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Can YouTube-based instructional videos improve statistical reasoning skills?

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ABSTRACT

This study investigates the potential of YouTube-based instructional videos to improve students' statistical reasoning skills in the context of learning Educational Statistics. Statistical reasoning is a fundamental competency in this subject; however, many students face difficulties in grasping and applying statistical concepts due to instruction that is often abstract and overly theoretical. To address this issue, the study was conducted to assess whether integrating YouTube as a learning medium could provide more concrete and accessible explanations, thereby enhancing students' understanding. The study employed a quasi-experimental one-group pretest-posttest design. Data were collected from undergraduate students enrolled in an Educational Statistics course using two instruments: a procedural knowledge test and a perception questionnaire. The results revealed a statistically significant improvement in students' statistical reasoning skills after participating in the YouTube-based learning intervention. Additionally, students expressed positive perceptions toward the use of YouTube videos in learning statistics. The highest average ratings were reported in learning effectiveness (M = 98), followed by learning motivation (M = 96), content clarity (M = 92), and ease of access (M = 87). These findings suggest that YouTube can serve as an effective digital learning tool to support conceptual understanding in technical subjects, highlighting the importance of integrating digital media in higher education pedagogy.

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ABSTRAK

Penelitian ini mengkaji potensi penggunaan video pembelajaran berbasis YouTube dalam meningkatkan keterampilan penalaran statistik mahasiswa pada mata kuliah Statistika Pendidikan. Penalaran statistik merupakan kompetensi mendasar yang menuntut mahasiswa memahami dan menginterpretasikan data. Namun, banyak mahasiswa mengalami kesulitan akibat penyampaian materi yang cenderung abstrak dan teoretis. Oleh karena itu, dibutuhkan inovasi pembelajaran yang lebih konkret dan mudah diakses. Penelitian ini menggunakan desain kuasi-eksperimen dengan pendekatan one-group pretest-posttest. Partisipan terdiri dari mahasiswa program sarjana yang mengikuti mata kuliah Statistika Pendidikan. Data dikumpulkan melalui dua instrumen, yaitu tes pengetahuan prosedural dan kuesioner persepsi mahasiswa terhadap media pembelajaran. Hasil penelitian menunjukkan peningkatan yang signifikan secara statistik dalam keterampilan penalaran statistik setelah pembelajaran berbasis YouTube. Selain itu, respons mahasiswa terhadap penggunaan YouTube sangat positif. Nilai rata-rata tertinggi diperoleh pada kategori efektivitas pembelajaran (M = 98), diikuti motivasi belajar (M = 96), kejelasan konten (M = 92), dan kemudahan akses (M = 87). Temuan ini mengindikasikan bahwa YouTube merupakan media pembelajaran digital yang efektif dalam mendukung pemahaman konseptual mahasiswa, terutama pada mata kuliah yang bersifat teknis. Oleh karena itu, integrasi media digital seperti YouTube perlu dipertimbangkan secara serius dalam pengembangan pedagogi pendidikan tinggi.

Kata Kunci: *kepuasan belajar; penalaran statistik; video pembelajaran; statistika pendidikan*

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INTRODUCTION

The learning of the Educational Statistics in the Bachelor's Program (S1) of Pendidikan Pancasila dan Kewarganegaraan (PPKn) or Pancasila and Civic Education, Fakultas Keguruan dan Ilmu Pendidikan (FKIP) or Faculty of Teacher Training and Education, Universitas Pamulang (Unpam), plays a strategic role by equipping students with statistical reasoning as the ability to interpret data critically, which is useful for evaluating effective learning interventions and conducting research at the end of their study period. The importance of learning Educational Statistics also aligns with global education trends that demand data-based accountability (Kurnia *et al*., 2024). In today's era, which is increasingly driven by data-based decision-making, statistical reasoning is a skill needed by future educators (Sarker, 2021). Thus, statistical reasoning is no longer an optional competence, but a crucial requirement for prospective teachers who will face challenges that demand precision in data analysis (Hokor *et al*., 2023).

Statistical reasoning requires mastery of two types of knowledge, namely declarative knowledge and procedural knowledge (Hokor *et al*., 2023). Declarative knowledge refers to the understanding of concepts, such as the definitions of statistical concepts like normality, probability, and so on, as well as an understanding of the basic principles in decision-making for testing, for example, non-parametric and parametric tests. Procedural knowledge refers to the ability to apply these concepts through a step-by-step process, such as selecting the appropriate statistical test, using statistical software to conduct analyses, and accurately interpreting statistical test results. Mastery of both types of knowledge is expected so that students understand what a statistical test is and how and when to apply it in real-world educational research scenarios (Hokor *et al*., 2023).

Previous studies consistently report that students in teacher education programs experience difficulties in interpreting statistical data. Many education students understand statistical concepts but often struggle with applying them in practice (Hadi & Faradillah, 2020). Specific challenges include confusion in choosing the appropriate statistical test, a lack of awareness about the underlying assumptions of testing, and difficulty in interpreting test results. These issues are exacerbated by high levels of statistical anxiety and low learning motivation. (Onwuegbuzie & Wilson, 2023).

The low level of statistical reasoning skills is related to the learning strategies that have been used so far. Conventional approaches rely heavily on lectures, memorization, and manual calculations, which do not adequately support contextual and real-world learning (Muhidin *et al*., 2023). While students may understand statistical procedures, they rarely learn how to interpret test results in real-world problems. Moreover, traditional learning often presents statistical tests separately, emphasizing the name of the test and its formula, without placing it within the complete research process that includes data input, test selection, software operation, interpretation of test results, and decision-making. As a result, students develop fragmented knowledge that is difficult to transfer from classroom learning to practice (Darling-Hammond *et al*., 2020). Considering that statistical reasoning involves cognitive tasks such as recognizing the type of problem, applying relevant procedures, and making judgments based on data, the mismatch in this learning strategy is an obstacle to the development of statistical reasoning and detrimental to students in the future (Muhidin *et al*., 2023).

In recent years, the development of digital technology has been rapid, presenting opportunities to address these learning challenges. Since its launch in 2005, YouTube has become a preferred source of information and learning for students. The presence of YouTube has provided easy access, making it a medium that can positively support learning (Lijo *et al*., 2024). Learning through YouTube videos allows students to observe complex processes repeatedly at their own pace (Kuhlmann *et al*., 2024). In the context of learning the Educational Statistics course, YouTube-based video learning can provide tutorials that visually and sequentially present each stage of statistical analysis, from entering data into the

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software, selecting the appropriate test based on the characteristics of the data, performing the analysis, to interpreting the test results and reporting them.

The video itself offers several advantages compared to printed materials or presentations (Mayer *et al*., 2020). With videos, statistical testing procedures can be precisely visualized, allowing students to connect concepts with practical steps. Secondly, videos support self-paced learning, as students can pause, play, and replay. Thirdly, videos are considered more engaging than traditional formats, maintaining attention and motivation. Finally, videos can be distributed quickly and accessed globally, making them a highly impactful tool for modern learning (Tetteh & Kankam, 2024).

The positive impact of using videos in learning has been documented in a number of studies. From a cognitive perspective, learning is most effective when visual and verbal information are presented simultaneously in a way that facilitates dual-channel processing. Videos facilitate dual-channel processing. Videos combine narration, visual cues, and interactive features. Such a combination can reduce cognitive load and enhance the construction of cognitive schemas (Mayer *et al*., 2020). A cognitive schema is a set of knowledge needed to understand problems and their solutions. Statistical tests are a subject that requires problem-solving skills, and therefore, a cognitive schema is needed so that students can solve statistical testing problems. Additionally, videos significantly improve learning outcomes in subjects that require reasoning (Fan *et al*., 2024; Ridwan *et al*., 2021). Students who learn from videos achieve better learning outcomes in applying procedures than those who rely solely on lectures (Ridwan *et al*., 2021; Tanjung *et al*., 2025).

The combination of cognitive, motivational, and technical benefits makes video an effective medium for enhancing learning, particularly in domains such as educational statistics, where students can not only perform statistical tests but also interpret them. However, relatively few studies have specifically explored its impact in the context of educational statistics within teacher education programs. Most previous research has focused on learning in mathematics, engineering, or medical education. Thus, there remains a gap in understanding how YouTube-based instructional videos affect statistical reasoning skills for preservice teachers. Given the specific demands of teacher education for being able to interpret statistical analyses, which is crucial for research and classroom assessment, research in this area becomes important.

Previous research has extensively examined the impact of videos on learning motivation (Alpay & Gulati, 2010; Bolliger *et al*., 2010; Drew, 2017; Hill & Nelson, 2011; McClung & Johnson, 2010) including attention retention, content relevance, and enjoyment (McClung & Johnson, 2010) as well as rewatching behavior and anxiety (Shi *et al*., 2024; Traphagan *et al*., 2010). Learning satisfaction from the use of instructional videos still needs to be studied. (Ridwan *et al*., 2021; Tanjung *et al*., 2025). Satisfaction can be seen from aspects of learning effectiveness, learning motivation, content clarity, and ease of access, serving as the basis for designing videos that will be used in learning (Fan *et al*., 2024). Learning is said to be effective if it can improve learning outcomes (Kuhlmann *et al*., 2024). Effective learning from videos occurs when students can integrate verbal and visual information without experiencing cognitive overload. If the YouTube video used presents too much information at once or is incoherent, the video may be engaging but not necessarily effective. (Mayer *et al*., 2020).

The second aspect of learning satisfaction is motivation. Motivation can be divided into intrinsic motivation and extrinsic motivation (Ryan & Deci, 2020). Intrinsic motivation is motivation driven by internal satisfaction to understand the material, while extrinsic motivation is motivation driven by the desire to gain recognition from others (Ryan & Deci, 2020). Educational videos can enhance motivation when the video content increases engagement while reducing cognitive processing (Kuhlmann *et al*., 2024). Adding animation or music to YouTube videos can boost engagement, but at the cost of comprehension, a phenomenon known as the engagement illusion effect. Educational videos that can improve understanding ultimately motivate students to learn.

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Another aspect of satisfaction is related to clarity. Clarity is related to the clarity of concepts, the ease of learning the content, and how accurately the content is explained. Not all video presentations automatically produce clarity. To achieve clarity, video development must consider the principle of coherence (Mayer, 2021). The coherence principle states that including irrelevant material, such as unrelated images and background music, can overload working memory and reduce actual clarity, even when students find the content easy to follow. Thus, students may judge a video as clear simply because the material is easy to understand. Video clarity can be enhanced by providing cues, for example, by highlighting certain parts or bolding text and segmenting by dividing information into several parts (Mayer, 2021).

Finally, ease of access. Digital access is not solely determined by the availability of technological devices or internet connection. Digital access encompasses a much more complex dimension, including digital literacy, previous experience in using platforms like YouTube, as well as the user's socioeconomic background (Guy & McNally, 2022). Digital literacy is key because a person needs to have the ability to search for, evaluate, and utilize information through digital media. In addition, prior exposure to YouTube also affects the extent to which an individual can use it effectively for learning purposes, not just for entertainment. On the other hand, socioeconomic status also influences the quality of access available, in terms of the devices used, internet speed, and environmental support.

While videos in learning are increasingly used in education, relatively little research has explored their impact specifically in the context of educational statistics within teacher education programs. Most previous studies focused on general learning outcomes or procedural knowledge in mathematics, engineering, or medical education. Thus, there remains a significant gap in understanding how YouTube-based learning videos affect educational statistics and reasoning skills, particularly for prospective teachers. Given the specific demands of teacher education, the ability to conduct and interpret statistical analyses is crucial for classroom research and assessment, and the lack of research in this area represents a gap that needs to be addressed.

The current research investigates the effectiveness of YouTube tutorial videos as a learning medium to enhance statistical reasoning skills in the Educational Statistics course. Specifically, this study aims to determine the effectiveness and learning satisfaction in learning through YouTube-based videos. By focusing on statistical reasoning, this research seeks to bridge the gap between theoretical knowledge and practical application in statistics education.

In addition to examining its impact on cognitive aspects, current research aims to study the affective aspects of video-based learning. This study contributes to the growing body of literature on digital learning by investigating how instructional videos, when designed with consideration of cognitive load, procedural modeling, and visual scaffolding, can change the way students acquire and apply statistical knowledge. Thus, this research addresses the needs of 21st-century learners who demand flexible, visual learning experiences aligned with real-world tasks. The urgency of this study lies not only in its potential to enhance statistics learning but also in its broader relevance to teacher education reform, where the integration of data literacy and technology-enhanced learning is increasingly regarded as important. By exploring the intersection between technology and statistical learning, this research offers insights for educators, curriculum developers, and policymakers who want to innovate in the context of higher education.

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LITERATURE REVIEW

Statistical Reasoning

In the era of a data-driven society, learning the course of Educational Statistics is not only focused on testing procedures but also on statistical reasoning (Wut & Wong, 2025). Statistical reasoning is a thinking process that involves understanding and using statistical concepts to explain, draw conclusions, and make decisions based on data (Hokor *et al*., 2023). Statistical reasoning is also defined as the ability to explain phenomena based on data and connect statistical concepts such as variability, distribution, and probability to interpret data. A person with statistical reasoning can interpret data, draw conclusions based on statistical evidence, understand uncertainty and variability, and construct arguments based on data evidence (Reinhart *et al*., 2022). This ability becomes essential in addressing data-based problems in real life.

Learning statistical reasoning is not an easy task. There are several challenges in developing statistical reasoning. Many students fail to connect the statistical concepts they learn with real-world contexts. As a result, students may be able to perform calculations but do not understand their meaning in real-world situations (Reichardt *et al*., 2023). In addition, students often have misconceptions, such as thinking that data distributions must always be symmetrical or misunderstanding the concept of probability (Hokor *et al*., 2023). A common mistake is the assumption that data distributions must always be symmetrical, whereas in reality, data distributions can be skewed to the left or right, depending on the characteristics of the data. Furthermore, students often also misunderstand the concept of probability. For example, they assume that if an event has occurred frequently, its likelihood of happening will decrease, whereas in many cases the probability remains constant, such as in a coin toss. Such misconceptions indicate the need for a more conceptual and contextual learning approach to ensure a more accurate understanding for students.

These challenges demand innovation in learning, both in terms of models and learning media. There are two methods offered, namely project-based learning or problem-solving learning (Athaya *et al*., 2024; Sabiq *et al*., 2025). Both types of learning approaches can enhance statistical reasoning skills, as these methods encourage data exploration in real-world contexts. Their drawback is that they provide less support for transfer skills, as learners have not yet acquired the cognitive schemes needed to solve statistical problems in new contexts (Fan *et al*., 2024). The weakness of project-based and problem-solving learning approaches tends to focus on the specific context being studied at that time. Students are indeed active in exploring data and finding solutions, but the knowledge gained is often specific to that particular situation. As a result, they do not develop general or flexible cognitive schemas—that is, abstract thinking patterns that can be applied to various types of statistical problems beyond the context they have studied. Without structured and deep cognitive schemas, students will struggle when faced with statistical problems in new situations that are not exactly like the projects or issues they have encountered before. This is why transfer skills, the ability to apply knowledge in different contexts, become less developed in this method unless accompanied by explicit strategies to build concept generalization.

To address these weaknesses, work-based learning is highly recommended (Chen *et al*., 2023). In example-based learning, students are given solution examples before being assigned problem-solving tasks. By providing examples, students can acquire the cognitive schemas needed to solve statistical problems in new situations that are not exactly like the projects or problems they have previously encountered. These solution examples can be presented through videos (Solé-Llussà *et al*., 2021). Evidence on the effectiveness of video-based learning is limited to problem-solving. The current study seeks to strengthen the empirical evidence regarding the impact of videos on statistical reasoning.

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YouTube-Based Learning Videos

Learning videos have become a recommended learning medium (Solé-Llussà *et al*., 2021). Learning videos can be defined as video presentations aimed at delivering specific learning materials, whether in the form of conceptual knowledge or procedural skills (Köse *et al*., 2021). In practice, learning videos encompass various types of content, such as medical topics, problem-solving, software usage, and lecture explanations. These videos are designed to present information gradually, systematically, and visually engagingly to facilitate understanding. Learning videos can be live recordings, screen captures, or computer animations, all serving as dynamic visualizations, representing information that flows over time (Köse *et al*., 2021).

The main characteristic of a video is its existence as multimedia that integrates narrative sound, moving images, and on-screen text in a cohesive manner (Mayer, 2021). Its content usually focuses on a single learning objective and is designed with deliberate instructional design principles. Some important characteristics that support the effectiveness of instructional videos include segmenting the material into smaller, manageable parts, camera angles that aid understanding (such as a combination of first-person and third-person perspectives), and visual emphasis to focus attention on key parts of the content. Additionally, videos designed in authentic and realistic contexts are easier to understand and have a greater emotional impact (Schittek-Janda *et al*., 2005).

With technological advancements, lecturers can create learning videos, which are then uploaded to YouTube; they are referred to as YouTube-based learning videos. The reason for utilizing YouTube is that it allows wide distribution and access to videos, supporting flexibility in self-paced learning anytime and anywhere (Breslyn & Green, 2022). YouTube-based learning videos also serve as a learning tool that encourages students to explore, discuss, and even produce their own content (Saurabh & Gautam, 2019).

YouTube can enhance learning engagement and motivation through appealing visual elements, flexible content, and ease of access (Breslyn & Green, 2022). YouTube can enhance engagement and learning motivation because it presents material with appealing visual elements, such as videos, animations, and illustrations, that make understanding difficult concepts easier. In addition, the learning content uploaded on YouTube is flexible, allowing students to access and study it anytime and anywhere according to their own pace and needs. This ease of access, combined with the variety of interactive material delivery, makes YouTube an effective platform to support active and enjoyable learning. Also, learning videos accessed on the YouTube platform provide advantages in terms of repetition and learning control, which is very useful for self-directed learners.

YouTube-based learning videos significantly contribute to improved understanding of concepts and knowledge transfer (Breslyn & Green, 2022). However, its effectiveness is influenced by design and utilization factors. Videos with good design, for example, the use of animations, verbal explanations, and content segmentation, are believed to be able to improve learning outcomes better than just text or images. The advantages of YouTube-based learning videos depend on how they are integrated into learning (Elareshi *et al*., 2022). YouTube-based educational videos created without learning objectives can lead to shallow and unfocused learning. However, if used in alignment with learning objectives and combined with appropriate learning strategies, such as a flipped classroom or structured discussions, YouTube videos can become an effective learning medium.

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Learning Satisfaction with Video

The current research aims to determine learning satisfaction with YouTube-based learning videos. Learning satisfaction can be seen from aspects of learning effectiveness, learning motivation, content clarity, and ease of access. These four aspects serve as the basis for designing videos that will be used in learning (Cho *et al*., 2023). Effective learning from videos occurs when students can integrate verbal and visual information without experiencing cognitive overload (Mayer *et al*., 2020). Presenting too much information at once or being incoherent, the video may be engaging but not necessarily pedagogically effective.

YouTube-based learning videos support multimedia features. The multimedia features of videos, including educational videos uploaded on YouTube, can reduce cognitive load (Mayer, 2021). The addition of animation or music elements can increase emotional engagement at the expense of conceptual understanding, a phenomenon known as the engagement illusion effect. From this perspective, it seems that learning educational statistics through YouTube videos can enhance understanding and ultimately motivate students to learn, provided it does not create a cognitive burden.

Another aspect of satisfaction is related to clarity. Clarity refers to conceptual clarity, ease of learning the content, and how accurately the content is explained. Only videos that apply the coherence principle can enhance clarity (Mayer, 2021). The coherence principle states that including irrelevant material, for example, unrelated images and background music, can overload working memory and reduce clarity, even when students find the content easy to follow. Thus, students may judge a video as clear simply because the material they are learning is understandable. Clarity in YouTube-based learning videos can be enhanced by providing signals, for example, by highlighting or using arrows on certain parts of the material, and by segmentation, dividing information into several parts.

Lastly, ease of access. Ease of access relates to technical issues such as internet speed and device compatibility (Guy & McNally, 2022). Videos can serve as a learning resource if the internet is available, as accessing them requires an adequate internet connection. Access is also related to digital literacy, previous experience using platforms like YouTube, and the user's socioeconomic background (Guy & McNally, 2022). Digital literacy is the ability to search for, evaluate, and utilize information through digital media. Previous exposure to YouTube also affects the extent to which an individual can use it effectively for learning purposes. A person's socioeconomic status greatly influences the quality of digital access. It is not just about whether they have a device or not, but also includes the type and condition of the device used, the stability of the internet connection, and support from the surrounding environment. Individuals from upper-middle-class families tend to have more advanced devices, fast internet access, and a comfortable learning space. Conversely, those from less affluent families may only have limited access, use older devices, or even need to share with other family members.

METHODS

This study aims to determine the effectiveness of YouTube-based learning videos in improving statistical reasoning skills. To achieve this, a quasi-experiment with a one-group pretest-posttest design was used. In this design, a control group was not included because the primary goal was to evaluate changes before and after the intervention. The experiment involved 31 fourth-semester students enrolled in the Educational Statistics course in the S1 PPKn Program, FKIP, Pamulang University.

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To assess statistical reasoning skills, a multiple-choice test was developed to measure understanding of how to interpret the results of statistical tests. A trial was conducted on 30 students who had characteristics similar to the target population. The validity test results using Pearson correlation showed that all items in the multiple-choice test had correlation coefficients (r) ranging from 0.41 to 0.78 ($p < 0.05$). Thus, the questions meet the validity requirements for questions that assess statistical reasoning skills. For reliability testing, the Kuder-Richardson (KR-20) test was used for multiple-choice tests, yielding a reliability coefficient of 0.81, indicating high internal consistency.

The learning satisfaction questionnaire consists of 15 items with a 4-point Likert scale, aimed at gauging participants' responses regarding ease of use, effectiveness, clarity, and learning motivation with YouTube-based learning. The questionnaire was adapted from previous research. (Cho *et al*., 2023). The items were modified to suit the Indonesian context. The validity test results using Pearson correlation showed that the item-total correlations for the questionnaire ranged from 0.39 to 0.74, which also meets the criteria for acceptable item validity. Internal consistency was measured using Cronbach's alpha, yielding a value of 0.87, which is considered very good according to standard psychometric benchmarks. The trial results indicate that both instruments are valid and reliable.

The experiment was carried out in four stages systematically to assess the effectiveness of YouTube-based learning videos in improving statistical reasoning skills. In the first stage, participants were asked to complete a pretest. This test was intended to measure their initial ability in statistical reasoning. The test consisted of multiple-choice items containing short cases relevant to statistical testing using JASP software.

After completing the pretest, the intervention consisted of an assignment to watch six educational videos on YouTube, which were developed by the researcher according to the principles of video development as described in the literature review. These videos provided step-by-step tutorials on the following statistical tests: paired sample t-test, Mann-Whitney test, independent sample t-test, Wilcoxon signed-rank test, Pearson correlation, and Spearman rank correlation. All statistical testing procedures used the Jeffrey Amazing Statistical Program or JASP. Students were expected to follow the analysis procedures shown in the videos and apply them to independent assignments using the provided simulated data. After the intervention, students were asked to complete a posttest in a format equivalent to the pretest. The posttest aimed to measure the students' final statistical reasoning abilities after learning through the YouTube videos. Along with the posttest, students are asked to complete a perception questionnaire regarding learning satisfaction.

The comparison of pretest and posttest scores serves as the basis for determining the effectiveness of YouTube-based learning videos. Pretest and posttest data were analyzed using a paired sample t-test to determine the significance of the differences. Assumption tests for analysis were conducted, and the results showed that the data were normally distributed and homogeneous. Questionnaire data were analyzed descriptively to obtain the percentage of scores for each indicator (%). Statistical tests were conducted using JASP.

RESULTS AND DISCUSSION

Results

Table 1 presents the number of participants (N), mean scores (M), standard deviations (SD), and degrees of freedom (df), as well as the results of a paired sample t-test to compare the mean pretest and posttest scores to assess the effectiveness of YouTube-based learning on statistical reasoning.

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Table 1. Means, Standard Deviations, and Significance Test

Measurement	N	M	SD	df	t	p
Posttest	31	81.290	9.997	30	14.230	<.001
Pretest	31	56.613	9.433			

Data source: 2024 Research

The test results presented in **Table 1** show that the average pretest score was 56.6 (SD=9.99), while the average posttest score increased to 81.3 (SD=9.43). A paired sample t-test was conducted to determine the significance of the improvement in statistical reasoning scores after an intervention involving educational videos delivered via YouTube. Based on **Table 1**, there is a statistically significant difference between the pretest and posttest scores (p<0.001). These results suggest that the use of YouTube videos in Teaching Statistics can enhance statistical reasoning.

The questionnaire scores were processed. **Figure 1** presents a graph of the average student satisfaction scores in learning, covering learning effectiveness, motivation to learn, clarity of the material, and ease of access.

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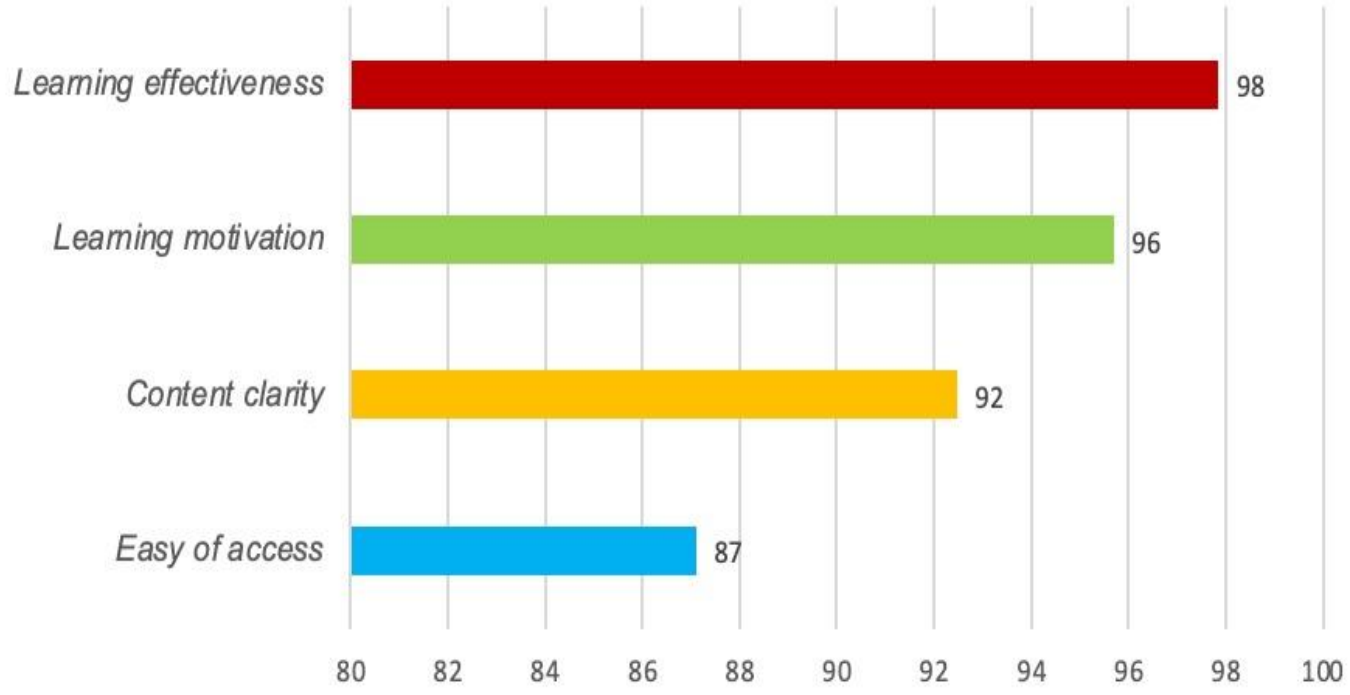

Figure 1. Learning Satisfaction with YouTube-Based Videos

Data source: 2024 Research

Learning satisfaction, as presented in **Figure 1,** shows that students reported a positive perception of using YouTube videos as a learning medium. The highest average score was observed in the learning effectiveness category (M=98), followed by learning motivation (M=96), content clarity (M=92), and ease of access (M=87).

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Discussion

Statistical reasoning ability

The results of this study demonstrate that YouTube-based learning videos can improve statistical reasoning scores. This result can be explained through the dual-channel theory (Mayer, 2021). The dual-channel theory states that information presented through two cognitive channels, namely the verbal channel (text and audio) and the visual channel (images or animations), is easier to process and remember because it involves two pathways in working memory. In practice, YouTube tutorial videos that combine verbal explanations and visual demonstrations help students simultaneously develop conceptual and procedural knowledge about statistical testing.

Educational videos have the potential to enhance cognitive engagement (Breslyn & Green, 2022). Learning through videos allows for repetition, pausing, and interaction, which encourages deeper elaboration of content through repeated viewing. This is particularly important in skill-based learning, such as educational statistics, where understanding testing assumptions, procedural steps, and interpretation of statistical results is required. Thus, educational videos that present step-by-step procedures along with explanations of statistical testing phases are not only useful for students to bridge the gap between theory and practice but also to activate a more reflective and independent learning process. Students no longer just follow a series of steps but can understand the "why" and "how" of each action taken.

This understanding supports the transfer of learning, that is, the ability of students to apply statistical knowledge in new contexts. For transfer to occur, students must have a mental model of how a procedure can be adapted to a new situation. A mental model refers to an individual's internal representation of how a system or process works (Duncan, 2025). In educational statistics, this includes conceptual understanding of statistical tests as well as the procedural knowledge required to conduct hypothesis testing. Transfer learning goes beyond mechanically repeating procedures; it requires students to understand the reasoning behind each step and to recognize how context can affect the application of concepts.

In this context, YouTube videos play a strategic role in supporting the acquisition of mental models. Videos that visually present the sequence of problem-solving, such as using JASP from data input to interpretation of test results, allow students to build an internal representation of the steps involved in statistical testing. Video-based demonstrations showing step-by-step problem solving are more effective than verbal explanations alone in promoting mental model acquisition (Tani *et al*., 2022). Combining verbal and visual elements enhances the construction of stable mental models, thereby strengthening the transfer process (Mayer, 2021). Thus, the use of videos in learning statistics not only supports procedural understanding but also reinforces the mental models needed for statistical reasoning.

These findings reinforce previous research that confirms video-based learning effectively enhances long-term understanding, especially when videos are designed with a logical flow and a clear focus on cognitive processes (Lin & Yu, 2023). Another advantage lies in the flexibility of time and place, allowing students to revisit the material as needed. In this context, YouTube, as an open-access platform, plays a role in supporting a student-centered and inclusive learning ecosystem. This study demonstrates that videos serve as a mediator that facilitates the internalization of knowledge through observation and repeated practice.

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Learning Satisfaction with YouTube-Based Videos

This study also measured learning satisfaction, which consists of four aspects: learning effectiveness, learning motivation, clarity of material, and ease of access. Overall, students' assessments of the four aspects of satisfaction were very high, first, learning effectiveness. A learning effectiveness score of 98% indicates strong student agreement that YouTube videos help students understand complex statistical test material in an easier way. The review of learning outcome data, as shown in the test results in **Table 1**, proves that the video-based learning approach truly facilitates deep understanding and knowledge transfer, particularly in complex domains such as Educational Statistics.

Videos can significantly improve learning outcomes only if they are designed to promote cognitive engagement (Fajriah *et al*., 2021; Tani *et al*., 2022). Learning through videos can foster cognitive engagement when presented in a structured manner, allowing interaction, segmentation, and self-paced learning. Although the videos used in this study were mostly passive, delivered in a lecture style without interaction, their content explained the statistical testing material from start to finish clearly and systematically. Even though the videos were not interactive, the content was very clear, systematic, and easy to understand, which sufficiently helped students grasp the material presented. Visualization of abstract concepts in statistics is far more effective through videos than through verbal explanations alone. Thus, the clarity of the material alone makes students consider learning with YouTube-based videos to be very effective.

The reason explaining the effectiveness of learning with videos is the multimedia theory. According to the cognitive theory of multimedia learning, effective learning from videos occurs when students can integrate verbal and visual information without experiencing cognitive overload (Mayer, 2020). If the YouTube video used presents too much information at once or is less coherent, the video may be engaging but not necessarily pedagogically effective. Positive perceptions of learning effectiveness, supported by learning outcome data, prove that instructional videos are capable of presenting the information needed by students to understand statistical testing.

The effectiveness of learning is also related to attention (Cho *et al*., 2023). It is generally known that students' attention to video learning sharply declines after the first 6 minutes, especially in longer videos. Therefore, unless the videos in this study are short, focused, and aligned with microlearning principles, there is a risk that perceived effectiveness reflects engagement with the ideas presented in the videos rather than ongoing cognitive processing or long-term retention. Additional learning activities such as summarizing, explaining, or applying information are important complements to video learning (Elareshi *et al*., 2022). If the learning experience does not provide opportunities to apply or reflect on what they have learned, students' responses to the videos may be exaggerated.

Second, the motivation aspect. A motivation score of 96% provides promising evidence of student engagement with YouTube-based learning videos. It is important to distinguish between temporary emotional appeal and sustained motivation. Without supporting data on behavioral indicators, for example, time spent and completion rates, high motivation alone may overestimate the impact of the videos. A more rigorous analysis would link motivational responses to task completion, depth of learning, and long-term interest in statistics.

Motivation itself is distinguished between intrinsic motivation, which is driven by internal interest and satisfaction, and extrinsic motivation, which is driven by rewards or superficial engagement (Ryan & Deci, 2020). Although YouTube videos can trigger situational interest through visuals, humor, or novelty, this does not necessarily lead to deep and sustained intrinsic motivation, especially if the content is not personally meaningful or related to learning goals. Thus, high motivation scores more accurately reflect internal interest and satisfaction and align with learning objectives.

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Multimedia features that are too dynamic or too engaging can increase emotional engagement but reduce cognitive engagement. If the YouTube videos used in this study contained fast-paced animations or music, they may have increased emotional engagement at the expense of conceptual understanding, a phenomenon known as the engagement illusion effect. The YouTube videos in this study did not contain any animation or music elements. Students' responses to the learning videos could motivate themselves, which seems related to the fact that YouTube videos can enhance their understanding of the material being studied and ultimately motivate them to learn.

Another factor is familiarity. The participants in this study were students who were already familiar with YouTube. YouTube is often associated with informal, entertainment-based content (Breslyn & Green, 2022). Students' familiarity with this platform can foster ease and comfort, which is ultimately interpreted as potentially motivating them to learn Educational Statistics in a familiar way. However, this comfort does not guarantee perseverance, especially when faced with difficult statistical concepts. Without structured guidance, students may selectively watch only the parts they find interesting, skipping segments that are critical but challenging, thus reducing motivation. Sustained motivation not only requires an attention-grabbing design but also alignment with learning objectives, self-confidence, and perceived task value.

Third, clarity. A material clarity score of 92% indicates that students responded positively to the structure and delivery of the YouTube videos. Clarity relates to conceptual clarity, ease of learning the content, and how accurately the content is explained. With this score, the YouTube-based learning videos fulfill the element of clarity. This can be explained through dual-channel theory (Mayer, 2021). Videos can support the integration of narration and demonstration on screen, which can enhance understanding by supporting dual processing. However, not all multimedia presentations automatically result in clarity. Including irrelevant material can reduce clarity, even when students find the content easy to follow. Thus, students rate videos as 'clear' because no irrelevant material is included in the video. This assessment aligns with the learning outcomes achieved. In fact, test results show that students' learning outcomes improved significantly, indicating that perceived clarity is related to improved learning outcomes.

Clarity in videos can be enhanced by providing signaling and breaking information into several parts (Yang *et al*., 2022). The clarity perceived by students when watching YouTube videos does not occur by chance, but is the result of internal features deliberately designed in the video. Two features that contribute significantly are signaling and segmentation. Signaling helps students focus their attention on important information through visual or audio emphasis, such as the use of color, arrows, or reinforcing sounds. Meanwhile, segmentation breaks down complex material into smaller, sequential parts, making it easier for students to absorb the explanation. The combination of these two features makes videos easier to understand and follow, which ultimately enhances students' perception of the clarity of the material. The YouTube videos in this study featured signaling and segmentation, and the clarity perceived by the students was clearly due to the internal features of the video. The simple delivery style helps clarify the material and improve understanding.

Finally, ease of access. Ease of access scored 87, and although this is lower than the others, the score is still considered high. Ease of access is related to internet speed, device compatibility, digital literacy, previous exposure to YouTube, and even socioeconomic status. Therefore, if the majority of students find access relatively easy, minority groups who are underserved may still face challenges that can be easily obscured in the average score. In other words, the 87% score may reflect underlying digital disparities, especially in contexts where students rely on mobile data or shared devices, or where bandwidth is unstable. In fact, YouTube videos are watched more often outside of class due to limited internet access on campus. Explaining material through YouTube videos has become familiar to students since the COVID-19 pandemic, when learning has been conducted using a learning management system (LMS), and materials are presented, one of which is through videos. Although YouTube is easily accessible and well-known, its primary function as an entertainment platform may not entirely align with educational needs

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(Cho *et al*., 2023). Students may be distracted by recommended videos, ads, or notifications, factors that technically do not block access but can disrupt learning. This is because the YouTube platform gives users control over how ads appear.

A score of 87% can also represent the perception of accessibility, not a measure of usage behavior. Often, students do not report difficulties or enhance accessibility, especially when they do not want to appear less fortunate (Lijo *et al*., 2024). For a more accurate picture, usage logs, bandwidth analysis, or feedback can help uncover hidden barriers. In fact, looking at usage logs, the number of users accessing videos is higher than the number of participants. This indicates that students may access videos multiple times.

Overall, these findings are consistent with previous research that found that multimedia learning, particularly videos, enhances learning outcomes by supporting diverse learning styles and allowing repeated access to content. High scores for learning motivation indicate that the use of videos promotes engagement and is well-designed, thereby reducing cognitive load and maintaining attention (Mayer, 2021). The relatively strong rating for content clarity implies that the structure, narrative, and visual illustrations in the videos contribute to understanding, reinforcing the finding that video duration, clarity, and visuals are crucial for engagement and comprehension. Although the ease of access score was slightly lower, it still reflects a generally positive perception, indicating that most students did not experience significant technical difficulties. Overall, these results emphasize that YouTube videos, when well-structured and pedagogically designed, not only serve as easily accessible and engaging content but also as a catalyst for deep learning and self-regulated learning behaviors. This reinforces the recommendation for integrating educational technology to complement or enhance traditional teaching methods.

From a student's point of view, ease of access received the lowest average score among the four criteria evaluated: learning effectiveness, motivation, and clarity of content. While still within the favorable range, this relative decline suggests that technical or infrastructure issues may have hindered students' ability to engage optimally with video-based learning materials. These findings are in line with previous research that emphasizes that accessibility remains a significant barrier, especially in contexts where students have inconsistent internet connectivity, limited access to devices, or inadequate digital literacy (Sailer *et al*., 2021). These barriers are often more evident in low-resource settings, where bandwidth limitations or device compatibility issues can hinder smooth access to video content. Even well-designed videos can fail to achieve their full impact if students experience delays, buffering, or high data consumption, issues commonly associated with streaming platforms like YouTube. These technical disruptions not only diminish the learner experience but can also affect motivation and concentration, leading to reduced engagement with the material.

Furthermore, access issues are not merely technical; they are also contextual and sociocultural. The digital divide is not just about access to hardware and the internet, but also about differences in how individuals can use and benefit from digital resources in meaningful ways. Some students may not be familiar with using platforms like YouTube for learning purposes, or they may lack the skills to effectively integrate online learning into their study habits, which further exacerbates disparities in learning outcomes.

Therefore, relatively low scores on access indicate that even though the videos themselves are considered clear, motivating, and educationally effective, there are still unresolved structural and personal barriers related to digital access. These findings underscore the importance of not only designing high-quality educational media but also ensuring that all learners have fair access to the infrastructure, skills, and support needed to benefit from them. Addressing this gap is crucial if digital learning tools are to be truly inclusive and impactful.

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Overall, these findings emphasize the importance of diversifying learning strategies in statistics education, particularly to bridge the gap between theoretical understanding and technical skills. In learning that is procedural and requires digital literacy, visual media such as YouTube should not only serve as a supplementary resource but as a core strategy to support practice-oriented learning.

CONCLUSION

This study aims to determine the effectiveness and learning satisfaction in learning with YouTube-based videos. The results of the study indicate that the use of YouTube-based learning videos significantly improves statistical reasoning in educational statistics courses. The analysis results show a significant increase in scores from pretest to posttest, indicating that video-based learning strategies are effective in enhancing statistical reasoning skills. Additionally, from the affective aspect, students responded very positively to the use of learning videos, as reflected in the scores for perceived learning effectiveness, motivation, content clarity, and ease of access. This suggests that videos help not only in cognitive aspects but also in affective aspects.

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REFERENCES

Alpay, E., & Gulati, S. (2010). Student-led podcasting for engineering education. *European Journal of Engineering Education*, *35*(4), 415-427.

Athaya, A. M., Kusmiati, M., & Faturachman, M. A. (2024). The analysis of project-based learning models implementation on student motivation and learning achievement. *Curricula: Journal of Curriculum Development*, *3*(2), 347-362.

Bolliger, D. U., Supanakorn, S., & Boggs, C. (2010). Impact of podcasting on student motivation in the online learning environment. *Computers and Education*, *55*(2), 714-722.

Breslyn, W., & Green, A. E. (2022). Learning science with YouTube videos and the impacts of COVID-19. *Disciplinary and Interdisciplinary Science Education Research*, *4*(1), 1-20.

Chen, O., Retnowati, E., Chan, B. B. K. Y., & Kalyuga, S. (2023). The effect of worked examples on learning solution steps and knowledge transfer. *Educational Psychology*, *43*(8), 914-928.

Cho, T., Cho, T., Choi, H., Yang, S., & Zhang, H. (2023). User satisfaction study for sustainability of YouTube content quality: Focusing on ski technology. *Businesses 2023*, *3*(1), 114-128.

Darling-Hammond, L., Flook, L., Cook-Harvey, C., Barron, B., & Osher, D. (2020). Implications for educational practice of the science of learning and development. *Applied Developmental Science*, *24*(2), 97-140.

Drew, C. (2017). Edutaining audio: An exploration of education podcast design possibilities. *Educational Media International*, *54*(1), 48-62.

https://doi.org/10.64014/jik.v22i3.70

Duncan, J. (2025). Construction and use of mental models: Organizing principles for the science of brain and mind. *Neuropsychologia*, *207*(1), 1-10.

Elareshi, M., Habes, M., Youssef, E., Salloum, S. A., Alfaisal, R., & Ziani, A. (2022). SEM-ANN-based approach to understanding students' academic-performance adoption of YouTube for learning during COVID. *Heliyon*, *8*(4)*,* 1-10.

Fajriah, N. D., Mulyadi, D., & Hadiapurwa, A. (2021). An effective learning model when SBTJJ is implemented in a pandemic period for junior high school students. *Mimbar Pendidikan, 6*(1), 24-37.

Fan, E., Bower, M., & Siemon, J. (2024). Video tutorials in the traditional classroom: The effects on different types of cognitive load. *Technology, Knowledge and Learning*, *29*(4), 2017-2036.

Guy, J., & McNally, M. B. (2022). Ten key factors for making educational and instructional videos. *Scholarly and Research Communication*, *13*(2), 18-30.

Hadi, W., & Faradillah, A. (2020). Hambatan mahasiswa calon guru matematika dalam menyelesaikan masalah bermuatan higher order thinking skills. *Aksioma: Jurnal Program Studi Pendidikan Matematika*, *9*(3), 662-670.

Hill, J. L., & Nelson, A. (2011). New technology, new pedagogy? Employing video podcasts in learning and teaching about exotic ecosystems. *Environmental Education Research*, *17*(3), 393-408

Hokor, E. K., Mensah, J. Y., & Rodríguez-Alveal, F. (2023). Novice elementary teachers' probabilistic and statistical reasoning: Addressing misconceptions. *Journal of Educational Studies in Science and Mathematics*, *2*(1), 43-71.

Köse, E., Taşlıbeyaz, E., & Karaman, S. (2021). Classification of instructional videos. *Technology, Knowledge and Learning*, *26*(4), 1079-1109.

Kuhlmann, S. L., Plumley, R., Evans, Z., Bernacki, M. L., Greene, J. A., Hogan, K. A., Berro, M., Gates, K., & Panter, A. (2024). Students' active cognitive engagement with instructional videos predicts STEM learning. *Computers and Education*, *216*, 105-150.

Kurnia, A. B., Lowrie, T., & Patahuddin, S. M. (2024). The development of high school students' statistical literacy across grade level. *Mathematics Education Research Journal*, *36*(1), 7-35.

Lijo, R., Castro, J. J., & Quevedo, E. (2024). Comparing educational and dissemination videos in a STEM YouTube channel: A six-year data analysis. *Heliyon*, *10*(3), 1-10.

Lin, Y., & Yu, Z. (2023). A meta-analysis evaluating the effectiveness of instructional video technologies. *Technology, Knowledge and Learning*, *29*(4), 2081-2115.

Mayer, R. E. (2021). Evidence-based principles for how to design effective instructional videos. *Journal of Applied Research in Memory and Cognition*, *10*(2), 229-240.

Mayer, R. E., Fiorella, L., & Stull, A. (2020). Five ways to increase the effectiveness of instructional video. *Educational Technology Research and Development*, *68*(3), 837-852.

McClung, S., & Johnson, K. (2010). Examining the motives of podcast users. *Journal of Radio and Audio Media*, *17*(1), 82-95.

Muhidin, A., Wibawa, B., Khaerudin, Doriza, S., & Rahmadi, I. F. (2023). Probing scaffolding self-regulated learning responses, resources contribution and target achievements of university students in statistics course. *International Journal of Interactive Mobile Technologies (IJIM)*, *17*(17), 82-93.

https://doi.org/10.64014/jik.v22i3.70

Onwuegbuzie, A. J., & Wilson, V. A. (2023). Statistics anxiety: Nature, etiology, antecedents, effects, and treatments--a comprehensive review of the literature. *Teaching in Higher Education*, *8*(2), 195-209.

Reichardt, C. S., Storage, D., Garrido, E. F., Huff, S. T., Lloyd, E. P., Miller, P. C., & Reichmann-Decker, A. (2023). Teaching students to use statistical reasoning to debunk astrology. *College Teaching*, *42*(1), 30-47.

Reinhart, A., Evans, C., Luby, A., Orellana, J., Meyer, M., Wieczorek, J., Elliott, P., Burckhardt, P., & Nugent, R. (2022). Think-aloud interviews: A tool for exploring student statistical reasoning. *Journal of Statistics and Data Science Education*, *30*(2), 100-113.

Ridwan, R. S., Al-Aqsha, I., Rahmadini, G., Studi, P., & Pendidikan, T. (2021). Pemanfaatan media pembelajaran berbasis video dalam penyampaian konten pembelajaran. *Inovasi Kurikulum*, *18*(1), 38-53.

Ryan, R. M., & Deci, E. L. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions. *Contemporary Educational Psychology*, *61*(1), 60-71.

Sabiq, M., Surya, E., Napitupulu, E. E., & Napitupulu, E. (2025). Effect of problem-based learning model on critical thinking and Math learning motivation. *Inovasi Kurikulum*, *22*(3), 1285-1300.

Sailer, M., Murböck, J., & Fischer, F. (2021). Digital learning in schools: What does it take beyond digital technology?. *Teaching and Teacher Education*, *103*, 103-346.

Sarker, I. H. (2021). Data science and analytics: An overview from data-driven smart computing, decision-making and applications perspective. *SN Computer Science*, *2*(5), 1-22.

Saurabh, S., & Gautam, S. (2019). Modelling and statistical analysis of YouTube's educational videos: A channel Owner's perspective. *Computers and Education*, *128*(1), 145-158.

Schittek-Janda, M., Tani-Botticelli, A., Mattheos, N., Nebel, D., Wagner, A., Nattestad, A., & Attstrom, R. (2005). Computer-mediated instructional video: A randomised controlled trial comparing a sequential and a segmented instructional video in surgical hand wash. *European Journal of Dental Education*, *9*(2), 53-58.

Shi, Y., Wang, M., Chen, Z., Hou, G., Wang, Z., Zheng, Q., & Sun, J. (2024). The impacts of instructor's visual attention and lecture type on students' learning performance and perceptions. *Education and Information Technologies*, *29*(13), 16469-16497.

Solé-Llussà, A., Aguilar, D., & Ibáñez, M. (2021). Video worked examples to promote elementary students' science process skills: a fruit decomposition inquiry activity. *Journal of Biological Education*, *55*(4), 368-379.

Tani, M., Manuguerra, M., & Khan, S. (2022). Can videos affect learning outcomes? Evidence from an actual learning environment. *Educational Technology Research and Development*, *70*(5), 1675-1693.

Tanjung, A. I., Azhari, I., & Mursid, R. (2025). Development of video learning media based on history to improve social studies achievement. *Inovasi Kurikulum*, *22*(3), 1431-1446.

Tetteh, P. K., & Kankam, P. K. (2024). The role of social media in information dissemination to improve youth interactions. *Cogent Social Sciences*, *10*(1), 1-17.

https://doi.org/10.64014/jik.v22i3.70

Traphagan, T., Kucsera, J. V., & Kishi, K. (2010). Impact of class lecture webcasting on attendance and learning. *Educational Technology Research and Development*, *58*(1), 19-37.

Wut, T. M., & Wong, H. S. M. (2025). Students' perceived learning and satisfaction in using a statistical software by learner-generated video. *Technology, Knowledge and Learning*, *60*(2), 1-13.

https://doi.org/10.64014/jik.v22i3.70

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