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# The use of mobile learning application to the fundament of digital electronics course

**L Rakhmawati and A Firdha**

Department of Electrical Engineering, Universitas Negeri Surabaya, Indonesia

lusiarakhmawati@unesa.ac.id

**Abstract.** A new trend in e-learning is known as Mobile Learning. Learning through mobile phones have become part of the educative process. Thus, the purposes of this study are to develop a mobile application for the Fundament of Digital Electronics course that consists of number systems operation, logic gates, and Boolean Algebra, and to assess the readiness, perceptions, and effectiveness of students in the use of mobile devices for learning in the classroom. This research uses Research and Development (R&D) method. The design used in this research, by doing treatment in one class and observing by using Android-based mobile application instructional media. The result obtained from this research shows that the test has 80 % validity aspect, 82 % of the user from senior high school students gives a positive response in using the application of mobile learning, and based on the result of post-test, 90, 90% students passed the exam. At last, it can be concluded that the use of the mobile learning application makes the learning process more effective when it is used in the teaching-learning process.

## 1. Introduction

Mobile learning (*m-Learning*) is a new paradigm in the world concern of erudition. This learning model appears to keep the development of the world of information and communication technology, especially information technology and mobile communication which is very rapid. In addition, it cannot be denied at this time, a mobile communication device is one device that is attached to the daily animation of the actors such as instructor and scholar [1]. M-Learning should have the power to connect to other equipment, especially computers, to present encyclopedias information and to realize bilateral communication between teachers and learners. M-Learning is a unique learning because the user can access code of learning materials, referrals and applications related to learning, whenever and wherever [11]. This will increase attention to learning materials, make learning pervasive, and can encourage learner's motivation to lifelong learning. In addition, compared to conventional learning, m-Learning allows for more chance for collaboration and informal interaction among learners [2]. M-learning is, at the present, more innovative and student-centered, concerning the use of mobile devices, like cell phones, Personal Digital Assistants (PDAs) and smartphones.

M-learning can be defined as "The intersection of mobile computing and e-learning: accessible resources wherever you are, strong search capabilities, rich interaction, powerful support for effective learning, and performance-based assessment. E-Learning is independent of location in time or space." [1]. Based on the definition, mobile learning is a learning model that utilizes information and communication technology. [10] In the concept of learning, mobile learning brings the benefits of the availability of teaching materials that can be accessed at any time and the visualization of interesting



materials. It is important to be noted that not every teaching material is suitable for mobile learning. The study of digital electronics is fundamental in electrical engineering courses that need to be taken especially for first to the third year of vocational engineering students. Generally, in these courses, classical teaching uses textbooks as the main element. However, the use of textbooks is very limited, too flat and static [3]. The basic knowledge of digital electronics is a lot of things that the students should memorize and understand. The students do not refer to the books everywhere as it is large, heavy and cannot bring everywhere. The independence of time and place becomes an important factor that is often emphasized. However, in traditional e-Learning, the minimum requirement remains a PC that has the consequence that the independence of time and place is not fully met. This independence cannot yet be fulfilled with the use of notebooks (portable computers) because of the real time and place. It means that a person can learn wherever he can access to learning materials [4]. Therefore, in this new technological context, it is important to develop new m-learning tools for these courses. A new m-learning framework for the digital electronics course was developed at Department of Electrical Engineering of Universitas Negeri Surabaya. The initial course material has been adapted to the *m*-learning environment and new contents were added, enriched with animations and interactive examples. Besides the traditional theoretical lessons and laboratory practices, we propose the use of this m-learning system to reach a wider blended learning methodology.

This paper is organized as follows; in Section II, we introduce related works regarding fundamental digital electronics course and mobile learning projects, while the methodology is presented in Section III. Section IV is dedicated to the presentation of the results and discussion about developed mobile learning. Finally, in Section V, conclusions are presented.

## **2. Mobile Application Overview**

E-Learning or electronic learning was first introduced by the University of Illinois at Urbana-Champaign using a computer-assisted instruction system and a computer called PLATO [5]. Some of the advantages of e-Learning compared with other learning is that it can be used anywhere at any time, most mobile devices have a relatively cheaper price than desktop PC prices, the size of the device is small and lightweight than a desktop PC, it is expected to include more learners because e-Learning utilizes technology commonly used in everyday life [2]. In e-Learning, the independence of time and place becomes an important factor that is often emphasized. However, in traditional e-Learning, the minimum requirement remains a PC that has the consequence that the independence of time and place is not fully met. This independence cannot yet be fulfilled with the use of notebooks (portable computers) because the real time and place independence means that a person can learn wherever he needs access to learning materials.

Mobile learning is one potential alternative to expand access to education [6]. However, there is not much information about the use of mobile devices, especially mobile phones, as a medium of learning. This is unfortunate given the already high level of ownership and usage levels that are underutilized for education [7]. In addition, there is currently very little development effort of mobile-based learning content based on widely accessible devices. Most of the content on the market is still dominated by entertainment content that has less educational aspect and most of it is the result of production from abroad which has different cultural background with our country [8]. This fact raises the need for more mobile, diverse, accessible, mobile-based content development. Factors that limit the utilization of m-learning are mostly related to the limitations of the device. Currently, most mobile devices have limited display screens, storage capacity, and limited power. M-learning also has a somewhat different learning environment with e-learning or conventional learning. M-learning, learners use more m-learning in spare time or idle time (idle time) so that the time to access learning is also limited.

Lack of m-Learning itself is actually gradually will be resolved, especially with the development of increasingly advanced technology [9]. The processor speed of the device is getting better, while the memory capacity, especially the external memory, is currently getting bigger and cheaper. The relatively small display screen can be overcome with the ability of the device to display the output display to TV or to the projector. Limited media input/output issues which consist of few buttons will be resolved by the presence of touchscreen technology (touchscreen) or virtual keyboard. Limitations

in the availability of the power supply will be overcome by the utilization of practical, easy-to-obtain and easy-to-carry alternative resources, such as liquid batteries, human motion, solar power and so on.

### 3. Methodology

This type of research uses Research and Development (R & D). The development procedure follows Brog and Gall procedure [9] that can be done more simply by involving four main steps are 1. conducting an analysis of products to be developed; 2. developing the initial product; 3. expert validation and revision; 4. test the small-scale field and Product revisions. With research, the models are tested systematically, evaluated, improved to obtain specific criteria for the same effectiveness, quality, or standard. This study is the process of implementation of learning steps that are applied in the classroom and the level of creativity to make mobile media applications and student learning achievement as a result of the use of Android-based mobile application media.

Based on the results of needs analysis, the next step of research and development make the design of the product to be developed. The product design that will be developed in this research is designing and preparing the tools and software needed to make the learning media easy to understand. We need Computers/Laptops, Android OS Smartphone, Game Maker Studio Software to implement m-learning.

Validation of this design in the form of learning media android based mobile application taken lecturer by media experts from the electrical engineering department. The validation results are then analyzed and revised according to the validator's suggestion. Next, once the product design is validated through expert judgment or discussion forum, it will know the shortcomings and advantages of the media. The deficiencies will then be revised or revised according to the advice given by media experts. After making a revision of the product design, then the next step researchers conduct product testing in the form of learning media based mobile application android to students of class X Audio Visual Technique of Public Vocational High School (TAV SMK Negeri) 1 Jetis Mojokerto on basic electronic engineering competence.

The steps of development of Android-based mobile application as follows:

1. Prepare the necessary materials such as software, gmx format images, fonts, designs, and audio.
2. Install Game Maker Studio software, CorelDRAW software. Game Maker Studio is used to create mobile apps and CorelDRAW is used to create required images, such as display design drawings, and images that pertain to the material to be explained.
3. Create submenu along with the necessary buttons by using CorelDRAW as supporting software. The submenu view and its sequence scan on the flowchart that has been created. The page is then equipped with the necessary audio and animation.
4. Make forty multiple choice questions about the number system materials, logic gates and Boolean algebra all set to Game Maker and to design drawings, working on the material using CorelDRAW. Problem wrote manually in CorelDRAW then included in Game Maker. How to configure the problem in game maker is to create two objects (right and wrong) create two scripts. The first script to randomize and query in the queue, e.g. (room, go to (choose (Problem 1, Problem 2, Problem 3, Problem 4, Problem 5, Problem 6, Problem 7, Problem 8, Problem 9, Problem 10.) The second script is used to call the queue sequence and delete the one already in Call so that it does not enter the queue of questions; the exercise of the problem is then imported into the evaluation file that has been made before. After that, the file that has been successfully created is stored with the name of the electronic module in one folder in local disc C.
5. Publish mobile application using Game Maker to form the application format .gmx
6. Create designs and images of mobile apps using CorelDRAW.
7. Run the Game Maker Studio program in .gmx format converted into the .apk format using Game Maker program by configuring Game Maker program by configuring Game Maker program then format changed to .apk. Mobile apps that have become .apk format can be directly installed and run on all smartphones with android (gingerbread) operating system upwards.

#### 4. Results and Discussion

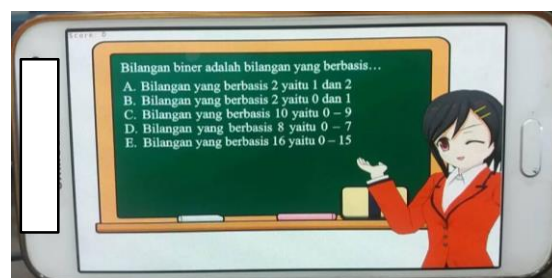
The main objective of this project is the implementation of an m-learning tool for the teaching of the fundamental of digital electronics. The purpose of this solution is not to replace the traditional teaching methods, but to create a complementary tool in order to improve the student's interest, motivation, and the resources availability in any place, at any time. The *m*-learning digital electronic course consists of several interactive modules. The contents of the modules cover the following main topics: Number systems, logic gates, and Boolean algebra.

The contents were developed in order to put an emphasis on demonstrating and assisting each theoretical concept with a practical application. Another important feature is the use of images and multimedia animations. As an example, Figure 1a shows a material about the Boolean algebra. With this image, students can see the logic simplification. Several interactive figures have been developed for the understanding and motivation of the students. Figure 1b neither shows an interactive circuit for NOR gate. Students can change the input of the gate to show the output of gate that they want to see.



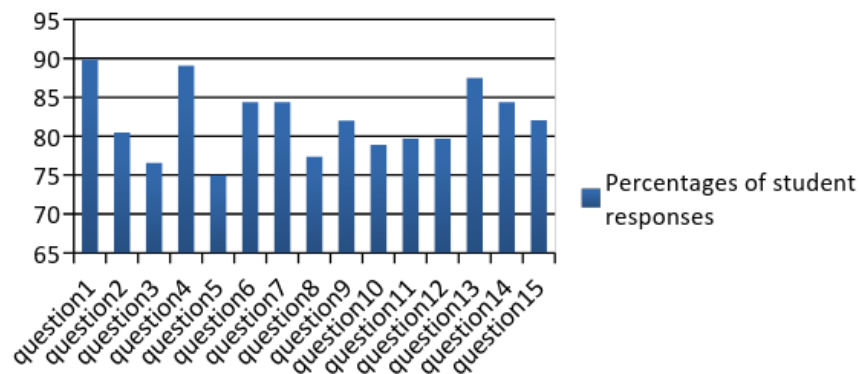
**Figure 1.** a).Logic simplification; b). NOR gate's interactive circuit

One important feature associated with the figures and interactive animations is the evaluative quizzes, informing about the results to the questions. In a case of failure, the student must start again the lesson as shown in Figure 2.



**Figure 2.** An example of the evaluative quizzes

To assess the readiness, perceptions, and effectiveness of students in the use of mobile devices for learning in the classroom, we have a methodology that mentions before. Based on Table 1, there are four categories of validation: format, design media, material, and language, for general information learning media developed with an average score of 80% are categorized as feasible or at a reasonable level of quality, so that the developed learning media can be used as a medium of learning with little revision. Student response is known through giving questionnaires to students who become research samples. The following data results of student responses to learning media can be seen in Figure 3, with 15 questions, the average is 82%.

**Figure 3.** Results Diagram of student responses**Table 1.** The results of m-learning validation

	Aspects	Percentages
Format	Systematic presentation	83 %
	Conformity of design	75 %
	The clarity of the use of letters	75 %
	The suitability of color display	75 %
	The ability of simulation in explaining material	91%
Design Media	Display design that served to help the students' understanding	100%
	Simulations are presented clearly, attractively and easily understood	100%
	Media design with a color display presented harmoniously	
	Ease of using the navigation menu	75%
	Giving audio in support of learning	75%
Material	Material compatibility with indicator	75%
	Truth material simulation with theory	91%
	Material is grouped according to the sequence	75%
	Material suitability with learning objectives	75%
	Material completeness with media	75%
Language	Language is easy to understand	75%
	Grammar	75%
	The language used can clarify the material delivered	75%

To know the extent to which students have attained the competence related to logic gate material students are given a post test in the form of multiple-choice questions. From the data completeness of student learning outcomes during the learning process by using learning media mobile application based on the android basic electronics engineering subjects in class X TAV SMK Negeri 1 Jetis Mojokerto. From the result of recapitulation of student value can be presented diagram as follows: From the results of the data above is known that the level of mastery of students' learning achievement class X TAV SMK Negeri 1 Jetis Mojokerto using learning media mobile application based on Android on basic electronics engineering subjects of 90.90% and at the student level is not complete 9.09%.



## 5. Conclusions and Future Work

The use of m-learning tools, if correctly conceptualized and built, it constitutes an efficient complementary tool to the traditional teaching methods. So, in this context, it was presented the development of a mobile learning framework for digital electronics course. The theoretical content of the course was structured in several interactive modules. At the end of each module, there are quizzes allowing students to be evaluated by themselves or by course teachers. The result obtained from this research shows that 80 % validity aspect, 82 % of the user from senior high school students give a positive response in using the application of mobile learning, and based on the result of post-test, 90,90% students passed the exam. At last, it can be concluded that the use of the mobile learning application can make the learning process more effective as used in the teaching-learning process. As future work, the teacher can receive automatic SMS from the student's mobile phone. This allows the teacher to have access to the student's progress and comments about the images and multimedia animations.

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