Student's Experiences with a Calculus Video-Based Module: A Qualitative Study

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Abstract

This study aims to determine the experience of students in using video-based module. The study was conducted in two public high schools in the Philippines in the second semester of School Year 2021-2022. This qualitative research, specifically narrative inquiry, used ten purposively chosen students as participants based on specific criteria. To elicit the needed data, the participants were given a researcher-made structured interview questionnaire, which were validated by experts. The data were analyzed using thematic analysis. The groundbreaking findings underscore the transformative potential of video-based modules, unveiling a dynamic realm of learning that effortlessly elevates student retention and engagement. It is evident that harnessing the power of video-based modules stands as a captivating and potent strategy to enhance students' grasp of complex concepts. Furthermore, the modules beckon for broader horizons, with larger-scale studies encompassing diverse populations and innovative data collection methods poised to further illuminate this exciting frontier in education.

Keywords: Calculus, experience, video-based module

INTRODUCTION

Calculus is a branch of mathematics concerned with the calculation of instantaneous rates of change (differential calculus) and the summation of infinitely many small factors to determine some whole (integral calculus) (Berggren, 2023). It serves as the foundation for various disciplines, including engineering, physics, and economics. Unfortunately, due to its abstract nature and complexity, calculus concepts are difficult for many students to understand. Recent studies have focused on identifying the challenges that students encounter in their calculus subject. Nguyen et al. (2014) conducted a survey to gain insights into students' errors with calculus concepts learned in high school. This research underscores persistent student challenges, including calculation errors and misconceptions about function domains. To improve mathematics instruction, educators must embrace a constructive attitude toward these errors, viewing them as valuable feedback. They should guide students in learning from mistakes and teach strategies for avoiding common pitfalls, ultimately enhancing the quality of math education in the classroom.

https://doi.org/10.59460/wvsurjvol13iss1pp13-19
E-ISSN: 2244-4345 | **P-ISSN: 2651-6659**
Published by the **West Visayas State University**

The Philippines' global rankings in key PISA categories are sobering: 73rd for Overall PISA Score (350.0), Math Score (353), and Science Score (357), and 74th for Reading Score (340). These scores lag significantly behind the global average of 487. Parallel with nations like the Dominican Republic and Kosovo, the Philippines' scores falling below 361 points signal an urgent need for educational reforms. The nation's underperformance in mathematics can be attributed to multiple factors, including insufficient education funding, a shortage of qualified educators, and inadequate instructional resources.

To enhance the learning experience, an increasing trend has emerged towards the use of video-based modules in teaching calculus. This approach offers an innovative and engaging way of delivering calculus content to students, making the learning experience more interactive and personalized. A study by Miller et al. (2018) found that students who used video-based tutorials in addition to traditional lectures had higher exam scores and were more likely to pass the calculus course than students who only attended lectures. Video-based modules provide students with a visual representation of complex calculus concepts, making it easier for them to grasp challenging ideas. However, little is known about this approach and the experiences of students.

It is in this context that the study is conducted to know the experiences of students with a calculus video-based. The findings of this study could provide valuable insights into the use of video-based modules in teaching calculus and identify areas where improvements could be made. Moreover, this study could contribute to the development of future video-based modules, leading to a better overall teaching and learning experience for calculus students.

METHODS

Research design

In the present study, a qualitative research design was employed to investigate and comprehend the experiences of students utilizing a calculus video-based module. This research approach, as outlined by Deakin University (2023), is characterized by its emphasis on unearthing the lived experiences and unique viewpoints of individuals. The central objective of this research was to gain a comprehensive understanding of students' encounters with the calculus video-based module.

Participants and Sampling

The participants of this study were ten (10) purposively selected students who met the following criteria: (1) enrolled in their respective schools for the school year 2021-2022, (2) Science, Technology, Engineering and Mathematics students, (3) had experience using the developed video-based module in their calculus class, and (4) willing to participate in the study.

Instrument

A structured researcher-made Students’ Experience Interview Questionnaire was used in the study. This 5-item open-ended questionnaire contained questions that would elicit answers from the students regarding their experience in using the developed video-based module. The questionnaire underwent validation by experts prior to use. The 5-item question are: How is the e-module helping you learn? What works well? What is challenging?; What was the most enjoyable aspect of the e-module so far? Why?; What was the most surprising/significant concept/fact you have learned so far in this e-module?; What was your best learning experience in this course so far and why?; and What’s the most important thing you learned and what questions are you left with?

Data collection

The data for this study were gathered through an online platform, specifically by uploading the questionnaire to a Google Form. The link to the questionnaire was then distributed to the Basic Calculus students, who were asked to provide their essay-type responses regarding their experience with the video-based module. Prior to data collection, the permission was obtained from the school principals, students, and their parents. To ensure the safety and confidentiality of the participants, they were informed that their participation would not cause harm, and that all data collected would be treated with the utmost confidentiality.

Data analysis

The study used thematic analysis to interpret the raw data, following the steps provided by Braun & Clarke, 2019. The collected data was thoroughly read and reviewed to gain familiarity with its content. Initial codes were then identified to capture the key elements of the data. The codes were then organized to identify potential themes, which were carefully reviewed to ensure they accurately reflected the data. The themes were refined to ensure coherence, relevance, and meaning. Once defined and named, the themes were mapped and analyzed for their relationships. Finally, insights were generated from the themes to provide a deeper understanding of the data.

RESULTS

When learners were asked about their experiences with the use of video-based module, their responses presented the idea that it was suited for auditory learners, the setup was close to face-to-face setup, contained adequate content, accessible and enjoyable, informative and complete that accommodates learner's need, tests comprehension and promotes retention, easy to use and navigate, engaging, clear and concise, measures learning, and more understandable compared to printed modules.

Figure 1 shows the classifications of experience of the students while using the video-based module.

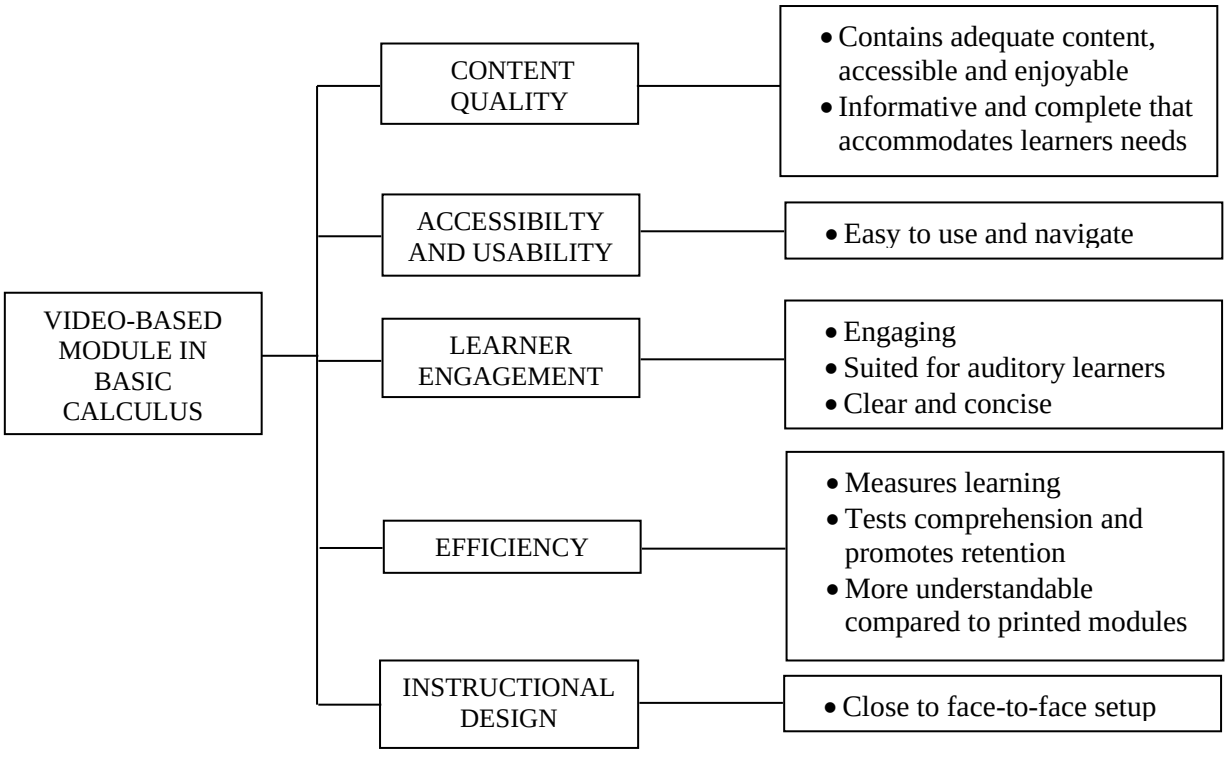

Figure 1. Students' Experience on the Use of Video-based Module

DISCUSSION

Content quality

The quality of a video-based module plays a pivotal role in shaping the learning experiences of students in today's digital educational landscape. These modules, designed to facilitate and enhance learning, are becoming increasingly prevalent. They often encompass a range of multimedia elements, from video lectures to interactive activities. In this context, Student E's perspective on an e-module's impact and effectiveness becomes particularly relevant. Their insights shed light on the crucial aspects of content quality and usability, which are central to the success of such modules. Moreover, Student E's views resonate with findings from a study by Jabbar in 2016, further highlighting the significance of enjoyable and effective e-Learning modules, especially within the context of gaming and tutorial methodologies.

Accessibility and Usability

Accessibility and usability are paramount considerations when designing a video-based module. Ensuring accessibility involves providing features such as captions and audio descriptions to accommodate individuals with disabilities, while usability entails crafting an intuitive interface and user-friendly controls to enhance the overall learning experience.

Student G stated, "Moreover, the evaluation clearly demonstrates the benefits the E-module brings to learners. It's also exceptionally user-friendly and navigable, ensuring a seamless learning experience." These sentiments align with the findings of Trilestari & Almunawaroh (2020), emphasizing the importance of interactive design and efficient usability in video-based modules, as they play a crucial role in preventing learner confusion.

Learner engagement

Engaging learners in a video-based lesson is a crucial goal for effective online education. When learners are actively involved and motivated, their comprehension and retention of the material are greatly enhanced. Student C's perspective highlights this engagement factor, noting that the interaction with the instructor and the content leads to a satisfying and interesting learning experience. This sentiment is echoed by the findings of Vidianti & Wijaya (2019) who emphasized the suitability of E-modules in assisting learners and their role in stimulating deep learning processes. E-modules, with their incorporation of multimedia elements, do not only make learning enjoyable but also foster independent reading and learning among students. In this context, it becomes evident that learner engagement plays a pivotal role in the success of video-based modules.

Efficiency

Efficiency is a key factor in the design and delivery of video-based lessons, as it directly impacts the effectiveness of the learning process. Student A's observation sheds light on the importance of well-structured activities within these modules, which do not only facilitate learning but also provide a means of assessing comprehension. This perspective aligns with the recommendations put forth in the study conducted by Trilestari & Almunawaroh (2020), emphasizing the need for assessments and interactive activities within e-books and E-modules. To ensure that learners grasp the material, these resources incorporate tests and activities within each section, along with providing immediate feedback and test results. This approach not only enhances efficiency but also contributes significantly to the overall learning experience.

Instructional design

The instructional design of video-based lessons is a critical factor in shaping the learning experience, particularly in the context of digital education. Student D's input underscores the significance of this design, highlighting how E-modules facilitate comprehension by providing clear explanations akin to face-to-face interactions. These observations align with the findings of Gherhes et al. (2021), indicating a general preference for face-to-face learning within the studied population. Notably, this preference tends to be higher among individuals who exclusively relied on face-to-face learning for their educational formation, underscoring the importance of effective instructional design in bridging the gap between traditional and online learning modalities.

The study explored the experiences of ten undergraduate students in using a video-based module in their calculus class and yields positive responses from the participants. The study by Boateng et al. (2016) also explored the perception and attitudes of students towards video-based learning the students thought that movies in general had some value for their educational endeavors. The majority of opinions on videos as a teaching and learning tool were favorable. The majority of participants believed that the films they watched improved their learning approach and outcomes. As a result, as part of the whole academic process, the use of videos should be contingent on the learning outcomes of both students and teachers. The result is similar with the findings by Wu et al. (2021). In terms of the learners' learning accomplishments, self-regulation, meta-cognitive awareness, and self-efficacy, their experiment results show that the self-regulated strategy (SRS) based spherical video-based virtual reality (SVVR) approach has more favorable effects than the non-SRS based SVVR approach. This study also made it clear that this method would not have an impact on pupils' cognitive burden. Therefore, the SRS-based SVVR technique suggested in the current study was successful in educating students about art history. In addition, the video-based module was effective in promoting student engagement and that students found the module to be clear, concise, and easy to understand. In comparison to the conventional approach of teaching human anatomy and physiology, which was based on printout visuals, the results by El-Sayed et al (2013). showed that video-based lectures deliver more successes and fewer failures in the immediate and follow-up measures. Additionally, students looked to be satisfied with their educational experiences as they gave all of the questions gauging their acceptance and happiness with the video-based lectures. Overall, the findings of this study, along with the previous studies mentioned, demonstrate the potential of video-based modules as a tool for enhancing student learning and engagement. However, it is crucial to consider students' diverse learning needs and preferences when designing and implementing video-based modules to ensure their effectiveness and promote active learning. It is vital to remember that only two teachers and ten STEM students in Grade 11 from two distinct schools made up the study's small sample size. The results may not generalize to other groups or circumstances and may not be representative of all students and teachers in a calculus course. Moreover, the study relied solely on self-reported experiences of the participants, which may be subject to bias or misinterpretation. Therefore, future research could aim to address these limitations by conducting a larger-scale study with a more diverse participant population and incorporating additional methods of data collection and analysis. By doing so, a more comprehensive understanding of the effectiveness of video-based instruction in calculus can be obtained. It can be implied that teaching with video-based modules can be a powerful and interesting technique to improve student learning and comprehension of challenging ideas.

CONCLUSION

The study's findings indicate that adding a video-based module to Basic Calculus classes would be a good way to improve learning and engagement among students. The video-based module was well-suited for auditory learners, closely resembled face-to-face instruction, and was educational, comprehensive, and adaptive to students' needs, according to students. These results are in accord with other investigations into the application of video-based modules across many academic fields. However, the results' generalizability may be impacted by the study's small sample size and dependence on the participant's self-reported experiences. Future research can address these limitations by conducting a larger-scale study with a more diverse participant population and incorporating additional data collection and analysis methods. This method is very helpful for auditory learners who might have trouble following standard printed modules. The adaptability and usefulness of video-based modules, which are accessible and useful as interactive teaching tools, can also help teachers. Overall, using video-based modules can help to increase student retention and engagement while also delivering a fun and convenient learning environment.

The recommendations from the study encompass various aspects of education. They suggest that education administrators should focus on developing instructional materials and providing teacher training in pedagogy and instructional design. Policymakers should evaluate the suitability of instructional materials for contemporary learners, and textbook authors are encouraged to include video-based e-modules to enhance learning. Teachers are urged to create customized e-modules and experiment with technology-based tools, while learners should use technology for independent learning. Finally, further research is recommended to assess the e-module's effectiveness and explore the impact of technology in other subject areas.

Acknowledgments

The researcher would like to express gratitude to DOST-SEI and all those involved, the experts who provided words of encouragement, comments and suggestions, his family and loved ones for their love and support, everyone who contributed to the research in any way, and of course, to the Almighty God for the wisdom bestowed.

Conflict of interest

None.

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