DESIGN AND DEVELOPMENT OF ANDROID-BASED LEARNING MEDIA FOR LEARNING ALGORITHM AND DATA STRUCTURE

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ABSTRACT

Learning media is part of the learning component, the media is included in the discussion of the overall learning system. The use of media is expected to be a special concern in every learning activity, this is to assist the delivery of learning in supporting the advancement of today's technology-based education world. One of the learning techniques is in the form of algorithms and data structures. Technological advances make learning media usable on Android devices. This study aims to design learning media algorithms and data structures based on Android. The research method uses a waterfall-type system development life cycle (SDLC). The results of the study are learning media algorithms and data structures can be designed for Android devices. The results of system testing using black-box testing provide results as expected.

Keywords: Android, Algorithms and Data Structures, Learning Media, SDLC.

INTRODUCTION

The development of mobile technology to date is growing rapidly to the realm of education (Heflin et al., 2017; Martin & Ertzberger, 2013). Today's education has been integrated with mobile technology. Teachers or lecturers in the mobile technology-based learning process can provide an instructed conception through a mobile application (Chen & Tsai, 2021). Research at Spanish University proves that there is an achievement of understanding in students with the mobile learning model, this is also helped by the increase in the way teachers integrate mobile learning with learning materials (Aznar-Díaz et al., 2020; Diacopoulos & Crompton, 2020; Hamat et al., 2012). The use of information technology for education in Indonesia during 2017-2020 has achieved an increase in published research (Revelation Widodo et al., 2021) and other research results mention that between 2003-2010 there were 164 research studies (Wu et al., 2012) and in 2007-2016 mobile learning has become a fairly increasing trend in scientific publications (Fu & Hwang, 2018). The integration of learning with mobile technology has also experienced an increase

in scientific publications, as many as 110 experiments were carried out during the period 1993-2013 (Sung et al., 2016). Meanwhile, in the period 2008-2017, there was an increase in the use of smartphones for academic purposes (Kates et al., 2018). At the higher education level, the use of mobile learning in 2010-2016 was dominated by students with an age range of 18-29 years, and interestingly, the faculty needs to facilitate this mobile learning model (Crompton & Burke, 2018).

Learning science, technology, engineering, mathematics (STEM) through mobile in 2003-2016 resulted in research publications reaching 60 articles, even in applications in the community, which can be reached to rural areas. This proves that mobile learning can be reached to various levels of society, both in urban and rural areas (Mutambara & Bayaga, 2021). Mobile learning has improved the quality of learning for students compared to conventional learning in the classroom (Jeno et al., 2020). Through this technological approach, learning is carried out, one of which is through mobile devices, where the features of the learning application must be designed in such a way that it can assist students in learning outside the classroom (Reychav et al., 2015). Besides that, it also increases students' creativity in material enrichment through mobile learning (Jahnke & Liebscher, 2020), one of which is the ability to dig up more information on the internet through mobile devices to enrich understanding of the material (Parsazadeh et al., 2018). Students in higher education are required to be independent and free to explore the information needed during lectures. This freedom of learning will speed up the process of absorbing the knowledge that students get (Siregar et al., 2020). Research proves that there are factors that influence student resistance and intention to use mobile learning by developing an integrated research model that combines innovation diffusion theory (IDT) and model of innovation resistance (MIR) (Kim et al., 2017).

Algorithm and programming are some of the materials in the field of computer science or informatics engineering (Wulandari, 2018). This material has been around since middle school level (Kusumadewi, 2016; Wulandari, 2018) up to college (Nasution, 2019), for college-level some use the name "algorithms and data structures" in addition to algorithms and programming. According to reports (Wulandari, 2018) found it difficult to understand the material for students in high school, because the material for algorithms and programming is still limited in reference. To anticipate these problems, a breakthrough in mobile technology for learning is the solution, in the form of mobile learning or known as m-learning (Kusumadewi, 2016). With m-learning, it will create a varied learning atmosphere, this can increase students' interest and motivation in learning (Wulandari, 2018).

Several studies related to m-learning technology for learning between 2010-2016 have increased (Chung et al., 2019), including research (Al Hakim et al., 2020; Al Hakim & Setyowisnu, 2021) which develops m-learning applications in the form of Android-based multimedia applications for mathematics materials. Study (Kusumadewi, 2016; Wulandari, 2018) developing learning media based on Android for basic programming lessons for high school students. Study (Sianturi & Yusfrizal, 2020) developing learning media for firebase real-time database security using an Android-based OTP algorithm. Study (Rustandi et al., 2020) developing Android-based learning media for simulation lessons and digital communication at the high school level. Study (Yahaya & Salam, 2014) developing m-learning applications for children. The development of mobile apps for learning purposes has also been researched by (Friday & Tasir, 2013).

Concerning learning about algorithms and data structures, one of the lecture materials in universities is still not much research done. In particular, research on the development of m-learning applications on algorithms and data structures. This study aims to try to solve these problems, by developing an Android-based learning media application for lectures on algorithms and data structures. It is hoped that this application can be useful for the learning process that is

integrated with technology and is not only used among students but for the general public who are interested in algorithms and data structures.
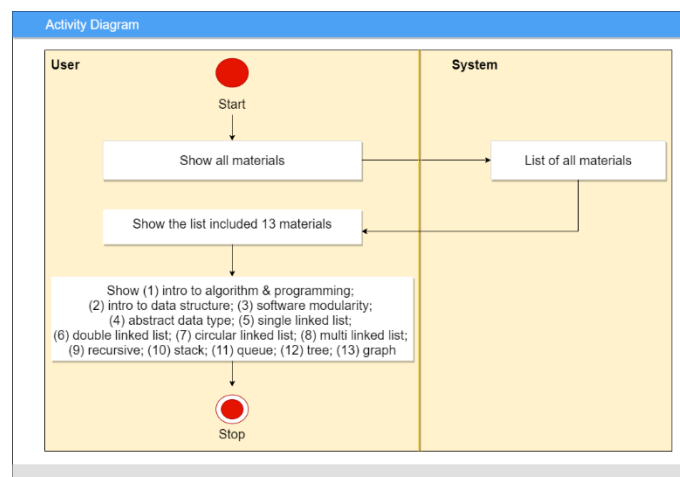
METHOD

The research method applies the multimedia development life cycle (MDLC) development method with stages including concept, design, material collection, installation, testing, distribution (Al Hakim et al., 2021).

Concept

This learning media application for algorithms and data structures has the concept of an Android-based m-learning application. This m-learning application will contain learning materials on algorithms and data structures for one semester. The m-learning application is expected to help the learning process based on smartphone technology.
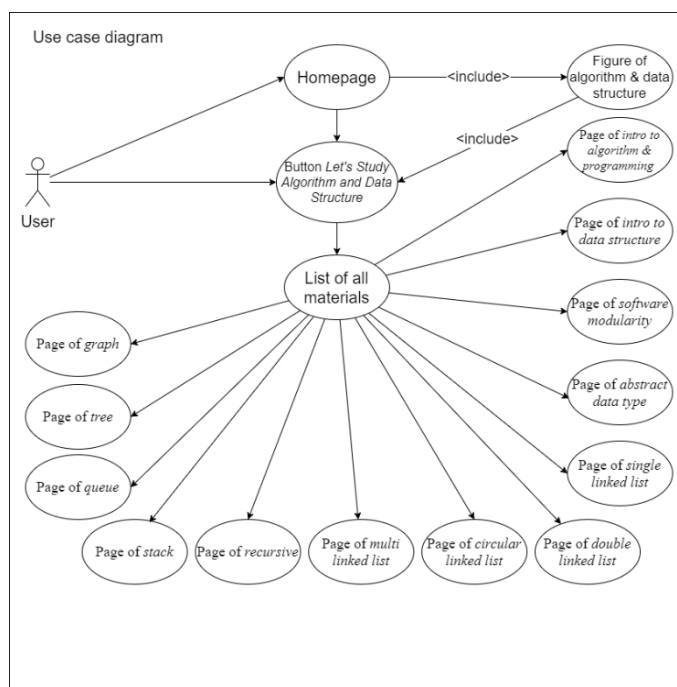
Design

This Android-based m-learning application is designed using a unified modeling language (UML) approach which consists of activity diagrams and use case diagrams. Activity diagrams describe the system processes in receiving orders from users. This can be seen in Figure 1.

Figure 1. Activity diagram of the m-learning system

Use case diagrams explains how users interact with the system and this results in a user-friendly m-learning application display. This can be seen in Figure 2.

Figure 2. Use case diagram of the m-learning system

Material Collection

Algorithm learning materials and data structures that will be stored in the system include introduction to algorithm and programming, introduction to data structure, software modularity, abstract data type, single linked list, double linked list, circular linked list, multi linked list, recursive, stack, queue, tree, and graph.

Installation

Android-based m-learning applications are written in Java, with Android Studio software. This m-learning application is free and can be used by anyone in the future.

Testing

Before reaching the distribution stage, the m-learning application is tested first to ensure that all the features on the system can run as expected. Testing is done by black-box testing.

Distribution

This m-learning application is an Android application product with *.*apk* file format. In the future, this application will be freely available in the market or through lecturers or universities regarding its distribution for use in the learning process.

RESULT AND DISCUSSION

Application *m-learning* algorithms and data structures are for a minimum version of Android 6.0. Marshmallows. The main display of the m-learning menu can be seen in Figure 3.

Figure 3. Main menu capture

Main menu displays illustrations of algorithms and data structures. There is a button to open the list of learning materials for algorithms and data structures "Let's Study Algorithm and Data Structure". The display of the list of algorithmic learning materials and data structures can be seen in Figure 4.

Figure 4. M-learning showing the list of all materials

Figure 4 displays all learning materials for algorithms and data structures contained in the system. Based on the collection of materials in the previous methodology, which contains 13 learning materials for one semester. An example of a menu that is accessed in the form of "Introduction to Algorithm and Programming" can be seen in Figure 5.

Figure 5. Example for showing the menu "Introduction to Algorithm and Programming"

Based on Figure 5, the material displayed is in the form of text, images, illustrations, sounds, and videos on several materials. The existence of m-learning greatly saves the textbooks used for one semester. Lecturers can provide teaching assistance as long as students use m-learning. Of course, students can also learn independently with m-learning without having to face to face in conventional classes. This m-learning application is then tested by black-box testing. The test results can be seen in Table 1.

Table 1. Result of black-box testing

Features Tested	Plan	Expected Result	Test Result
Show Homepage	Can showing the homepage	Showing the homepage correctly	Suitable
Show Main Menu	Can showing the main menu of the app	Showing the main menu page correctly	Suitable
Show Introduction to Algorithm and Programming Page	Can showing Introduction to Algorithm and Programming page	Showing Introduction to Algorithm and Programming page correctly	Suitable
Show Introduction to Data Structure Page	Can showing Introduction to Data Structure page	Showing Introduction to Data Structure page correctly	Suitable
Show Software Modularity Page	Can showing Software Modularity page	Showing Software Modularity page correctly	Suitable
Show Abstract Data Type Page	Can showing Abstract Data Type page	Showing Abstract Data Type page correctly	Suitable
Show Single Linked List Page	Can showing Single Linked List page	Showing Single Linked List page correctly	Suitable
Show Double Linked List Page	Can showing Double Linked List page	Showing Double Linked List page correctly	Suitable
Show Circular Linked List page	Can showing Circular Linked List page	Showing Circular Linked List page correctly	Suitable
Show Multi Linked List page	Can showing Multi Linked List page	Showing Multi Linked List page correctly	Suitable
Show Recursive Page	Can showing Recursive page	Showing Recursive page correctly	Suitable

Show Stack Page	Can showing Stack page	Showing Stack page correctly	Suitable
Show Queue Page	Can showing Queue page	Showing Queue page correctly	Suitable
Show Tree Page	Can showing Tree page	Showing Tree page correctly	Suitable
Show Graph Page	Can showing Graph page	Showing Graph page correctly	suite

CONCLUSION

The m-learning algorithm and data structure application is for Android version 6.0. Marshmallow and above by loading 13 lecture materials and system testing results as expected. We hope that in the future the distribution of this m-learning application so that can be used in mobile technology-based learning processes.

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