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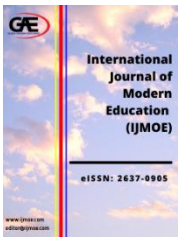

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ENHANCE EDUCATION VISION TO SUPPORT SDG 4: STUDENTS' PERCEPTION TOWARDS EASYMATH2U V2.0

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Abstract:

Oftentimes, students experience difficulties in mastering foundational mathematical concepts. When studying, they demonstrate limited engagement in independent practice, especially outside of the classroom session. This is cause for concern as continuous practice is the key to strengthening students' understanding of important concepts in maths. To address this issue, EASYMATH2U was developed in 2023 by introducing an alternative learning style for this subject. It is a mathematics application based on a game and a self-quiz that users can easily control using a self-learning approach. In the year 2024, EASYMATH2U was upgraded to EASYMATH2U V2.0. Five topics (i.e., complex numbers, inequalities, lines, circles, and parabolas) are covered in the application, and their contents consist of TRUE or FALSE questions, step-by-step solutions, and short notes to engage students' interest. To gain feedback from users, a set of questionnaires

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was distributed to 69 respondents from the Diploma in Mathematical Sciences programme and the Diploma in Computer Sciences programmes, UiTM Johor, Segamat Campus. Descriptive statistics, independent t-test, and Spearman's rank correlation coefficient are applied to analyse the data. The finding illustrates that the highest frequency of using this mathematics application is less than or equal to five times. More than half of the respondents reported high levels of satisfaction with the application. Most respondents also positively perceived the application as easy to use and fun. Through this integration of learning techniques, students can learn at their own pace from any location with internet access, foster independent learning, and increase problem-solving skills.

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Keyword:

Education; Mathematics; Perception: Self-Learning; True-False

Introduction

Mastering mathematics requires consistent practice to gain a better understanding of a concept or technique. In other words, students need to practise self-revision on regular basis to gradually develop their mathematical skills. However, many students find this difficult to accomplish because they tend to rely on others (teachers, friends, family members, etc.) for motivation, feedback, and explanations of the solutions. Moreover, students often use too many learning materials simultaneously (e.g., notes, reference books, and tutorials), which can be overwhelming and make it difficult for them to process and retain all the information. In line with the changes and developments in the current generation, teachers need to adopt more flexible and engaging approaches to encourage students to complete more revision exercises rather than solely relying on traditional learning methods.

Educators, such as teachers and lecturers, play a significant part in identifying students' problems in mathematics subjects. Their role is essential in providing support and interventions to continuously improve the students' performance. Several factors lead to students' struggles in mathematics, such as lack of understanding (Nejad, 2012), lack of motivation (Hossein-Mohand, 2023; Velez and Abuzo, 2024), lack of practice and lack of resources (Chirimbana et al., 2022). A research study by Abdul Gafoor, and Kurukkan (2015) reported that lack of effort, lack of previous knowledge, reluctance to seek help, lack of attention, disinterest, and difficulty in understanding questions are major findings causing the difficulties in learning mathematical subjects.

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The lack of understanding is due to weak foundation in basic mathematical concepts, which poses a major challenge for many students (Mangarin and Caballes, 2024). When encountering difficult topics, they tend to become discouraged and less engaged, which makes it challenging for them to understand complicated mathematical ideas. In this case, providing these students with extra tools and individualised training could greatly assist them in closing these gaps and lay a stronger basis before moving to the next mathematical level.

Insufficient educator support and explanation can further exacerbate students' struggles in mathematics, thus leading to their underperformance in the subject (Saha et al., 2024). To tackle this issue, methods like peer tutoring, one-on-one assistance, or alternative teaching methods can be utilised (Mangarin and Caballes, 2024).

Some students have learning disabilities or cognitive disabilities. In this case, special interventions are required to support their mathematical learning process. Firstly, educators should be aware of these types of students in their classes. Only then will they be able to design appropriate strategies to implement in the classroom, such as using flashcards, providing a flowchart, using colour, highlighting the important keywords, and using a simple font (Soares, 2017).

Negative perspectives and attitudes towards mathematics itself can be a significant factor contributing to the lack of student motivation and engagement (Aguilar, 2021; Saha et al., 2024). A study conducted by Bacong et al. (2023) revealed that one of the participants reported feeling impatient and unmotivated when studying mathematics because the same processes are repeatedly applied in the lessons and exercises. To address this issue, educators could foster a more positive mindset among their students by incorporating lessons with real-world applications and hands-on activities. Implementation of more interactive lessons could make mathematics more relevant and interesting for their students. Eminita et al. (2024) also suggested that educators should keep improving their teaching and learning style to boost student motivation.

Promoting motivation and engagement in lessons is vital to address students' fear of failure and low self-confidence. A study by Asdar Ahmad et al. (2024) found that teachers reported that students were not actively involved in the learning process such as in giving feedback on the questions given by the teacher. They are also not familiar with each other, which leads to limited communication and lack of openness regarding learning difficulties among those in class. All these factors contribute to low mathematical learning outcome. Educators can help students by encouraging a growth mindset, providing constructive feedback, and creating a supportive learning environment to overcome their fear (Van Hoeve et al., 2023).

Some students demonstrate inconsistent study habits, such as neglecting a proper study routine and failing to set goals or objectives in mathematics. Inconsistent study habits are a factor contributing to student failure, as reported by Saha et al. (2024). In addition, a study by Musa and Garba (2019) found a positive relationship between study attitude and academic performance. They also recommended that teachers and counsellors should collaborate to promote students' development of effective study habits, which in turn would improve their mathematical performance.

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Some students are not aware of where to obtain the extra mathematics exercises and notes to practice while those who come from low-income family backgrounds may have limited access to these study materials due to lack of resources (Chirimbana et al., 2022; Mangarin and Caballes, 2024; Ismael Gómez-Talal, 2024). Nowadays, online resources have become more accessible to people from many different backgrounds. Moreover, many schools are equipped with computers available for students use. This allows students to independently explore the subject on any relevant online website whenever needed. Alternatively, those who prefer printed materials can find a wide range of study resources in bookstores. With all these readily available resources, students can learn and enhance their confidence in mathematics.

Many students have their own preferred study techniques. However, while certain techniques may be effective for some subjects, they may not yield the same results when applied to mathematics. Students usually have difficulty in this subject without help from others (Diana et al., 2023). Therefore, students should explore alternative study methods, such as finding the right tutor, joining group discussions, or engaging in educational games. The use of varied study techniques can help enhance students' understanding of mathematical concepts.

A study by Hui and Mahmud (2023) found that game-based learning (GBL) has a positive effect on teaching and learning in terms of cognitive (knowledge and mathematical skills) and affective domain (achievement, attitude, motivation, interest, and engagement). Machaba (2019) highlighted that games can help children practise mental calculation and solve barriers in mathematical language. Games have the potential to enhance children's motivation to perform tasks, which helps facilitate their performance in solving mathematics. Çelikdemir et. al (2024) examined the effect of applying math games on the development of mathematical skills for preschoolers. The results showed that the interventions significantly improved the children's mathematical skills. A study on the effectiveness of game-based learning in mathematics has also been conducted by Cayang and Ursabia (2024) with fourth-grade pupils, and it showed positive results. Other relevant studies on this topic include Ramani and Scalise (2020) and Hidayat et al. (2024).

Despite the availability of various digital learning tools, a significant gap remains. There is still lack of a platform that integrates concise notes, step-by-step solutions, and interactive self-assessment specifically for Pre-Calculus. Current educational resources often require students to juggle multiple materials simultaneously, which leads to high cognitive load and scattered information. Furthermore, many existing applications lack immediate, simplified explanations for mistakes, leaving students reliant on external intervention from teachers or friends to bridge their understanding gaps. There is a clear need for a minimalist, self-learning tool that addresses these limitations by offering a student-centered approach that functions independently without reliance on other resources or direct supervision. The EASYMATH2U application was designed with these considerations in mind to support and promote student learning.

The application is a true or false game covering five basic topics from Pre-Calculus that adopts the concept of self-learning and applies student-centered mechanisms. The main objective is to facilitate students in completing Mathematics exercises using smartphones or computers regardless of their location provided that an internet connection is available. This approach is convenient for students and may encourage independent learning. Additionally, it can help students understand a topic without needing to rely on several resources at once. Each question is equipped with step-by-step solutions, additional examples, and simple notes to ensure that students can learn on their own. The explanations are also kept simple to avoid confusion in

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the learning process. The design is minimalist and user-friendly to facilitate users' concentration on the essential elements of a given topic of interest.

Technology plays an increasingly significant role in teaching and learning nowadays. Hence, an education-based games like EASYMATH2U would be useful for students as part of their lessons and as a potential income generator. This innovation is an exceptional initiative that can be applied to other subjects as well. The earlier development phase of this game used simple Microsoft PowerPoint. Later, to make it available online, the materials were transferred to *Google Slides* for easier access. Individuals with basic technology literacy can adopt the same idea, make some improvements, and develop an even better online learning resource. Additionally, students are expected to spend less on this game compared to purchasing reference books.

In this paper, the study focused on university students' level of perception towards the EASYMATH2U innovation. Initiated in 2023, the EASYMATH2U V2.0 was upgraded and tested again in 2024. A set of questionnaires was distributed to the respondents (students), and appropriate statistical methods such as descriptive statistics, independent t-test, and Spearman's rank correlation coefficient were used to analyse the data.

Methodology

An instructor-centred approach has long been implemented in lessons for many subjects, including mathematics. However, educators such as teachers and lecturers realize that most of their students of the new generation are already being exposed to technology. Thus, EASYMATH2U V2.0 was introduced as an educational game intended to help students strengthen their basic mathematical concepts. Through smartphone usage, students can access and engage with the application together with friends or independently, anytime and anywhere. This helps promote self-directed learning.

EASYMATH2U V2.0 was developed using Microsoft PowerPoint. This tool was chosen due to its variety of features and user-friendly functions. In this section, the innovative features, characteristics, and visualization of the application are discussed. Initially, EASYMATH2U was developed to help students increase their basic knowledge in mathematics. Version 1 was developed in 2023 and revised as Version 2 in 2024. Figure 1 shows the flow chart of problem definition until problem solving.

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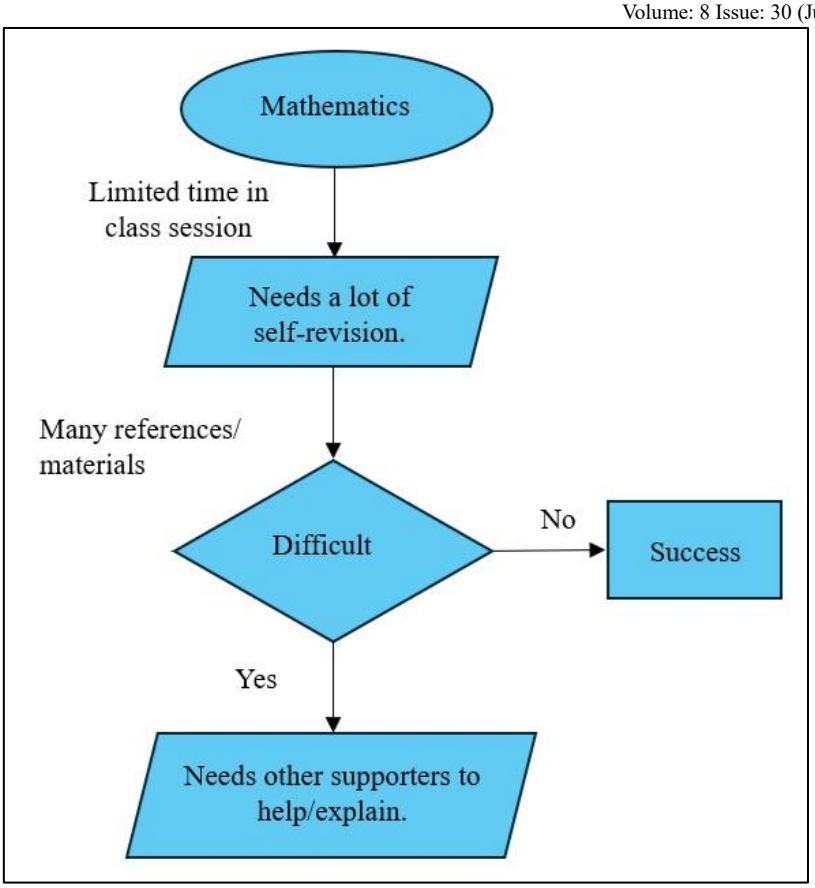

Figure 1: The Illustration of Steps in Problem Solving

Characteristics of EASYMATH2U V2.0

EASYMATH2U V2.0 was designed as a simple presentation, with user-friendliness as its main feature. Thus, students can focus more on the content. Figure 2(a) shows the front page of EASYMATH2U V2.0, with a clear and easy-to-understand introduction. Five topics are covered, which are complex numbers, inequalities, lines, circles, and parabolas. The user can click the 'CLICK HERE' button to enter the game. Figure 2(b) is the navigation page that will lead students to the desired topic by clicking one of the black buttons. The 'END' button will lead the user to end the game.

(a) (b)

Figure 2: Front Cover and Contents of EASYMATH2U V2.0

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Users will be directed to the simple notes page after they choose a topic, as shown in Figure 3. Meanwhile, the 'HOME' button will bring the user back to the navigation page. Otherwise, the user can click the 'READY' button to start answering questions when they are prepared to start.

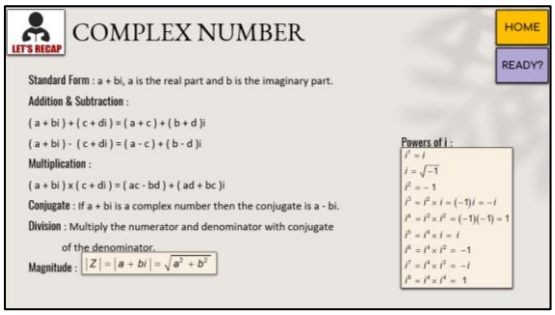
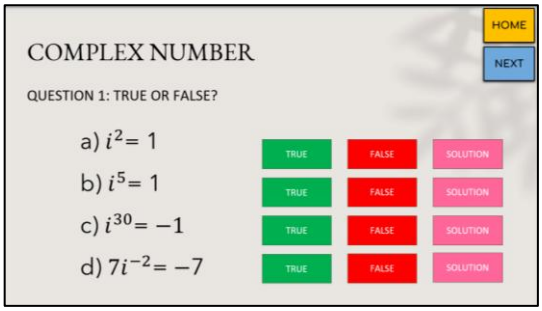
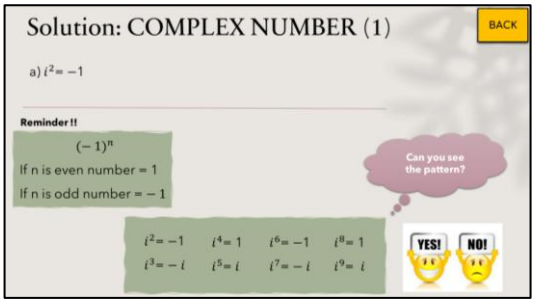


Figure 3: Notes for Complex Number

There are two stages of TRUE-FALSE questions with complete solutions, simple explanations, extra notes, formulas, and examples. In the first stage, a simple question is asked, as in Figure 4(a), and the level of difficulty increases in the second stage (Figure 4(c)). Through this platform, students can learn from their mistakes by reviewing the provided solution, as in Figure 4(b) and Figure 4(d).



(a)



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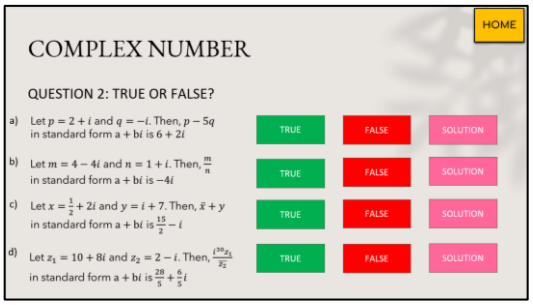
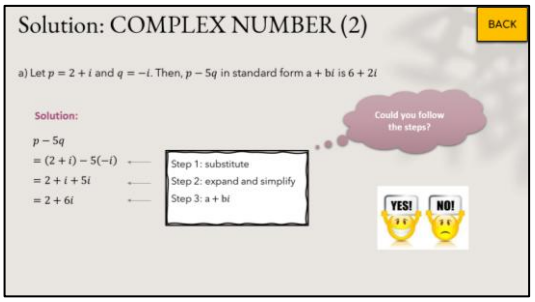


(c)



(d)

Figure 4: Question 1 and Question 2 in Complex Numbers

Figure 5 illustrates the notifications as responses after the user clicks the TRUE or FALSE button as their answer to the related question. The 'HOME' button will lead the user back to the list of questions.

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(a) (b)

Figure 5: Correct and Wrong Notification

The users are advised and encouraged to use a computer or a laptop to get the best view and smooth control while using EASYMATH2U V2.0.

Sampling Technique and Sample Size

This study used convenience sampling, a type of non-probability sampling technique. Participants were selected based on their accessibility and willingness to participate rather than through random stratification. This method was chosen for its efficiency, cost-effectiveness, and ease of implementation. The sample consisted of 69 respondents who were already using the EASYMATH2U V2.0 application as part of their learning process. Based on Roscoe (1975), a standard minimum of 30 participants is recommended for exploratory study. Thus, the sample size of 69 respondents was considered sufficient to test the meaningful patterns in student interaction with the EASYMATH2U V2.0 application.

Research Instruments

In this study, a structured questionnaire was used as a data collection method. This questionnaire was divided into two sections. The first section covered personal information which consist of gender, programme and the frequency of using EASYMATH2U V2.0 application. Meanwhile, the second section focused on perceptions toward EASYMATH2U V2.0 application. In this section, there were eight questions in total where the answers were in the form of five-point Likert scale. A score of one was given for strongly disagreeing and a score of five was given for strongly agreeing.

Data Analysis

In this study, several statistical methods such as descriptive statistics, independent t-test, and Spearman's rank correlation coefficient were used. The respondents' demographic profiles were determined using a frequency table. The usage frequency of the EASYMATH2U application among respondents was also ascertained using a bar chart. The level of students' perception toward EASYMATH2U was then determined by using the mean and standard deviation. To determine the students' perceptions toward the EASYMATH2U application across gender and course, an independent T-test was performed. An independent t-test is used when comparing the variable means of two independent groups. Lastly, a Spearman's rank-order correlation was calculated to determine the relationship between the mean score of students' perception toward EASYMATH2U and their overall evaluation of the application. All the data gathered was then analysed using the IBM SPSS program, version 26.0.

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Results

Demographic Background

This section examines the characteristics of the respondents, which include gender and course. Based on Table 1, the percentage of respondents representing females and males is comparable, totalling at 47.8% and 52.5%, respectively. Most of the respondents which is 63.8% in this study were from the Diploma in Computer Sciences programme, while the other 36.2% were from the Diploma in Mathematical Sciences programme.

Table 1: Demographic Profile of the Respondents

Variables	Frequency	Percentage (%)
Gender		
Female	33	47.8
Male	36	52.5
Programme		
Diploma in Mathematical Sciences	25	36.2
Diploma in Computer Sciences	44	63.8

The Usage Frequency of the EASYMATH2U Application

From Figure 6, it is shown that 60.9% of the respondents used EASYMATH2U application 1 to 5 times. Next, 27.5% of the respondents used the EASYMATH2U application 6 to 10 times, followed by 5.8% of the respondents who used the application 11 to 15 times, and another 5.8% of the respondents used the application more than 15 times.

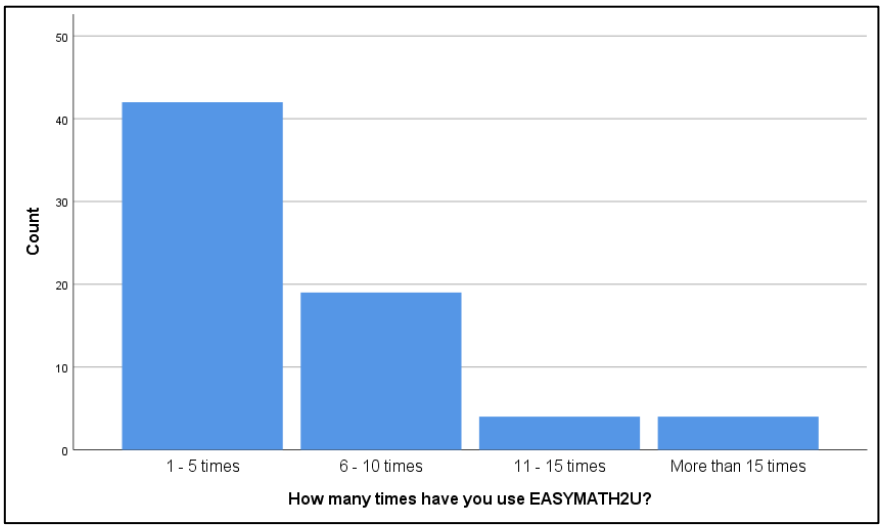

Figure 6: The Frequency of Usage of EASYMATH2U

The following Table 2 represents the evaluation of the EASYMATH2U application among university students. The scale is between 1 and 5, with 1 indicating very poor, 2 indicating poor, 3 indicating average, 4 indicating good, and 5 indicating very good. The results show that 37 respondents, which is 53.5%, rate EASYMATH2U as a very good application. Meanwhile,

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40.6% (28 respondents) mentioned good applications, and 5.8% (4 respondents) evaluated the EASYMATH2U as an average application.

Table 2: Evaluation of EASYMATH2U Application of the Respondents

Variables	Frequency	Percentage (%)
Average	4	5.8
Good	28	40.6
Very good	37	53.6

Level of Students' Perception towards the EASYMATH2U application.

Table 3 shows the level of students' perception towards the EASYMATH2U application. The highest rated item is "EASYMATH2U is effective in enhancing my engagement in Pre-Calculus (MAT133) course," with the mean value of 4.54 and the standard deviation being 0.584. The lowest rated item is "EASYMATH2U stimulates my interest in learning Pre-Calculus (MAT133)" with a mean value of 4.30 and a standard deviation of 0.734.

The overall mean score of students' perception toward the EASYMATH2U application was 4.40 ± 0.617 on the 5-point Likert scale. Therefore, it can be concluded that most of the respondents agreed that the statement related to the EASYMATH2U application. This means that the level of perception of the EASYMATH2U application among university students was high, and most of the respondents showed positive perceptions toward the EASYMATH2U application in their study.

Table 3: Level of Students' Perception

No	Items	Mean	Standard Deviation	Interpretation
B1	EASYMATH2U is easy to use.	4.41	0.551	High
B2	EASYMATH2U helps me review the course material.	4.49	0.585	High
B3	EASYMATH2U is effective in enhancing my engagement in the Pre-Calculus (MAT133) course.	4.54	0.584	High
B4	EASYMATH2U stimulates my interest in learning Pre-Calculus (MAT133).	4.30	0.734	High
B5	Doing exercises on EASYMATH2U is fun.	4.41	0.577	High
B6	EASYMATH2U has an attractive display.	4.33	0.657	High
B7	EASYMATH2U feels like a game, so I do not feel tired and bored while I use it.	4.32	0.630	High
	Students' Perception	**4.40**	**0.617**	**High**

The Difference of Students' Perception towards EASYMATH2U in terms of Gender.

The result of the difference in students' perception towards the application between male and female university students is shown in Table 4, where it is shown that the p-value (0.428) is greater than $\alpha = 0.05$. It is consistent with the confidence interval of (-0.133, 0.311), indicating that the interval passes through the zero value. This shows that no significant difference was

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found between students' perception and gender, suggesting that the female and male students have similar perceptions of the EASYMATH2U application.

Table 4: The Difference between Students' Perception and Gender

Gender	N	Mean	Standard Deviation	t	P-values	95% Confidence Interval of the Difference	
						Lower	Upper
Female	33	4.446	0.484	0.797	0.428	-0.133	0.311
Male	36	4.357	0.441				

The Difference of Students' Perception towards EASYMATH2U Application in terms of Programmes

Table 5 shows the result of the difference in students' perception towards EASYMATH2U between the two programmes, which are CDCS143 Diploma in Mathematical Sciences and CDCS110 Diploma in Computer Sciences. The results show that the p-value (0.003) is lower than $\alpha = 0.05$. It is consistent with the confidence interval, which is (0.115, 0.550), indicating that the interval does not pass through zero. Thus, it can be concluded that there is a significant difference between students' perceptions and the programme they are in. This indicates that students from the Diploma in Mathematical Sciences had different perceptions about the EASYMATH2U application compared to those from the Diploma in Computer Sciences.

Table 5: The Difference of Students' Perception in terms of Course

Course	N	Mean	Standard Deviation	t	P-values	95% Confidence Interval of the Difference	
						Lower	Upper
CDCS143 Diploma in Mathematical Sciences	24	4.611	0.407	3.050	0.003	0.115	0.550
CDCS110 Diploma in Computer Sciences	44	4.276	0.450				

Relationship between the Mean Score of Students' Perception towards EASYMATH2U and Their Evaluation of EASYMATH2U

Table 6 represents the Spearman correlations between the mean score of students' perception towards the EASYMATH2U application and their evaluation of EASYMATH2U. The results show a significant relationship between both variables. There is a statistically significant, moderate positive correlation ($\rho = 0.604$, $p < 0.01$) between students' perception scores and their overall evaluation of EASYMATH2U. This suggests that improvements in student perception are associated with better overall evaluations of the application. As students' perception scores increase, their overall evaluation of the EASYMATH2U application tends to improve as well, and vice versa.

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Table 6: Spearman Correlations Between the Mean Score of Students' Perception Towards EASYMATH2U Application and Their Evaluation of EASYMATH2U

Variables	Mean Score of Students' Perception	Evaluation of EASYMATH2U
Mean Score of Students' Perception	1.000	**0.604****
Evaluation of EASYMATH2U	**0.604****	1.000

***Correlation is significant at the 0.01 level (2-tailed).*

Discussions

The study shows that there is no significant difference in perception towards the application between genders. This suggests that EASYMATH2U is equally effective for male and female learners. This result is consistent with prior studies on technology-enhanced learning tools, which show minimal gender-based differences in digital engagement (Vekiri and Chronaki, 2008). However, there is significant difference in perceptions between students from the Diploma in Mathematical Sciences and the Diploma in Computer Sciences, which indicates that prior mathematical background and familiarity with content influence students' acceptance and satisfaction with the application. This finding is consistent with the previous research by Mangarin and Caballes (2024) that highlights the role of prior knowledge in shaping technology adoption in education.

The students have also shown a positive perception of the EASYMATH2U application, with an overall mean score of 4.40 on a five-point Likert scale. This suggests that this application effectively supports independent study and engagement in mathematics courses, particularly Pre-Calculus. These findings aligned with the principles of Self-Determination Theory (SDT), which highlights the importance of competence and autonomy in fostering motivation (Chiu, 2022). Through its interactive and user-friendly design, EASYMATH2U allows students to learn at their own pace, fulfilling the need for autonomy and reducing the dependency on teacher-led instruction.

The moderate positive correlation between perception scores and overall evaluation of the application suggests that enhancements in user experience can directly improve students' overall satisfaction and potential for continued use. This reinforces the relevance of the Technology Acceptance Model (TAM), particularly the construct of perceived ease of use, which appears to be a major factor in the positive reception of EASYMATH2U.

Conclusions and Recommendations

The findings of this study suggest several practical implications for educators, institutions, and developers. Incorporating EASYMATH2U as a supplementary tool within the mathematics curriculum can enhance blended learning approaches and support self-directed learning, particularly in challenging subjects such as Pre-Calculus.

Despite all the positive outcomes, the results also show that the frequency of use was relatively low, with application usage of most students ranging from one to five times. This suggests that while the application is well-received, sustained engagement remains a challenge. Future

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iterations of EASYMATH2U could incorporate gamification strategies such as leaderboards, progress tracking, and adaptive difficulty levels to encourage continuous usage. These features have been shown in prior research (Hui and Mahmud, 2023) to enhance engagement and promote long-term adoption. Moreover, improving accessibility through the development of a mobile-friendly version will broaden the reach of the application, making it more convenient for students from diverse socioeconomic backgrounds. These strategies will not only improve the usability and effectiveness of EASYMATH2U but also position it as a scalable and sustainable educational tool.

Game-based learning turns mathematical concepts from being merely theoretical into engaging and interactive experiences. Moving beyond traditional instructor-centered and lecture-heavy methods, game-based learning offers an active, student-centered approach that transforms passive learners into active problem-solvers. By incorporating gamification, educators encourage independence, critical thinking, and a positive mindset towards challenging subjects. Consequently, it is vital to embrace these innovative, student-focused strategies to promote academic achievement. Applying interactive methods throughout the curriculum beyond just mathematics is essential for nurturing a true and persistent curiosity and enthusiasm in every academic field. Hopefully, it will greatly enhance student motivation and improve their understanding of learning mathematics and other subjects.

In the context of digital learning, EASYMATH2U V2.0 demonstrates how common and cost-effective tools like Microsoft PowerPoint and Google Slides can be utilized to develop accessible interactive platforms. This will empower educators with basic technological literacy to bridge the gap in digital resource creation. Its minimalist interface is specifically designed to reduce cognitive overload by consolidating essential content, allowing students to focus on core mathematical concepts without being overwhelmed by multiple learning materials. Pedagogically, EASYMATH2U V2.0 fosters a self-directed learning environment that can increases student's independency on teacher's assistance and mitigates math-related frustration. This gamified approach significantly enhances student motivation and transforms challenging Pre-Calculus topics into interactive, confidence-building experiences.

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