

PAPER

Students' Perception of Mobile Applications in Calculus Learning

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ABSTRACT

Mathematics is a crucial subject that students learn from primary school onward. However, some students have a negative perception of mathematics, considering it difficult and tedious, especially among Generation Z, who have grown up in a world where information is readily available at their fingertips. So, traditional teaching methods may not be very effective. This study aimed to determine students' perceptions of mobile applications in calculus learning. The study involved 35 students from a private university in Kedah. This quantitative study utilizes a survey method and employs a questionnaire as the research instrument. The perception questionnaire is divided into four categories: attractiveness, effectiveness, relevance, and motivation. Based on the research findings, this study concludes that students had a positive perception of four aspects—attractiveness, effectiveness, relevance, and motivation—when using a mobile application for calculus learning.

KEYWORDS

calculus learning, students' perception, mobile application

1 INTRODUCTION

Mathematics is a crucial subject that students learn from primary school onward. Mathematics is divided into several branches, including algebra, trigonometry, discrete mathematics, statistics, and calculus. It is widely used in various fields, such as engineering, physics, economics, and business. Mathematics can be used to solve problems by analyzing data and developing models to understand complex situations. However, some students have a negative perception of calculus, considering it difficult [1], tedious, and stressful [2], especially among generation Z. This generation has who has grown up in a world where information is readily available at their fingertips, so traditional teaching methods may not be as effective [3]. They are more likely to be engaged if lessons are interactive and hands-on. This can often lead to difficulties with the subject. Therefore, teachers must help students develop a positive attitude towards mathematics in order to understand and learn the material.

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Even though the world is rapidly changing due to contemporary and digital developments, traditional learning is still being utilized today. Learning materials are still produced in traditional formats, with complete words and pictures in physical books, using traditional printing methods [4]. Furthermore, students' challenges can limit their learning potential, especially in a traditional classroom setting where the teacher primarily uses lecture-based teaching methods. As a result, many students who are comfortable with computers and smartphones are bored and uninterested in learning because this outdated teaching style is used as instructional material [5]. Furthermore, traditional learning approaches typically lack an appropriate strategy for presenting illogical and explicit content. Information and communications technology (ICT) may help improve teaching and learning in many subjects, particularly mathematics.

In this study, the researcher will utilize the basic mobile application (BMA), a mobile application designed and developed by researchers specifically for calculus learning. The BMA incorporates multimedia elements to enhance the learning experience. The BMA is a mobile application that provides two topics in calculus: Topic 1: Functions and Topic 2: Limits and Continuity. It was designed and developed to transition learning techniques from traditional to digital, utilizing Android as a platform because conventional teaching methods are not engaging. The researcher created the BMA to capture students' attention in class, boost their motivation, and enhance their creativity while studying. Some multimedia components, such as audio, video, text, interaction, and graphics, were utilized in this mobile application to produce films centered around two calculus topics. Multimedia features are utilized to attract, inspire, and enhance students' imagination for learning.

2 LITERATURE REVIEW

With the increased availability of technology and an emphasis on science, technology, engineering, and mathematics (STEM) education, there is an urgent need to investigate the impact of technology-mediated mathematical interventions on student outcomes [6]. Mathematics is a fundamental branch of science that is essential for mastering science, that is, technology. However, according to Barcelos et al. [7], mathematics is a complex subject for students in many countries. Today, mathematics education has been grappling with conventional issues in this context, particularly regarding educational quality. The reality of the field shows that student success in mathematical disciplines is relatively poor [8].

Generation Z, the true digital natives, have access to technology primarily through mobile phones. Mobile phones have become a necessary tool for their daily lives [9]. It is not only a communication device but also a powerful tool for learning. With the development of technology, more and more mobile applications are designed for educational purposes. Students can use their mobile phones to access information both in class and outside the classroom [10], making learning more accessible and engaging. Mobile phones are less expensive nowadays than other devices, such as desktop computers or laptops. Hence, mobile phones are excellent low-cost teaching and learning equipment for students [11].

The use of mobile applications in learning has surged in recent years. In 2020, approximately 87.61% of the population in Malaysia used smartphones [12]. This number is expected to increase as smartphones become more affordable and accessible. As a result, an increasing number of educators are turning to mobile applications to enhance classroom learning.

There are many benefits to using mobile applications in learning environments. Perhaps one of the most apparent advantages is that they provide educators with an additional tool for engaging students [13] [14] [10]. Many mobile applications are designed for educational purposes and offer features that make learning more enjoyable [14] and engaging for students [13]. A mobile application is an interactive software program that is typically more flexible and accessible than traditional websites, making it ideal for use in various settings [15]. According to [16], students will be more motivated when the mobile application satisfies them with an attractive, simple, and creative display. Additionally, the mobile application can supplement traditional instruction by providing additional resources such as videos, electronic textbooks, lecture texts, and others [13]. These resources can help students learn concepts more thoroughly. Furthermore, educators can assist students in learning and staying on track [17].

Despite all these advantages, however, there are potential disadvantages associated with using mobile applications in education settings too quickly or without proper planning or consideration for pedagogical goals and objectives (eLearning Industry). The result [18] reveals students' difficulties, considering the lack of electronic devices. Mobile phones' disadvantages should also be given good attention, such as a small screen that limits the amount of information displayed, limited data space, and the battery life of the mobile phone [13]. These limitations and obstacles create significant resistance to utilizing mobile app learning to enhance learning in both individual and organizational learning environments. The critical factors that must be addressed include the lack of mobile technological competency, the scarcity of standards for designing and evaluating mobile learning applications, incompatibility with certain educational methodologies, a lack of personal engagement, and the absence of a clear vision for integrating mobile technology in education [15].

According to [19], the study's findings on attitude constructs, basic knowledge of mathematics, and interest in mathematics show that mobile applications based on a playful learning approach for teaching and learning mathematics among students have the potential to be developed. The learning outcomes revealed a significant improvement in mathematics learning achievement and student learning behavior [10]. The findings indicated that developing a mobile application to illustrate calculus teaching and learning (T&L) would enhance the quality of comprehension and absorption of calculus concepts [20]. The augmented reality in calculus (ARC) mobile application has been shown to increase student engagement and visualization skills in calculus classrooms, resulting in a significant improvement in final grades [21].

3 METHODOLOGY

This study aimed to determine students' perceptions of mobile applications in calculus learning using the BMA. This study utilized quantitative analysis through a descriptive questionnaire to assess students' perceptions of the BMA's usefulness in learning calculus. The questionnaire focused on four key aspects: attractiveness, effectiveness, relevance, and motivation. The research was focused on Universiti Islam Antarabangsa Sultan Abdul Halim Mu'adzam Shah (UniSHAMS), a private university in Kedah. The study sample consisted of 35 students studying calculus in the second semester, which is a compulsory core course for the bachelor of information technology.

The questionnaire was distributed after the students had spent four weeks learning two topics: Topic 1 – Functions and Topic 2 – Limits and Continuity, using the BasiCal mobile application. The acquired data were coded, recorded, and analyzed using the statistical package for the social science (SPSS) application to determine

the mean and percentage of the evaluated features. The Likert scale approach was employed to determine the students' perceptions of mobile applications in calculus learning. This Likert scale is also used to assist researchers in assessing students' perceptions of the BMA using a five-point Likert scale, as presented in Table 1. Subsequently, the average score of the five Likert scales is categorized into three levels based on the framework proposed by [22], as illustrated in Table 2.

Table 1. Likert scale scores

Statement	Score
Strongly Disagree	1
Disagree	2
Neutral	3
Agree	4
Strongly Agree	5

Table 2. Interpretation of mean scores

Mean Value	Level
1.00 – 2.33	Low
2.34 – 3.66	Moderate
3.67 – 5.00	High

4 FINDINGS AND DISCUSSION

Data from the questionnaires were analyzed using descriptive statistics, which included calculating means and percentages. Thirty-five respondents from the study sample participated in this questionnaire. The questionnaire is divided into four aspects: attractiveness, effectiveness, relevance, and motivation. Each aspect consists of three statements. In total, there are 12 statements.

The research sample comprised 35 students who were enrolled in a compulsory calculus course in the Bachelor of Information Technology (BIT) program. Among these 35 students, 22 were female, and 13 were male, as shown in Table 3.

Table 3. Gender ratio

		Frequency	Percent
Gender	Male	13	37.1
	Female	22	62.9
	Total	35	100.0

In Table 4, on average, 71.4% of students agreed that BMA is an appealing mobile application for learning calculus, with an average score of 4.0000. Furthermore, this BMA is interesting because 65.7% of students agreed that the videos available in the BMA could attract students to learn calculus, with a mean score of 3.9714. In addition, 74.3% of students agreed that the content in this BMA made them feel more comfortable learning calculus, with a mean score of 4.0286. From the attractiveness

aspect questionnaire, all statements obtained a high mean score, as interpreted in Table 4. These findings clearly show that learning calculus using this mobile application can attract students to learn calculus because the videos and content available in BMA have multimedia elements that can increase students' attention to learning and, in turn, provide students comfort in learning.

Table 4. Questionnaire attractiveness aspect

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Level
BMA is interesting for calculus learning	0.0%	5.7%	22.9%	37.1%	34.3%	4.0000	High
BMA videos attract me to learn calculus	0.0%	5.7%	28.6%	28.6%	37.1%	3.9714	High
BMA content makes calculus learning become comfort	0.0%	2.9%	22.9%	42.9%	31.4%	4.0286	High

According to the data provided in Table 5, 91.4% of students agreed that the content found in BMA improved their understanding of calculus, with a mean score of 4.2857. At the same time, 74.3% of students agreed that this mobile application could also better capture their attention in learning calculus, with a mean score of 4.0857. Besides, 68.6% of participants agreed that the videos available in this BMA could help students complete tasks more quickly in learning calculus, with a mean score of 3.8286. From the perspective of effectiveness, all statements obtained a high mean score on the questionnaire. These findings show that most students agree that this mobile application can have a positive impact on learning calculus. This is because the use of video in BMA attracts interest in learning calculus. In addition, the content features of BMA, such as notes and tutorials, enable students to review and practice, thereby assisting them in completing assignments.

Table 5. Effectiveness aspect

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Level
BMA content enables me to gain an understanding of Calculus learning	0.0%	2.9%	5.7%	51.4%	40.0%	4.2857	High
BMA content captures my attention better in Calculus learning	0.0%	0.0%	25.7%	40.0%	34.3%	4.0857	High
BMA videos help to accomplish study tasks quicker in Calculus learning	0.0%	11.4%	20.0%	42.9%	25.7%	3.8286	High

Table 6 shows the relevance aspect, where 71.5% of the students agreed that the videos used in this mobile application were relevant to the Calculus course, with a mean score of 4.0. In addition, 82.9% of the students agreed that the modules used in this BMA could improve comprehension in learning, with a mean score of 4.0857. Furthermore, 80.0% of the students agreed that the content presented in the BMA video was easy to understand, with an average score of 4.1143. From the perspective of relevance, all statements obtained a high mean score on the questionnaire. In conclusion, the modules available in the BMA can enhance students' understanding of calculus learning because the videos are easy to comprehend and relevant to the calculus course. Furthermore, this video is specifically designed to meet the syllabus requirements of the calculus course at UniSHAMS.

The last aspect is the motivational aspect shown in Table 7. 74.3% of the students agreed that the video used could motivate them to learn more calculus, with a mean score of 3.9714. In addition, 68.8% of the students agreed that the video in BMA made them feel more motivated to learn calculus, with a mean score of 3.8571. The content in this BMA increases students' confidence in learning calculus by 80.0%, with a mean score of 4.0857. From the motivation aspect of the questionnaire, all statements obtained a mean score at a high level. Therefore, it is concluded that the majority of students are satisfied with learning calculus using BMA because the videos in BMA play an essential role in fostering students' enthusiasm for learning calculus.

Table 6. Relevance aspect

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Level
BMA videos used are relevant to course content	0.0%	0.0%	28.6%	42.9%	28.6%	4.0000	High
The module on BMA videos increases my comprehension of the lesson	0.0%	2.9%	14.3%	54.3%	28.6%	4.0857	High
The content of BMA videos is easy to understand	0.0%	5.7%	14.3%	42.9%	37.1%	4.1143	High

In general, all statements in the questionnaire received a positive response in four aspects: attractiveness, effectiveness, relevance, and motivation. The mean score obtained for these aspects was at a high level, as interpreted in Table 2. Most students showed a high interest in mobile applications because Generation Z is more comfortable using technology and more likely to engage in interactive and engaging learning. The video available in this mobile application contains various multimedia elements, including audio, text, interactivity, and graphics. Furthermore, the content in the BMA aligns with the syllabus of the calculus course in the BIT program at UniSHAMS. As a result, students' understanding of the calculus course increases, which in turn boosts their confidence and motivation to learn calculus.

Table 7. Motivation aspect

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Level
BMA videos motivate me to learn more	0.0%	5.7%	20.0%	45.7%	28.6%	3.9714	High
BMA videos make me enthusiastic about learning calculus	0.0%	8.6%	22.9%	42.9%	25.7%	3.8571	High
BMA content makes me confident in learning calculus	0.0%	5.7%	14.3%	45.7%	34.3%	4.0857	High

5 CONCLUSION

Some students have a negative perception of mathematics, viewing it as difficult and tedious, particularly among Generation Z. This generation has grown up in a world where information is easily accessible, making traditional teaching methods less effective. Therefore, using mobile applications as a learning tool is believed to be one of the methods that can facilitate students in learning and

improve their understanding of calculus courses. This study utilized quantitative analysis in the form of a descriptive survey, specifically a questionnaire, to assess students' perceptions of the use of the BMA in calculus learning. The statements in this questionnaire focused on students' perceptions of four aspects: attractiveness, effectiveness, relevance, and motivation. A five-point Likert scale was used for answer choices. A total of 35 students participated in this study by completing a questionnaire. From the results, it is evident that BMA is a mobile application that has the ability to attract students, have a positive impact on them, be relevant to the course content, and motivate students to learn calculus. The study results indicate that the majority of students responded positively to every statement regarding each aspect of the questionnaire. It also shows that BMA functions well in understanding the concepts of calculus. However, it still needs to be built and deployed soon for future use. This paper concludes that the mobile application provides a positive perception of students. Furthermore, mobile applications can enhance student achievement and serve as a valuable learning tool in today's technological age. The use of technology in education is essential for improving understanding and achieving better results in the field of education.

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