DESIGN AND DEVELOPMENT OF LEARNING MEDIA APPLICATION IN EXTRACURRICULAR LEGO EDUCATION BASED ON MOBILE AT SCI-ROBO BANDUNG COMPANY

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ABSTRACT

SCI-ROBO is one of the companies in the field of education Lego Education in collaboration with several elementary schools in the city of Bandung. Based on the results of interviews to trainers, that trainers sometimes difficult to explain the material. Then from the results of the questionnaire to the students, that when learning difficulties in making Lego project because the guide only shows the theme image of each material, then other problems faced when the completed project is created, the students want to bring home the project made, but Because the Lego part is only lent so the students can not take home the project for them to learn. Based on the problems that have been described then the application is made based on mobile android, and has a 3D simulation feature and the class level of Robotic material level 5. This application is built using Leocad tools to boost 3d Lego, Blender to create animation and unty3D as application maker. Then test the application using blackbox and UAT methods. The results of this study, with this application more than 70% facilitate students in learning extracurricular Lego education and facilitate trainers to explain the material.

Keywords: Extracurricular, Lego Education, Learning Media

1. INTRODUCTION

1.1. Background

Lego commonly known to people is a toy, but in reality has a medium of learning through Lego Education. Based on the method of questionnaire data collection with the number of respondents 30 students using Guttman scale measurement method, that 70% of students have problems when creating project Lego Education, 82.3% of students have constraints when they finish the project they want to take home the project that has been made as a reference To be learned, trainers sometimes find it difficult to finish Lego Education materials to students.

1.2 Purpose and Objectives

The purpose of this study is to make the application of learning media extracurricular Lego Education mobile-based that can be used by students and trainers.

The purpose of this research is:

A. Simulates three dimensions (3D) Lego Education learning guide that is expected to make learning easier and more interesting.

B. Create an android mobile app that students can use, so they can relearn the material already taught at home.

Simplify the trainer in explaining Lego Education materials.

2. THEORETICAL BASIS

2.1 Understanding of Learning

Learning is a subset of education so that the existence of learning really can not be negated in education. Learning is not something that is separate or contradictory to education, but an integrated thing of the educational process and even a major determinant of educational success. Learning is a programmable teacher activity in intruksional design, to make students learn actively, emphasizing the availability of learning resources. [4]

2.2 Learning Objectives

The learning objective in Sugandi et al's book is to help the students to gain experience and with that experience the behaviors include knowledge, skills and values or norms that serve as behavior control and behavior of students. Learning objectives describe the ability or level of mastery that is expected to be achieved by students after they follow a learning process. [5]

2.1 Understanding Extracurricular

Extracurricular is an educational program implemented by schools under the responsibility and guidance of schools. In a large Indonesian dictionary, extras are extras beyond the official ones. While curricular is concerned with the curriculum. So the extracurricular assertion is that the out-of-school activity of the separator or part of the scope of the lesson given in the school is not an integral part of the subject set in the curriculum. [6]

2.2 LEGO

Lego is a kind of small plastic plastics game that is famous in the world especially among children or adolescents regardless of male or female. These bongkah and other pieces can be arranged into any model. Cars, trains, buildings, towns, statues, ships, airplanes, spacecraft and robots can all be made.

2.3 LEGO EDUCATION

We LEGO Education, For more than 37 years we have worked with teachers and education specialists to provide a play learning experience that brings a vibrant and lively lifestyle atmosphere. We have a variety of physical and digital educational resources that encourage students to think creatively, systematically and unleash their potential to shape their own future.

Our solutions for learning and teaching inspire the interest of Science, Technology, Engineering, and Mathematics (STEM), targeted at preschool, primary and high school. It is based on the LEGO Education system to learn to play combined with relevant curriculum materials and digital resources. With educational sets, lesson plans and curriculum materials, assessment tools and teacher training and support, we can help meet the curriculum goals and provide the tools needed to make the learning situation interesting and effective.

We believe that expanding knowledge and building 21st century skills will create active and collaborative learning. Together with educators, we aim to enable each student to succeed in education and be prepared for the challenges of life in the future. [7]

3 RESEARCH CONTENTS

Analysis of the ongoing system is an activity to analyze work procedures that occur on the existing system today. The ongoing procedures at the SCI-ROBO BANDUNG company in the extracurricular learning activities of Lego Education are as follows:

1. ***Procedure for Granting Material****s*

The procedure as follows:

A. Trainer prepares the material to be delivered during the extracurricular learning process of Lego Education.

B. Trainer prepares an object image or guide to create a Lego project.

C. Students receive an object image or guide to create a Lego project

D. Trainer describes the learning materials to be made by the students.

E. Students receive material explanations from trainers.

F. Trainer prepares the Lego part to be assembled.

G. Students receive the Lego part to be assembled.

H. Students work on materials that have been given by trainers.

I. Trainer photographed project material that has been made for the documented

2. ***Material Exercise Procedure***

The procedure as follows:

A. Trainers prepare material exercises to be made by students.

B. Trainer explains the theme of the material exercises to be made by the students.

C. Students receive an explanation from the trainer.

D. Trainer prepares the lego part to be assembled.

E. Students receive the Lego part to be assembled.

F. Students do material exercises according to the theme given by the trainer.

G. Trainer photographed the project material exercises that have been made by the students.

Trainers assess the project made by the students.

3.1 Material Analysis

Interactive Learning on Lego Education extracurricular material that will be applied to this application according to Mr. Ramdhan from interview result is learning for class 5 semester 1, level of Robotic level, because at that level difficulty level is difficult enough, with material can be seen in table 3.1.

Table 3.1 Material Class 5 Semester 1

Pertemuan	***Project***	***Learning Area***
1	*Review* dan Pengenalan NXT software	
2	*Gear Ratio (Fan)*	*Building Confidence*
3	*Fishing Rod*	
4	Jembatan Otomatis	*Creative Thinking*
5	Mobil	
6	Bianglala	
7	Mini golf	*Problem Solving*
8	*Hammer*	
9	*Mixer*	
10	*walker robot*	*Logical Thinking*
11	*Line Follwer*	
12	*Sumo Bot*	

From these materials will be simulated in 3D (3 Dimensions), which will contain parts of each Lego project that will be assembled, then parts one by one will be coupled by pressing the button that is applied. Then there will kemangandan images parts what is needed to build the material project.

3.2 Exercise Analysis

The exercise menu is a menu for students to practice students' understanding of the material. By

doing the exercises students are expected to really understand the material provided. Exercise material is given in the form of a part-shaped key to be assembled, part will be assembled one by one according to the material. Exercise given is taken from four learning areas that will be randomized into four practice menu.

3.3 Evaluation Analysis

Menu evaluation is a menu for students where students test the understanding of the material that has been given, which will then be used as a benchmark whether the student understands or not understand the material provided. Then the given theme is random from the given material. To get into the first evaluation menu must login first, then the application will display the theme of the material that has been selected trainer, then students press the button that shaped the part that will be strung. Part will be assembled one by one according to the theme that is on the matter, if the student pressing the right button will get the value, but if the wrong answer will not get the value, the value obtained will be stored into the database, then will be displayed on the menu what value The value he gets.

3.4 Architecture Sistem

The physical architecture of the system to be built consists of users ie trainers or students, android smartphone, and the application of extracurricular learning media Lego education. System architecture in the development of software development can be seen in Figure 3.1 below:

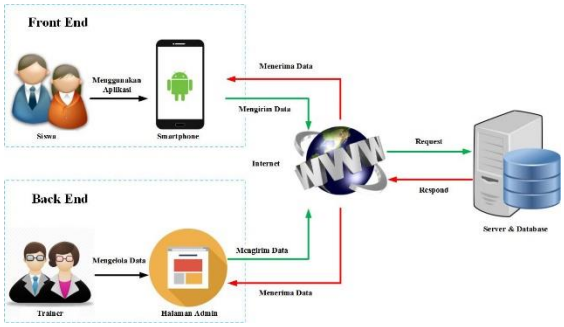


Image 3.1 Architecture Sistem

3.5 Specification of Software Requirements

Software requirements specification is a software requirement as a result of the analytical process undertaken in the context of software development. Analysis of software requirements specification that will be described is the analysis of functional and non-functional requirements. Specific analysis of functional requirements can be seen in Table 3.2.

Table 3.2 Spesification Of Software Requirements

No	Kode Kebutuhan	Deskripsi Kebutuhan
1	SKPL-F001	Sistem menampilkan materi Lego *education*
2	SKPL-F002	Sistem mensimulasikan materi Lego *education*
3	SKPL-F003	Sistem dapat merotasi kamera
4	SKPL-F004	Sistem melakukan latihan materi
5	SKPL-F005	Sistem menampilkan menu *login* siswa untuk masuk ke menu evaluasi
6	SKPL-F006	Sistem menampilkan evaluasi
7	SKPL-F007	Sistem dapat memilih *part* yang akan dirakit
8	SKPL-F008	Sistem menampilkan nilai dari hasil evaluasi
9	SKPL-F009	Sistem melakukan pendafataran siswa
10	SKPL-F010	Sistem menampilkan menu *login trainer* untuk masuk ke pengolahan data
11	SKPL-F011	Sistem mengelola data *trainer*
12	SKPL-F012	Sistem mengelola data siswa
13	SKPL-F013	Sistem mengelola data soal evaluasi

Analysis of non-functional software requirements specification can be seen in table 3.3.

Table 3.3 Spesification Of Software Non Requirements

No	Kode Kebutuhan	Deskripsi Kebutuhan
1	SKPL-NF001	Analisis kebutuhan perangkat keras
2	SKPL-NF002	Analisis kebutuhan perangkat lunak
3	SKPL-NF003	Analisis kebutuhan pengguna

3.6 Non-Functional Needs Analysis

Non-functionality requirement analysis describes the need beyond the system needed to run the built application. The non-functional requirement in the application of learning media extracurricular Lego education covers the needs of hardware, software needs and system users who will use the application. The analysis of non-functional requirements aims to build applications that can be used as needed.

3.7 Hardware Requirement Analysis

The hardware used in the application of learning media extracurricular Lego education ie Android smartphone, as for the existing smartphone can be seen in table 3.4.

Table 3.4 Spesifikasi Perangkat Keras *Smartphone* Android yang ada

No	Spesifikasi	
1	Processor	1.2 Ghz quad-core
2	RAM	2 GB
3	Free storage	10 GB
4	Layar	1280x720 pixels

While the smartphone used for implementation and application testing built in this study can be seen in table 3.5.

Table 3.5 Spesifikasi Minimum Perangkat keras *Smartphone* Android

No	Spesifikasi	
1	Processor	1.2 Ghz quad-core
2	RAM	512 MB
3	Free storage	2 GB
4	Layar	960x540 pixels

In conclusion that the existing software meets the standard needs of learning media applications extracurricular Lego education, so will maximize the performance of this application.

3.8 Software Requirements Analysis

The software needed to build the extracurricular learning app Lego education can be seen in table 3.6.

Table 3.6 Perangkat Lunak Untuk Membangun Aplikasi

Komputer	
No	**Perangkat Lunak**
1	Sistem Operasi Windows 10
2	Unity 3D 5.5.2
3	LeoCad
4	Standard Development Kit versi 25.2.5
5	Java Development Kit versi 6
6	Adobe Photoshop CS3
7	Microsoft Visio

While the software used for implementation in this study can be seen in table 3.7.

Table 3.7 Perangkat Lunak Untuk Implementasi Aplikasi

Smartphone	
No	**Perangkat Lunak**
1	Sistem Operasi Android versi 4.1 Jelly Bean

2.9 User Needs Analysis

User needs analysis is an analysis of the users who will use the system to be built. Application of extracurricular learning Lego education consists of two system users that can be seen in table 2.8.

Table 3.8 Analisis Kebutuhan Pengguna Sistem Yang Akan Dibangun

Pengguna	Hak Akses	Fakta	Pengalaman
Trainer	Mengelola data siswa, data nilai dan soal evaluasi.	Trainer terbiasa browsing di mengguna kan web browser .	Sudah terbiasa browsing menggunk an web browser.
Siswa	Mengguna kan aplikasi media pembelajar an ekstrakurik uler Lego *education*	Berdasark an jawaban kuisoner, hampir semua siswa memiliki smartphon e berbasis android.	Mengerti cara mengguna kan *smartphon e* Android.

In conclusion, that analysis of user needs from the application of learning media extracurricular Lego education has met the necessary needs.

2.10 Functional Needs Analysis

Functional requirements analysis describes the needs of the system to be built on the application of learning media Lego education. Functional needs are modeled by using object orientation modeling with UML (Unified Modeling Language). Modeling stages in this analysis include use case diagrams, activity diagrams, squence diagrams, and class diagrams.

2.11 Use Case Diagram

Use Case Diagram is the highest part of the functionality of the system that will disguise how a person or actor will use and utilize the system. Use case application of extracurricular learning media Lego education can be seen in picture 3.2 use case diagram

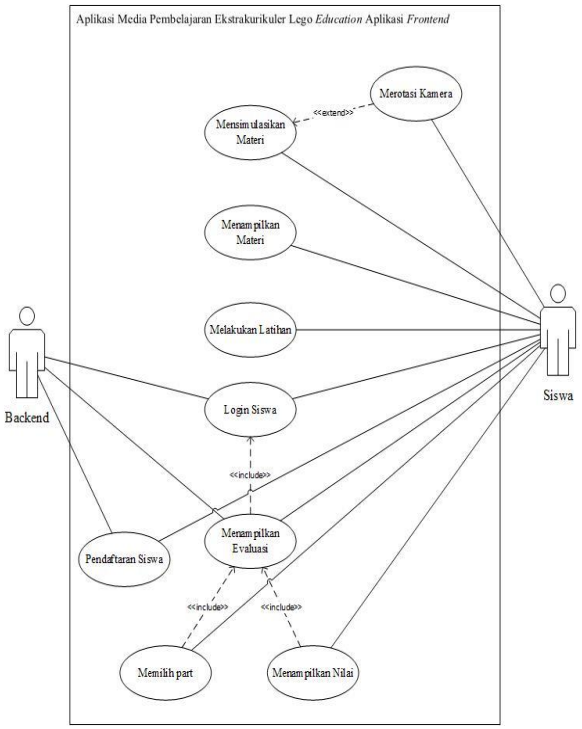


Image 3.2 *Use Case Diagram Front End* Aplikasi Media Pembelajaran Ekstrakurikuler Lego *Education*

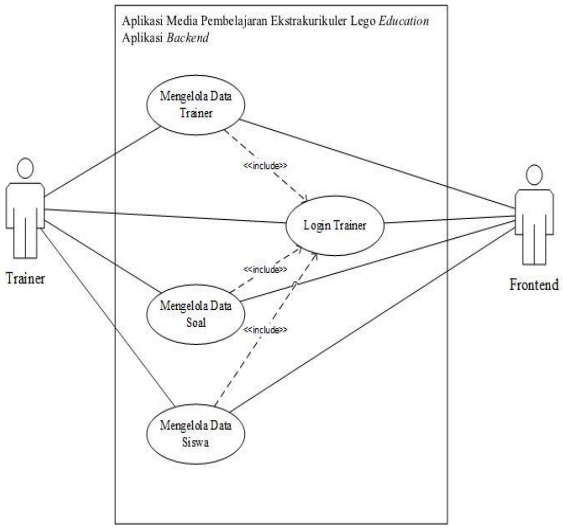


Image 3.3 *Use Case Diagram Back End* Aplikasi Media Pembelajaran Ekstrakurikuler Lego *Education*

4. IMPLEMENTATION AND TESTING

4.1 Hardware Development Implementation

The hardware needed to build Lego education learning apps can be seen in the following table.

Table 4.1 Implementasi Perangkat Keras Pembangunan

No	Perangkat Keras	Spesifikasi
1	Proccessor	Intel I3-3217U 1.80GHz
2	RAM	4 GB
3	Harddisk/Storage	500 GB
4	Resolusi Layar	1366x768 pixels
5	VGA	NVDIA GEFORCE 740M 4GB

4.2 Hardware Test Implementation

The hardware used in testing Lego education learning application media that has been built can be seen in the following table.

Table 4.2 Implementasi Perangkat Keras Pengujian *Front End*

No	Perangkat Keras	Spesifikasi
1	Proccessor	Qualcomm Snapdragon 410 Quad-core 1.21 Ghz
2	RAM	2 GB
3	OS	Android OS V6.0.1 (Marshmello)
4	Resolusi Layar	720x1280 Pixels
5	Ukuran Layar	5.7 Inch

4.3 Implementation of Software Developmen

Software used in the development of application systems extracurricular learning media Lego education is as follows:

Table 4.3 Implementasi Perangkat Lunak Pembangunan

No	Perangkat Lunak	Spesifikasi
1	Sistem Operasi	Sistem Operasi Windows 10
2	Unity 3D	5.5.2
3	Design Objek 3D	LeoCad
	Design Gambar	Adobe Photoshop CS3
	Design Animasi	Blender 2.7.7
4	Android SDK	Standard Development Kit versi 25.2.5
6	XAMPP	3.2.2

4.4 Implementation of Testing Software

The software used in testing the learning media application Lego education is divided into 2, namely the front end testing and testing the back end applications.

A. Front End Testing Software

The software used in testing the front end application can be seen in the following table.

Table 4.4 Implementasi Perangkat Lunak Pengujian *Fornt End*

No	Perangkat Lunak	Spesifikasi
1	Sistem Operasi	Marshmallow 6.0.1

a. **Back End Testing Software**

The software used in testing the back end application can be seen in the following table.

Table 4.5 Implementasi Perangkat Lunak Pengujian *Back End*

No	Perangkat Lunak	Spesifikasi
1	Sistem Operasi	Microsoft Windows 10
2	Browser	Chrome, Mozila Firefox

4.5 Application Implementation

Application of extracurricular learning media Lego education requires the installation process on the android device. Users must have a SciRobo.apk file on android device, then install the SciRobo.apk file on the android device that will be used to run this application.

4..6 Class Implementation

In the development of learning media applications extracurricular Lego education there are several classes. The class implementation table can be seen in the following table.

Table 4.6 Implementation Class

No	Nama Class	Nama File	Nama File Executable	Keterangan
1	Menu Utama	MenuUtama.unity	MenuUtama.cs login_siswa.cs	*Class* yang digunakan untuk menampilkan menu utama dan login siswa
2	MenuPilihanMateri	MenuPilihanMateri.unity	MenuPilihanMateri.cs	*Class* yang digunakan untuk menampilkan menupilihan materi
3	Menu Materi	Menu Materi1.unity Menu Materi2.unity Menu Materi3.unity Menu Materi4.unity Menu Materi5.unity Menu Materi6.unity Menu Materi7.unity Menu Materi8.unity Menu Materi9.unity Menu Materi10.unity Menu Materi11.unity Menu Materi12.unity	MenuMateri1.cs MenuMateri2.cs MenuMateri3.cs MenuMateri4.cs MenuMateri5.cs MenuMateri6.cs MenuMateri7.cs MenuMateri8.cs MenuMateri9.cs MenuMateri10.cs MenuMateri11.cs MenuMateri12.cs	*Class* yang digunakan untuk menampilkan menu materi
4	MenuPilihanLatihan	MenuPilihanLatihan.unity	MenuPilihanLatihan.cs	*Class* yang digunakan untuk menampilkan menu pilihan latihan

No	Nama Class	Nama File	Nama File Executable	Keterangan
5	Menu Latihan	MenuLatihan1.unity MenuLatihan2.unity MenuLatihan3.unity MenuLatihan4.unity MenuLatihan5.unity MenuLatihan6.unity MenuLatihan7.unity MenuLatihan8.unity MenuLatihan9.unity MenuLatihan10.unity MenuLatihan11.unity	MenuLatihan1.cs MenuLatihan2.cs MenuLatihan3.cs MenuLatihan4.cs MenuLatihan5.cs MenuLatihan6.cs MenuLatihan7.cs MenuLatihan8.cs MenuLatihan9.cs MenuLatihan10.cs MenuLatihan11.cs	*Class* yang digunakan untuk menampilkan menu latihan
6	Menu Login	MenuUtama.unity	Login_siswa.cs	*Class* yang digunakan untuk menampilkan *login* siswa
7	Menu Daftar Siswa	MenuUtama.unity	Login_siswa.cs	*Class* yang digunakan untuk menampilkan daftar siswa
8	Menu BerhasilLogin	MenuUtama.unity	Login_siswa.cs	*Class* yang digunakan untuk menampilkan berhasil login siswa
9	Menu Evaluasi	MenuEvaluasi1.unity MenuEvaluasi2.unity MenuEvaluasi3.unity MenuEvaluasi4.unity MenuEvaluasi5.unity MenuEvaluasi6.unity MenuEvaluasi7.unity MenuEvaluasi8.unity MenuEvaluasi9.unity MenuEvaluasi10.unity MenuEvaluasi11.unity	MenuEvaluasi1.cs MenuEvaluasi2.cs MenuEvaluasi3.cs MenuEvaluasi4.cs MenuEvaluasi5.cs MenuEvaluasi6.cs MenuEvaluasi7.cs MenuEvaluasi8.cs MenuEvaluasi9.cs MenuEvaluasi10.cs MenuEvaluasi11.cs	*Class* yang digunakan untuk menampilkan menu evaluasi
10	Menu Nilai	MenuEvaluasi1.unity MenuEvaluasi2.unity MenuEvaluasi3.unity MenuEvaluasi4.unity MenuEvaluasi5.unity MenuEvaluasi6.unity	MenuEvaluasi1.cs MenuEvaluasi2.cs MenuEvaluasi3.cs MenuEvaluasi4.cs MenuEvaluasi5.cs MenuEvaluasi6.cs MenuEvaluasi7.cs MenuEvaluasi8.cs MenuEvaluasi9.cs MenuEvaluasi10.cs	*Class* untuk menampilkan nilai

No	Nama Class	Nama File	Nama File Executable	Keterangan
		MenuEvaluasi7.unity MenuEvaluasi8.unity MenuEvaluasi9.unity MenuEvaluasi10.unity MenuEvaluasi11.unity	MenuEvaluasi11.cs	
11	Menu Login		Login.php Model_login.php Form_login.php	*Class* untuk *login* pada aplikasi *back end*
12	HalamanUtama		Dashboard.php View_dashboard.php	*Class* untuk menampilkan menu utama *back end*
13	HalamanSiswa		Siswa.php Model_siswa.php Lihat_data_siswa.php	*Class* untuk menampilkan menu siswa
14	HalamanTambahDataSiswa		Form_input_siswa.php	*Class* untuk tambah data siswa
15	HalamanEditDataSiswa		Form_edit_siswa.php	*Class* untuk merubah data siswa
16	HalamanTrainer		Trainer.php Model_trainer.php Lihat_data_trainer.php	*Class* untuk menampilkan menu *trainer*
17	HalamanTammbahDataTrainer		Form_input_trainer.php	*Class* untuk tambah data *trainer*
18	HalamanTammbahDataTrainer		Form_edit_trainer.php	*Class* untuk merubah data *trainer*
19	HalamanSoalEvaluasi		Lihat_data_soal_evaluasi.php	*Class* untuk menampilkan menu evaluasi
20	HalamanRubahSoalEvaluasi		Form_edit_soal.php	*Class* untuk merubah soal evaluasi
21	Database		Aplikasilego.sql	*Class* database

4.7 Cases and Test Results Black Box

Here is a case for testing software that has been built using black box methods based on pre-made test scenarios.

A. Black Box Test Front End

Cases and test results on the front end of extracurricular learning media application Lego education can be seen as follows.

1. Testing Main Menu

Testing the main menu is a functionality test to select the menu available. The results of the testing process can be seen in the following table.

Table 4.11 Pengujian Menu Utama

Kasus dan Hasil Uji				
No	**Deskripsi**	**Hasil yang diharapkan**	**Hasil yang sebenarnya**	**Kesimpulan**
1	Menekan button pilihan materi	Menampilkan menu pilihan materi untuk memilih materi	Menu pilihan materi tampil	[✓] diterima [ ] ditolak
2	Menekan button pilihan latihan	Menampilkan menu pilihan latihan	Menu pilihan latihan tampil	[✓] diterima [ ] ditolak

3	Menekan button pilihan evaluasi	Menampilkan menu login siswa yang akan masuk ke menu evaluasi	Menu login siswa tampil	[✓] diterima [ ] ditolak
4	Menekan button keluar	Keluar dari aplikasi	Keluar dari aplikasi	[✓] diterima [ ] ditolak
5	Menekan button login trainer	Menampilkan halaman login trainer pada browser	Login trainer pada browser tampil	[✓] diterima [ ] ditolak

4.8 Conclusion Black Box Testing

Based on the results of testing black box that has been done can be drawn the conclusion that the application of learning media extracurricular Lego education goes according to the initial design. But there is a possibility of errors when the application is used, either device errors are used, user errors, or other errors. So it requires a maintenance process or check (maintenance) to keep the application running as expected..

4.9 User Acceptance Testing Test (UAT)

UAT testing is a test conducted objectively, tested directly to the field related to user satisfaction with applications that have been built. In testing UAT (User Acceptance Testing) there is a test scenario that is the application testing process involves potential users who exist in the company and in dampingi when testing. This is done in order to find a system defect not found by the developer. Then do UAT testing, after the system is applied in the corporate environment by doing a questionnaire to 30 student respondents and 8 respondents trainers.

5 CLOSING

5.1 Conclusions

From the test results that have been done then it can be concluded as follows:

a. A. With the application of learning media extracurricular Lego education can help students in the learning process.
b. B. 3D simulation allows students at every stage to create a Lego project.
c. *C. With the mobile technology android application is a means of learning that can be used anywhere and anytime.*

5.2 Suggestion

The suggestions that can be given from the results of this study are:

a. A. Not all Lego education levels are in the system.
b. B. Better simulations are presented with drag and drop.
c. *C. Lego project simulation is better there is animation function of each project created Lego.*

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