



Faculty of Computer Science and Information Technology

ILMAC: Interactive Learning Mobile Game for Autism Children

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ILMAC: Interactive Learning Mobile Game for Autism Children

Muslihah Hassan

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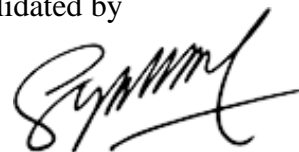


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ABSTRACT

This project aims to develop computer-based interactive games to assist learning in children on the autism spectrum enjoy and benefit from interaction with a computerized system to enhance various aspects learning and development in children on the autism spectrum. Children with autism spectrum disorder (ASD) usually have difficulty in communication and interaction with other people, cognitive flexibility and interpersonal relationship. Therefore, Interactive Learning Mobile Game for Autism Children (ILMAC) is developed based on subject Mathematics. ILMAC will have several features that are included to attract children interest in learning while playing a game. Two types of testing have been conducted to validate the objectives. Functional testing focuses on the functionality of each feature that exists in the application. The non-functionality test is intended to measure the application 's effectiveness in delivering the content to the children. Three autism children from age of 7 to 10 years old (mean = 8.50) were selected in usability testing. As for the result, the pre-test has achieved higher mean score value where the children take 30 to 39 minutes to answer the questions (mean = 38.00; S.D = 2.646). Meanwhile, the post-test has achieved less mean score value where the time taken for children to answer the questions is between 20 to 28 minutes (mean = 24.33; S.D = 4.041). Therefore, the test results indicate that this project will improve the level of children understanding and performance thus attract children to learn while playing.

Keywords: Autism Spectrum Disorders, Serious Games, Children with Autisms, Autism Spectrum Disorder

ABSTRAK

Projek ini bertujuan untuk mencipta permainan interaktif berasaskan komputer dalam membantu pembelajaran kanak-kanak yang mempunyai spektrum autisme untuk menikmati dan memanfaatkan interaksi dengan sistem berkomputer dalam meningkatkan pelbagai aspek pembelajaran dan perkembangan kanak-kanak spektrum autisme. Kanak-kanak yang mengalami gangguan spektrum autisme (ASD) kebiasanya mengalami kesukaran dalam komunikasi dan interaksi dengan orang lain, fleksibiliti kognitif dan hubungan interpersonal. Oleh itu, Permainan Pembelajaran Interaktif untuk Kanak-kanak Autisme (ILMAC) dibangunkan berdasarkan Matematik subjek. ILMAC mempunyai beberapa ciri yang dimasukkan untuk menarik minat kanak-kanak untuk belajar sambil bermain. Dua jenis ujian telah dilakukan untuk mengesahkan objektif. Pengujian fungsional memberi tumpuan kepada fungsi setiap ciri yang ada dalam aplikasi. Ujian tidak berfungsi bertujuan untuk mengukur keberkesanan aplikasi dalam menyampaikan kandungan kepada anak-anak. Tiga kanak-kanak autisme dari usia 7 hingga 10 tahun ($min = 8.50$) dipilih dalam sesi ujian. Hasilnya, ujian pra telah mencapai nilai skor min yang lebih tinggi di mana kanak-kanak mengambil masa 30 hingga 39 minit untuk menjawab soalan ($min = 38.00$; $S.D = 2.646$). Sementara itu, ujian pasca telah mencapai nilai skor min yang kurang di mana masa yang diambil untuk kanak-kanak menjawab soalan adalah antara 20 hingga 28 minit ($min = 24.33$; $S.D = 4.041$). Oleh itu, hasil ujian menunjukkan bahawa projek ini akan meningkatkan tahap pemahaman dan prestasi kanak-kanak sehingga menarik minat kanak-kanak untuk belajar sambil bermain.

Kata kunci: *Gangguan Spektrum Autisme, Permainan Berat, Kanak-kanak Dengan Autisme, Gangguan Autisme Spektrum*

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CHAPTER 1

INTRODUCTION

1.1 Study Background

The purpose of this project is to develop an interactive game which is able to help in the learning process and increase interaction in children with autism spectrum disorders, to attract children interest in learning while playing the game and to develop an interactive platform in the area of learning. This project is not meant to replace parent or teacher, but it is as tools to enhance the children with autism disorders learning experience using technology. Nowadays children enjoy playing with computers and technological devices by themselves. The implementation of an interactive mobile game in education for students are widely used.

Meanwhile, the changes from conventional technology such as desktop computers to digital devices such as mobile phones or smartphones are rising. Many applications have been developed for people with autism on the iPhone and Android platform (Leijdekkers, Gay, & Wong, 2013). Educational apps are used to enhance communication skills among children with autism with others (Aziz, Abdullah, Adnan, & Mazalan, 2014). The use of interactive mobile game-based learning in education is intended to provide an interesting learning tool (Huang, Chang, & Wu, 2017). The proposed gamified learning tool includes thinking skills and a problem-solving activity for autism to enjoy and benefit from it.

1.2 Problem Statement

Autism Spectrum Disorders (ASD) is a neural development disorder that affects communication and behaviour. Children with autism have difficulty in interpreting people

intentions, facial expression and emotional reactions. They use a nonverbal expression in their action or responds to others. Due to the obstacle, they may have different skills in memorizing facts or solving the problems. Furthermore, children with autism typically play their own toys. This is because children with autism have difficulty in forming social relationships with others. This project will develop interactive game-based learning for children with autism using technology to solve this problem.

1.3 Scope

This project is focused on children with autism spectrum disorder at the age of 7 to 10 years old. This learning context includes adding, subtracting and counting topics where the children need to use their thinking skills and problem-solving while playing the game.

1.4 Aims and Objectives

The objectives of this project are to:

- i. Create an interactive mobile game application for autism children.
- ii. Test user experience level among the autism children who are going to use the apps.

1.5 Brief Methodology

Figure 1.1 shows the ADDIE model that will be used in this project.

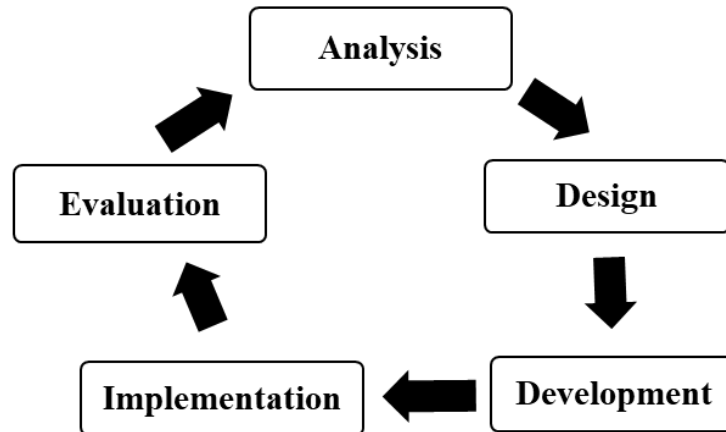


Figure 1.1 ADDIE Model (Adapted from: Widyastuti & Susiana, (2019))

The ADDIE model is chosen for this project. ADDIE model is divided into five phases which are analysis, design, develop, implementation and evaluation. Each phase of the ADDIE model is an important element of the design process to ensure the game experience's effectiveness.

1.5.1 Analysis

The first phase involves understanding what needs to analysis, what is its the function and purpose. During this phase, diagnostic test requirements for the autistic student is being taken. Normally at this phase, developers will create a timeline for the development of the project while simultaneously analysing the constraints that will surface.

1.5.2 Design

The design phase is a system of the process where the project is designed. It helps in specifying in the graphic design, user interface and the content of the project is decided in this game development.

1.5.3 Development

In the development phase, the design is carried out using all the requirements and materials acquired during the first two phases of the ADDIE model.

1.5.4 Implementation

During this stage, the design from the previous phases is transformed into the actual system. The mobile application will be developed using android and game development tool.

1.5.5 Evaluation

The last phase of the ADDIE model is evaluation. At the evaluation, phase consists of two types of evaluation which are formative and summative. Formative takes place in each stage of the ADDIE process, while summative consists of tests designed for referenced criterion items and providing users with the opportunity to give feedback on the product itself.

1.6 Significance of the project

This project will help students with autism that faced difficulty in carrying out social interactions in general. The significance of this interactive application is having the ability to be adaptive towards the learning, communication and sensory differences that are found among the individuals on the autism spectrum. Besides that, the development of this game can provide a chance to interact through gestures while playing the game. Lastly, this project as a better tool that can be more effective in helping children with autism in learning.

1.7 Project schedule

The project schedule is a way to communicate what tasks need to get done and a document that need to submit the project on time. For this final year project, it has two parts which are Final Year Project 1 (FYP1) and Final Year Project 2 (FYP2). FYP1 consists of chapter 1 which is an introduction, chapter 2 consists of background or literature review and chapter

3 consist of methodology or requirements analysis and design. While for FYP2 consists of chapter 4 which is implementation and testing and chapter 5 consist conclusion and future works. Refer to Appendix A.

1.8 Expected outcome

The expected outcomes for this project are:

- An interactive game application for children with autism.
- A usability guideline based on user experience in using the app.

1.9 Conclusion

In conclusion, this chapter provides a brief detail about the development of the game for children with an autism spectrum disorder. This proposed project will be developed game-based learning an interactive game application with a more effective learning experience. To sum up, this chapter gives a better understanding of others on understanding what this project is about, explaining the flow and exposing the details of this project.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview

This chapter presents the literature review of past research projects and three related games previously developed. Other than that, the characteristics of autism and gamification of learning will be discussed. The benefits and challenges in implement mobile application in learning will also be discussed. This chapter also reviews three related apps for children with ASD.

2.2 What is ASD?

The term autism to describe the condition as it is known today has emerged in 1943 (Aziz, Ahmad, & Zulkifli, 2015). The term autism means a developmental disability that affects verbal and non-verbal communication and social interaction significantly. Autism spectrum disorder (ASD) is a dynamic state of development involving ongoing difficulties in social interaction, speech and nonverbal communication, and repetitive behaviour. Each person has different effects on ASD and the level of severity of symptoms (Capano et al., 2018).

Children with autism have difficulty in language ability which make them hard to express what they need (Gudu, 2015). Autism is a lifelong development difficulty which affects their intellectual capability in communication, social interaction and repeated or limited behaviour patterns (Bernardini, Porayska-Pomsta, & Smith, 2014; Matson & Goldin, 2014). Because of their special experiences, they cannot concentrate in the same way as the normal kids would, makes them act differently, and often unacceptable by their families. This problem drives these kids away from social connections, thus they prefer to isolate

themselves (Qidwai & Connor, 2019). Autism is the world's fastest-growing neurological disorders that typically occur by three years of biological age (Mohanaprakash, 2015).

Some individuals with autism, have ‘stimming’ behaviour, also known as self-stimulatory behaviour. ‘Stimming’ is the random behaviour of a person who has developmental disabilities such as autism, either through action or conversation. This behaviour is made consciously or unknowingly, following the circumstances of the perpetrator. Several studies have been done by researchers about the autism and difficulties faced by them. Table 2.1 shows the table definition of autism.

Table 2.1 Definition of Autism

Author (Year)	Difficulties
Capano et al (2018)	Difficulties in social interaction, speech and nonverbal communication, and repetitive behaviour or interest.
Bernardini, Porayska-Pomsta, & Smith (2014)	Difficulty in communication, social interaction and repeating or limited behaviour patterns
Aziz, Ahmad, & Zulkifli (2015)	Lifelong development difficulty
Matson & Goldin (2014)	Difficulty in intellectual capability
Gudu (2015)	Difficulty in language ability, make them hard to express what they need.

In short, ASD is a group of disorders of neural development. They are referred to as a spectrum of disorders because the characteristics and symptoms can appear in different ways for the individual at several different intensity levels.

2.3 Gamification of Learning

Gamification is an increasing trend in education because of its influence on learning for students (Chen, Li, & Chen, 2020; Sanchez, Langer, & Kaur, 2020; Zainuddin, Shujahat,

Haruna, & Chu, 2020). Gamification applied to education or business activities has become very significant, plays a critical role, is valued for the genetic quality of users and helps to influence them positively in the use of gamified applications. Gamification includes integrating online gaming features such as points, leader boards and badges into non-gaming contexts in order to improve interaction with both employees and customers (Rodrigues, Oliveira, & Rodrigues, 2019).

In education, Kahoot software was used more often when conducting formative assessments. A gamified e-quiz has been effective in assessing learning performance. Gamification of learning is an alternative solution for a formative evaluation system can be a gamified e-quiz. In addition, game concepts can be a promising tool for attractive competition among students. Besides that, quiz competitions inspired students to play with each other after lectures. The characteristics of game concepts are fun, interest, excitement and curiosity (Zainuddin et al., 2020).

Next, there are some impacts of gamified quizzes on student learning. Testing whether online quizzes gamification features can enhance the testing effect. Other than that, gamification has not affected test performance because of more quizzes. The impact of gamification did not sustain over time, probably because of the novelty effect. The gamified quiz format did not benefit the lower performing students (Sanchez et al., 2020).

Web-based collaborative reading annotation system (WCRAS) with gamification mechanisms is for motivating student annotation behaviours and promoting student reading understanding performance. Gamified WCRAS will make it easier for students to produce more eligible annotations than non-gamified WCRAS. This study suggests some improvements to the gamified WCRAS because there are no significant effects on reading

comprehension. Certainly, the most critical issue in game-based learning is probably how to better associate game features and learning performance (Chen et al., 2020).

2.4 Interactive Mobile Game for Autism Children

The use of mobile applications has become more popular as applications can be accessed anytime and anywhere (Muhamad, Wan, Laila, Ghani, & Drus, 2019). Windows Mobile, Google Android, Palm OS, Symbian, OD, Adobe Flash Lite BREW, WIPI, Apple iOS or Windows Phone 7 are widely used platforms and technologies to build these mobile game (Helmi Adly Mohd Noor, Faaizah Shahbodin, Naim Che Pee, 2012). Good gameplay could motivate and engage the player (Kamaruzaman, 2015). The learning process takes place without being tied to a situation and a specific environment. Neurodiversity is a movement that wants the way we think about autism to change. It opposes the idea that autism is a disorder and instead treats it as a neurological condition. Digital applications are being developed by designers to support neurodiverse users, including autistic children (Alarcon-Licona, Loke, & Ahmadpour, 2018). Gesture plays an important role in child ASD early language acquisition (Baumann, Özçalışkan, & Adamson, 2019). These are also good educational devices because children with ASD are often encountered uncomfortable social interactions and prefer a structured learning environment (Wainer & Ingersoll, 2011).

Based on statistics, the rate of autism occurrence has increased from 1 in every 110 children in 2009 and the number is doubled in 2013 (Fatimah, Ahmad, Hashim, & Nadia, 2017). Thus, it is important to pay special attention to assisting these children in their learning process. The arrival of mobile technology has increased the chances of learning effectively for children with autism. Children with autism need a digital intermediary to communicate socially with others (Eder, Diaz, Madela, Mag-usara, & Sabellano, 2016). Children with ASD may enjoy learning and developing their skills through devices. In recent