Video explainer, e-module, or both: which is better to improve statistics performance of graduate students?

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ABSTRACT

Technology is an essential component of modern education, and teachers use various types of technology to improve classroom performance. Meanwhile, statistics is one of the seemingly difficult courses according to students across levels. This study experimental aimed to determine if video explainer and e-module improve students' performance in statistics. There were 78 graduate school students participated and used video explainer, e-module, or both as an intervention. A 100-item performance test in statistics was used. The statistical techniques employed were mean, standard deviation and analysis of covariance (ANCOVA). Results revealed that students' pre-test performance was "average". Additionally, their posttest performance was "high", regardless of the intervention utilized. Significant differences emerged between groups who utilized both video explainer and e-module and those who used simply video explainer or e-module. Video explainer and e-modules should be integrated carefully into the instruction, helping graduate students develop a solid understanding of statistics. The results of the study suggest that studying statistics is more successful when one uses these interventions because it integrates visuals, audio, real-world applications, accessibility and flexibility towards various learning styles. Learning stakeholders should cooperate to ensure seamless integration of these materials into the curriculum and provide ample support to educators in generating and managing content.

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1. INTRODUCTION

Technology and education work together in the modern education system. Contrary to the conventional way of delivering instruction, education today has evolved into its new form which significantly functions better with technology. This evolution of the world's education system has considerably aided in the most recent dilemma the world faced.

The coronavirus disease (COVID-19) was the worst interruption to educational systems in human history. Nearly 1.6 billion students in more than 200 nations have been affected by the terrible effects of this infectious disease. After introducing social segregation measures, a string of lockdowns, and limited movement regulations, several schools, training centers, and higher education facilities worldwide stopped operating. Additionally, almost 94% of the world's student population has been harmed by the closing of educational institutions [1].

As a result, educational leaders took measures such as the shift from face-to-face learning in class to virtual class with an e-learning system. They put them into action to adjust to the changes brought about by the new normal in education [2]. According to Muller and Faltin [3] and Nussbaumer *et al*. [4], e-learning is an electronic learning approach supported by the internet and the use of digital platforms and tools like computers, laptops, tablets, or smartphones. Therefore, materials for electronic learning also support electronic learning [5].

In recent years, education has witnessed a significant transformation with technology integration into traditional teaching methods. One such innovation that has gained prominence is using video explainers and e-modules in various academic disciplines. Given its importance in academic and research settings, statistics has also welcomed this technological change.

Statistics is a fundamental component of many graduate-level programs, it serves as the backbone of most quantitative research. However, statistics courses are often perceived as difficult [6]–[8] due to their abstract nature, complex concepts, and reliance on mathematical foundations [9]. Considering the importance of statistics in research and in academic growth, it is an urgent concern to examine this perception and find ways to propose a solution. As a result, educators have sought innovative ways such as making use of video explainer and e-module to bridge the gap between these challenging concepts and students' comprehension.

The term "video explainer" in statistics refers to using instructional videos to teach graduate students' statistical topics and procedures. These videos serve as the alternative method of instruction in online courses because they were created and developed using instructional design concepts. Learners' views on the overall course efficacy and their learning experience are highly impacted by the effectiveness of video lessons in online courses. According to research done with graduate students, a positive overall learning experience was strongly correlated with the student's satisfaction with the instructional videos [10]. The success of a course cannot, however, be ensured by the quality of its course videos alone. According to Ou *et al*. [10], courses that employ videos with poor production values and poor design are more likely to obtain low student evaluation scores.

Numerous academic fields, including physics, mathematics, and foreign languages, have examined how instructional videos affect student participation and performance. For instance, it has been shown that utilizing instructional videos with embedded quiz questions increased student achievement compared to videos with quiz questions [11] in a physics course for undergraduates. Similarly, using movies to teach listening improves learners' listening skills in an elementary school context [12]. Also, virtual lab demonstrations via films were found to improve students' mastery of fundamental laboratory practices in the setting of biology [13]. Finally, more learners benefit from video courses in statistics since they are kept on an external device that can be inserted into their mobile phone or other suitable device and viewed at any time without an internet connection. They may study and understand the teachings at their own pace and in their own environment [14].

In contrast, e-modules are digital instructional materials or learning media that promote active learning. E-modules simplify the transfer of knowledge from professors to students while also introducing a level of participation by harmonizing with current technology breakthroughs. In addition to textual material, multimedia features such as movies, music, and short films play an important part in delivering information in e-modules [15]. An effective e-module should be self-instructional, freestanding, adaptable, and user-friendly [16]. When strategically designed with students' requirements in mind and presented in an interesting manner, e-modules can serve as the primary teaching tool, reducing student boredom during the learning process [17].

Numerous studies by other researchers have explored the benefits of e-modules. For instance, Nabayra [18] developed mathematics e-modules that captured students' interest, facilitating effective and responsive learning. Sagge and Divinagracia [16] found that their e-module was well-suited to help learners quickly grasp Basic Calculus concepts. Tamrongkunanan and Tanitteerapan [19] created online programs that positively impacted students' academic performance, while Sofyan *et al.* [20] designed e-modules based on local wisdom. Aprilia and Suryadarma [21] utilized e-modules to enhance self-regulated learning, and Hill *et al.* [22] researched the impact of online learning modules on conceptual understanding. Asrial *et al.* [17] developed an ethnoconstructivism e-module to increase students' motivation, interest, and perception.

The integration of video explainers and e-modules in education has the potential to revolutionize how students engage with and comprehend subjects. By harnessing the benefits of visual and auditory learning, interactivity, and flexibility, educators can elevate student performance, foster a deeper conceptual understanding of statistics, and prepare students for successful careers in research and academia. This suggests that the pandemic, while posing challenges to society, has also opened up possibilities for institutions to experiment with new learning modalities. Consequently, this study aims to investigate the effect of using video explainers and e-modules in statistics to enhance the performance of graduate school students.

The purpose of this study was to evaluate and determine the effect of using both video explainer and e-module interventions on the academic performance of graduate students studying statistics. The major goal was to determine how various teaching strategies affected students' understanding, engagement, and overall performance in the subject area. By delving into the comparative analysis of video explainer and e-module approaches, the study aimed to provide valuable insights into effective pedagogical strategies for enhancing statistical education at the graduate level. This study specifically tried to answer the following questions:

- How do students' performance levels in statistics compare before and after exposure to i) a video explainer, ii) an e-module, and iii) both a video explainer and an e-module?
- Is there significant difference in students' posttest performance in statistics exposed to i) video explainer, ii) e-module, and iii) both video explainer and e-module when controlling the pretest?

2. METHOD

2.1. Research design

The objective of this research was to assess the impact of a video explainer and an e-module on the statistics performance of graduate students. To achieve this objective, the researcher employed an experimental approach, specifically adopting a multiple-group design. As defined by Davis and Smith [23], a multiple-group design is an experimental design that compares three or more levels or quantities of an independent variable. Unlike a design that necessitates a control group, a multiple-group design can consist entirely of experimental groups. Additionally, the researcher ensured that: i) participants were matched based on a characteristic that could influence their performance in the dependent variable; ii) each participant engaged in the treatment condition; and iii) the size of the natural sets being examined was taken into consideration. Figure 1 illustrates the design implemented by the researcher to meet the specified criteria. Pretest results were utilized to confirm the equivalence of the three groups. The allocation of intervention to each group was randomly determined using a lottery drawing system.

Section		Intervention	
MAEd-1A	Pretest	Video Explainer	Posttest
MAEd-1B	Pretest	e-module	Posttest
MAEd-1C	Pretest	Both	Posttest

Figure 1. Research design paradigm

2.2. Participants

Initially, all the 89 students from the three intact sections were pretested as to the level of their performance in statistics. The three sections that participated were: masters of arts in education (MAEd)-1A with 28 students, MAEd-1B with 30 students, and MAEd-1C with 31 students. The final participants were 78 MAEd; specifically, 26 students for each class. Sampling size was determined using the Cochran formula set at 99% confidence level. Cohen *et al*. [24] recommend a minimum of 15 participants in experimental research. Furthermore, in accordance with Gall *et al*. [25] recommendations, a balanced distribution of at least fifteen participants in both the control and experimental groups is required. This method not only conforms to accepted standards, but it also improves the reliability and validity of your comparisons. In addition, the 26 participants in each group were picked via a thorough match-pairing process based on their pretest performance to satisfy the conditions of analysis of covariance (ANCOVA). Using one-way analysis of variance (ANOVA), the pretest results showed that the three groups were equivalent, with no significant differences in pretest performance [$F(2,75)=1.435$; $p=0.245>0.05$] which satisfy the conditions for experimental research.

To avoid internal and external validity issues, the researchers ordered the students not to write their names; instead, researcher requested a research assistant to randomly assign them their individual examinee number throughout the pretest and posttest. As a result, their identities were not divulged in relation to their findings during the research method. Furthermore, classes in each of the three sections chosen were all scheduled in the morning to decrease the influence of extraneous factors. Participants who were delinquent, including their pair, were also removed.

2.3. Data gathering instrument

Statistics performance test. The research instrument used in this study is a researcher-made test based on the graduate school statistics course syllabus. The test has 100 multiple-choice questions about major topics such as introduction to statistics, descriptive statistics, inferential statistics, and hypothesis testing. Each question has been meticulously crafted to align with the comprehensive coverage of the subject matter. The validity and reliability of the test used was ensured through expert validation and reliability testing, respectively. Five validators who are faculty of West Visayas State University–Integrated Laboratory School and College of Arts and Sciences, validated the questionnaire. Revisions and improvements in the instruments were made based on the validation results.

In addition, the test also underwent reliability test using the Kuder-Richardson 20 (KR 20) formula and revealed a reliability coefficient of 0.7512 indicating that the test is reliable. In this instrument, each of the correct answers was given a score of 1. The accumulated scores from the multiple-choice type were interpreted as follows: 80.01–100.00 "very high", 60.01–80.00 "high", 41.01–60.00 "average", 20.01–40.00 "low", and 0.00–20.00 "very low".

2.4. Procedure and intervention

To change the traditional method of instruction, the researcher wanted to make use of technology in teaching statistics among graduate students. The teacher must adapt different strategies of teaching to suit the needs of the students. There are no single correct ways to teach a particular set of students in a class [26]. For this reason, the researcher employs the use of video explainer and an e-module as an intervention to determine if this contributes to the improvement of students' performance in Statistics. Before the start of the experiment, a pretest was given first. Then the group was randomly assigned to one of the interventions. Permission to conduct the study as well as consent form were also secured in this stage.

The intervention lasted six weeks, from January 29 to March 16, 2023. All classes were supplemented by a video explainer, an e-module, or a mix of the two, depending on the intervention assignment. Statistics lessons were held on Saturdays for three hours at the university where the researcher teaches. Throughout the class, the researcher served as facilitator, guiding and monitoring students' performance. The students were given the identical topic, quiz, chapter test, and assignment. The sole difference between them is the type of intervention utilized. After six weeks of intervention, the groups are given a posttest to see if the graduate school student's performance improved.

This study's statistical techniques included the use of mean and standard deviation for descriptive statistics. In the field of inferential statistics, the researchers chose to use one-way ANCOVA. To guarantee the accuracy of the statistical analyses, careful attention was given to ensuring that all of the underlying assumptions of one-way ANCOVA were rigorously satisfied prior to implementation. This rigorous methodology demonstrates the study's dedication to ensuring the integrity and trustworthiness of its findings.

3. RESULTS AND DISCUSSION

3.1. Levels of students' performance in statistics

Table 1 shows the pretest performance of graduate school students based on the type of intervention they were given: video explainer, e-module, or both video explainer and e-module. Students that were given video explainers received a mean score of 43.92. The standard deviation (SD) is 4.09, suggesting that the results in this group are near to the mean. This shows that students who received the video explainer obtained a relatively consistent performance. In addition, the average score for students who used the e-module is 44.85. The SD is 3.34, which is lower than that of the group that used video explainers. This suggests that students in this group scored somewhat higher on average than students in the video explainer group, and their results were more uniform and more clustered around the mean. Finally, students who got both the video explanation and the e-module achieved a mean score of 42.69. The SD is 5.97, which is more than the SD of the other two groups. This shows that students who used both teaching resources had higher variety in their results, and their average score was slightly lower than the other two groups. The pre-test results further show that all three groups show "average" performance. This suggests that students in each group performed similarly on average, with no group surpassing the others in terms of performance level. The observation of students doing averagely in statistics highlights the importance of ongoing attempts to enhance teaching and learning approaches in this subject. Students can better manage the difficulties offered by statistics and understand its value in varied academic and professional courses by addressing the root causes and offering assistance and motivation.

Table 1. Pretest and posttest scores in statistics of graduate school students

	Pretest				Posttest			
	N	SD	M	Interpretation	N	SD	M	Interpretation
Video explainer	26	4.09	43.92	Average	26	9.00	69.46	High
e-module	26	3.34	44.85	Average	26	10.54	66.38	High
Both video explainer and e-module	26	5.97	42.69	Average	26	6.16	78.23	High

Note: 100.00-80.01 "very high", 80.00-60.01 "high", 60.00-40.01 "average", 40.00-20.01 "low", 20.00-0.00 "very low"

In the post-test, the group that used both the video explainer and the e-module (combination of two interventions) obtained the highest mean score (78.23), indicating the best overall posttest performance of the three groups. The video explainer group also fared well with the mean score (69.46), with a moderate standard deviation (9.27), showing that students performed relatively consistently. The e-module group had the lowest mean score (66.38) and the largest standard deviation (10.54), indicating that while average performance was lower in the e-module group, there was more variety in results. Overall, it appears that the combination of the video explainer and e-module yielded the highest performance on the posttest. Furthermore, the other individual interventions (i.e., video explainer and e-module) also resulted in a "high" performance; though the e-module group had more variability in scores. These findings suggest that using both methods together may be the most effective instructional approach for graduate school students.

Based on the results, integrating technology in the classroom have resulted to an increase in the performance of the graduate school students. The result is consistent with the study of Sagge and Segura [14] and Sagge and Bacio [27] that computer generated instructional material (CGIM) is essential in schools as a tool for improving students' achievement in mathematics, problem solving skills, and habits of the mind. Digital learning resources come in different forms such as: teacher-developed, publisher-developed, online videos from streaming sites (e.g., YouTube), free content from online resource website among many others. Lalian [28] also writes that when videos are used as learning media in mathematics instruction, it could potentially enhance learners' knowledge, understanding of the lesson, motivation, and overall achievement. The findings of this current research have implications on educational stakeholders: teachers, students, administrators, curriculum developers among others. It may be iterated that educational stakeholders already have a significantly positive predisposition towards resources that were developed digitally [29]. Hence, the results of this research may be used as groundwork for initiating efforts towards developing computer- or digitally-generated learning resources [26]. It is highly likely that the interventions examined in this study may be of critical importance to enhancing learners' performance across education levels.

3.2. Differences in students' performance in statistics

The differences in the students' performances in statistics were also examined. One-way ANCOVA was utilized to compare the effects of the different type of instructional materials on the posttest performance of students in statistics while controlling for the pretest. Levene's test [F (2,75)=2.526, p=0.87) and normality (Kolmogorov-Smirnov: pretest=0.200, posttest=200; Shapiro-Wilk: pretest=0.268, posttest=0.167) checks were carried out and the assumptions were met.

Table 2 shows that there was a significant difference in the posttest performance [F (2,74)=14.760, p=0.000] among students who used different types of instructional materials. That is, students who used the combination of video explainer and e-module have a significantly different performance in comparison to those who used video explainer (p=0.001) alone and solely e-modules (0.000). From these adjusted means, it is clear that students who used both video explainer and e-module had gained more understanding (M=78.23) as compared to the other two groups. The partial eta squared value indicates the effect size and should be compared with Cohen's guidelines (0.2–small effect, 0.5–moderate effect, 0.8–large effect). It can be seen that the effect size is small (0.29) which means that only 29% of the variance in the students' performance in the posttest is explained by type of instructional materials used when controlling the pretest. From the result of the study, it simply shows that combining different forms of technology as a supplementary material in delivering statistics lessons could help improve graduate students' statistical performance.

The findings of this study are consistent with the findings of Tamrongkunanan and Tanitteerapan [19], who found that using e-modules greatly improved students' knowledge and abilities. Furthermore, video classes improve students' academic achievement [30], [31]. Also, Nabayra [32] claimed that video-based e-module is one-of-a-kind and student-friendly instructional resource that included technology that motivates and enable 21st century students' learning. It was further found in a systematic review of 100 studies that ICT-enriched educational practices improve students' performance [33].

Table 2. ANCOVA results on the difference in pretest and posttest scores in statistics performance

	Sum of squares	df	Mean square	F	Sig	Partial eta squared
Contrast	2180.925	2	1090.462	14.76*	0.000	0.285
Error	5466.913	74	73.877			

*p<0.001

This research examined three types of interventions: i) video explainer, ii) e-module, and iii) video explainer and e-module and how they were utilized for graduate school students to learn statistics. These learning materials were developed through technology and implemented or used through technology. The similarities among these interventions are that they combine the elements of visuals, audio, creativity, accessibility, and flexibility of learning towards different schedules and learner types. These interventions allow varied types of learners to learn statistics in their most preferred way, frequency, time and place. The findings of these study have a positive implication on the partnership of educational strategies and technology in fostering learning in a statistics course. In addition, the study has also demonstrated the different intelligence types that the students possess. The interventions allow learners to maximize the type of intervention that they prefer to use, in which they learn best.

In addition, the findings of this study imply that the use of digital learning resources (e.g., video explainers, e-modules, combination of both) may be replicated and implemented because of its positive impact on the students' learning performance. The learning materials studied may be able to assist educators across all levels in delivering the lessons in a statistics course. Additionally, the interventions may be very useful to mathematics education stakeholders in designing up-to-date and novel ways to teach statistics; away from the traditional lecture inside the classroom.

4. CONCLUSION

In conclusion, the use of video explainers and e-modules as tools to improve graduate student Statistics performance has the potential to be a highly successful and helpful method. These audio-visual resources provide dynamic, self-paced learning experiences for students, making complicated statistical topics more accessible and interesting. They combine visual aids, allow for real-world applications, and provide ease and accessibility, therefore appealing to a wide range of learning styles and schedules. Furthermore, these resources provide quick evaluation and feedback, which aids in the retention of statistical information. In addition, video explainers and e-modules can supplement traditional teaching techniques and serve as cost-effective, adaptable tools that enable graduate students to grasp statistics, a topic that is vital in a variety of academic and professional domains. To optimize their impact, educators should carefully integrate these tools into a comprehensive educational approach that takes into account student needs and learning preferences.

Moreover, based on the results of the study, the researchers propose the multimedia learning enhancement theory. The said theory proposes that incorporating video explainers and e-modules into the educational framework at the graduate level, specifically in the field of statistics, has the potential to markedly improve student performance. This theory is founded on the belief that multimedia tools, such as video explainers and e-modules, offer a multifaceted approach to learning that goes beyond traditional methods. By integrating visual and auditory elements, these tools create a dynamic and engaging learning experience, allowing students to interact with complex statistical concepts in a more accessible and comprehensible manner. The theory suggests that this multimedia approach promotes active learning, encourages self-pacing, and caters to diverse learning styles, ultimately contributing to a more effective educational environment for graduate students studying Statistics.

As a consequence of this research, it is recommended that both video explainers and e-modules become fundamental components of graduate-level statistics teaching, representing an important element of a comprehensive approach aimed at improving student performance. Collaboration among academics and administration is required to effectively integrate these teaching resources into the curriculum. Furthermore, proper assistance for instructors in the production or structuring of material is required to maximize the usefulness of these instructional tools. Educational institutions may improve the entire learning experience and outcomes for graduate students studying statistics by developing a holistic approach.

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