

Android Application for the Plan and Elevation Topic in Form Five Mathematics

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Abstract: An android application for the 'Plan and Elevation' topic was developed in this study as it was found that there were issues in education regarding students' unsatisfactory academic achievement in the topic's teaching and learning (T&L) process. Students' difficulty in mastering geometry learning was found to be due to weaknesses in their spatial-visual skills. This study aims to (i) help teachers by providing a teaching aid that can be used in the T&L process, and (ii) allow students to learn at any time on their own and not be limited to class-learning. The development of this android application also helps users to learn how to solve problems related to the topic of Plan and Elevation. In this study, an android application was developed using the ASSURE design model. The model consisted of six phases namely student analysis; statement of objectives; selection of methods, media, and materials; use of media and materials; involvement of students in learning; and product evaluation. Adobe Flash Professional CS6 was used as the android application's development platform. The android application has four sections: "Introduction", "Topics", "Learning Videos" and "Mind Questions". The research instrument used is a questionnaire form aimed at confirming the functionality of this application. Developers collected research data from lecturers of related expertise from the Faculty of Technical and Vocational Education. In conclusion, the use of the android application for learning the Plan and Elevation topic will help improve students' mathematic achievements, especially those which do not involve computation. This will potentially impose positive impact on the T&L process.

Keywords: Android Application, Development, Mathematics, Plan And Elevation

1. Introduction

Issues in education are often viewed from the aspect of students' academic achievement which is not conducive to the Teaching and Learning (T&L) process in the classroom. Students' low academic achievement needs to be given attention due to a variety of factors such as the innovative and creative

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nature of teachers in managing the T&L process (Jasmi & Tamuri, 2011). An effective T&L method can be created if teachers are innovative and creative and are skilled at using the teaching aids – indirectly, these qualities allow the teachers to make a great impact on the teaching process by making it easy, convenient and effective.

The concepts of geometry, geometric reasoning and problem-solving geometry are often found to be hard due to students' difficulty in mastering geometry learning (Noraini, 2009). Abdullah and Zakaria (2013) agreed that impairment in geometry learning is generally due to students' inability to understand and master basic concepts of geometry. Most students learn the concept of geometry using the memorisation approach, making it difficult for them to actually recognise any geometry series, geometric features, and the relationships between geometric features. Therefore, the T&L method which uses 21st-century methodology should be implemented more systematically to increase students' level of mastery of geometry.

Konyalioglu and Aksu (2012) explained that the difficulty of understanding geometric concepts and solving problems among students is due to weaknesses in spatial-visual skills. Three-dimensional (3D) geometry learning in the Plan and Elevation topic requires spatial-visual skills and capabilities especially as it involves the representation of 3D objects in two-dimensional (2D) views. In addition, difficulties and weaknesses in spatial visual ability are attributed to weak or low levels of student imagination in solving problems and lack of basic knowledge of solid shapes (Abdul Halim, 2012). Therefore, android-based learning or M-learning needs to be implemented to be used on mobile devices such as smartphones to aid this issue. M-based learning is an easy-to-understand form of learning that can reduce time, energy, and cost.

As a result of the problem raised, problems in the T&L process amongst students regarding the methods used by teachers during the T&L session on the Plan and Elevation topic have been identified. During the T&L process, teachers need to be creative and innovative in leveraging the latest technologies and not relying solely on traditional methods. The use of teaching aids is very helpful in generating students' creativity and thinking. Most students do not think critically and creatively during the T&L process as they only focus on choosing the right answers, therefore the task of thinking is taken over entirely by teachers because they tend to provide answers without demonstrating the problem-solving process for each question (Cai & Lester, 2010). At the same time, the examination-oriented and systematic Malaysian education system requires that teachers finish their syllabus within the stipulated timeframe, which is one of the key factors that discourages creativity in the T&L process (Rashimah, 2012).

Understanding also plays an important role in students' mathematical achievement. Understanding the concepts found in mathematics require the use of elements from High-Order Thinking Skills (HOTS) and problem-solving skills, all of which are closely linked to students' academic achievement (Idris et al., 2009). As such, this study was undertaken to produce an Android application for the Plan and Elevation topic which is included in Form Five (5) Mathematics syllabus to provide guidance to both students and teachers on the topic and hence, treat the technology as an aid to the usual T&L process.

1.1 Mobile Learning (M-Learning)

M-Learning generally involves two (2) learning methods, which are distance learning methods (d-Learning) and electronic learning (e-Learning). One of the main purposes of m-learning is to make the learning process more flexible, mobile and fun (Nawi & Hamzah, 2013). In general, mobile-based technology provides many benefits to the learning process. Reference searches and information searches are also considered part of m-Learning conceptual learning (Yulius Hari, Darmanto & Minny Elisa Yanggah, 2016). Among the examples of technologies or devices that can be used for m-learning are such as Personal Digital Assistants (PDAs), mobile phones and so on. The development of mobile

systems involves two main criteria, among them is the use of a 'mobile server' which is one of the web servers-based mobile service applications. In addition, the second criterion of the m-Learning application system architecture involves the use of mobile clients that can access mobile server services directly, as shown in Figure 1 (Abdul Majid, 2012).

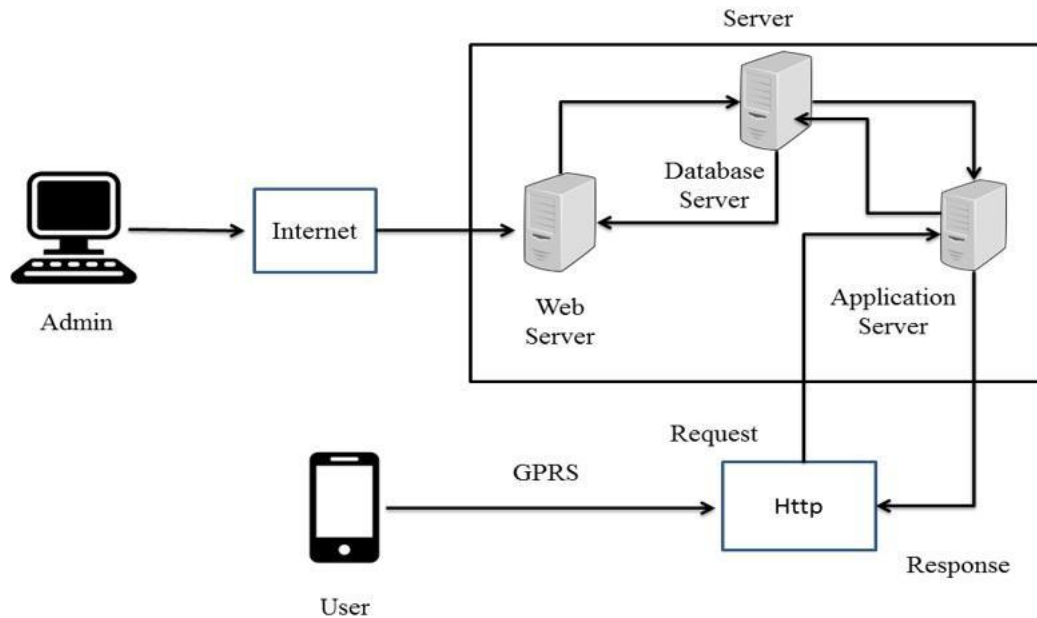


Figure 1: M-Learning Application System Architecture (Abdul Majid, 2012)

M-Learning has a unique nature and is increasingly being implemented, especially in the T&L process of schools and universities. There are several advantages of m-Learning, such as being able to supply and provide the latest and most up-to-date information at any time. Therefore, using m-Learning, students can study anywhere according to their own time, and the flexibility of learning is not limited (Rosli & Mohamad, 2011). The same points were also supported by Siraj and Saleh (2013) who argued that through m-Learning, learning materials can be taken anywhere; subsequently, m-Learning can be said to have successfully reduced the use of lecture halls, tutorial rooms and so on.

1.2 Android Application in Teaching and Learning

Technology development is so rapid nowadays in line technological achievements and breakthroughs, therefore making data access faster and more practical. The increase of phone users, especially those with android applications on smartphones has also enabled rapid technological development. According to Sfaat (2012), android -based smartphones and tablet PCs' application programming is software embedded on mobile devices that includes operating systems, middleware, and other applications.

The Android Standard Development Kit (ASDK) provides the tools and Application Programming Interface (API) needed to start application development on the android platform using Java code as it contains the data and source files required for applications combined with the app tools needed to produce an Android package. The file is marked with an .apk extension. This file is used as an application and can be installed on smartphones. Thus, the use of android applications for T&L can serve as a pillar in education and as a necessity that gives a positive and effective effect to the T&L process because it is very easy to create android-based learning application software on a smartphone. By doing so, all learning processes can be done easily and quickly at any time.

2. Methodology

The developer selected the ASSURE Design Model founded by Heinich as guideline for this study. According to Heinich et al., (1996), this ASSURE model means ensuring or "to ASSURE" that learning occurs. The model proposes six phases which are student analysis; statement of objectives; choice of methods, media, and materials; usage of media and materials; student involvement; and evaluation/review of materials. The student analysis phase is the most important stage because this phase covers issues regarding the development of Android applications. In this phase, analysis was made on students' general characteristics, and this included descriptions of the students' age, level of education, background and so on. The information collected therefore became the basis for media selection. In addition, the media used should be adapted to students' characteristics, lesson content, methods, media and learning materials. Therefore, to analyse students' characteristics, three (3) important things need to be seen where one of it is the use of media in the T&L process which should be adapted to students' characteristics so that its use is effective and meaningful to the students themselves (Mohamed et al., 2007).

The phase of choosing objectives is important in the development of an Android app according to Yahaya (2009) who stated that the objective of teaching is the result of students being dominated by a teacher while the teaching process occurs. The Sim teaching Model showed that the objective is an important element in creating interaction between instructors and students as it forces the main components to focus during T&L. The next phase is the selection of methods, media and materials. According to Abdullah (2007), selection of appropriate methods will lead to success of products produced. In a lesson, various methods such as induction sets, introduction to concepts, group activities, and training can be applied as adaptations to selected T&L activities. In addition, appropriate media selection for the T&L process allows messages or information to be delivered meaningfully (McGloughlin, 2001). At the same time, the material is a source that guides development, so it coincides with the learning objective (McGloughlin, 2001). Besides that, T&L sources which refer to the content of education used is also a learning focus. Textbooks can be used as materials in the T&L process.

The correct use of media and materials is very important because it can determine the effectiveness of the T&L process (Vaughan, 2004). During this phase, students were actively involved in the T&L process, and this helps ensure that the software or materials provided are attractive and effective for the learning environment. Therefore, in the development of this Android app, researchers use computer media and materials that can be used to reference and guide throughout the application. The next phase is the involvement of students in learning. Through this phase, students are actively involved in learning to ensure that software or materials provided are an attractive and effective learning environment. Based on reactions to the Android application developed, it was evident that students can engage directly with the material. This may be because the application developed contained activities such as training and quizzes which attracted the students' interest.

The final phase conducted was the evaluation/review of the material. In this phase, the Android application was tested for its functional permeation. Testing was carried out through semi-structured interviews and questionnaires with experts in the field of communication technology, especially those with expertise in the design of instructional and mathematical education. The questionnaire form used contains 21 items that seek the experts' evaluation on the application in terms of design, interaction, and interface. The responses were analysed according to their frequency. The questionnaire consisted of four sections: Section A which contains six details (demographic characteristics), section B which contains 7 items (interface design), section C which contains 7 items (interaction design), and section D which also contains 7 items (content design). The final product was then presented to supervisors and evaluation panels who evaluated and scored the application developed. In this phase, the application's

errors or weaknesses were improved on. The layout of the Android application for the Form 5 Plan and Elevation topic was developed as reference for both teachers and students in mastering the topic deeper.

3. Results and Discussion

The data obtained were calculated using percentage of frequency values. The experts involved were three lecturers from the Faculty of Technical and Vocational Education (FPTV). The three experts from FPTV were involved in assessing the design of the interaction together with the content and interface of the products developed. The interface for the main menu of the Android application is as shown in Figure 2 which consists of four menus developed (introduction, topics, learning videos and mind questions).



Figure 2: Main menu of the Android Apps

An example of the interface for the learning material in the Android app is as shown in Figure 3.

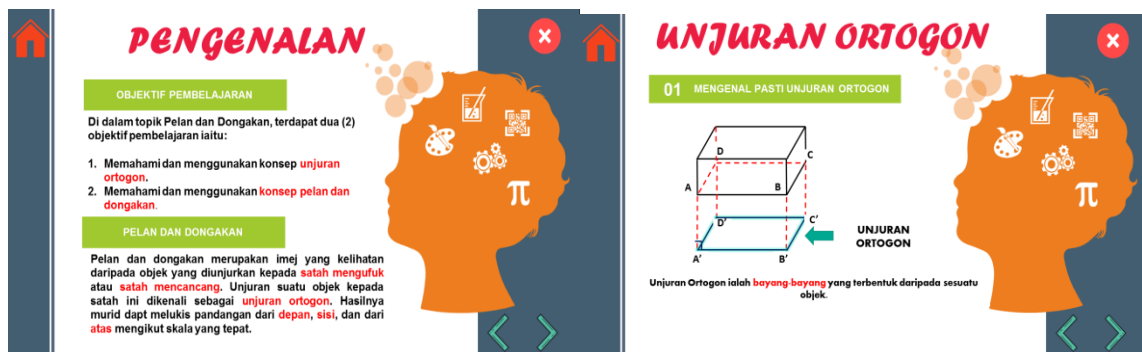


Figure 3: Interface of the Android applications for the topic of Plan and elevation

Table 1 shows the results from the content analysis. The three experts tested the functionality of the android application. Responses to Item 7 of the questionnaire proved that the contents of the application were found to be easy to understand by students; nonetheless, one out of the three experts disagreed with this matter. In general, respondents stated that the application’s content is well-organized, and all of them (three experts) agreed that the contents of the application are in the correct order. Furthermore, all experts agreed that the content of the application complies with the proper learning process.

Table 1: Analysis of Content Design

Item	Statement	Frequency	
		Yes	No
1	The content of the application fulfils the learning process correctly	3	0
2	The content of the application covers the selected topics	3	0

3	The content of the application fulfils the objectives set	3	0
4	The content of the application is according to the stated requirements	3	0
5	The content of the application follows the correct order	3	0
6	The content of the application has no spelling errors	3	0
7	The content of the application is easily understood by students	2	1

Table 2 shows the results of the analysis conducted on the design of interactions. All experts agreed that the Interaction design fits with the purpose of the Android application developed - all navigation buttons are functioning well, and all of the inserted videos can be played well. For Item 7 in Table 1, the developer found that one of the experts stated that "the content of the application can easily be understood by students", so the developer had successfully identified and improved the content of the application according to the expert's view.

Table 2: Analysis of Interaction Design

Item	Statement	Frequency	
		Yes	No
1	The navigation buttons were set up well	3	0
2	The navigation buttons available in each interface view are appropriate	3	0
3	The navigation buttons' configuration is easy for students' use	3	0
4	The navigation buttons prepared meet the principles of clarity and uniformity	3	0
5	The videos inserted can be played well	3	0
6	The size of the application button is used appropriately	3	0
7	This application is easily managed by users	3	0

Table 3 shows that the analysis of interface design consists of seven (7) items. Only one item of the design analysis which Item 1 that two out of three experts commented, which is on the type of font used for the appropriate text in the developed application. On the other hand, for all other items, all experts agreed that the interface design corresponds to the purpose of the Android application developed.

Table 3: Analysis of Interface Design

Item	Statement	Frequency	
		Yes	No
1	The font type used in this text is appropriate for this application	3	0
2	The font size used on this text is appropriate for this application	3	0
3	The text size used in this application is suitable	3	0
4	The interface used in the application is appropriate	3	0
5	Diagrammes are used appropriately in this application	3	0
6	The icon design is clear and easy to understand	3	0
7	Selection of themes and colours is suitable for the application	3	0

The ASSURE design model was used as a guide in the development of the Android application for the Plan and Elevation topic of Form 5 Mathematics. The development involved six phases which are student analysis; statement of objectives; choice of method, media, and materials; use of media and materials; student engagement; and evaluation/ review of materials. Adobe Flash CS6 was used for the media and materials development stages to develop the Android application. The application was designed with graphics, animation, audio, and text. All teaching materials were developed in phases

using media and materials and the appropriate hardware and software. The application was then published in APK format to facilitate installation into smartphones.

When the results of the data analysis were tabulated, the three specialists agreed with the notion that the content design of the application meets the objectives of learning the syllabus for the chosen topic and fulfilling the need to teach students. Consent to the content developed is important to ensure that the information presented in the application is organised, in accordance with the learning syllabus in the school, and is able to be used to achieve the set objectives. All the experts agreed that the contents of the application aid the process of learning. However, one of the experts disagreed about the content of the application being easily understood by students. The experts opined that more explanation on each part of the topic is needed if this is a new topic learnt by students. Nonetheless, all the experts agreed that the content in the application is easily understood and consistent from the low-level to high-level difficulty. In addition, the content of the application meets the objectives stated. This statement is supported by Kamruddin (2012) who said that a consistent content layout allows for credibility and teaching in a professional and orderly manner.

In the evaluation of the design and interaction, the three experts had agreed on all items mentioned in the questionnaire form. Next, the use of navigation in the application also received support as it was agreed upon by the three experts who agreed that the navigation provided in each view is appropriate, fulfils the principle stated, and is functioning well. All three experts agreed on the seven (7) items presented in the interaction design analysis questionnaire as proven by the achievement of a hundred percent (100%) percentage of acceptance, with all experts answering 'YES' for each item asked. This proves that all navigation buttons work well, and users can control this application successfully. The statement is supported by Harun & Tasir (2006) who posited that each page should have a navigation button for the user to easily control the application used according to the user's needs.

The interface design was also evaluated by the three (3) experts, based on the analysis of data obtained, it was found that all three experts agreed that the background of the interface in each display is interesting and appropriate. Next, for the text colour and theme used, all experts agreed that the colour of the texts and themes used are also in accordance with the developed application. One expert did not agree on the type of font used for the text in the application. The experts even argued about the title on each page, especially on the note, as they felt that it needs to be explained in bold and using a different style of writing. The developer received the suggestions and comments for improvements to the application. This is because the font type used must be compatible with the combination of size, colour and use of text. According to Hashim (2015), the combination of font, size, and background colour in a text can also affect the level of readability and readability of the text to the user. The choice of clear, easy-to-read fonts is important to allow the message to reach the user easier and faster.

4. Conclusion

This study was conducted to develop a mobile application that acts as one of the alternative materials for Form Five (5) students to study the Plan and Elevation topic which is included in their Mathematics subject. This approach was pursued because it has the topic has been identified as difficult to understand, and this application is able to provide more effective T&L. In addition, it acts as one of the effective alternatives to be used as reference by students and can encourage students to learn independently after T&L time. Overall, the developer managed to develop an android application for the Plan and Elevation topic for Form Five students. The developer's strategy was to emphasize more on the aspects of self-directed learning uses interactive instructional videos and animated notes.

The development of this android application was based on the ASSURE Model (1996). The ASSURE model involves six phases, namely the analysis phase; statement of objectives; selection of methods, media, and materials; use of media and materials; student involvement in learning; and the evaluation/review phase of materials. A total of three experts made the product verifications for this

android application. The design of this android application uses materials that are more suitable and easier to operate to enable it to provide a clearer understanding to students and teachers.

Finally, the evaluation phase using the application functionality testing method was implemented well. Overall, the developer successfully developed an android application for the Plan and Elevation topic and the feedback received from all the experts was positive and satisfactory. Every view and comment from the experts were used as a guide to improvements made to the application. Therefore, the end result of the application is of better quality and the application itself can be used as reference by other researchers in the effort to produce more effective android applications.

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