

Research Article

The Digital Revolution in Education: Transforming Math Learning with DrMaths Apps

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Abstract: Smartphones, laptops, and tablets are no longer uncommon. Because students in this era were not born to be limited by the limits of basic learning, the education system is advancing for the purpose of advancement. Their curiosity is limitless and cannot be satisfied by previous educational systems. Hence, digitalization and the uses of technology should be practiced in education systems instead of just classic chalk and board. On this basis, the DrMaths Apps (DMA) was introduced as an innovation focusing on two subjects which are Intermediate Mathematics for Pre Science (MAT086) and Pre-Calculus (MAT133) in the early stages before it was used comprehensively by other subjects. This project aims to create an interactive teaching tool that uses websites and mobile applications to facilitate subject learning in Mathematics. DMA combines the website and mobile applications, allowing students to access all two subjects simultaneously on a single platform. The website and mobile applications can be accessed via laptop, computer, smartphone, and tablet. These mobile applications are effective, simple to use, and do not consume a lot of internet data. DMA features include interactive videos, notes, game-based learning, quizzes, and activities that provide students with an enjoyable and engaging learning experience. The empirical results show that DMA motivates students to learn Mathematics and is extremely useful in revising lessons. The students are also pleased that this is one of the best platforms for improving their performance in these two subjects.

Keywords: digitalization; blended education; e-learning; basic maths; Calculus.



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1. INTRODUCTION

Even though the pandemic that has been ravaging the country for more than two years had many negative consequences, there were some that we could take advantage of. Positive effects include those related to education digitization. As a result of travel restrictions, the government and those

involved have taken the initiative to use digital as one of the ways people work and go to school. The majority of school exercises are also given in digital format, with the theme of gamification. This culture persists to the present day, and yes, it is no longer considered foreign and has become part of society's norm because it has positive effects on some parties. Because many people are becoming increasingly aware of the positive effects of digital involvement in the world of education, the importance of digital education in education has become a hot topic among various parties. Online learning is defined as teaching through the use of the internet and related technology for the development and preparation of teaching materials, delivery, and course management through appropriate platforms.

The Movement Control Order (MCO) has dealt a severe blow to the education sector in the country. The Teaching and Learning process is disrupted because of the COVID-19 pandemic, particularly in the subject of Mathematics, where face-to-face classes appear to be more practical than online learning. Previous research has found that online learning has a negative impact on course retention and performance in mathematics and English (Xu & Jaggars, 2011). Educators and students must adapt to information and communication technology, which is replacing face-to-face classes with online classes, as a new norm in Teaching and Learning. As a new norm in teaching and learning, educators and students must adapt to information and communication technology that replaces face-to-face classes with online classes. However, teachers and students with poor internet connections may be unable to conduct online learning that relies on technology and the internet (Adedoyin & Soykan, 2020). If students are using outdated devices, they will struggle to meet some of the technology requirements of online learning. Among other issues, only a few Mathematics learning applications have been developed in Malaysia. Because of this, applications that contain extensive teaching materials are critical for assisting students in learning online. Students will be more inspired by online learning tools and mobile applications that make Mathematics subjects more interesting than traditional teaching techniques (Drigas & Pappas, 2015).

On this basis, DMA has been introduced as an innovation in open and distance learning for two courses, namely MAT086 and MAT133. DMA integrates internet and mobile applications, allowing students to access all three courses simultaneously on one platform. The goal of this project is to create an interactive teaching tool that uses websites and mobile applications to help students learn mathematics. It also aims to provide an engaging and enjoyable learning experience that encourages student interaction and performance. Another study discovered that online learning applications and mobile applications can stimulate students, making Mathematics courses more interesting and participatory than traditional teaching techniques (Supandi et al., 2018). Furthermore, mobile devices enable access to learning resources outside of the classroom and improve learning at any time and from any location.

2. METHOD & MATERIAL

The ADDIE model is used to create DMA. The ADDIE model is based on behaviourism, an idea developed by Dick and Carry in 1996 to design a learning system. The acronym ADDIE stands for (A-analyse, D-design, D-develop, I-implement, E-evaluation). Researchers chose the ADDIE model to develop DMA because it is the main instructional design model and the source of the emergence of other models (Carr-Chellman, 2011). In the field of education, teaching design is a systematic strategy, method, and technology used to help students mastered the desired objectives (Yusup & Razmah, 2006). Figure 1 depicts the stages found in the ADDIE model. The application of the five processes presented by the ADDIE model in the development of the teaching module demonstrates that it is very effective and efficient in attracting students' interest and motivating students' seriousness about the lessons learned.

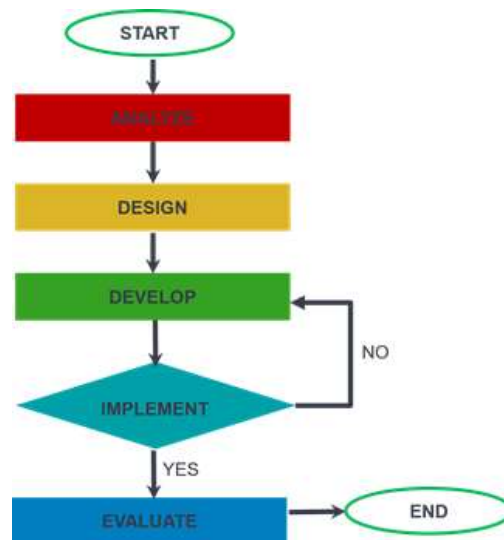


Figure 1. ADDIE Model Stages for DMA Development

The development of DMA began with a questionnaire to determine the level of need for this application. As project pioneers, 58 students from the Pre-Diploma Science, Microbiology Technology Diploma, and Textile Technology Diploma programmes were chosen. The student questionnaire results were analysed to determine the level of development required for this application to be used by lecturers in the coming semester (Figure 2).

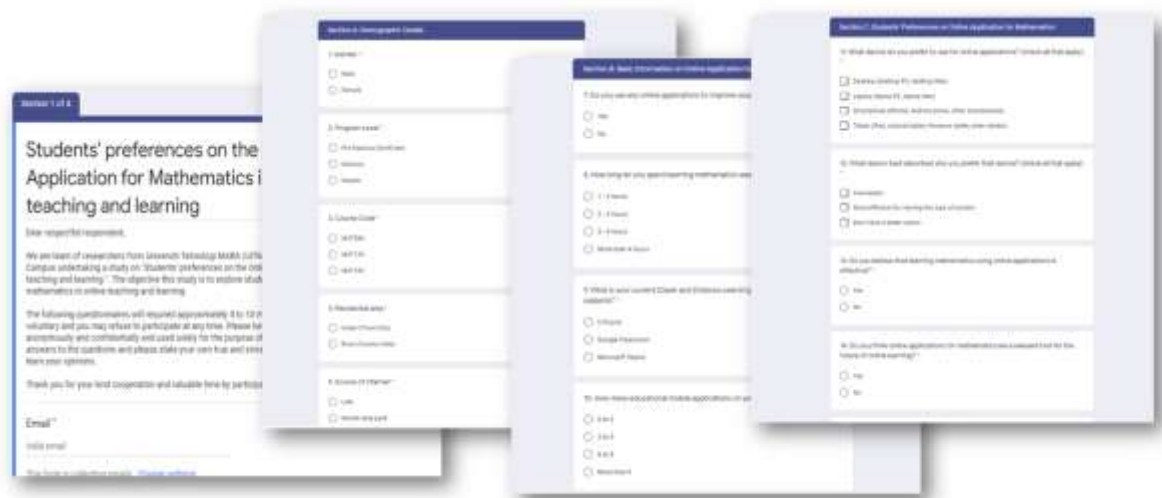


Figure 2. Questionnaire Form to Study the Level of DMA Development Needs

Following the collection of student feedback, the DMA website was developed using Google Sites. This website is provided for free to all Google users without the need for a domain. Once the website is complete, DMA can be pre-booked directly from a smartphone using Thinkable. DMA can be downloaded by Android users using the Android Package File (.apk). DMA can now be accessed by students using computers, tablets, and smartphones from anywhere. Figure 3 depicts two applications that are involved in the development of DMA.



Figure 3. Applications Used in DMA Development

DMA is very suitable as a simple and user-friendly online learning platform because it does not require students to log in if they want to access any teaching material (Figure 4).



Figure 4. (a) DMA Preview by Android User

(b) DMA Website Preview

The DMA main menu displays the MAT086 and MAT133 courses, where students can make a choice by selecting the desired course code (Figure 4). Various materials can be integrated using this application, including learning notes and videos, interactive games, Google Classroom code, assessment exercises, compilation of final exam questions, formula lists, and feedback forms where students can interact with lecturers if there are any problems and access UiTM MOOCs (Figure 5).



Figure 5. DMA Characteristics

DMA allows students to obtain all course-related information, make self-exercises, and check and review lessons outside of lecture time (Figure 6). In addition, students can also access the compilation of final exam questions, formula lists, and interactive games found in this application, as shown in figure 7.

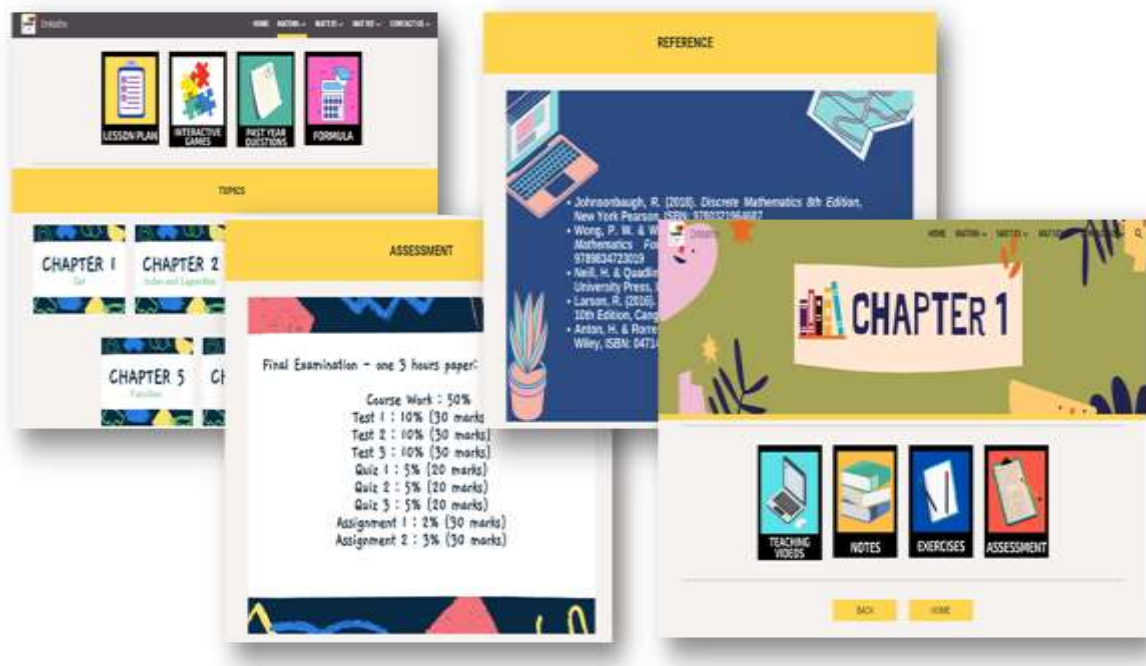


Figure 6. Examples of Teaching Materials



Figure 7. Display of a Compilation of Final Exam Questions, Formula List, and Interactive Games.

DMA has been practised for students throughout the semester, and a questionnaire has been administered to determine the effectiveness of DMA for the students involved (Figure 8).

Figure 8. Questionnaire Form for Students' Satisfaction Survey.

3. FINDINGS

A questionnaire based on demographic details, basic information, and student preferences for online mathematics applications was administered to examine the level of need for the development of online learning innovations that are compatible with open and distance learning. The total number of respondents is 58, with 46 female students and 12 male students. They are Pre-Diploma Science, Microbiology Technology Diploma, and Textile Technology Diploma students at the UiTM Cawangan Negeri Sembilan, Kampus Kuala Pilah. Half of the respondents were MAT133 students, and the other half were MAT086 students.

Table 1 shows the average study time for the mathematics subject, which is between 2 and 3 hours per week, and a total of 39 students have uploaded at least two education-based mobile applications as learning reference material. This clearly demonstrates how little time students devote to mathematics and the scarcity of educational applications.

Table 1. Time allocated by students for mathematics subjects

	Frequent	Moderate	Less
Time allocation	2 - 3 hours	3 - 4 hours	1 - 2 hours
	43.1%	32.8%	24.1%
Numbers of applications	0 - 2 apps	3 - 5 apps	6 - 9 apps
	62.1%	34.5%	3.4%

By measuring students' preferences for online mathematics applications, they are asked to make decisions about the best devices for open and distance learning. As shown in Figure 9, the results show that laptops and smartphones are the best choices for online applications because the display makes it easier to see the course content.

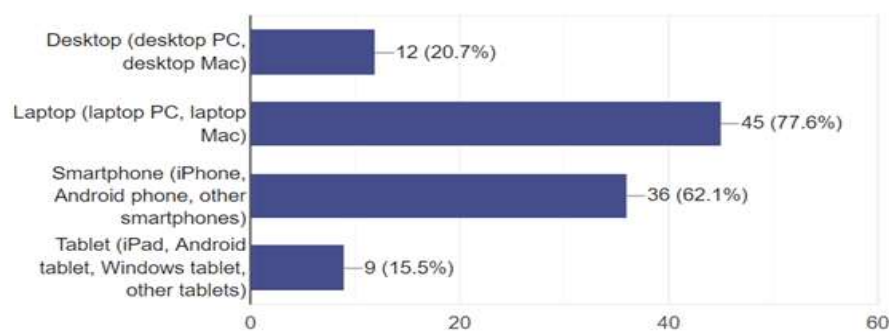


Figure 9. Appropriate Devices for Mathematical Applications

The measurement of students' preferences for online mathematics applications resulted in the majority of respondents agreeing that learning mathematics will be very effective, can improve understanding, and will be appropriate for the times (Table 2).

Table 2. Preference Against Mathematical Applications

	Yes	No
Learning Effectiveness	86.21%	13.8%
Comprehensive and Futuristic	91.4%	8.6%

As you may be aware, mathematics is one of the most difficult subjects to teach online. However, the availability of interactive platforms such as websites and mobile applications makes mathematics teaching more interesting and interactive. Similarly, most students agree with the use of

this platform; learning mathematics becomes very practical (Figure 10), and the majority of them support the efforts to combine all mathematics subjects into one platform.

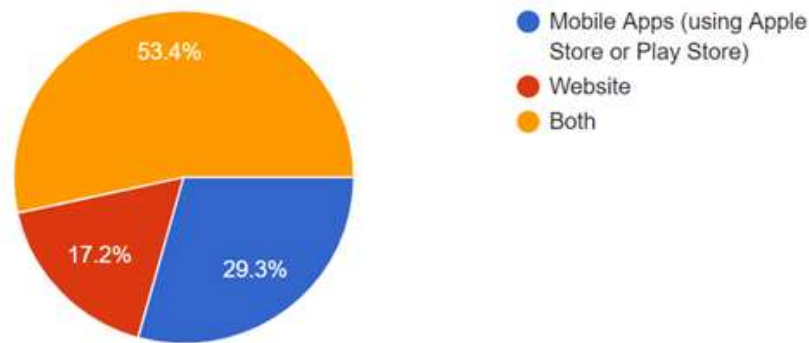


Figure 10. Appropriate Platforms for Mathematical Applications

Based on the positive feedback from all these respondents, an innovation known as DMA was created to meet all the needs of students facing online learning, particularly in the subject of mathematics. This concept is the result of an innovation created by combining two calculus-based mathematics subjects for pre-diploma and diploma students. This innovation has been adapted via the website and is accessible via all mobile digital devices, including laptops, smartphones, and tablets. This application's unique features include the ability to save internet data usage, the lack of a strong internet connection, and the ability to save user phone space. DMA also meets the needs of open and distance learning by including notes, learning videos, games, assessment exercises, and a variety of visually appealing and highly interactive interfaces.

A questionnaire based on the evaluation and views of using DMA was conducted to examine the effectiveness of using DMA for students involved throughout the semester. Table 3 demonstrates how important this application is to students, particularly mathematics, which was previously thought to be difficult.

Table 3. Evaluation of DMA

	Good	Fair	Poor
Advantageous	74.4%	18.6%	7%
User Friendly	76.7%	14%	9.3%
Comprehensible	76.7%	14%	9.3%

The majority of students agreed that this application has good navigation, interesting content, and functionality (Figure 11).

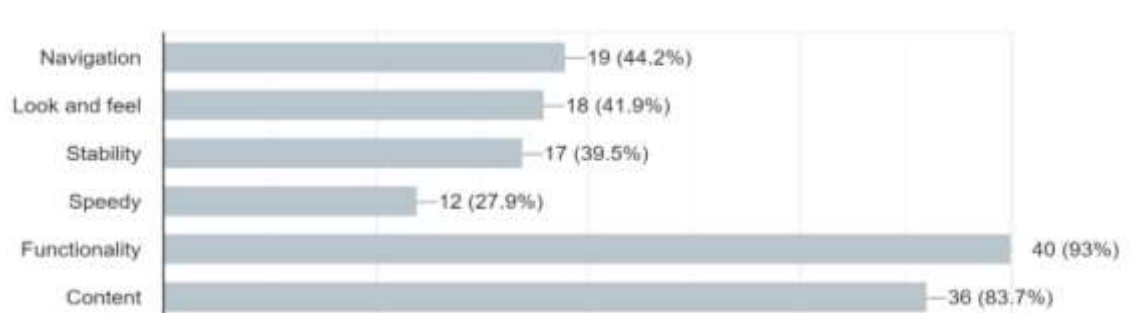


Figure 11. DMA Privileges

As a result, the efficacy of DMA for students has been demonstrated, with the majority of students agreeing that this application has a significant impact on their learning, as illustrated in Figure 12.

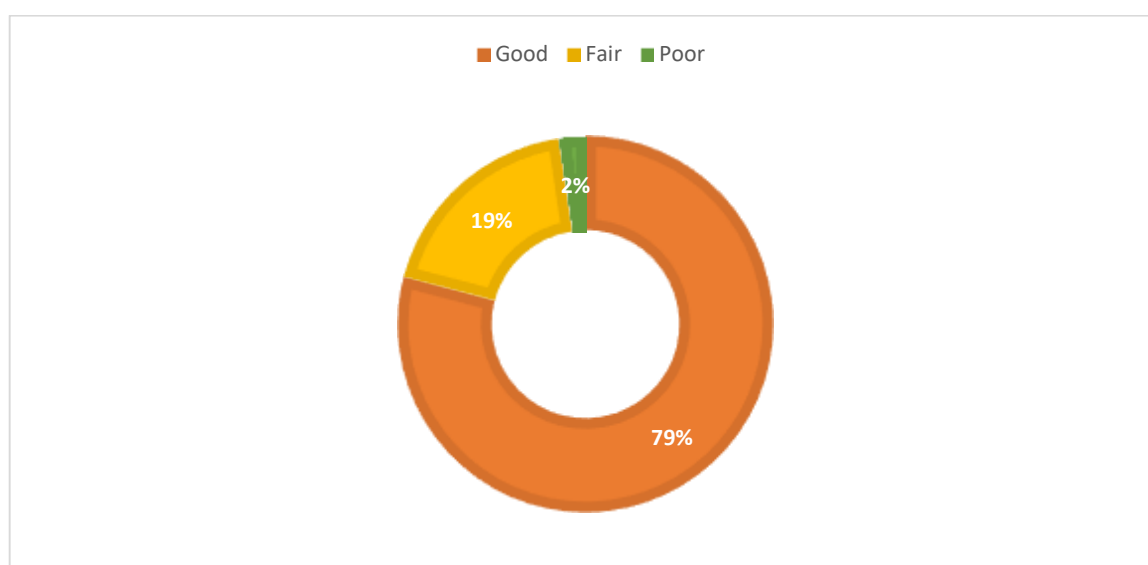


Figure 12. Overall Assessment of DMA

4. DISCUSSION

DMA distinguishes itself through its user-friendly interface, extensive features for students and teachers, and adaptability to a variety of learning environments. This application allows for personalised learning experiences and encourages student engagement. It's also compatible with a variety of devices, making it more accessible to a broader audience.

Recognition at international competitions serves as a hallmark of excellence in the rapidly evolving landscape of innovation and technology. Such honours not only recognise ingenuity, but also the potential for positive change that new ideas and creations bring to the world. DMA is a prime example of this, having won gold at NSIEx 2021 and silver at NSIEx 2022.

We recognised the importance of safeguarding our intellectual property against unauthorised use or duplication. To accomplish this, we obtained copyright permission from UiTM (Universiti Teknologi MARA), ensuring that DMA's distinctive features and functionalities remain exclusive to our application. This step not only protects our innovation but also gives our users and partners confidence.

DMA's success in international competitions demonstrates Malaysia's potential in educational technology. It promotes innovation and emphasises the significance of investing in such projects. The

DMA's recognition can attract attention and partnerships, fostering the growth of the education technology sector not only in Malaysia, but globally.



The primary goal of the project is to find and implement the best online platform for open and distance learning in two subjects: Intermediate Mathematics for Pre-Science (MAT086) and Pre-Calculus (MAT133). According to a survey conducted at the UiTM Cawangan Negeri Sembilan Kampus Kuala Pilah, most students prefer an online learning platform that includes all mathematics courses. As a result, the DMA was created to provide interactive teaching tools via websites and mobile applications, and it was a success.

One of DMA's main goals is to engage students by providing innovative learning methods that encourage interaction and improve performance. In comparison to traditional teaching methods, the project's goal is to make mathematics more engaging and interactive. DMA also addresses the scarcity of mathematics learning applications in Malaysia that are tailored to the university curriculum.

To ensure its effectiveness, DMA will be subjected to periodic testing to determine its suitability for open and distance learning in the specified subjects. Furthermore, the app will be made available on popular app platforms such as the Google Play Store (Android) and the App Store (iOS), providing additional accessibility options in the future.

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