ENHANCING STATISTICAL UNDERSTANDING: A COMPARATIVE EFFECTIVENESS ANALYSIS OF YOUTUBE AND E-MODULE IN SOCIAL SCIENCES

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Abstract:
This study aimed to test the effectiveness of using YouTube and e-modules for statistics learning for social science students enrolled in statistics courses. Statistics is often considered an abstract and difficult subject to understand, which can trigger anxiety and reduce students' learning motivation. A total of 31 students of the Islamic community development study program at UIN Sultan Maulana Hasanuddin participated in this study. Students were divided into one group that underwent two learning sessions: first, they studied frequency distribution material with YouTube learning media (audiovisual), and second, central measurement with e-module learning media (text-based), with a comparative quantitative approach evaluated through pretest and posttest. The results showed that both YouTube and e-modules were equally effective in improving students' understanding of statistics. However, 84% of students who used YouTube showed a significant increase in understanding, while only 68% showed an increase after using the e-module. The average increase in scores with YouTube was 13.81 points, higher than 4.77 points on the e-module. The paired sample t-test indicated that YouTube was significantly more effective than the e-module, with a p-value < 0.05. YouTube's advantages mainly lie in its visual and interactive features that help facilitate the understanding of abstract concepts in statistics. This study recommends integrating YouTube and e-modules to optimize statistics learning outcomes, especially in the social sciences.

Keywords: YouTube, E-module, Statistics Learning, Effectiveness, Frequency Distribution, Central Tendency Measure, Social Sciences

MENDALAMI STATISTIKA: ANALISIS PERBANDINGAN EFEKTIVITAS MEDIA PEMBELAJARAN YOUTUBE DAN E-MODUL PADA RUMPUN ILMU SOSIAL

Abstrak:
Tujuan dari penelitian ini adalah untuk menguji efektivitas penggunaan YouTube dan e-modul untuk pembelajaran statistika pada mahasiswa rumpun ilmu sosial yang

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terdaftar dalam mata kuliah statistika. Statistika sering kali dianggap sebagai mata kuliah yang abstrak dan sulit dipahami, yang dapat memicu kecemasan dan menurunkan motivasi belajar mahasiswa. Sebanyak 31 mahasiswa Program Studi Pengembangan Masyarakat Islam di UIN Sultan Maulana Hasanuddin berpartisipasi dalam penelitian ini. Mahasiswa dibagi menjadi satu kelompok yang menjalani dua sesi pembelajaran: pertama, mereka mempelajari materi distribusi frekuensi dengan media pembelajaran YouTube (audiovisual), dan kedua, ukuran pemusatan dengan media pembelajaran e-modul (berbasis teks), dengan pendekatan kuantitatif komparatif yang dievaluasi melalui pretest dan posttest. Hasil penelitian menunjukkan bahwa baik YouTube maupun e-modul sama-sama efektif dalam meningkatkan pemahaman mahasiswa terhadap statistika. Namun, 84% mahasiswa yang menggunakan YouTube menunjukkan peningkatan pemahaman yang signifikan, sementara hanya 68% yang menunjukkan peningkatan setelah menggunakan e-modul. Rata-rata peningkatan nilai dengan YouTube adalah 13,81 poin, lebih tinggi dibandingkan dengan 4,77 poin pada e-modul. Uji *paired sample t* mengindikasikan bahwa YouTube secara signifikan lebih efektif dibandingkan e-modul, dengan p-value < 0,05. Keunggulan YouTube terutama terletak pada fitur visual dan interaktif yang membantu memfasilitasi pemahaman terhadap konsep-konsep abstrak dalam statistika. Studi ini merekomendasikan integrasi antara YouTube dan e-modul untuk mengoptimalkan hasil belajar statistika, khususnya di bidang ilmu sosial.

Kata Kunci: YouTube, E-modul, Pembelajaran Statistika, Efektivitas, Distribusi Frekuensi, Ukuran Pemusatan, Ilmu Sosial

INTRODUCTION

Statistics is a branch of mathematics that is essential in various fields of science, especially in the social sciences. However, many students have difficulty understanding statistics, which is often considered a scary and difficult subject (Permatasari, Sari, Winanda, Saputra, Silvi, Annisa, & Fitriani, 2023). Research shows that many students find mathematics boring and scary (Indofah & Hasanudin, 2023). Research by Zaidan, Ismail, Yusof, and Kashefi (2012) found various misunderstandings in descriptive statistics among postgraduate students in social sciences. Overall, although more than 50% of students were able to answer some questions correctly, these results indicate a lack of statistical reasoning skills that pose a significant challenge in

understanding the basic concepts of descriptive statistics (Zaidan, Ismail, Yusof, & Kashefi, 2012).

Although the study from Berndt, Schmidt, Sailer, Fischer, Fischer, and Zottmann (2021) did not compare statistical understanding in medical, social sciences, and economics students, the results showed that social science students obtained the lowest test scores in both phases of the study. Statistics courses are often delivered in a way that is more appropriate for science or medicine, and therefore not contextual enough for the needs of social sciences (Berndt, Schmidt, Sailer, Fischer, Fischer, & Zottmann, 2021). This makes students feel that statistical material is not relevant to their studies, which can reduce their motivation and understanding. This negative view of mathematics has long been known in education, especially related to the phenomena of mathematics anxiety and statistics anxiety, which have been shown to affect students' academic performance (Baloglu, 1999; 2004). Zeidner (1991) found that statistics anxiety correlates with low mathematics achievement during school, which then continues to college. However, it cannot be denied that the efforts made by teachers in helping students understand statistical materials are extraordinary, this is demonstrated by Schoen, Rhoads, Perez, Jacobbe, and Li (2024) who developed an inquiry-based curriculum and provided intensive professional training for teachers.

Statistics anxiety has a significant impact on students' ability to master statistical concepts, which ultimately affects learning outcomes. A recent study confirmed that this level of anxiety has an impact on exam performance and formal assessment results (Hunt, Mari, Knibb, Christiansen, & Jones, 2023). In this context, educators need to develop more effective learning methods to address these challenges. Maravelakis (2019) emphasized the importance of adapting statistical learning techniques to the needs and context of social sciences so that they are more relevant to students.

In the digital era, platforms such as YouTube have proven effective in supporting learning. Research shows that YouTube can increase student motivation and engagement (Astriyani & Fajriani, 2020; Qonitatillah & Ramadani, 2022). Students at Kohat University of Science & Technology in Pakistan reported positive experiences in using YouTube for educational purposes (Khan, Saeed, Anwar, & Kanwal, 2023). Research by Permana, Sari, and Suhendra (2023) showed that learning statistics through YouTube is also effective, but this study did not specify the study program of the respondents.

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Meanwhile, e-modules have been shown to improve statistical understanding among students (Dzakwan, Murtinugraha, & Arthur, 2021).

However, most of this research has been conducted in science programs, where students generally demonstrate stronger abilities in mathematics and statistics than social science students. This difference underscores the need for tailored teaching methods to accommodate varying levels of ability, especially in the social sciences, where students often face greater challenges in mastering the material. Based on my experience as a lecturer teaching in social science programs, it is clear that many students have difficulty understanding basic mathematical concepts, which further hinders their understanding of statistics material. For social science students, statistics is often considered irrelevant and difficult, thus requiring a different approach. Cognitive Load Theory and Multimedia Learning Theory can be used as a basis for designing effective learning strategies. To prevent students from feeling overwhelmed with knowledge, Cognitive Load Theory highlights the importance of controlling cognitive load during the learning process, especially when dealing with complex subjects such as statistics (Sweller, Ayres, & Kalyuga, 2013). However, according to Multimedia Learning Theory, student understanding can be improved when information is presented using visual and aural components (Mayer, 2002).

Therefore, with the YouTube platform, teachers can utilize it in the learning process of statistical material. The results of a study conducted by Zhao, Zang, and Nie (2024) also provide significant support for this study, which shows that statistical cognitive abilities generally peak in the age range of 21 to 30 years. This finding underscores the importance of optimal education at this age range to maximize the development of statistical abilities.

In addition, the relevance of statistical learning in the context of job readiness cannot be overstated. As recent research on graduates of the Islamic Community Development (PMI) Study Program at UIN Sultan Maulana Hasanuddin Banten demonstrates, the length of job search is significantly influenced by academic factors such as GPA, duration of study, and work experience (Afifah, Rahmadhani, & Rifqi, 2024). This emphasizes that an important need for students, especially in social sciences, is to gain strong analytical skills including basic material in statistics courses. This will indirectly be useful in improving employability. According to Bandura's Social Cognitive Theory, developing these skills through observational learning (Yanuardianto, 2019). For example, learning through YouTube videos or

electronic modules, can increase self-efficacy and competence in statistical tasks. Given that the industry is increasingly dependent on data-based decision-making, social science students must be equipped with statistical knowledge to remain competitive in the job market.

This study aims to examine the effectiveness of statistics learning through two digital learning media, namely YouTube and e-modules, for social science students. YouTube with its visualization is expected to facilitate the understanding of abstract concepts, while e-modules provide deeper and more independent learning flexibility. This study is significant because it answers the challenges of learning statistics, an essential course that is often considered difficult and uninteresting by social science students. If the results of the study show that one of the media is more effective, then this finding can be a guideline for lecturers and educational institutions in choosing the right learning media. Thus, this study not only contributes to the development of more effective learning strategies but also helps improve students' academic performance in statistics courses.

METHODS

This study used a comparative quantitative design to evaluate and compare the effectiveness of two different instructional media: YouTube (audio-visual) and e-module (text-based).
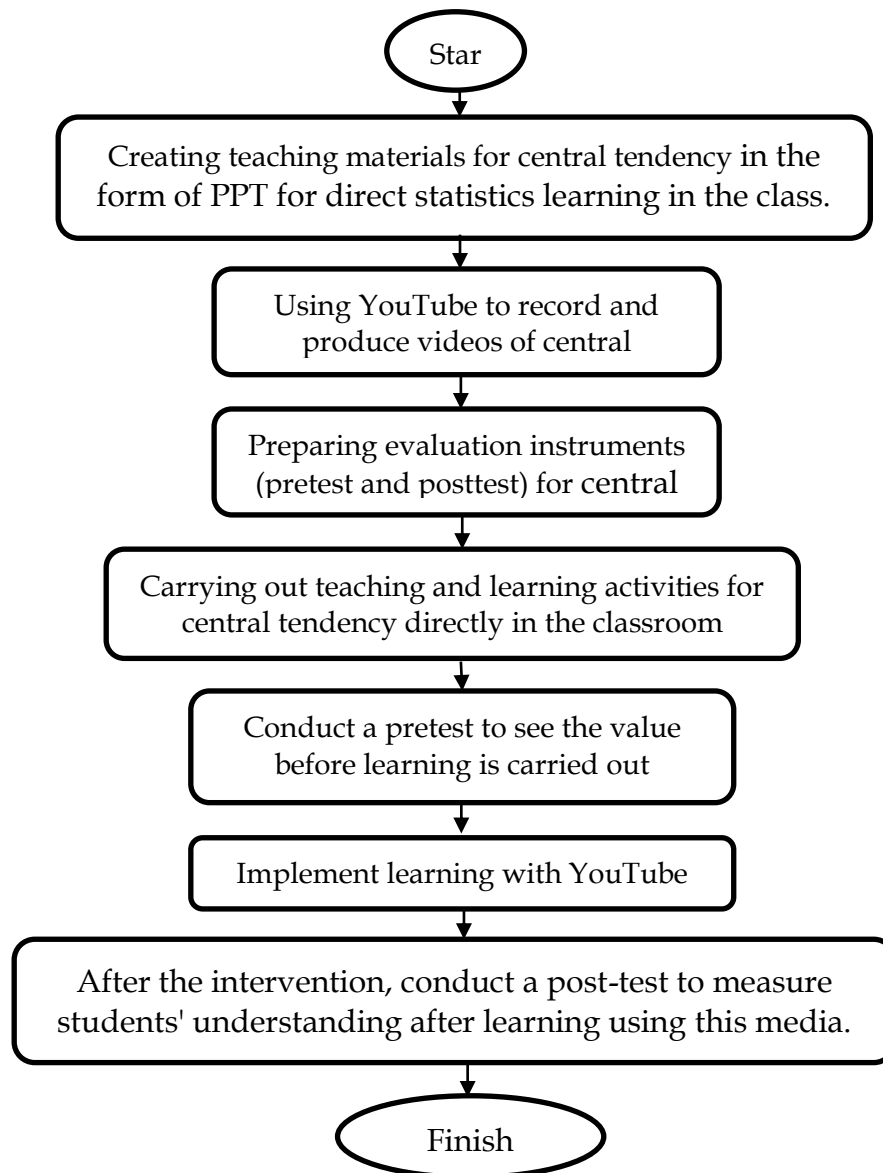
The population of this study comprised all students from the Faculty of Da'wah, UIN Sultan Maulana Hasanuddin, with a purposive stratified disproportionate sampling technique. The sample included 54 students from the Islamic Community Development (PMI) Study Program enrolled in a statistics course, but only 31 students completed both the pretest and posttest for the e-module and YouTube in full. Although this sample size may seem small, it is typical for experimental studies in educational research. According to Creswell, a sample size of between 20 and 50 participants is generally adequate for experimental designs in educational settings, especially when the study involves intensive pre- and post-intervention testing (Creswell & Creswell, 2018). In this study, the group of students taught using YouTube media and e-modules was the same, enabling a comparison of the effectiveness of both media. The YouTube group had 41 students, while the e-module group had 39. However, 31 students participated in both, forming the final sample for comparison. Each group experienced 4 meetings, which

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included direct classroom learning, a pretest, media-specific learning (YouTube or e-modules), and a posttest, totaling 8 meetings per student.

The research variables are divided into independent variables and dependent variables. The independent variables consist of two learning methods, namely statistics learning through YouTube (X1) and statistics learning through e-modules (X2). The dependent variables include the pretest value (Y1) and post-test value (Y2) of statistics learning for each media, which measures students' understanding before and after the intervention. The following is a research flow chart below.
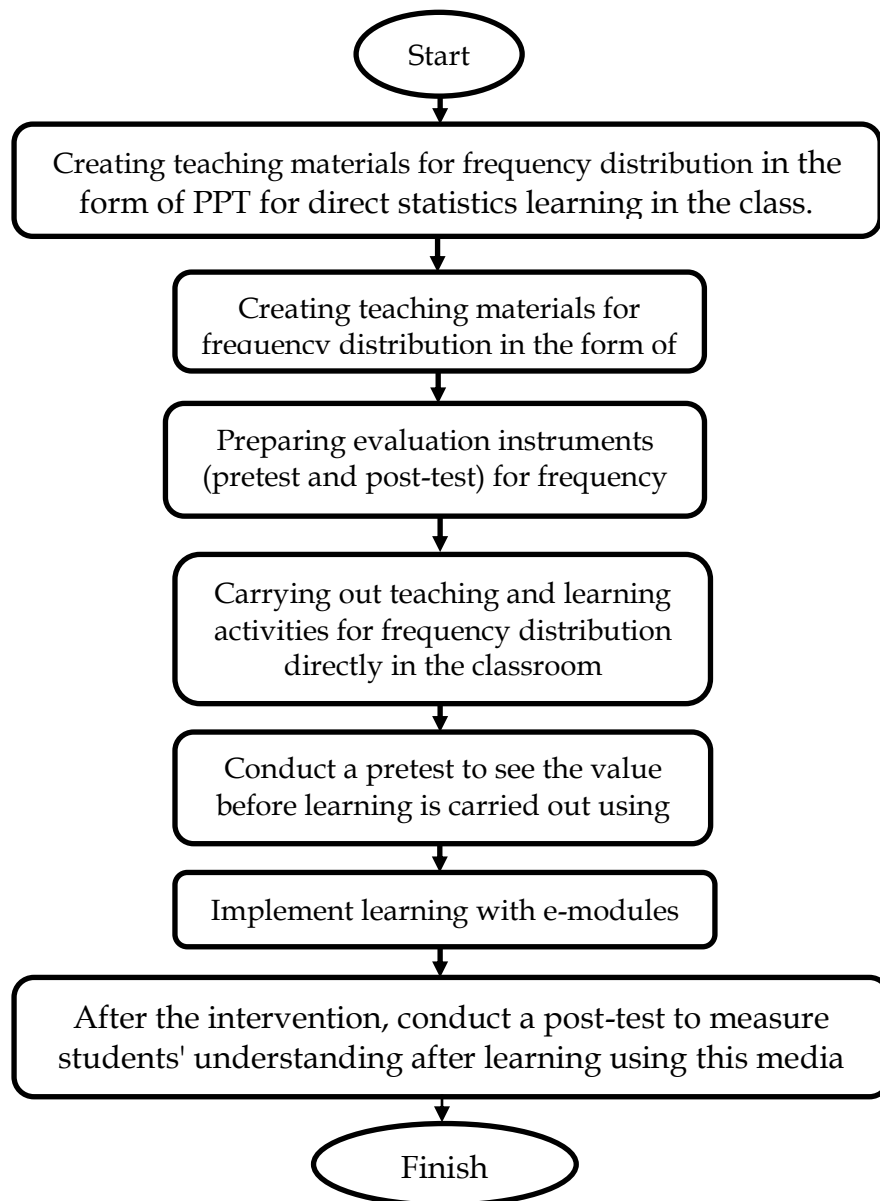
Figure 1. The Flowchart of Research for E-Module

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                           ┌─────────┐
                           │  Star   │
                           └─────────┘
                                │
    ┌────────────────────────────────────────────────────┐
    │  Creating teaching materials for central tendency   │
    │  in the form of PPT for direct statistics learning  │
    │  in the class.                                      │
    └────────────────────────────────────────────────────┘
                                │
        ┌───────────────────────────────────────┐
        │  Using YouTube to record and          │
        │  produce videos of central            │
        └───────────────────────────────────────┘
                                │
        ┌───────────────────────────────────────┐
        │  Preparing evaluation instruments     │
        │  (pretest and posttest) for central   │
        └───────────────────────────────────────┘
                                │
    ┌────────────────────────────────────────────────────┐
    │  Carrying out teaching and learning activities for  │
    │  central tendency directly in the classroom         │
    └────────────────────────────────────────────────────┘
                                │
        ┌───────────────────────────────────────┐
        │  Conduct a pretest to see the value   │
        │  before learning is carried out       │
        └───────────────────────────────────────┘
                                │
        ┌───────────────────────────────────────┐
        │  Implement learning with YouTube      │
        └───────────────────────────────────────┘
                                │
    ┌────────────────────────────────────────────────────┐
    │  After the intervention, conduct a post-test to     │
    │  measure students' understanding after learning     │
    │  using this media.                                  │
    └────────────────────────────────────────────────────┘
                                │
                           ┌─────────┐
                           │ Finish  │
                           └─────────┘
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Figure 2. The Flowchart of Research for YouTube

Subsequently, both were analyzed using a paired sample t-test to determine whether the e-module is effective in learning statistics courses and whether YouTube is effective in learning statistics courses. Then, analyze the pretest and post-test data using a paired sample t-test to determine which is more effective in learning statistics between e-modules and YouTube in the social sciences group.

The pretest and posttest of each material were designed with 15 questions consisting of multiple choice and essay. These questions were

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developed based on competency indicators that students must master in statistics courses, referring to the applicable curriculum and syllabus. Before being used, this instrument was tested for validity and reliability using the Pearson Correlation and Cronbach's Alpha formulas. The results of the analysis showed that out of 17 questions on the frequency distribution material, 15 questions had pretest and posttest validity values of less than 0.05 and reliability reached 0.839, indicating that the instrument was suitable for use. Meanwhile, out of 18 questions on the central measurement material, 15 questions had pretest and posttest validity values of less than 0.05 and reliability reached 0.783, indicating that the instrument was suitable for use (Sugiyono, 2019).

The hypothesis of this study is:

(1) $Cap\ H_0$: There is no significant difference between learning statistics using YouTube media and learning statistics using e-module media in the social sciences.

(2) $Cap\ H_1$: There is a significant difference between learning statistics using YouTube media and learning statistics using e-module media in the social sciences.

Data analysis was performed using SPSS version 25. Paired sample t-test was used to analyze significant differences between pretest and post-test scores in each group. Paired sample t-test formula (Lind, Marchal, & Wathen, 2021):

$$t = \frac{\bar{d}}{Sd/\sqrt{n}} \tag{1}$$

With df = $n - 1$, and
$\bar{d}$ is the average difference between paired observations.
$Cap S_d$ is the standard deviation of the difference between paired observations
n is the number of paired observations.

RESULTS AND DISCUSSION

Before the inferential test was conducted, a descriptive test was conducted first to see the picture of the increase in scores on both learning media.

1. Descriptive Test of Pretest and Posttest Scores

The results of the descriptive analysis showed that 31 students who participated in this study consisted of 19 female students and 12 male

students. Table 1 presents the average pretest and posttest scores for both media groups.

Table 1. The Results of the pretest and posttest scores

Media Learning	Mean Pretest	Mean Posttest	Significance
E-module	27.00	31.77	4.77
YouTube	27.03	40.84	13.81

The mean pretest score for the E-Module was 27.00, which increased to 31.77 in the posttest, indicating a significant improvement in understanding the subject matter. Similarly, the mean pretest score for YouTube was 27.03, which rose to 40.84 after the intervention. This suggests that both media effectively enhanced students' comprehension of statistics.

In addition, a graph is provided showing the level of improvement between the pretest and posttest.
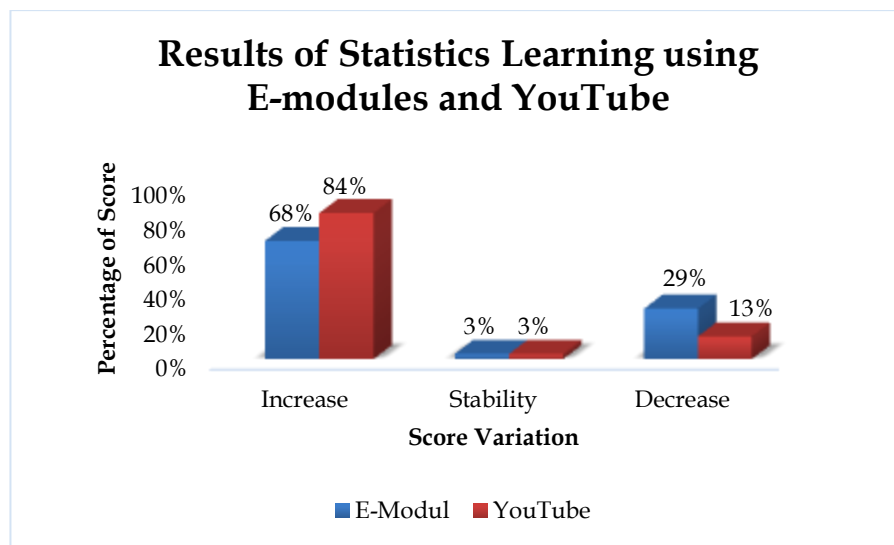
Figure 3. The Comparison of Pretest and Posttest Score of Statistics Learning Using E-Modules and YouTube

It can be seen in figure 3 that in statistics learning with YouTube, looks superior. As many as 84% of students experienced an increase in grades, while 68% in e-module learning. In both e-modules and YouTube, there are a small number of students whose grades remain the same (no change in posttest scores), namely 3%. There are even some students who experienced a decrease in grades after learning through e-modules or YouTube.

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2. Normality Test

The normality test was performed using Shapiro-Wilk because the data was below 50 (Elliott & Woodward, 2007). If the results of the normality test indicate that the data is normally distributed, then the paired sample t-test is continued. However, if the data is not normally distributed, the Wilcoxon signed rank test is performed (Lind, Marchal, & Wathen, 2021).

Table 2. The Results of the pretest and posttest scores

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	df	Sig.
Pretest_E-Modul	0.110	31	0.200	0.968	31	0.471
Posttest_E-Modul	0.146	31	0.089	0.960	31	0.292
Pretest_YouTube	0.087	31	0.200	0.970	31	0.514
Pretest_YouTube	0.113	31	0.200	0.957	31	0.243

Based on these two normality tests, all data can be considered normally distributed because the significance value (sig.) is greater than 0.05. This indicates that the normality assumption is met for the four data groups. Because the data is normally distributed, the next test that will be used is the paired sample t-test.

3. Effectiveness of Statistics Learning through E-Modules and YouTube Media

Based on the output of the paired sample t-test.

Table 3. Paired Samples Test

	Mean	Std. Deviation	t	df	Sig. (2 – tailed)
Pretest E-Module * Posttest E-Module	-4.774	8.613	-3.086	30	0.004
Pretest YouTube * Posttest YouTube	-13.806	13.908	-5.527	30	0.000

For the e-module media, the t-test value of -3.086 and p-value of 0.004 confirm the statistical significance of this improvement. In contrast, for the YouTube media, a paired-sample t-test yielded a t-value of -5.527 and a p-value of 0.000, confirming the significance of this improvement.

Table 4. Paired Samples Correlation

	Correlation	Sig.
Pretest E-Module * Posttest E-Module	0.520	0.003
Pretest YouTube * Posttest YouTube	0.424	0.018

In addition, a significant correlation between pretest and posttest scores (r = 0.520, p = 0.003) suggests that students with a stronger prior understanding of statistics benefited more from the e-module. This highlights the importance of tailoring the e-module to accommodate varying levels of prior knowledge and providing additional support for students with lower initial understanding. For the YouTube media, the correlation value of 0.424 with a p-value of 0.018 indicates a moderate positive relationship between the pretest and post-test scores. This means that students with a better initial understanding of statistics tend to show greater improvement after using YouTube for learning. This significant correlation suggests that students with a stronger foundational knowledge are more likely to effectively engage with and benefit from YouTube content.

4. Comparison of the Effectiveness of Statistics Learning through E-Modules and YouTube

Table 5. Paired Samples Test

	Mean	Std. Deviation	t	df	Sig. (2 – tailed)
Posttest - Pretest E-Modul * Posttest - Pretest YouTube	-9.032	17.802	-2.948	30	0.006

A paired t-test (t = -2.948, p = 0.006) showed that the difference between the two methods was statistically significant, indicating that YouTube offered superior learning outcomes in this context. However, the standard deviation of the post-test results in the YouTube group (SD = 13.908) was greater than that of the e-module group (SD = 8.613), indicating greater variability in student performance.

Table 6. Paired Samples Correlation

	Correlation	Sig.
Posttest - Pretest E-Module * Posttest - Pretest YouTube	-0.098	0.600

Interestingly, the correlation analysis between the pretest and posttest differences for both methods (r = -0.098, p = 0.600) did not show a significant relationship, meaning that improvement in one method did not predict improvement in the other. This suggests that YouTube and e-modules serve different learning needs. YouTube is most effective for enhancing understanding of abstract concepts that are more visual, whereas e-modules may be better suited to reinforcing basic knowledge more consistently.

5. Discussion of Results Interpretation

a. Discussion on the effectiveness of the e-module media

The e-module consists of 8 pages covering one of the basic topics in statistics, namely frequency distribution. Students reported that they read the e-module twice on average, although a small number admitted to not completing the module in its entirety. This limited engagement may explain the relatively small improvement in post-test scores. The lower standard deviation of the post-test results (SD = 7.911) suggests that although the e-module did not provide dramatic improvements, it did provide more consistent results across students.

This very small increase implies that e-modules may not have the dynamic and interactive components needed to foster a deeper understanding of difficult subjects, even though they help to review basic knowledge. Students who prefer controlled learning may benefit from the self-paced nature of e-modules, while those who struggle with motivation or self-regulation may find the lack of interaction or real-time feedback a drawback. The results of this study are consistent with those of Dzakwan, Murtinugraha, and Arthur (2021), who showed that the use of e-modules improved statistical learning. In addition, this study is supported by Hidayanti, Saluky, and Misri (2017), who stated that learning modules are not only effective but also able to increase motivation to learn statistics.

b. Discussion on the effectiveness of YouTube media

YouTube increased scores by an average of 13.81 points. The findings of Permana, Sari, and Suhendra (2023) who demonstrated that learning statistics via YouTube was successful with an average increase of 13.17, are likewise consistent with the findings of this study. The YouTube videos used in the study were 23.55 minutes long. However, student engagement with the videos varied significantly. Most students reported watching only 5-10 minutes per session, splitting their viewing time across multiple sessions. While this

engagement was not entirely optimal, the significant increase in post-test scores suggests that even when exposed to video content was incomplete, it still had a positive impact on student learning. This highlights the power of YouTube in conveying complex concepts through visual and audiovisual elements, which is particularly effective in simplifying abstract statistical topics.

Furthermore, the large standard deviations also suggest that YouTube's effectiveness may depend on the level of student engagement and individual learning preferences. Some students who watched the full video gained greater understanding than those who watched only a portion of it, and the gains in understanding were different. This suggests that YouTube's interactivity and visual appeal can enhance learning outcomes, but additional strategies may be needed to ensure consistent engagement for all students.

The study by Noh, Yusoff, and Yusoff (2015) who research blended learning supports this point of view. According to the study, students are better able to understand difficult statistical concepts through blended learning than through traditional techniques. Learning outcomes improve as a result of increased student motivation and engagement. It has been proven that blended learning, which combines video information with traditional learning modules, encourages a deeper understanding of the subject matter and active engagement (Noh, Yusoff, & Yusoff, 2015; Rohana, Sukasno, & Purwasi, 2019). Hendrayati and Pamungkas (2016) also successfully used hybrid learning in statistics education.

Thus, YouTube can be stated as an effective medium for learning statistics in the social sciences, especially in facilitating the understanding of more abstract and complex materials. This is also supported by previous studies which show that students are more motivated, enthusiastic, and active if learning is carried out using YouTube media (Astriyani & Fajriani, 2020; Qonitatillah & Ramadani, 2022).

c. Discussion on comparison of the effectiveness of e-module and YouTube media

The standard deviation of the YouTube group's post-test results (SD = 13.908) was higher than that of the e-module group (SD = 8.613), indicating that student performance was more variable. This implies that although YouTube had a more significant overall effect, students' experiences with it varied greatly in terms of effectiveness. This variation may be due to variations

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in how students engaged with the video material; as indicated earlier, some students watched the YouTube learning videos multiple times, while others only watched part of them. In contrast, the self-study e-module produced more consistent results with less variation in scores. This could be because the e-module was more structured and allowed students to progress through the material at their own pace, resulting in a more reliable learning experience. However, the smaller mean score increases suggest that while e-modules are effective for basic learning, they may not provide the same level of cognitive engagement or conceptual clarity as YouTube's visual and interactive format.

These findings have significant implications for statistics learning in the social sciences. YouTube's superiority in enhancing student understanding is supported by Multimedia Learning Theory Mayer (2002), which states that the use of visual and auditory media together facilitates understanding of complex material. The abstract visualizations provided by YouTube help reduce cognitive overload, as explained by Cognitive Load Theory (Sweller, Ayres, & Kalyuga, 2013). Lecturers are advised to combine YouTube media with e-modules so that learning can involve more visual and verbal aspects and provide flexibility for independent learning.

These findings are in line with previous research showing that academic achievement, such as GPA, length of study, and work experiences have a significant impact on the job search duration of PMI at UIN Sultan Maulana Hasanuddin Banten graduates (Afifah, Rahmadhani, & Rifqi, 2024). Using YouTube and e-modules as media for learning statistics has been proven to improve their understanding of statistics, this aims to make students better prepared to face challenges in the job market, especially in sectors that require data analysis skills and accelerate getting a job when they graduate later.

Furthermore, it should be noted that, based on the researcher's experience as a lecturer, statistics courses often have a negative impact on students' GPA. This is similar to research conducted by Zaidan, Ismail, Yusof, and Kashefi (2012), that social science students, including postgraduates, often have difficulty with statistics. Therefore, innovative learning methods, as explored in this study, have been shown to improve their understanding of statistics. This result is expected to not only help improve students' GPA but also make it easier for them to get jobs. This finding highlights the importance of developing more effective learning strategies to improve the competitiveness of social science graduates in the job market.

6. Evaluation of The Results of Statistical Learning Interventions Both Through E-Module and YouTube Media

a. Math anxiety and its impact on statistics learning

Math anxiety is one of the main obstacles in statistics learning among social science students, who generally tend to avoid courses involving mathematics. This condition causes fear and anxiety that can affect concentration and information-processing abilities (Baloglu, 2004; Hunt, Mari, Knibb, Christiansen, & Jones, 2023; Zeidner, 1991). While this study did not explicitly measure math anxiety, the phenomenon was evident in students' responses during the learning process. Students with math anxiety showed greater difficulty in understanding the material, which resulted in lower learning outcomes. Therefore, in the future, the evaluation of statistics learning can be enriched with a more in-depth assessment of the role of math anxiety and strategies to overcome it, such as a more supportive pedagogical approach and reducing stress when dealing with numbers.

b. Lack of interest in the material and relationship to the application context

One of the main obstacles in learning statistics is the lack of relevance that students feel towards the material, especially when concepts such as frequency distributions and measures of central tendency are presented theoretically without clear applications in the social sciences. The results of the study showed that although there was an increase in post-test scores, some students showed stagnation or even decline. This indicates that interest and motivation towards the material play an important role in successful learning. Suggestions that can be given to increase student interest include introducing case studies and example problems that are relevant to contemporary social issues (Berndt, Schmidt, Sailer, Fischer, Fischer, & Zottmann, 2021). This can make it easier for students to see how statistics can be applied practically, which has the potential to increase their understanding and interest in the course.

c. YouTube video length and its impact on student focus

The duration of learning content via YouTube, which averaged 23.55 minutes in this study, was considered too long by most students, who reported losing focus after a few minutes of watching. The results of this study are supported by research by Mega, Nissa, and Nugraha (2020) which revealed that the optimal video duration on YouTube is between 6 and 10 minutes. Shorter and more interesting learning video durations are recommended to

increase their effectiveness. To maintain the flow of knowledge, it is very important to ensure that video separation does not disrupt the continuity of the content.

d. Distractions during learning and their implications for the effectiveness of learning media

The biggest obstacle experienced by students when learning through YouTube and e-modules is distractions, especially those caused by notifications from social networking applications. According to Zivcakova (2011), working on multiple tasks at once while using social media during the learning process reduces the quality of learning. According to this study, many students have difficulty concentrating when using both media, which shortens their learning time. Applications that limit notifications are one type of supporting technology that can be used as an intervention to overcome this problem. Students should also be encouraged to avoid external distractions and provide a supportive learning environment.

CONCLUSION

Based on these findings, YouTube and e-modules are both proven effective tools for improving students' understanding of statistics, particularly in the social sciences. Although research suggests that YouTube is more effective than e-modules, each has its unique strengths and weaknesses. YouTube's dynamic and visual content is highly effective in driving significant learning gains, although its success is somewhat dependent on student engagement. E-modules offer a more structured and consistent learning experience, making them valuable for reinforcing basic concepts. To maximize learning outcomes, a blended approach that combines the strengths of both media, using e-modules for basic knowledge and YouTube for more complex and abstract topics, is expected to provide the most comprehensive learning experience for students in the social sciences. Although this study showed positive results, some limitations need to be acknowledged. The relatively small sample size and limited diversity in the student population limit the generalizability of the results of this study. In addition, student engagement with YouTube videos varied, with some students watching the entire video while others only watched part of it. Future research should further explore the effectiveness of YouTube at different levels of student engagement and motivation, as well as assess whether the use of more dynamic interactive e-

modules can further enhance comprehension. Long-term research is also recommended to assess long-term knowledge retention from both media.

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