in Mathematics in WASSCE. Also, the result of the 2014 WASSCE had it that only 38.93% of 587830 students who took the examination scored credit and above in mathematics which is not encouraging. Alozie (2013) further reported that 48.88% of 151569 candidates who took mathematics in the 2014/2015 WASSCE examination scored C6 and above. Furthermore, the JSSCE three-year result analysis 2009 – 2012 (Appendices C – E) collected from four schools in Kwara South Education Zone, proved the poor achievement of students in mathematics. For the period in question, none of the schools recorded up to 10% credit level scores in achievement in mathematics. Similar deterioration in regular Secondary School teachers' achievement tests in Mathematics has also been reported by Ali. The persistent failure rate made many students shy away from the subject and conclude that it is very difficult to learn. As such students prefer studying other subjects to the detriment of mathematics. This attitude encouraged poor performance in teacher-made achievement tests, JSSCE, WASSCE and NECO.

Different efforts made to forestall the devastating situation have not yielded any visible results. Researchers like Effandi et al. (2010) introduced anxiety reduction methods and curriculum restructuring, among others; the Post Primary Schools Service Commission, in conjunction with the Ministry of Education, organized seminars and conferences for teachers on using student-friendly teaching methods and appropriate teaching aids usage. Despite all these efforts, students still fail in mathematics. Based on this, the present researcher concludes that there is a missing link and becomes motivated to seek more practical approaches to the students' problems (involving students in solving their mathematical problems individually during their private studies), using YouTube, Vimeo and Facebook watching learning techniques strategy. This study, therefore, examined the effect of VBW on students' academic performance in selected mathematics concepts in Kwara State.

**Integration of Multimedia in Secondary Education.** Multimedia integration in secondary education has garnered considerable attention recently, with researchers exploring various aspects of this field. For instance, one study conducted a scoping review on online lectures in undergraduate medical education, emphasizing the importance of applying multimedia design principles in medical education (Tang et al., 2018). Despite challenges such as time constraints and existing standards of practice, online lectures were effective when part of broader educational interventions. Innovative methods like hybrid learning, which integrates computer multimedia technology and internet technology in preschool education, have also been studied (Wang et al., 2019). This approach enriches teaching resources, enhances flexibility in learning time, and improves teacher-student interaction, showing the potential of computer multimedia technology in enhancing preschool education. In college education, the impact of implementing an inquiry-based physical education teaching model in a multimedia network classroom was investigated, showing that it effectively increased students' interest in learning and stimulated their inner learning motivation (Li & Tsai, 2021). Similarly, the integration of multimedia in fine arts education has been found to enhance students' attention, learning motivation, and learning freshness (Sun et al., 2022).

Multimedia technology has also been applied in college and university moral education teaching systems, gradually replacing traditional teaching modes and widely adopted in Chinese higher education (Yu, 2022). In mathematics education, multimedia technology, including computer media and network technology, has been utilized to enhance the integration of resources and improve the teaching and learning experience (Du & Zhao, 2021). Studies have shown that integrating multimedia components into the mathematics curriculum can enhance students' mathematics learning, including for low-income and special education students (Liu, 2012). Interactive multimedia, combining audio, visual, and animation elements, has been particularly effective in improving mathematics learning outcomes in elementary school students, making learning more engaging and helping students understand and master mathematical concepts more effectively (Ratnasari et al., 2021; Susanti & Aryani, 2021).

**Application of VBW for Instruction in Secondary Education**. Video-based instruction has become increasingly popular in various educational settings, including secondary education (Satsangi et al., 2019). Research suggests that online learning, often incorporating video-based instruction, can be effective and applicable in education (Satsangi et al., 2019). Video-based instruction offers flexibility and accessibility for students, enabling them to access instructional support from various devices and settings (Hua et al., 2012). However, when implementing video-based instruction, it is crucial to consider the quality and selection of the videos. Healthcare organizations and academic institutions should produce high-quality medical multimedia resources for healthcare professionals and students (Carr et al., 2014). Similarly, in secondary education, the selection of videos should consider educational standards, completeness of information, and procedural correctness (Carr et al., 2014). Video modeling, a strategy that uses video depictions with audio feedback, effectively teaches secondary students with learning disabilities (Satsangi et al., 2018). This strategy is based on observational learning theory and provides an alternative delivery system for instruction (Satsangi et al., 2018). Incorporating video-based discussions into lessons can facilitate interaction and communication among students, teachers and video films (Soto et al., 2019). Video-based classroom discussions can be used as an instructional tool to support lessons and engage students in different activities (Soto et al., 2019).

Video-based interventions have also been successful in teaching students with autism spectrum disorder (ASD), demonstrating efficiency in teaching various skills, including social, communication, functional, behavior, play, and self-help skills (Solis et al., 2019). Handheld devices (e.g., smartphones and tablets) make video-based interventions portable and accessible for students (Solis et al., 2019). Video-based social networking sites show promise in education, particularly in teaching mathematics to students with learning disabilities. Satsangi et al. (2019) conducted a study on using video modeling to teach geometry word problems to students with learning disabilities, showing that video modeling effectively improves problem-solving skills in mathematics.

Similarly, Satsangi et al. (2018) compared video modeling with explicit instruction for teaching mathematics to students with learning disabilities, finding that both strategies were effective, but video modeling improves student performance better. In the context of secondary school education in Nigeria, Kellems et al. (2020) explored video-based instruction via augmented reality to teach mathematics to middle school students with learning disabilities, showing significant gains in problem-solving skills, indicating the potential of video-based instruction in enhancing mathematics learning. These studies highlight the potential of video-based social networking sites for teaching mathematics in secondary schools, particularly for students with learning disabilities, providing visual and interactive learning experiences that can enhance understanding and engagement in mathematics.

**Students' Attitude Towards the Use of VBW for Instruction.** The use of VBW for instruction has shown a positive impact on students' attitudes and satisfaction. Several studies indicate that students report higher satisfaction and a positive change in attitude towards the subject matter when video-based instruction is employed (Choi & Yang, 2010). This method is often perceived as more interesting and enjoyable, making the learning experience more engaging for students (Choi & Yang, 2010). Furthermore, instructional videos effectively promote student awareness and understanding of specific topics. For instance, student-generated instructional videos have been used to promote awareness of green chemistry principles, enabling students to engage in scientific discourse with their peers (Grieger & Leontyev, 2020). Similarly, interactive videos are engaging and enjoyable for students, enhancing their learning experience (Ketsman et al., 2018). Video-based instruction also has the potential to improve students' motivation and attention. In a study comparing video-based instruction to traditional text-based instruction, learners showed a significant difference in motivation and attention, with video-

delivered material being more memorable (McClean et al., 2016). Instructional videos can provide a motivating environment for students' learning, leading to improved problem-solving skills and attitudes towards the subject matter (Wong & Chu, 2014).

However, the design and implementation of video-based instruction are crucial. Effective instructional design, including methods, curriculum, time parameters, netiquette, and effective medium utilization, has been found to correlate positively with students' engagement with video lectures (Costley et al., 2017). Additionally, providing opportunities for student response and timely feedback is crucial for effective video-based instruction (Cesare et al., 2021). Students' attitudes towards VBW for learning mathematics have been the subject of several studies. Huang et al. (2020) found that students had positive attitudes and low anxiety towards video creation activities for learning mathematics. They perceived the activity as highly useful and reported improvements in mathematics achievement. The students also enjoyed and engaged in the video creation activity, which helped them learn mathematics better and develop communication and teamwork skills. On the other hand, Bates et al. (2016) highlighted the challenges in translating effective video-based learning activities to online platforms. They emphasized that simply building online video-based learning websites does not guarantee teacher learning or practice improvement.

The effectiveness of these websites depends on how teachers engage with the content and whether it impacts their learning or practice. Trinh et al. (2019) conducted a study on mobile learning (M-learning) for high-school mathematics and found that its feasibility for self-study was limited due to difficulties in accessing mathematics websites and the quality of website content. They suggested that M-learning should consider contextual factors such as students' self-learning ability and engagement. During the COVID-19 pandemic, websites as mathematics learning media have gained importance. Suripah and Susanti (2022) found that using interactive multimedia on websites increased students' enthusiasm for learning mathematics. Multimedia, including audio, text, video, and animation, enhanced student motivation during learning. The effectiveness of video-assisted learning models, such as the flipped classroom model, has also been studied. Jafar et al. (2020) demonstrated that the flipped classroom model, with the use of learning videos, was effective in improving student learning outcomes in mathematics. Shyu (1999) investigated the effects of computer-assisted video-based instruction on students' attitudes towards mathematical instruction and problem-solving skills. The study found that video-based instruction in a situated learning environment positively affects students' mathematical achievement and attitudes.

**Influence of Gender on the Use of VBW for Instruction.** Gender plays a significant role in VBW for instruction, as several studies have explored its influence on various aspects of video-based learning platforms. For instance, one study found gender bias in student evaluations of professors, with male instructors receiving higher scores than female instructors, even in identical online courses (Mitchell & Martin, 2018). This suggests that gender may impact how students perceive and evaluate instructional content. Another study examining YouTube videos found that gender-polarized videos, whether male or female, are less viewed (Thelwall & Foster, 2021), indicating that gender may influence popularity and engagement with video-based content. Preferences for synchronous online training also show gender differences, with female students tending to prefer traditional face-to-face approaches. On the other hand, male students prefer online learning approaches (Ulfa & Bringula, 2022), suggesting that gender may influence the choice of learning delivery mode. Additionally, a study on gender bias in educational videos on YouTube found a significant bias towards male narrators, particularly in STEM-related queries (Gezici & Saygin, 2022), highlighting potential gender bias in the representation of instructional content on video-based platforms.

In the context of teachers using video-based learning websites, it is essential to note that simply building these websites does not guarantee teacher learning or practice improvement (Bates et al., 2016). The impact of video-based learning on teachers' learning and practice is still less understood. Gender differences in anxiety levels have also been observed in video conferencing courses, with female students experiencing higher anxiety levels compared to male students (McKnight & McKnight, 2012), suggesting that gender may influence the emotional experience of online learning environments.

In the context of learning mathematics in secondary schools in Nigeria, gender and multimedia have been topics of interest. Several studies have explored the relationship between gender and mathematics performance and the use of multimedia resources in teaching mathematics. Awofala (2016) investigated the effect of personalization of instruction on students' motivation to learn mathematics word problems in Nigeria and found that personalization

of instruction positively affects students' motivation, with gender not significantly affecting motivation. Awofala et al. (2020) explored the correlation between motivation to learn mathematics, gender, and performance in mathematics among senior secondary school students in Nigeria. The study found a very high level of motivation to learn mathematics among the students and revealed that gender significantly influences students' performance, with self-efficacy, gender, and intrinsic motivation being major predictors of performance.

Regarding the use of multimedia resources in teaching mathematics, Gbordzekpor et al. (2023) investigated the availability and accessibility of multimedia resources for teaching and learning mathematics in senior high schools in Ghana. The study found that the availability of multimedia resources varied among schools, and teachers' perceived ability to use them was influenced by their gender. Akinbadewa and Sofowora (2020) examined the effectiveness of multimedia instructional learning packages in enhancing students' attitudes toward learning biology in secondary schools, providing insights into the potential benefits of using multimedia resources in teaching and learning.

Overall, these studies underscore the importance of considering gender and the use of multimedia resources in the context of learning mathematics in secondary schools. Personalization of instruction and the availability of multimedia resources can positively impact students' motivation and attitudes toward mathematics, influencing their performance.

## METHODOLOGY

This study employed a quantitative research approach, focusing on objective measurements and statistical, mathematical, or numerical data analysis using computational techniques. A quasi-experimental design with a pre-test post-test non-randomized control group was utilized to compare the performance of students exposed to a VBW with those exposed to the conventional method. Additionally, descriptive research of the survey type was conducted to gather responses about students' attitudes toward the use of VBW. The research design layout is shown in Table 1.

Table 1.
*Research Design Layout*

| Group | Pretest | Treatment | Post Test |
|---|---|---|---|
| $A_1$ | $B_1$ | $T_1$ | $B_2$ |
| $A_2$ | $B_1$ | $T_2$ | $B_2$ |
| $A_3$ | $B_1$ | $T_3$ | $B_2$ |
| C | $B_1$ | 0 | $B_2$ |

Where $A_1$, $A_2$, $A_3$: Experimental Groups C: Control Group
$B_1$: pretest $B_2$: post test
$T_1$, $T_2$, $T_3$: treatment (Youtube and Vimeo and facebook)
0: no treatment

B1 and B2 served as instruments administered to the subjects to measure their performance on the dependent variables. The pretest and posttest were identical, although the questions were rearranged and renumbered. The experimental group consisted of both the experimental and control groups. The control group received no treatment but used the conventional method during the preparatory classes. After six weeks, their performance was compared with that of the experimental groups, who were exposed to treatment through a VBW. Moreover, the population for this study comprised all secondary school students in Kwara state. The target population for this study comprised students in Kwara state, Nigeria. SS2 students from two secondary schools in the Ilorin metropolis were purposively selected as samples for this study. The choice of the two secondary schools was based on the premise

that the school possess a functional ICT facility and the students possess tablet phones, Android, iPhone, and a working Gmail account to facilitate learning on the cloud-based multimedia. Specifically, SS2 students from school A were participants in the experimental group because most of them possess PC tablets, and some have various mobile devices that can access the cloud-based multimedia. While SS2 students from school B participated as a control group. An intact class was used in both schools.

***Research Instruments***

Five research instruments were utilized for data collection in the study:

1. Treatment Instrument I**:** Vimeo on Mathematics Concepts (VMC) and course materials were used. The treatment instrument was a Vimeo platform containing each of the selected mathematics concepts. Appropriately packaged web-based materials were known to help students build mental links to deepen their understanding (Arasasingham, 2005). These instruments were used to upload, share, and stream videos to the participants, covering the selected mathematical concepts in this study.
2. Treatment Instrument II: Facebook was used to teach the experimental group. Teaching mathematics concepts in a senior secondary school was an effective way to engage students and make learning more interactive. A private Facebook group was created in this study for the mathematics class. The Facebook group was set to be closed or secret to maintain privacy and security. Clear guidelines were established for how the group would be used for educational purposes. Additionally, respectful and constructive communication was encouraged. Mathematics-related content, particularly in geometry, was posted regularly, including math problems, questions, and assignments. Moreover, live Q&A or math problem-solving sessions were hosted using Facebook Live or other live streaming tools. Various mathematical multimedia, such as images, videos, and links to online resources, were used to enhance understanding. Real-world examples illustrating the practical applications of mathematical concepts were also shared.
3. Treatment Instrument III**:** YouTube on Mathematics Concepts (YMC) and course materials were used. The treatment instrument was a YouTube platform containing each mathematics concept selected. Appropriately packaged web-based materials were known to help students build mental links to deepen their understanding (Arasasingham, 2005). Using YouTube to teach mathematics concepts in senior secondary school was an effective way to engage students and enhance their understanding of the subject.
4. Test instrument: The Students' Performance Test on Mathematics Concepts (SPTMC) was developed as the test instrument. It was a researcher-designed test that covered the contents of the three video-based websites on mathematics concepts (VBWM) and the course materials on the selected mathematics concepts. The test was used for both the pre-test and post-test on the experimental and control groups. The students were taught two hours weekly for four (4) weeks.
5. The test comprised two sections: the demographic section and the test section. The instrument included thirty multiple-choice test questions with four stem options ranging from A to D, with only one correct answer. Students were given thirty minutes to answer the questions.

**Student' Attitudinal Questionnaire (SAQ) (Lee & Chan, 2007).** The questionnaire contained items that were used to elicit responses from students on their feelings when they used the VBWM. This instrument was adapted from Akinpelu (2022) and contained two sections (demographic data and items section). The instrument included ten items, requiring respondents to tick appropriate options using a four-point Likert scale ranging from Strongly Agree (SA) to Strongly Disagree (SD).

***Data Analysis Techniques***

The analysis and interpretation of data obtained from the test items and questionnaire in this study will be conducted using a combination of descriptive and inferential statistics. Descriptive statistics, such as mean and standard deviation, were used to summarize and describe the data, providing insights into the central tendency and variability of the responses. Mean scores were calculated for each questionnaire item, with a ranking of 4 assigned to "Strongly Agree," 3 to "Agree," 2 to "Disagree," and 1 to "Strongly Disagree" for positively worded items; the reverse was applied for negatively worded items. This ranking system allows for a quantitative assessment of participants' attitudes and perceptions. Inferential statistics was employed for hypothesis testing using the Statistical Package for Social Science (SPSS) version 20.0. The analysis of covariance (ANCOVA) statistical technique was specifically used to test the research hypotheses.

ANCOVA is a powerful tool for comparing group means while controlling for the effects of other variables, such as pre-test scores or demographic factors. This approach helps determine whether any observed differences in outcomes between the experimental and control groups are statistically significant, considering any potential confounding variables. All hypotheses were tested at the 0.05 level of significance, which means that any differences or relationships observed in the data must be sufficiently strong to be considered unlikely due to random chance alone. This rigorous approach to data analysis ensured the validity and reliability of the study's findings, providing valuable insights into the effectiveness of using VBW for teaching mathematics concepts in senior secondary schools.

## RESULTS

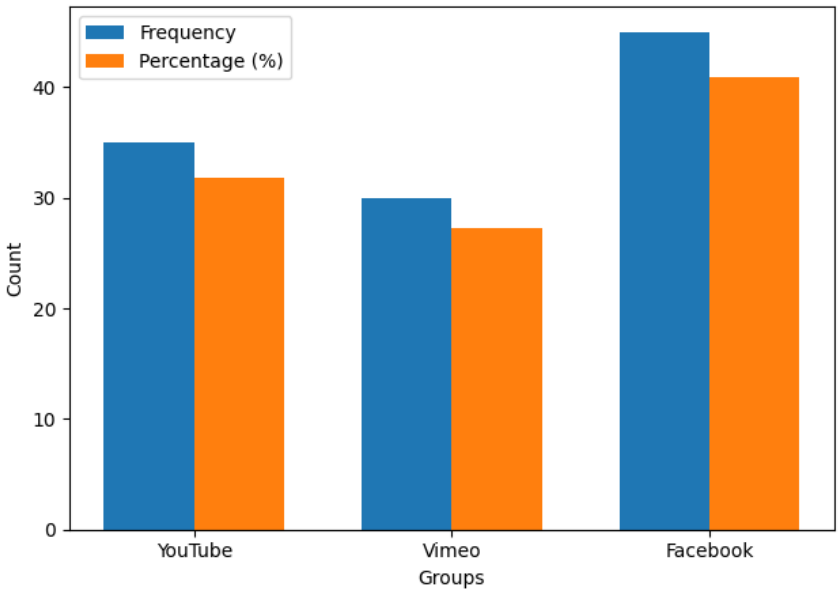
This section presents the demographic information used for the study. It presents answers to the research questions raised, and it shows the results of the tested hypotheses. The section also presents the summary of the findings, which were based on the research questions raised and the hypotheses formulated.

Table 2.
*Demographics Information by Groups*

| Groups | Frequency | Percentage (%) |
|---|---|---|
| YouTube | 35 | 31.81 |
| Vimeo | 30 | 27.27 |
| Facebook | 45 | 40.90 |
| **Total** | **110** | |

Table 2 presents the demographic information of the surveyed population categorized by their preferred online platform usage, including YouTube, Vimeo, and Facebook. The data reveals that out of the total sample size of 110 respondents, 35 (31.81%) reported using YouTube, 30 (27.27%) preferred Vimeo, and the majority, 45 (40.90%), indicated Facebook as their platform of choice. These findings suggest a notable preference for Facebook among the surveyed individuals, followed by YouTube and Vimeo. The table's clear organization and concise frequency and percentage data presentation allow for easy comparison and interpretation of the demographic distribution across different platform users. This information is valuable for researchers and marketers seeking to understand the demographic characteristics of users on these platforms and tailor their strategies accordingly.

Figure 1.
*Frequency and Percentage of Groups*




[16]

The bar chart illustrates the frequency and percentage distribution of three popular online platforms among the surveyed population (YouTube, Vimeo, and Facebook). The data indicates that Facebook is the most frequently used platform, with 45 respondents (40.90%) reporting its usage. YouTube follows closely behind with 35 respondents (31.81%), while Vimeo is the least used among the three, with 30 respondents (27.27%). The chart's dual-axis design allows for a clear comparison between the absolute frequency of platform usage and the percentage distribution within the sample. This visual representation effectively conveys the relative popularity of each platform among the surveyed population.

***Analyses of the Research Questions***

Research Question 1: What is the mean effect of YouTube on students' mean performance scores in a selected mathematics concept?

A total of thirty-five junior secondary school students were taught algebra in mathematics using the YouTube platform. A pre-test was conducted for the students before the introduction of the treatment and a post-test after the introduction of the treatment. The result is presented in Table 3.

Table 3.
*Descriptive Statistics of Pre-test and Post-test Scores for Secondary School Students' Academic Performance in Mathematics Concept using Google YouTube*

| | | Mean | N | Std. Deviation | Std. Error Mean | Mean Gain |
|---|---|---|---|---|---|---|
| Pair 1 | Pre-test score | 6.25 | 35 | 1.13 | 0.69 | 1.00 |
| | Post-test score | 7.25 | 35 | 1.60 | 0.88 | |

*Source. Result from SPSS Output*

Table 3 shows that the mean pre-test score of students using YouTube for learning was 65.25, with a standard deviation of 13.13 and a standard error mean of 0.69. The mean post-test score increased to 7.25, with a standard deviation of 1.60 and a standard error mean of 0.88. The mean gain in performance, calculated as the difference between the post-test and pre-test scores, was 1.00. This indicates that, on average, students using YouTube for learning experienced a gain of 1.00 points in their performance score in the selected mathematics concept. Overall, these findings suggest a positive effect of YouTube on students' mean performance score in the selected mathematics concept, as indicated by the increase in the mean post-test score compared to the mean pre-test score.

Research Question 2: What is the effect of Vimeo on students' mean performance scores in selected mathematics concepts?

A total of thirty- junior secondary school students were taught algebra in mathematics using the Vimeo platform. A pre-test was conducted for the students before the introduction of the treatment and a post-test after the introduction of the treatment. The result is presented in Table 4.

Table 4.
*Descriptive Statistics of Pre-test and Post-test Scores for Secondary School Students' Academic Performance in Mathematics Concept using Google Vimeo*

| | | Mean | N | Std. Deviation | Std. Error Mean | Mean Gain |
|---|---|---|---|---|---|---|
| Pair 1 | Pre-test score | 6.0 | 30 | 1.62 | 0.12 | 2.50 |
| | Post-test score | 8.50 | 30 | 1.57 | 0.29 | |

*Source. Result from SPSS Output*

The table shows that the mean pre-test score of students using Vimeo for learning was 6.0, with a standard deviation of 1.62 and a standard error mean of 0.12. The mean post-test score increased to 8.50, with a standard deviation of 1.57. The mean gain in performance, calculated as the difference between the post-test and pre-test score, was 2.50. This indicates that, on average, students using Vimeo for learning experienced a gain of 2.50 points in their performance score in the selected mathematics concept. Overall, these findings suggest a positive effect of Vimeo on students' mean performance scores in selected mathematics concepts, as indicated by the increase in the mean post-test score compared to the mean pre-test score. The relatively small standard error means suggest that the sample means are likely close to the population mean, adding confidence to the findings.

$Ho_3$: There is no significant difference between the mean performance score of secondary school students taught selected mathematics concepts using Facebook and those taught with the conventional method.

Research Question 3: What is the effect of Facebook on students' mean performance scores in selected mathematics concepts?

A total of 45 junior secondary school students were taught algebra in mathematics using the Facebook platform. A pre-test was conducted for the students before the introduction of the treatment and a post-test after the introduction of the treatment. The result is presented in Table 5.

Table 5.
*Descriptive Statistics of Pre-test and Post-test Scores for Secondary School Students' Academic Performance in Mathematics Concept using Facebook*

| | | Mean | N | Std. Deviation | Std. Error Mean | Mean Gain |
|---|---|---|---|---|---|---|
| Pair 1 | Pre-test score | 11.64 | 45 | 2.13 | 0.74 | 2.12 |
| | Post-test score | 13.76 | 45 | 2.60 | 0.97 | |

*Source. Result from SPSS Output*

Table 5 revealed that the mean pre-test score of students using Facebook for learning was 11.64, with a standard deviation of 2.13 and a standard error mean of 0.74. The mean post-test score increased to 13.76, with a standard deviation of 2.60. The mean gain in performance, calculated as the difference between the post-test and pre-test score, was 2.12. This indicates that, on average, students using Facebook for learning experienced a gain of 2.12 points in their performance score in the selected mathematics concept. Overall, these findings suggest a positive effect of Facebook on students' mean performance scores in selected mathematics concepts, as indicated by the increase in the mean post-test score compared to the mean pre-test score. The relatively small standard error means suggest that the sample means are likely close to the population mean, adding confidence to the findings.

Research Question 4: Which of these Video-Based Websites (YouTube, Vimeo, Facebook) is most effective in enhancing students' academic achievement in mathematics?

Table 6.
*Video-Based Websites (YouTube, Vimeo, facebook)*

| S/N | Platform | Mean | Standard Deviation |
|---|---|---|---|
| 1 | Youtube | 7.25 | 1.60 |
| 2 | Vimeo | 8.50 | 1.57 |
| 3 | Facebook | 13.76 | 2.60 |

Table 6 provides each platform's mean and standard deviation of academic achievement scores. The table shows that YouTube students' mean academic achievement score was 7.25, with a standard deviation of 1.60. For Vimeo, the mean score was 8.50, with a standard deviation of 1.57. Facebook had the highest mean score of 13.76, with a standard deviation of 2.60. Based on these findings, it appears that Facebook was the most effective platform in enhancing students' academic achievement in mathematics, as it had the highest mean score. Vimeo followed closely behind, while YouTube had the lowest mean score among the three platforms. However, it is important to note that while Facebook had the highest mean score, other factors, such as the specific content or teaching methodology used on each platform, could also have influenced the results. Further analysis and research may be needed to fully understand the factors contributing to the effectiveness of each platform in enhancing students' academic achievement.

***Hypotheses Testing***

$Ho_1$: There is no significant difference between the mean performance score of secondary school students taught selected mathematics concepts using YouTube and those taught with the conventional method.

Table 7.
*ANCOVA Analysis on the Significant Difference Between the Mean Performance Score of Secondary School Student Taught Selected Mathematics Concepts Using Youtube and Those Taught with the Conventional Method*

| Source | Type III Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | .055[a] | 2 | .014 | .101 | .982 |
| Intercept | 1414.425 | 1 | 1414.425 | 10396.736 | .000 |
| Youtube | .055 | 2 | .014 | .101 | .982 |
| Error | 126.930 | 70 | .136 | | |
| Total | 8005.708 | 72 | | | |
| Corrected Total | 126.985 | 71 | | | |

The analysis of covariance (ANCOVA) was conducted to examine the hypothesis that there is no significant difference between the mean performance scores of secondary school students taught selected mathematics concepts using YouTube and those taught with the conventional method. The results of the analysis are presented in Table 6. The F statistic for the effect of the teaching method (YouTube vs. conventional) on student performance was found to be 0.101, with a corresponding p-value of 0.982. This indicates that the difference in mean performance scores between the two teaching methods was not statistically significant at the 0.05 level. Therefore, the null hypothesis was not rejected. These findings suggest that, based on the data analyzed, no evidence supports the claim that teaching selected mathematics concepts using YouTube leads to significantly different performance outcomes than the conventional teaching method. However, it is important to note that other factors not accounted for in this analysis may still influence student performance and should be considered in future research.

$Ho_2$: There is no significant difference between the mean performance score of secondary school students taught selected mathematics concepts using Vimeo and those taught with the conventional method.

Table 8.
*ANCOVA Analysis on the Significant Difference Between the Mean Performance Score of Secondary School Student Taught Selected Mathematics Concept Using Vimeo and those Taught with the Conventional Method*

| Source | Type III Sum ofDf Squares | | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | .055[a] | 2 | .014 | .101 | .982 |
| Intercept | 1414.425 | 1 | 1414.425 | 10396.736 | .000 |
| Vimeo | .055 | 2 | .014 | .101 | .982 |
| Error | 126.930 | 65 | .136 | | |
| Total | 8005.708 | 67 | | | |
| Corrected Total | 126.985 | 66 | | | |

*a. R Squared = .000 (Adjusted R Squared = -.004) Significance at 0.05*

The analysis of covariance (ANCOVA) was conducted to investigate the hypothesis that there is no significant difference between the mean performance scores of secondary school students taught selected mathematics concepts using Vimeo and those taught with the conventional method. The results of the analysis are presented in Table 8.

The F statistic for the effect of the teaching method (Vimeo vs. conventional) on student performance was found to be 0.101, with a corresponding p-value of 0.982. This indicates that the difference in mean performance scores between the two teaching methods was not statistically significant at the 0.05 level. Therefore, the null hypothesis was not rejected.

Based on the data analyzed, these findings suggest that no evidence supports the claim that teaching selected mathematics concepts using Vimeo leads to significantly different performance outcomes than the conventional teaching method. As with the previous analysis, it is important to consider other factors that may influence student performance in future research.

$Ho_3$: There is no significant difference between the mean performance score of secondary school students taught selected mathematics concepts using Facebook and those taught with the conventional method.

Table 9.
*ANCOVA Analysis Significant Difference Between the Mean Performance Score of Secondary School Student Taught Selected Mathematics Concept Using Facebook and Those Taught with the Conventional Method*

| Source | Type III Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 469.023[a] | 2 | 117.256 | 3.919 | .087 |
| Intercept | 3979.417 | 1 | 3979.417 | 132.998 | .061 |
| Facebook | 469.023 | 2 | 117.256 | 3.919 | .017 |
| Error | 598.417 | 65 | 29.921 | | |
| Total | 7726.000 | 67 | | | |
| Corrected Total | 1067.440 | 66 | | | |
| a. R Squared = .439 (Adjusted R Squared = .327) | | | | | |

The analysis of covariance (ANCOVA) was conducted to examine the hypothesis that there is no significant difference between the mean performance scores of secondary school students taught selected mathematics concepts using Facebook and those taught with the conventional method. The results of the analysis are presented in Table 9. The F statistic for the effect of the teaching method (Facebook vs. conventional) on student performance was found to be 3.919, with a corresponding p-value of 0.087. Although the p-value is greater than the conventional significance level of 0.05, it is noteworthy that it is less than 0.10, which some researchers consider a marginally significant result. The interpretation of this result should be cautious. While the analysis did not find a statistically significant difference between the mean performance scores of the two teaching methods at the 0.05 level, the marginally significant p-value suggests that there may be a trend or tendency toward a difference. This could imply that further investigation with a larger sample size or a different methodological approach may be warranted.

Additionally, the R squared value of 0.439 indicates that the model accounts for 43.9% of the variance in performance scores, suggesting that other factors not included in the analysis may also influence student performance. In conclusion, based on the analysis conducted, there is some evidence to suggest that there may be a difference in mean performance scores between students taught selected mathematics concepts using Facebook and those taught with the conventional method. However, further research is needed to confirm these findings and to understand the underlying reasons for any observed differences.

**DISCUSSION**

The study investigated the mean effect of YouTube, Vimeo, and Facebook on students' mean performance scores in a selected mathematics concept, addressing research questions and hypotheses related to the effectiveness of these platforms compared to conventional teaching methods. The results indicated a positive effect of YouTube, Vimeo, and Facebook on students' mean performance scores, with no significant difference between these platforms and the conventional method.

The findings align with previous research, such as Solis et al. (2019), which demonstrated the effectiveness of video-based interventions, including those delivered through handheld devices, in teaching various skills to students with autism spectrum disorder. Similarly, Satsangi et al. (2018, 2019) highlighted the effectiveness of video modeling in teaching mathematics to students with learning disabilities, showing improvements in problem-solving skills. Kellems et al. (2020) also found significant gains in problem-solving skills among middle school students with learning disabilities when using video-based instruction via augmented reality. The integration of multimedia technology, including video-based social networking sites, has shown promise in enhancing mathematics education. Sun et al. (2022) found that integrating multimedia into fine arts education improved students' attention, learning motivation, and freshness of learning. In Chinese higher education, multimedia technology has been widely adopted in the moral education teaching system, replacing traditional modes of teaching (Yu, 2022). In mathematics education, multimedia technology has been used to enhance resource integration and improve the teaching and learning experience (Du & Zhao, 2021). Overall, the findings suggest that multimedia technology, including video-based interventions and interactive multimedia, can enhance mathematics learning outcomes, particularly for students with learning disabilities and those in secondary schools. These technologies provide visual and interactive learning experiences that engage students and help them understand and master mathematical concepts more effectively.

Effective instructional design, including methods, curriculum, time parameters, netiquette, and effective medium utilization, has been found to correlate positively with students' engagement with video lectures (Costley et al., 2017). Additionally, providing opportunities for student response and timely feedback is crucial for effective video-based instruction (Cesare et al., 2021). Students' attitudes towards VBW for learning mathematics have been the subject of several studies. Huang et al. (2020) found that students had positive attitudes and low anxiety towards video creation activities for learning mathematics. They perceived the activity as highly useful and reported improvements in mathematics achievement. The students also enjoyed and engaged in the video creation activity, which helped them learn mathematics better and develop communication and teamwork skills. On the other hand, Bates et al. (2016) highlighted the challenges in translating effective video-based learning activities to online platforms. They emphasized that simply building online video-based learning websites does not guarantee teacher learning or practice improvement.

The effectiveness of these websites depends on how teachers engage with the content and whether it impacts their learning or practice. Trinh et al. (2019) conducted a study on mobile learning (M-learning) for high-school mathematics and found that its feasibility for self-study was limited due to difficulties in accessing mathematics websites and the quality of website content. They suggested that M-learning should consider contextual factors such as students' self-learning ability and engagement. During the COVID-19 pandemic, websites as mathematics learning media have gained importance. Suripah and Susanti (2022) found that using interactive multimedia on websites increased students' enthusiasm for learning mathematics. Multimedia, including audio, text, video, and animation, enhanced student motivation during the learning process. The effectiveness of video-assisted learning models, such as the flipped classroom model, has also been studied. Jafar et al. (2020) demonstrated that the flipped classroom model, with the use of learning videos, was effective in improving student learning outcomes in mathematics. Shyu (1999) investigated the effects of computer-assisted video-based instruction on students'

attitudes towards mathematical instruction and problem-solving skills. The study found that video-based instruction in a situated learning environment positively affects students' mathematical achievement and attitudes.

## CONCLUSION AND RECOMMENDATION

In conclusion, the study investigated the effect of using YouTube, Vimeo, and Facebook on students' mean performance scores in a selected mathematics concept compared to conventional teaching methods. The results indicated a positive effect of these platforms on students' performance, with no significant difference between them and the conventional method. These findings contribute to the growing body of literature supporting the effectiveness of multimedia technology, particularly video-based interventions, in enhancing mathematics education. The study aligns with previous research that has demonstrated the benefits of multimedia technology in improving student engagement, understanding, and mastery of mathematical concepts, especially for students with learning disabilities. Educators and policymakers can consider integrating multimedia technology, such as video-based social networking sites, into mathematics education to enhance teaching and learning experiences. Future research could explore the long-term effects of using multimedia technology in mathematics education and investigate its impact on other subject areas and student populations. The study, therefore, recommended that providing professional development opportunities for educators to learn how to use these technologies effectively can further enhance teaching practices. Continued research on the long-term effects of multimedia technology in education, as well as its impact on other subject areas and student populations, is also recommended to understand its potential benefits better and inform future educational practices.

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