Faculty of Cognitive Sciences and Human Development

DEVELOPMENT AND EVALUATION OF A MOBILE LEARNING APPLICATION TO INTRODUCE COGNITIVE SCIENCE

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Grade: A-

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Final Year Project Report ☒

Masters ☐

PhD ☐

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DEVELOPMENT AND EVALUATION OF A MOBILE LEARNING APPLICATION TO INTRODUCE COGNITIVE SCIENCE

CHONG JIA LU

This project is submitted
in partial fulfilment of the requirements for a
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The project entitled 'Development and evaluation of a mobile learning application to introduce cognitive science' was prepared by Chong Jia Lu and submitted to the Faculty of Cognitive Sciences and Human Development in partial fulfilment of the requirements for a Bachelor of Science with Honours (Cognitive Science)

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ABSTRACT

This study focuses on the development and implementation of an Android-based learning mobile application to introduce Cognitive Sciences. This mobile application was built by using *Unity 5* and the evaluation of the development of this application was determined using a Questionnaire for User Interaction Satisfaction (QUIS) involving 30 participants. Results from the evaluation session reveal that need to be improved and recommendations for improvement are included. The internal strengths, internal weakness, external opportunities and external threats of this mobile application are outlined in SWOT analysis framework.

Keywords: Cognitive Sciences, *Unity*, mobile application.

ABSTRAK

Fokus kajian ini adalah untuk membentuk, mengimplimentasikan aplikasi mudah alih untuk mengenalkan bidang sains kognitif bagi system Android. Aplikasi mudah alih ini dibentuk dengan system perisian *Unity 5*. Penilaian aplikasi ini dilakukan kepada 30 peserta dengan soalan Questionnaire for User Interaction Satisfaction (QUIS). Keseluruhan hasil kajian daripada sesi penilaian menunjukkan bahawa sebahagian aspek dalam soalan penilaian masih perlu ditingkatkan dan cadangan-cadangan untuk meningkatkan fungsi-fungsi aplikasi mudah alih ini telah termasuk. Kekuatan, kelemahan, peluang and ancaman aplikasi mudah alih ini telah disenaraikan di dalam rangka kerja Analisis SWOT.

Kata Kunci: Sains kognitif, *Unity*, aplikasi mudah alih.

CHAPTER ONE

INTRODUCTION

Education is one of the global issues that has been concerned by the whole world. The main intention of the education is to improve learners' skill of higher order thinking and cognitive abilities such as critical thinking or problem solving. There are two forms of education: conventional education and distance education (Mehdipour & Zerehkafi, 2013). Conventional education provides sit in class learning environment which students raise their hands asking question to teacher has not been changed from 1900s until now. Unfortunately, this kind of learning environment only promote learners engaged passively and lead to a low probability of improving cognitive abilities (Mehdipour & Zerehkafi, 2013).

With recent robust development of technologies, technologies have infinite potential to improve learning, and so distance education has been introduced to improve the conventional education. In the old days, mobile phone only capable to be a voice communication device but smartphone nowadays featured touchscreen technology brings a high portability, personalized and an intuitive user interface (McQuiggan, Kosturko, McQuiggan, & Sabourin, 2015).

This advantage of smartphone' capabilities made it become a staple of our society and lead to a high growing penetration rate among society, everyone from different group of ages owning at least one. Especially students, they are the most passionate and dedicated users of smartphone (Goenka, Makhni, & Narisetti, 2016). Hence, it is possible to take benefits of mobile devices to design a mobile learning (m-learning) system and implemented in educational process to improve and promote thinking skills.

M-learning is one of the types of electronic learning (e-learning) and it is a learning that conducted via mobile devices (Sarrab , Elgamel, & Aldabbas, 2012). M-learning is

considered special and different from other kinds of e-learning because of the "mobile" aspect. It provides inexpensive learning opportunities (Crescente & Lee, 2011) and learning environment at anytime, anywhere (Liu, Diao, & Tu, 2010). With m-learning, learners are break free of the classroom and can adjust the learning time to follow own's schedule (Oller, 2012).

The concept of m-learning is started from 1990s when Palm Pilot Personal Digital Assistants (PDAs) were designed as the first handheld devices with multi-function that could be utilized in the educational settings (Berge & Muilenburg, 2013). Then during 1998, The Handheld Learning Resource (HandLeR) project is proposed to study the design of mobile devices in an attempt at creating an instrument to aid "lifelong learning" (Sharples, Corlett, & Westmancott, 2001). Nowadays, m-learning is famous and always been implemented in the educational field of various countries, including Malaysia.

On the other hand, Cognitive Science is a scientific multidisciplinary study of the human mind. The Cognitive Science term existed since mid-1950s when researches began to interested in discovering and developing theories of mind (Thagard, 1996). During the mid-1970s, the Cognitive Science Organizational and Cognitive Science Society are formed and there began the publisbing of journal *Cognitive Science* (Thagard, 1996).

In global, there are eigbty-one universities have offered Cognitive Sciences programs, and many others colleges also have instituted Cognitive Sciences courses (Thagard, 1996). Meanwhile in Malaysia, Universiti Malaysia Sarawak (UNIMAS) is the only local university that offered Cognitive Sciences programme for undergraduates since 1994 and broadening their concentration to psychology (The Star Online, 2013).

Background of the Study

The reason for the cognitive science could be related to the m-learning is Cognitive Science is considered as a fresh and young field which is not popular among Southeast Asia countries yet, especially Malaysia. Although the term cognitive science has existed long time ago, there are only seven universities offered Cognitive Science programme in Asia (iCogSci, 2012). In addition, there is only one iOS mobile application named "Cognitive Science" in App Store to let user download the research papers but not introduce cognitive science. Many Malaysians did not know or understand cognitive science term and having any kind of basic knowledge about cognitive science. In fact, Cognitive Science is one of the major disciplines that promises to be increasingly important in the 21st century. Sad to say that Malaysians have very limited chances of being exposed to the field of Cognitive Science generally and therefore it is very much ill-informed in terms of knowledge regarding this field. Therefore, it is a great challenge to educate Malaysia society about this field because most of the Malaysians are not exposed to Cognitive Science yet. The situation is that Malaysians didn't have any interests in pursuing the cognitive science field as their further studies or occupations.

Objectives

Given the limited m-learning of Cognitive Science on mobile devices and the limited chances of Malaysians being exposed to the Cognitive Science field, the primary objective of the present project is to develop, implement and evaluate an on-the-go Android mobile learning application. This mobile application is used to increase interests in pursuing cognitive science field among upper secondary high school students.

Significance of the Study

By utilizing the benefits of m-learning, Malaysians can have a better understanding of cognitive science and pique their interest of pursuing the Cognitive Science field. Apart from that, this project can become the first mobile application to introduce cognitive science and become one of the learning platforms to introduce Cognitive Science to the public with a much higher efficiency, thus creating awareness of the field of Cognitive Science among Malaysians.

Definition of Terms

I. Cognitive Science

Cognitive science is the scientific multidisciplinary study on the human mind (Sobel & Li, 2013). The eight main multidisciplinary approaches include psychology, neuroscience, philosophy, linguistics, learning sciences, human factors, artificial intelligence and computer science (Sobel & Li, 2013). Due to the reason of cognitive science is not an independent field of study, the study of cognitive science is to intersect and converge work on specific problems in various field (Friedenberg & Silverman, 2006). However, the main topic which glue the various fields which related to cognitive science together is still the topic of human mind (Friedenberg & Silverman, 2006).

II. Mobile application

Mobile application is an application software which is known as 'app' in general (Technopedia, 2006). The concept of application software is similar to computer software. However, computer software can he installed in desktop or laptop but application software only can function on mobile device such as tablet computer, smartphone or some of the mobile gadgets (WebWise, 2012). The function of mobile application also similar to

computer's software but it is relatively small and more individualized with limited and isolated functionality such as calculator or game (Technopedia, 2006).

III. Mobile learning

Mobile learning (m-learning) is a subtype of electronic learning (e-learning) (Sarrab , Elgamel, & Aldabbas, 2012). M-learning involves learners conduct their learning via wireless and digital mobile devices and technologies especially in third level education (Traxler, 2007). Generally, mobile learning emphasis on the mobility of learning to learners strongly as the most important is learners could really get experiences when learn something via mobile devices (El-Hussien & Cronje, 2010).

CHAPTER TWO

LITERATURE REVIEW

Ubiquitous Use of Mobile Phone

Back in 2004, Malaysian Communications and Multimedia Commission did statistics regarding the readiness of Malaysia's citizen on the implementation of m-learning apps in Malaysia Higher Education. The statistics shown that the number of mobile phones used by the citizen exceeds the number of the citizen which is 30,379,000 and 28,250,000 respectively (Malaysian Communications and Multimedia Commision, 2014). This indicates that Malaysian own a mobile phone and able to operate it themselves. Another study shows that the percentage of students who own and use smartphone for learning raises from 58% to 77% from 2012 to 2014 (Chen, Seilhamer, & Bauer, 2015). With the reason of commonly owned, smartphone which is a personal device is an ideal for personalised informal learning (Jones, 2011).

Potential of Mobile Learning

Many studies have discussed on potential of mobile learning in education field. According to Hu (2007), technology assisted learning supports better in learners' information processing and knowledge applications if compared with conventional learning which is also face-to-face learning. Hence, learners' intellectual stimulations could be enhanced to help them achieve learning objectives and enrich their learning experience (Hu, Hui, Clark, & Tam, 2007). This could be happened by technology assisted learning establishes effective and efficiency learning environments which learners develop their own learning strategies for gaining, retaining, and retrieving knowledge or information (Cohen, 1984).

Apart from achieving learning objectives, technology assisted learning allows teachers to see their students improve their efficiency in learning as the students can get more self-motivation, retention, performance improved and encourage responsibility (Barati & Zolhavarieh, 2012). In Adeyomo's research about the benefits of using mobile learning to learning in University of Ibadan, Nigeria can be concluded that mobile phones are able to reduce student's stress and ease their learning activity by made the learning become more fun and attractive (Adeyemo, Adedoja, & Adelore, 2013). Clough (2008) also shows that mobile learners have utilize their mobile devices in an informal learning way and in ways that correspond to the constructive, collaborative and contextual in mobile learning activities.

In conventional education, there comes a problem that lack of communication between one teacher and hundreds of students in a big classroom. To overcome this problem, Cobb (2010) found in her research that smartphone can actually increase the interaction of teaching and learning process. The result is seventy-one percent of students reporting that they like it and would like to learn with using mobile device again. Corbeil and Valdes-Corbeil (2007) also stated that m-learning can reduce the barriers of cultural communication between students and teachers by adding some components within the mobile application, such as video, audio or text-to-speech components.

The benefits of m-learning that can be carried out anytime and anywhere also managed to reduce the use of classrooms and overcome the problem of limited time of teaching and teaching content materials (Hamdan, Din, & Manaf, 2012). According to Kamaludin (2012), mobile learning is suitable for learning practice or revision in this era of high capabilities of technology since mobile learning can be real-time or self-paced. Thus m-learning provides life-long learning which students can also take their favourite subjects or courses which did not been offered in school.

In addition, US National Research Council concluded that m-learning encourage effective learning because m-learning involves learners' and communities' needs, knowledge and assessment centred at the same time. M-learning builds on the students' skills and knowledge so that students can be do reasoning by their own experiences. Furthermore, the curriculum is built from good foundation of validated knowledge and with inventive use of concepts and methods. The m-learning's assessment allows teachers understand the students' ability and offer suitable diagnosis and guidance. M-learning also promotes sharing knowledge and supporting less able learners (O'Malley, Vavoula, Glew, Taylor, & Sharples, 2005).

The proliferation of mobile devices is able to enhance m-learning with extra learning resources and management system. Soon mobile devices will replace the textbooks, aid library research and foster contextual learning because mobile devices provide easy access and find information from mobile devices (Educause, 2010). Students just need to take out their mobile devices from pocket and used on the spot to check information or data, blogging or enter question or answer to online discussion forum. This kind of convenient that available anytime and anywhere when a question arises, could change our learning method and become a new way we solve problems (Educause, 2010).

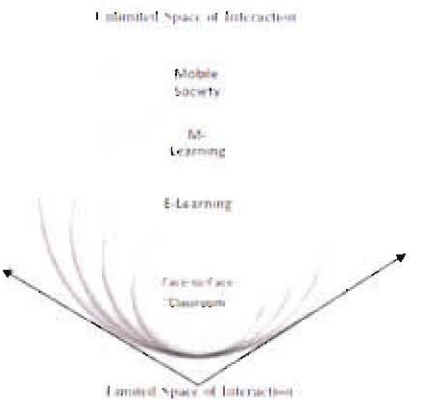

Figure 1. Visual amount of interaction and space offered by different learning methods (Annan, Ofori-Dwumfuo, & Falch, 2012).

Educational Mobile Application

In worldwide, various types of educational mobile application have been developed to assist in learning. For example, in Kiswahili of Kenya, a mobile assistant named *Eneza* consisted quizzing platforms, performance dashboards and tips for teachers helping their students. This platform improves student engagement and increase their academic scores by letting students read educational content, browse through Wikipedia and ask teachers questions online through smartphone messages (Briggs, 2014).

In the meanwhile, Norway has *One2Act Mobile Feedback* mobile application to allow teachers get real time feedback from students and reply customised feedback to learners in a short time (Briggs, 2014). The teachers will be using a dashboard about the students' understanding of the topic covered to increase the interaction of classroom, group collaboration, and peer learning for reflection and discussion (Briggs, 2014).

Not only in foreign country, m-learning is widely implemented at tertiary education level in Malaysia (Singh, Devinder, & Zaitun Abu Bakar, 2006). One of the local m-learning application is *Structural Programming* which enhance the existing conventional and e-learning method including academic information, assignment, lecture materials, quizzes and discussion (Wenderson, Ahmad, & Haron, 2010). Another mobile application is *Basic Computer Architecture* which assist teaching and learning method on basic computer architecture with notes, flash card and quiz (Kamaludin, Kasim, Selamat, & Hui, 2012).

ADDIE Model

A useful guideline is essential to develop an educational mobile application efficiently and effectively. ADDIE model is an Instructional System Design (ISD) model that originally developed in 1975. It is a flexible and powerful guideline for designing and developing effective and efficient educational, training programs and performance support tools which

commonly used by training developers and instructional designers (McGriff, 2000). The ADDIE model consists 5 phases. They are analysis, design, development, implementation and evaluation. These five phases may overlap sometimes and can be interrelated.

According to Forest (2014), occupations that involved in design or develop educational and training programs such as educators, training developers or instructional designers found that ADDIE model is useful instrument because this model has stated and define five stages clearly and each of the stages is facilitate the implementation of effective training tools.

ADDIE model has been used widely in education field to design hybrid learning, online courses and large lecture classes (Bates, 2014). In United Kingdom, the Open University always adopts ADDIE model to design for their unique multi-media distance education courses. Open University succeed in develop a high quality complex distance learning materials and this material has inspired many other institutions which also providing distance education to produce their own learning materials using ADDIE model (Bates, 2014). In Malaysia, a mobile learning application which designed for children called *Belajar Bersama Dino* also developed by using ADDIE model (Yahaya & Salam, 2014).

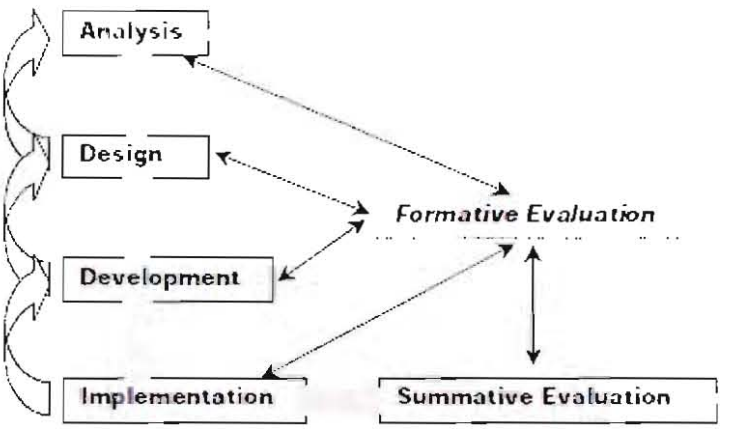

Figure 2. ADDIE model with overlapping evaluation phase (McGriff, 2000).

Analysis phase. The first stage of the ADDIE model which make instructional designers feel crystal clear about their goals. Analysis phase includes learner analysis (learner's needs and skills), task analysis (list and procedure of tasks to be instructed), goals analysis (identify final desired results) and learning objectives analysis (ways to measure achievement of goals) (Alddobie, 2015).

Design phase. The second stage of the ADDIE model which collect the outputs that produced from analysis phase and convert them into the inputs of this phase. In design phase, the instructional designer focuses on planning and creating an instructional strategy and a design instrument which can really help in learner's learning (Alddobie, 2015).

Development phase. The third phase of the ADDIE model which depend on both analysis and design phases. The main purpose of development phase is to generate the sample of course materials and develop them by using technology, which may include hardware and software (Alddobie, 2015).

Implementation phase. The fourth phase of the ADDIE model which deliver the content to learner effectively and efficiently. This phase includes three steps: 1) train instructors, 2) prepare learner and 3) organize learning environment (whether in classroom or lab) (Alddobie, 2015).

Evaluation phase. Evaluation phase. The final phase of the ADDIE model which is also an important stage to make sure the final works meet learner's needs and archive the goals that set earlier (Alddobie, 2015). This phase includes two types of evaluation: formative evaluation and summative evaluation. Formative evaluation is the evaluation which carried out after every stage while summative evaluation is the evaluation which is conducted at the final stage to evaluate the overall effectiveness of final works (Blank, 1993).

Qnestionnaire for User Interface Satisfaction (QUIS)

The Questionnaire for User Interface Satisfaction (QUIS) is originally published by Ben Shneiderman (1987). It is a type of questionnaire to test the overall satisfaction of users to computer interface but not to test the content of the system. Therefore, it is suitable to be applied in the evaluation phase of this project. QUIS is a high reliability with low variability tool (Akilli, 2005) which contains simple demographic questions, a questionnaire of overall system satisfaction with six scales and five interface factors (screen factors, terminology and system feedback, learning factors, system capabilities, usability and user interface). There are sub-questions within every five interface factors. Generally, each section mainly measures the overall satisfaction of users with interface's particular features, on a ten-point scale where the higher the number, the better the rating and vice versa.

Unity

According to *Unity* (2015), *Unity* is a game development platform which is flexible and ultimate enough to create multiplatform 2-Dimensional or 3-Dimensional games and interactive experiences. Although *Unity* is made as a game development platform originally, *Unity* is also suitable to create mobile application as it can implement augmented reality or virtual reality features into mobile application. Other than that, *Unity* has a function for developer to set up Android development environment or using plug-ins to call Android functions written in C/C++ language directly from C# scripts (Unity, 2015). Compared to other types of software to develop mobile application, the function for development and implementation phase in *Unity* is more than that of other types of software.