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# Reimagining Pedagogical Strategies: YouTube-Based Edutainment in Learning Difficulty Concepts in Secondary School Mathematics in Nigeria

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**Abstract.** Mathematics remains one of the most challenging subjects in STEM education at the secondary level, particularly in topics such as Statistics and Probability. This study examined the effectiveness of YouTube-based edutainment as a pedagogical strategy for improving students' learning outcomes in these complex concepts. A quasi-experimental pretest-posttest nonequivalent group design was adopted, involving 112 Senior Secondary II (SS2) Mathematics students purposively selected from two public schools in different educational zones of Ogun State, Nigeria. The schools were comparable in teacher qualifications, facilities, student population size, and urban location. Quantitative data was collected and analysed using ANCOVA after preliminary tests for statistical assumptions. While the Shapiro–Wilk test indicated non-normality ($F(112) = 0.97$; $p < .05$), Levene's test confirmed homogeneity of variances ($F = 1.34$; $p > .05$), while the ANCOVA analysis showed a statistically significant difference in favour of the experimental group (mean 21.00; SD = 2.78) than the control group (mean=14.6; SD = 3.49), $F(1, 109) = 112.70$, $p < .01$. There was no significant difference in the learning outcomes based on gender. The study concludes that YouTube-based edutainment positively influenced students' learning outcomes, suggesting that incorporating engaging, technology-driven content into mathematics instruction can improve comprehension of complex topics and foster more profound learning experiences in secondary education.

**Keywords:** Pedagogical strategies; YouTube-based; Edutainment; Learning difficulties and Secondary School

## 1. Introduction

Effective pedagogy involves more than just implementing a set of teaching strategies. It refers to what teachers do in the classroom and their underlying ideas, knowledge, and attitudes toward learners, the curriculum, and the teaching and learning process. At the heart of effective pedagogy are the strategies teachers

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adopt, which directly influence how learners interact and understand complex subjects. Williams (1988) observed that meaningful learning occurs when students are actively involved: "Tell me mathematics, and I will forget; show me mathematics and I may remember; involve me… and I will understand mathematics." Educators are also turning to technology-based tools to foster engagement and deeper understanding.

The rise of educational video platforms, such as YouTube, is reshaping instructional methods and supporting more dynamic, student-centred learning experiences (Walter, 2024). Modern classrooms are becoming increasingly innovative to enhance teaching and learning experiences (Colasante,2022). Traditional teaching strategies, characterised by face-to-face teaching, paper-based assessments, and a fixed curriculum, are no longer the preferred approach in contemporary education (Hu, 2024). We live in a digital age shaped by cutting-edge technologies powered by advanced ICT applications, which influence nearly every aspect of life, including education (Tahmina, 2023).

For over two decades, YouTube has emerged as a prominent and influential social media platform, hosting a diverse range of content and activities (Aulawi et al., 2023). Since its launch in 2005, YouTube has become one of the most widely used platforms globally. As of 2020, the YouTube platform had over 1.9 billion users, more than 100 million videos, which are present in over 100 countries (Gerundo et al., 2022). Each month, over two billion people access YouTube, collectively viewing more than a billion hours of content (Çoklar & Cihangir, 2021). YouTube has become one of the world's leading video-sharing platforms, offering an extensive collection of user-generated and professionally produced content (Roy, 2023; Maden & Kaya, 2023).

YouTube is a digital platform that allows users to upload, share, and view videos. It has grown into a full-fledged educational resource, offering millions of instructional videos across diverse disciplines (Mohamed & Shoufan, 2024; Umoh, 2024). With adequate internet access, anyone can view YouTube videos worldwide (Tutiasri et al., 2020). Studies conducted in various countries have highlighted the growing academic interest in the educational use of YouTube. For instance, Duncan et al. (2013) investigated the use of YouTube as a teaching tool for clinical skills in the United Kingdom. Almobarraz (2018) examined how YouTube is an information resource supporting university coursework in Saudi Arabia.

Similarly, Albahlal (2019) investigated the impact of YouTube on enhancing secondary school students' speaking skills in Riyadh. Several studies have explored YouTube's role in developing speaking abilities in Indonesia. Meinawati et al. (2020) examined its effectiveness in improving students' speaking skills, while Arroyyani (2018) implemented a YouTube video project to support speaking development among nursing students. In South Africa, Kibirige and Odora (2021) investigated the effects of YouTube on students' cognitive achievement among technology education learners. In Nigeria, YouTube has been

used as an educational tool to stimulate secondary school students' interest in Biology (Edache-Abah & Dike, 2019).

Despite existing literature highlighting the efficacy of using YouTube in enhancing students' learning outcomes, a significant gap remains in its application to mathematics within the Nigerian context. Mathematics continues to be a challenging subject for many learners (Tomasetto et al., 2021; Radiamoda, 2024), indicating that the potential of YouTube as a pedagogical tool for improving mathematics learning outcomes has not been fully realised. This underscores a critical need for further research on practical intervention. Therefore, the present study aims to fill this gap by investigating the impact of YouTube-based edutainment on students' understanding of complex mathematical concepts**.**

### 1.1 Research Questions

This study intends to answer the following question:

1. Will there be a statistically significant difference in the learning outcomes of students taught Statistics and Probability using YouTube-based edutainment and the Lecture method?

### 1.2 Hypotheses

This study is guided by two hypotheses, which are tested at a 0.05 confidence level.

1. There will be no statistically significant difference in the learning outcomes of students taught Statistics and Probability using the YouTube-based edutainment and those taught using the lecture method.

2. There will be no statistically significant difference in the learning outcomes of male and female students taught Statistics and Probability using YouTube-based edutainment.

## 2. Literature Review

### 2.1 Theoretical Framework

This study is guided by two interrelated theoretical frameworks: Shulman's (1987), who pioneered the concept of Pedagogical Content Knowledge, and Mishra Koehler's (2006), whose theoretical lens is guided by Technological Pedagogical Content Knowledge (TPACK). PCK emphasizes the intersection of content knowledge (CK) and pedagogical knowledge (PK). These two highlight the teachers' ability to transform subject matter into teaching form to promote students' understanding.

Resting on this foundation, the TPACK framework is extended by introducing technological knowledge (TK), the third domain that allows technology in modern teaching and learning (Leahy & Mishra, 2023; Mishra, 2019). These frameworks provide insight through which this study investigates the integration of content, pedagogy, and technology in secondary school mathematics.

The TPACK framework is relevant to this study because it examines how the in-service teacher integrates YouTube into their pedagogical practices for teaching statistics and probability, which are considered abstract and challenging to understand for learners (Su et al., 2024). Effective instruction requires teachers to combine content knowledge of these concepts, pedagogical strategies suited to them, and technological tools like YouTube. The assumption guiding this study is that student learning outcomes improve when these three domains are meaningfully integrated, rather than technology being used in isolation. (see figure 1)

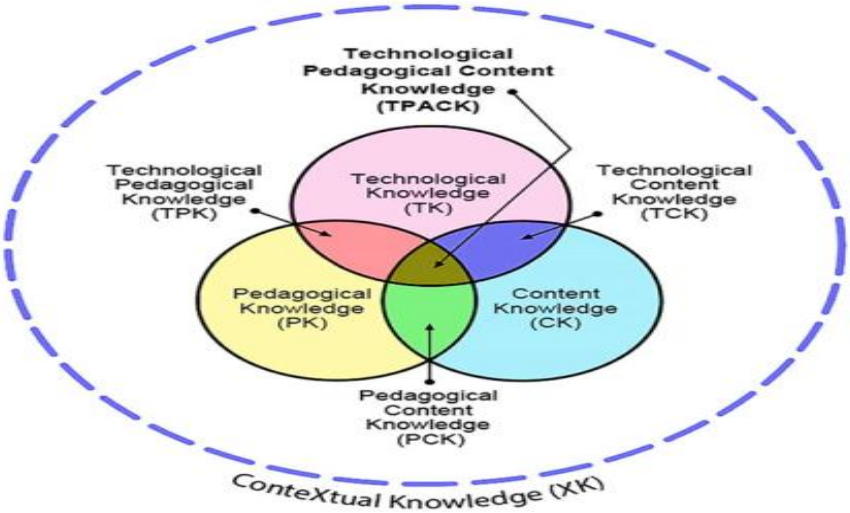


**Figure 1: Revised TPACK (Mishra, 2019)**

Using YouTube, a rich multimedia platform, allows teachers to visualize abstract concepts, demonstrate real-life applications, and offer differentiated learning opportunities tailored to diverse learners' needs (Duffy,2008). These frameworks also support the evaluation of teachers' ability to select, adapt, and sequence digital content in a manner that aligns with curricular goals and cognitive levels, especially in topics that require high-order reasoning.

Moreover, the study focuses on in-service teachers, many of whom already possess significant content knowledge but may require the support of pedagogical and technological integration, so TPACK becomes an essential lens through which growth and professional competence can be achieved. It provides insight into how professional development or instructional interventions, such as exposure to or training on YouTube integration, can improve teachers' capacity to merge all three knowledge domains effectively and efficiently.

Finally, TPACK informs the design and interpretation of this study by highlighting how the thoughtful interplay of technology, pedagogy, and content knowledge enhances instructional quality. It provides a theoretical basis for understanding the potential transformation in teaching practices and learning outcomes when technology, such as YouTube, is leveraged not as an add-on, but as an integrated instructional tool tailored to subject matter and learner needs.

**2.2 What makes a concept difficult?**

In many African educational contexts, the terms "concept," "subject," and "topic" are often used interchangeably. The difficulty of a topic or concept refers to the extent to which learners find it challenging to understand (Okebukola et al., 2013). The spectrum of difficulty ranges from "least difficult," where learners can transition from rote memorization to meaningful understanding with ease (Grove & Bretz, 2012), to "most difficult," where they struggle to develop accurate and deep comprehension (Awaah et al., 2020). Several factors can contribute to conceptual difficulty, including anxiety toward the subject, poor study habits, lack of motivation, limited cognitive capacity, and ineffective teaching strategies.

Additionally, fear, disengagement, and misconceptions resulting from weak pedagogical approaches can exacerbate these challenges (Ncube & Luneta, 2024). Sibiya et al. (2025) emphasise that abstract and conceptually complex topics inherently require higher order thinking skills, significantly increasing learners' cognitive load. Statistics and Probability fall squarely within this category. When misconceptions in these areas are not promptly addressed, they can become entrenched and serve as cognitive barriers that impede future learning (Chinn, 2020). Addressing these challenges requires the adoption of effective instructional strategies, such as multimedia-based interventions, that can simplify abstract content and promote deeper conceptual understanding.

**2.3 Why Statistics and Probability?**

Statistics is the science of data learning. Ross (2020) opined that the process begins with data collection, organisation, analysis, interpretation, and conclusion. However, the full value of statistical analysis cannot be realized without probability. Probability theory enables us to make informed predictions and measure uncertainty, strengthening statistical outcomes' reliability. Walpole et al. (2012) highlights that probability is a critical complement to statistical methods, providing the foundation for drawing meaningful and confident inferences. They form a reciprocal relationship: statistical methods validate probabilistic assumptions, and probability informs statistical inferences. This dual role is essential in making sound decisions in uncertain situations (Borovcnik, 2022).

Recognizing this critical interplay and its relevance in data-informed reasoning, educational policymakers in Nigeria have incorporated Statistics and Probability as core components of the National Mathematics Curriculum. These topics are taught from Basic 8 to Senior Secondary School (SSS 2), equivalent to grade 11 in many developed countries. Integrating Statistics and Probability in the curriculum enhances global competitiveness and empowers learners with essential mathematical skills (Nuera, 2025). Their applicability across diverse disciplines underscores their significance in today's data-driven society.

However, numerous studies have shown that students often perceive abstract topics such as probability as difficult (Shafie & Wun, 2022; Yildiz & Baltaci, 2015), notably when instruction lacks visual and interactive components. Traditional lecture methods may not sufficiently bridge the gap between theory and application, especially in environments with limited resources (Hu, 2024). According to the Cognitive Theory of Multimedia Learning (Mayer, 2022),

students learn better from combining words and pictures than from words alone. In the Nigerian context, students' poor performance in mathematics topics is often linked to teacher-related factors, such as the failure to adopt innovative, technology-integrated teaching methods that could enhance conceptual understanding (Onyeneho et al., 2023).

Hence, this study aims to utilise multimedia tools, such as YouTube, to foster students' more profound understanding and address the learning gaps reported by the Nigerian WAEC chief examiners' report. WAEC chief examiners' reports (2018–2021) confirm the severity of the problem despite its importance. In 2019, the WAEC report revealed that over 60% of students struggled with interpreting probability-based questions, indicating deficiencies in conceptual understanding and application. Therefore, these findings underscore the need to test whether YouTube-based instruction can improve Nigerian students' conceptual understanding of statistics and probability.

**2.4 Rationale for YouTube-based Edutainment**

Edutainment refers to the integration of educational content with entertaining elements, allowing learners to engage in enjoyable activities while learning occurs simultaneously. This approach may involve games, puzzles, drama, mime, animation, or other activities that merge fun with informative experiences (Mehrotra, 2020). Edutainment is characterised as a fusion of education and entertainment that leans heavily on visual media, narrative or game-based formats, and a casual, non-traditional mode of delivery (Putra & Setyaningrum, 2018). YouTube-based edutainment exemplifies this fusion, offering content that educates and entertains (Morant et al., 2021).

This approach makes learning more attractive and dynamic by presenting instructional material engagingly and enjoyably. YouTube offers several video contents that can be used in classrooms for educational and entertainment goals (Berk, 2009). Several studies have highlighted the effectiveness of YouTube as a learning tool that enhances learners' problem-solving, communication, and collaboration skills (Greeves & Oz, 2024; Jia, 2019; Mohamed & Shoufan, 2024). As a platform seamlessly merges instructional value with entertainment, YouTube captivates learners' attention and supports diverse learning styles through its rich multimedia content. Therefore, YouTube stands out as a powerful edutainment tool, providing a strong rationale for its purposeful integration into contemporary teaching and learning practice.

**2.5 YouTube and Students' Learning Outcomes**

Recent studies have increasingly highlighted the positive role of social media in enhancing students' academic achievement and overall learning outcomes (Papademetriou et al., 2022; Gumede et al., 2024). Among these platforms, YouTube emerged as an educational tool, offering a combination of accessibility, multimedia engagement, and interactive features that support diverse learning needs (Moghavvemi, 2018). YouTube's efficacy in education is evidenced by its growing relevance as a knowledge-sharing platform, where students and educators can access structured learning resources, tutorials, and demonstrations tailored to various disciplines (Mohamed & Shoufan, 2024). Its ability to facilitate

asynchronous learning, allowing learners to revisit content at their own pace and engage in self-directed study, has proven beneficial for promoting deeper understanding and retention (Habes, 2019).

In the global shifts toward digital education, YouTube plays a pivotal role in expanding access to educational opportunities (Rudenkin & Grushevskaya, 2019). Online learning environments, particularly those that leverage video content, have become essential in overcoming traditional barriers such as geographic location, institutional limitations, and economic constraints (Yeh & Tsai, 2022; Gunawardena & Dhanapala, 2023). This is especially important in low-resource settings where formal classroom instruction may be limited. Moreover, YouTube's interactive features, such as comments, discussion threads, and sharing functions, foster collaborative learning environments that encourage students to exchange ideas, clarify doubts, and engage with content more critically (Khubayi et al., 2024; Salloum et al., 2019). These features enhance student engagement and social presence, which are well-documented factors in promoting learning outcomes.

## 3. Methodology

A quasi-experimental research design (pretest-posttest nonequivalent group design) was adopted, as the researchers could not randomly assign participants to the experimental and control groups during data collection. A quantitative data collection approach was employed. The Ogun State Education School System covers many Senior Secondary Schools (SSS) across the State's four education zones: Egba, Ijebu, Remo, and Yewa-Awori. These zones are structured along geographical and administrative lines for effective school management and policy implementation. Each zone contains numerous government-owned public schools, typically structured with different Junior and Senior Secondary sections, while many operate within the same compound.

Most senior secondary schools are co-educational and serve both urban and rural populations. Senior Secondary Schools in Ogun State represent Nigeria's final secondary education phase. This stage follows Junior Secondary School (JSS) and spans three academic years (SS1 to SS3), usually for students aged 15–18. This study's total sample of 112 Senior Secondary Two Mathematics students was purposively selected from two public schools in separate educational zones. SS 2 students were appropriate for this study because they had completed one year of their senior secondary school after completing their mathematical background from the junior secondary school. Also, at this stage, one must possess the capacity for abstract reasoning, consistent with Piaget's cognitive development theory. The selected schools shared comparable features, including similar teacher qualifications in Mathematics, available facilities, student population size, and urban location characteristics**.**

The YouTube group comprised 53 students (29 males and 24 females), while the conventional group comprised 59 students (27 males and 32 females). Mathematics teachers from the selected schools served as research assistants for the study. Senior Secondary School II (equivalent to Grade 11) students in Ogun State, Nigeria, were appropriately selected for this study because of their prior

exposure to mathematics experience and understanding of foundational concepts relevant to the study.

This class level was also found appropriate as students at this stage can typically engage in abstract reasoning, which aligns with Piaget's theory of cognitive development. According to Jean Piaget, the adolescent age begins at 11 and above, which is characterised as the formal operational stage of cognitive development. Learners at this stage are capable of higher order thinking such as abstract reasoning, hypothesis testing, logical analysis and systematic problem-solving.

### 3.1 Instrumentation

A total of 40 multiple-choice questions (MCQs) were initially drawn from the West African Senior School Certificate Examination (WASSCE), designed to assess the knowledge of mathematics concepts, specifically statistics and probability, among Senior Secondary School II (SS II) students. For validation, these items were reviewed by a panel of five experts, comprising senior secondary school mathematics teachers and test construction experts. The validated test items reflected both content relevance and appropriate cognitive domain coverage. The distribution of the final 30 items followed Bloom's taxonomy, with 20% assessing knowledge recall, 40% targeting comprehension, 20% measuring application, 10% focused on analysis, and the remaining 10% split evenly between synthesis and evaluation.

This distribution ensured a balanced assessment of lower-order and higher-order cognitive skills, aligning with the study's objective of measuring a broad range of mathematical thinking abilities. The instrument was first administered to 17 students who were not part of the main group of students and were from a different zone as a pilot study. This allows the researcher to assess the clarity and appropriateness of items. Reliability was conducted using the split-half method. Using Spearman–Brown formula, the reliability coefficient was given as 0.79. This value indicated acceptable internal consistency, making the instrument suitable for use in the study.

### 3.2 Data Collection Procedure

After obtaining permission from the appropriate authorities to conduct the study in the two selected schools, the school's mathematics teachers assisted the research team in creating a friendly and supportive environment to ensure that students felt comfortable and motivated to participate. The purpose of the study was explained, and students were assured that participation was entirely voluntary. Each participant signed an attestation statement on the questionnaire, indicating their freedom to participate and willingness to do so under the school's authority.

Thereafter, data collection began with administering a pretest to all 112 experimental and control students to assess their initial academic proficiency. The intervention phase spanned four weeks, with each group receiving 80 minutes of instructional contact weekly. The experimental group participated in well-structured learning experiences in Statistics and Probability using YouTube-based

instruction, while the control group received traditional teaching without any multimedia components.

### 3.3 Data Analysis

Quantitative data from both groups' pretest and posttest scores were analyzed using descriptive and inferential statistics. Descriptive statistics summarized the data, while inferential statistics tested the study's hypothesis at the 0.05 significance level to determine whether there were statistically significant differences in learning outcomes between the two instructional methods.

#### *3.3.1 Intervention in the experimental group*

**STEP 1:** Before the lesson, students were introduced to the topic through a short YouTube video projected by the teacher, since phone use was not permitted during school hours. The videos were carefully selected to relate statistics and probability to real-life situations such as predicting the weather, using dice to explain outcomes, or using bar charts to analyse class attendance. This step activated students' prior knowledge and introduced the digital component of the learning experience.

**STEP 2:** At the start of the lesson, following the teacher's brief introduction, students were divided into mixed-sex and mixed-ability groups to share their reflections on how the concepts applied to everyday life. Each group summarised and presented their findings to the class, enriching learning with technological and contextual perspectives. The teacher then facilitated a whole-class discussion to address misconceptions and connect the shared ideas to the curriculum objectives.

**STEP 3:** During the core teaching session, the teacher used a projector to display selected YouTube clips focusing on subtopics such as calculating mean, median, mode, and conducting simple probability experiments. The teacher paused the videos at key points to explain concepts, pose questions, and engage students in short problem-solving exercises that reinforced understanding in real time.

**STEP 4:** As the lesson progressed, students were assigned problem-solving tasks and were encouraged to participate in simple experiments, such as coin tosses or drawing-colored balls to apply probability concepts. Groups were allowed to use phones or laptops to review video segments, solve worksheets **a**fter school hours and present their findings in class again.

**STEP 5:** At the end of each week, the teacher sent a concise 3-minute summary of the lesson via WhatsApp. Student group leaders were responsible for creating and sharing their reflections, solving problems, or digital summaries with the class. This practice fostered retention, personalized engagement, and sustained learning with YouTube resources beyond the classroom.

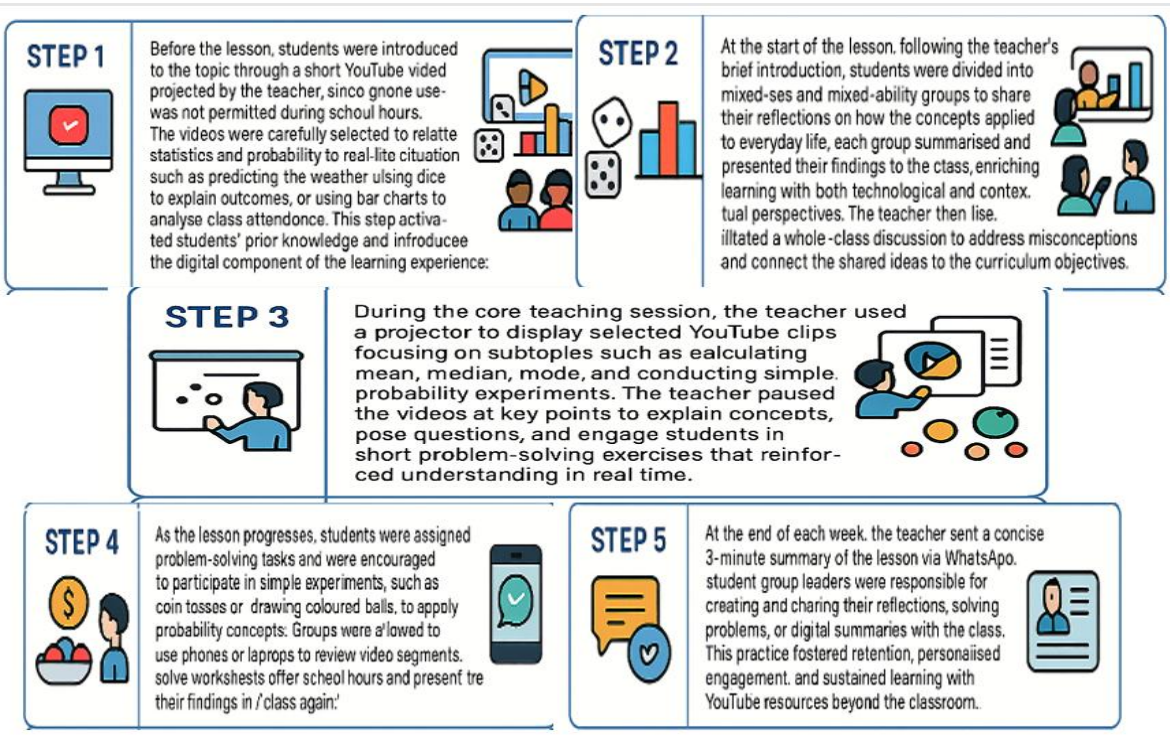


**Figure 2: Steps for the intervention**

*3.3.2 Intervention in the control group*

**STEP 1**: The teacher introduces Statistics and Probability by stating its objectives. The purpose of stating the objectives was to guide the students' focus. To capture learners' attention, the teacher highlights the topic's relevance in everyday life with examples like a game of chance and weather forecasting.

**STEP 2:** The teacher explains key concepts of statistics and probability using the lecture method. Concepts such as data collection, mean, median, mode, probability, and chance were systematically presented using lecture textbook examples.

**STEP 3:** At the end of the explanation**, t**he teacher summarises the main points discussed, reinforcing formulas, definitions, and typical problems. Problems were revisited, and solutions were outlined for the students to model in their own practice.

**STEP 4:** The students were allowed to ask questions to clarify areas of difficulty. The teacher responded by giving further explanations that allowed for correcting misconceptions, so the students could ask questions to clarify their understanding and then assigned practice exercises from the textbook.

**STEP 5**: To reinforce classroom learning, the teacher gave assignments to the students from the textbook. This was to strengthen students' understanding of the basic principles of statistics and probability. These assignments are usually completed at home and submitted for marking.

## 4. Results and Findings

The key focus of the study was to investigate whether YouTube would promote learning outcomes in statistics and probability concepts. The quantitative dataset went through preliminary tests to assess the normality of the population and homogeneity of variance to ensure that the assumptions of the statistical tool ANCOVA were satisfied. The analysis showed that Levene's Test of Equality of Error Variances. This shows that the assumption was not violated ($F(1,110) = 1.34$; $p > .05$) **(Table 1).**

According to Zach (2022), a significance level greater than .05 in Levene's test confirms that the variances are equal and the assumption is met. Since the assumption is met, we proceeded to a one-way ANCOVA to analyse the learning outcomes scores for the students in the two groups. The results from the descriptive statistics show the learning outcome scores of the Mean and Standard Deviation of the students. **(Figure 2)**

**Table 1: Levene's Test of Equality of Error Variances**

| F | df1 | df1 | Sig. |
|---|---|---|---|
| 1.40 | 1 | 110 | .24 |

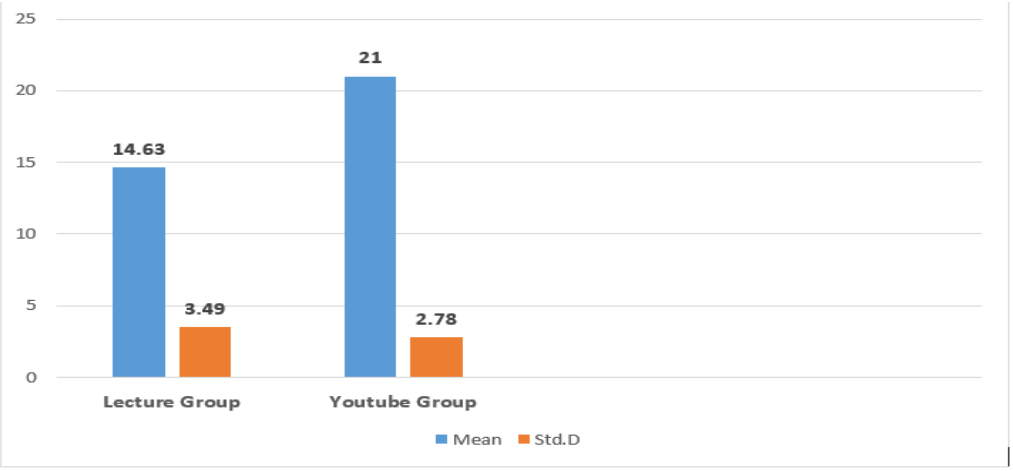


**Figure 2: Mean and SD of students' performance in the experimental and control groups**

Figure 3 was used to answer only the research question in the study. The data collected was subjected to descriptive statistics as presented in Figure 3. The results showed that the YouTube group had a Mean score of 21.00; SD = 2.78, and the Lecture method group had a Mean score of 14.63; SD = 3.49, respectively. The implication is that the students taught statistics and probability with YouTube-based edutainment instruction performed better than their counterparts taught with a conventional method. Inferential tests were also conducted on the data to assess whether the observed differences were statistically significant based on the teaching methods and gender. See **Table 3 and Table 4.**

**Table 3: A summary of the ANCOVA scores of students taught Statistics and Probability using Lecture and YouTube groups**

| Source | Type III Sum of Squares | Df | Mean Square | F | Sig. | Partial Eta Squared |
|---|---|---|---|---|---|---|
| Corrected Model | 1194.95[a] | 2 | 597.48 | 62.34 | .00 | .53 |
| Intercept | 3407.69 | 1 | 3407.69 | 355.5 | .00 | .77 |
| PretestAchi | 61.04 | 1 | 61.04 | 22.56 | .01 | .06 |
| Methods | 1176.05 | 1 | 1176.05 | 112.70 | .00 | .52 |
| Error | 1044.76 | 109 | 9.59 | | | |
| Total | 37102.00 | 112 | | | | |
| Corrected Total | 2239.71 | 111 | | | | |

a R Squared = .534 (Adjusted R Squared = .525)

The result in Table 3 indicates a statistically significant difference in students' learning outcomes in the two groups (Lecture and YouTube). This shows that the teaching method significantly affected the students' posttest achievement. Specifically, the posttest analysis revealed a statistically significant difference in the students' performance based on the instructional strategy employed, $F(1, 109) = 112.70$, $p < .01$. The decision is to reject the null hypothesis. These findings show that students in the YouTube group, who were taught statistics and probability using YouTube as instructional tools, performed better than their peers in the lecture group, who received instruction through conventional methods.

**Table 4: A summary of ANCOVA scores for male and female Students taught Statistics and probability using YouTube-based edutainment**

| Source | Type III Sum of Squares | Df | Mean Square | F | Sig. | Partial Eta Squared |
|---|---|---|---|---|---|---|
| Corrected Model | 27.13[a] | 2 | 12.56 | .67 | .52 | .01 |
| Intercept | 3751.35 | 1 | 3751.4 | 184.81 | .00 | .63 |
| PretestAchi | 17.99 | 1 | 17.99 | .86 | .35 | .01 |
| Gender | 8.23 | 1 | 8.23 | .41 | .53 | .00 |
| Error | 2212.59 | 109 | 20.30 | | | |
| Total | 37102.00 | 112 | | | | |
| Corrected Total | 2239.71 | 111 | | | | |

a R Squared = .012 (Adjusted R Squared = .006)

The results in Table 4 showed no significant difference in learning outcomes between male and female students after the treatment ($F (1, 109) = 0.41$, $p > .05$). **Decision**: We do not reject the null hypothesis. In other words, gender did not influence students' performance in the posttest.

### 4.1 Discussions

One of the aims of this study was to find out if there would be a statistically significant difference in the learning outcomes of students taught Statistics and Probability using YouTube as an instructional method compared to the Lecture method. The finding between the pretest and posttest scores shows that the

students' learning outcomes in the YouTube (Intervention) class were higher than their counterparts in the lecture method (Conventional) class. The findings of this study align with those of Omer et al. (2017), who demonstrated that YouTube enhanced EFL students' listening and speaking abilities while motivating them to engage in verbal communication in English. The study is further validated by the findings of Angeline and Ranadev (2018) and Shumba and Iipinge (2019), who reported similar results, highlighting the contribution of digital media to language development.

Two hypotheses guided this study. The first hypothesis sought to determine whether there would be no statistically significant difference in the learning outcomes of students taught Statistics and Probability using YouTube-based edutainment instructions compared to those taught using the traditional lecture method. However, the results revealed a statistically significant difference in favour of the YouTube group, indicating that the mode of instruction substantially impacted students' academic performance. This finding supports the view that digital media, particularly YouTube, enhances learning outcomes when effectively integrated into instruction.

These findings are consistent with those of Al-Bataineh (2010), who reported a significant difference in test performance between experimental and control groups, favouring video in improving English proficiency among undergraduates in the university. Similarly, Kibirige and Odora (2021) found that engineering students taught with YouTube-based resources showed higher retention levels than those taught through conventional methods. In line with this, Mohamed and Shoufan (2024) emphasised YouTube's value as a tool for self-directed learning beyond the classroom, while Namubiru Ssentamu et al. (2020) found that embedding YouTube videos in classroom instruction improved not only learner engagement with the content but also peer and teacher interaction.

Several studies in science education also corroborate the current findings. Nwafor et al. (2025) reported that students taught physics using a YouTube instructional video package retained more knowledge than their counterparts taught with only the traditional lecture method. This also agrees with Uzobuike and Okoli (2020) and Edache-Abah and Dike (2019), who found that YouTube-supported teaching enhanced students' interest in science.

Additionally, Sunday et al. (2024) observed a significant difference in mean interest scores between students taught physics using YouTube and those taught through the lecture method. Beji and Saidu (2021) also confirmed that YouTube-based instruction led to higher mean retention scores than the lecture method. Collectively, these findings highlight that YouTube is an instructional tool that enhances students' learning outcomes and fosters greater engagement, interest, and knowledge retention across different disciplines.

The second hypothesis examined whether there would be a statistically significant difference in the learning outcomes of male and female students taught Statistics and Probability using YouTube-based edutainment as an instructional method.

The results revealed no significant difference in the posttest performance between male and female students; the implication is that gender did not influence the efficacy of the YouTube-based instruction. This finding aligns with the results of Adedoja and Fakokunda (2015), who equally reported that gender had no significant impact on students' performance when taught with video-based instructional approaches.

Supporting these findings, Nwafor et al. (2025) and Sunday et al. (2024) also found no significant difference in the mean interest scores of students taught physics using YouTube instructional video packages based on gender. Also, Sakkir et al. (2020) observed that YouTube can stimulate interest in both male and female learners equally. This aligns with Audu's (2018) and Tetteh et al (2025) findings that gender does not affect learners' interest or academic performance. Regardless of differences in the findings in prior studies, this study found that gender has no significant role in shaping students' learning outcomes or interest when using YouTube as a teaching tool for Statistics and Probability.

## 5. Conclusion and Recommendations

This study investigated how YouTube-based edutainment can improve the students' learning outcomes in Statistics and Probability compared to the traditional lecture method. The findings revealed a statistically significant improvement in the performance of students exposed to YouTube-based edutainment compared to those taught using the traditional lecture method, showing the potential of video-digital platforms as practical instructional tools for complex mathematics concepts.

It is therefore suggested and recommended that mathematics teachers and curriculum planners integrate well-structured YouTube-based edutainment resources into their teaching strategies, particularly for abstract or conceptually demanding concepts. Seminars and training workshops should be organised regularly for in-service teachers as part of their professional development, and they should focus on the effective use of YouTube. These programs should provide hands-on training on identifying YouTube educational content, designing lesson plans around video-based instruction and facilitating student engagement and interaction through multimedia.

Also, future studies could extend this research by examining the long-term retention effects, exploring its impact on other STEM subjects and investigating how teacher training influences the effective implementation of video-based pedagogy. Research could also explore student perceptions, engagement patterns, and potential challenges such as screen time management, accessibility issues, and content appropriateness. However, the findings of this study are not intended to be generalised beyond the sampled population.

## 6. Ethical Statement

Approval was obtained from the appropriate educational institutions before conducting the study. The researchers ensured all participants were provided with written informed consent by signing a consent form in the response booklet,

affirming their voluntary participation. Participants were informed about the purpose of the study and assured that their responses would remain confidential and be used solely for academic research. The researchers emphasised to school authorities and participants that participation was entirely voluntary and that individuals could withdraw at any point without providing a reason. Furthermore, no participant was exposed to any form of physical or psychological harm or exploitation throughout the study.

## 7. Declaration of Conflicting Interests

The authors report no potential conflicts of interest related to this article's research, authorship, or publication.

## 8. References


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