Learning Chinese Characters via Stroke-based Mobile Game in Education

C. K Lim, K. L Tan, A.B Isak, N.Hambira

Abstract: ***The aim of this article is to propose an intelligent and flexible e-learning mobile game application based on learning objects to facilitate learning to write Chinese characters in correct stroke sequences. In designing the overall system architecture, the paper adopts an incremental approach to emphasize the system's extensibility. As part of the learning object metadata, the basic features of the system including the evolution and pronunciation of each Chinese character can be embedded to enhance students' understanding of Chinese characters. A prototype of the proposed e-learning game software was to be used built on smartphones to demonstrate the feasibility of this research so that students could learn to carry out the evaluation at anytime and anywhere as the case study. Quantitative approaches are used to for this assessment. A number of 31 foreign online players (Namibian and Thais) from UPSI are chosen to direct this experiment. Data were analyzed using descriptive and explorative data analysis. Descriptive analysis describes how well a player is performing by looking at the number of strokes the player traces without faults. Exploratory data analysis is to find new dilemma faced among the players, and players can provide comment and remarks as future recommendations. Findings showed that there are improvements in game play for experimental group, were the experiment group has gained significant experience whether they had not prior knowledge or not. The results also showed there was a significant critical thinking with significant experience for the group experiment. As a conclusion, a Chinese character writing board game, has improved students' experience and critical thinking skills in Chinese character writing. As the outcome, the study implicates that the use of mobile games can enhance the effectiveness of teaching and learning to write Chinese character.***

Index Terms: Evaluation, Visual Informatics, Mobile Learning, Mobile Application

I. INTRODUCTION

Today's learners know technology more than their teachers. They are growing up in today's technology-based world. Language learning for students involves memorizing a large number of words in writing vocabulary.

Revised Manuscript Received on May 22, 2019.

C. K Lim, Department of Computer Science, Faculty of Art, Computing and Creative Industry, Sultan Idris Education University, TanjongMalim, Perak DarulRidzuan 35900, Malaysia

K. L Tan, Department of Computer Science, Faculty of Art, Computing and Creative Industry, Sultan Idris Education University, TanjongMalim, Perak DarulRidzuan 35900, Malaysia

A.BIsak, Department of Computer Science, Faculty of Art, Computing and Creative Industry, Sultan Idris Education University, TanjongMalim, Perak DarulRidzuan 35900, Malaysia

N.Hambira, Department of Computer Science, Faculty of Art, Computing and Creative Industry, Sultan Idris Education University, TanjongMalim, Perak DarulRidzuan 35900, Malaysia

According to [18], with China's rapid economic growth, learning Chinese is undoubtedly very important and popular worldwide. One of the major challenges in learning Chinese for most foreigners and local students is to write Chinese characters in correct stroke sequences that are considered significant in Chinese culture [18].

However, with the introduction of character recognition techniques, due to the potentially complicated structures of Chinese characters along with their stroke sequences, it would effectively address the training task involved in an efficient and flexible manner. A character game is therefore a persuasive game that tries to make users on their mobile phones more comfortable and lead a more active lifestyle. The Chinese character game is a way to learn how to write the Chinese number system easily for children or students. In addition, the game provides an incentive for learners to learn subject language skills, as well as helping them stay mentally active.

The lack of language grammar among learners from all walks of life leads researchers to develop a simple game of mobile applications that can help increase the skills of these learners in different schools. Language can refer either to the specific human capacity to acquire and use complex communication systems or to a particular instance of such a complex communication system [4]. According to [8], language is a systematic means of communicating ideas or feelings through the use of conventionalized signs, sounds, gestures or marks that have understood meanings. Language is a complex, specific skill that grows in the child spontaneously, without conscious effort or formal instruction, is deployed without awareness of its underlying logic, is qualitatively the same in each individual, and is distinct from more general information processing or intelligent behaviour. This language can be used in many ways, mainly through oral and written communication, as well as through the use of body language expressions.

Many students feel confused about speaking smart, fast Chinese or any other language. Where to start, though, they were confused. Must grammar, conversation, vocabulary, reading or writing first be mastered? Vocabulary is one of the aspects of language. Without understanding the meaning of words, students cannot read, speak, listen and write. However, students can easily read, understand and memorize vocabulary faster by teaching to write first, because this is a very effective way to do so. Furthermore, using games, such as character writing board game, is a better and easier way to teach a language, especially character writing game to students.

According to [10], Chinese learning has become very important for both Chinese and foreigners due to China's surprisingly rapid economic development and growing political influence on the global stage in the past decade. Among the four basic skills such as listening, reading, speaking and writing to master any language, learning to write Chinese characters with the correct stroke sequences is often the most challenging task for foreigners, or even Chinese students, considering the complicated structures and diversity of Chinese characters with their unique stroke sequences [7]. This is because the game might be an alternative or variation in teachers' methods of teaching Chinese language. Students will not be bored with this method in learning Chinese, but will become critical and active children in Chinese learning.

According to [15], we often have to meet words or sentences in a language in everyday life (maybe it's through television, radio, advertising, drug brochure writing, or talking to foreigners). There are certainly one or two (or many) words among a language's words that we don't know what it means. Well, if we want to try to find meaning by guessing the meaning through the sentence context or opening the dictionary, that means we need to keep it in our brains. Conversely, if we don't care and don't want to know the meaning, then we mean that these words are not stored by our brains. The word will be ours if we can use it to understand speech or to read in a language, or in that particular language to speak or write to others [15].

New technology devices such as notebooks, smart phones, personal digital assistants (PDAs), tablet computers, iPhones, and other mobile devices were invented to assist in learning, according to [2]. These devices, however, are often disguised as a gaming device as they are highly capable of playing a variety of games. There is evidence, however, that games improve the understanding of students and the learning outcomes [20]. For any educational level, a Chinese character writing game can be designed to make them an ideal learning activity for the students. Teaching languages as written activities through the character writing game and at the same time making the students passive learners fun. The teaching process of these characters was applied in active communication activities to teach students how to memorize a word search for a spelling test. In this research, the objectives are 1) to investigate how the use of Chinese character writing games can improve learning Chinese vocabulary, 2) to design appropriately and develop a Chinese character writing game on mobile and 3) to evaluate the effectiveness of the game in practice.

II. RELATED WORK

There are many reasons why a "educational game" is defined nowadays. While some games are competitive in nature, others may simply allow students to work together as a class to resolve a general issue where no one is "winning" or "losing." It is the act of problem-solving that makes games so engaging that games are not all that much fun with the lack of challenge or risk of failure [9]. On the contrary, [16] discusses the powerful capabilities of interactive multimedia games in which students work together as a class to categorize information in charts by moving facts so that they are placed in the appropriate columns.

Revisiting these types of games and activities can help students to reiterate important information. 14] stated that iteration or repetition of the process is critical to "supporting the learning process by encouraging experimentation, testing of hypotheses and synthesis," all of which are higher-level thinking skills. Because of the active learning components present in each[5], both formats of gaming activities tend to show learning benefits. Games that bring out these higher-level thinking skills are becoming more popular, although there is a need for more research and scientific assessment to measure their overall effectiveness as they are relatively new. Regardless of the format of the game, if an instructional game is well-designed, students can simultaneously develop their problem solving skills while having fun throughout the process [1].

Strokes are the lines used to construct Chinese characters, according to [17]; they are the smallest unit of Chinese characters. In modern Chinese the smallest Chinese character only have one stroke, such as “一, 乙” etc., and in modern Chinese Dictionary the most strokes of Chinese character is “齉”, the pronunciation is “nàng”, it has 36 strokes [17]. When foreign students see a complex Chinese character having many strokes, writing these Chinese characters can cause fear. Teacher should therefore tell them that the strokes of Chinese characters are fixed, the order of the stroke and the structure also has many rules [17]. When we learn 26 English alphabets compared to English, we can write English words, it's the same in Chinese, if we master the order of strokes and structure of Chinese characters, it's not going to be difficult to write Chinese characters. 18] added that Chinese characters are highly structural as they are completely different from alphabetical languages such as English, Latin and Greek used elsewhere in the world. However, each Chinese character is inherently made up of basic stroke sets/types as their components. There are about 30 basic stroke types and the ten common types of basic strokes are shown in Figure 1.

Fig. 1 The Ten Common Types of Basic Strokes

For example, Chinese Characters have 5 basic strokes: 丶一丨丿乀, on this basis, there are 26 different shapes about these 5 strokes. [17] gave an instance, in the first lesson we should tell students that there are some basic orders when we write Chinese Characters,

such as (1) "一" before "丨", e.g. 十, 干, 丰. (2) "丿" before "乀", e.g. 八, 人, 入. (3) from top to bottom, e.g. 三, 京, 高. (4) from left to right, e.g. 川,衍,做. (5) from the outer to the inner, e.g. 月, 匀, 同. (6) the middle before two sides, e.g. 小, 水, 办. and (7) Inside before surround, e.g. 回, 目, 国.

[19] argued that mobile learning games can play an important role in the process of acquiring Chinese literacy and reporting on the unique challenges of Chinese language learning, in particular its logo-writing system. [6], argued the emergency and wide-ranging adoption of mobile technology, such as smartphones and tablet computers, creates promising learning opportunities anywhere and anytime. In terms of mobility and connectivity, large screen sizes, easy-to-use multimedia production and sharing tools, and tangible user interfaces, contemporary mobile technology is powerful [3]. Although many of them have been designed to support learning English, little work has been done for Chinese language education [13]. A Chinese character learning App 2010 was developed by [11] for university students to learn some fundamental set of Chinese Characters via Pocket PC technology. However, there is no thorough evaluation on the learning App was carried out.

This app is called Mobilese. The advantages of this app over multimedia courseware based on a computer are evident. The technical features of modern mobile technologies— the iPod Touch in this project— enable students to easily input and output language learning information in a variety of formats. Students are not confined to fixed devices and may use a variety of mobile-based tools (e.g., camera features). The iPod Touch's mobility allows children to learn whenever they feel like learning while walking in the classroom, on their way home, or anywhere else. Computer-based multimedia courseware, however, requires certain levels of technical skill to accomplish learning tasks successfully, such as typing with keyboards and handling the mouse, which is challenging for students of lower grade [22]. Writing on the mobile devices ' tangible user interface with fingers is more intuitive, fun and close to the experience of handwriting. There is evidence that cognitive load can be reduced by interaction with tangible user interface [12]. This app was specifically designed for primary school students compared to other related mobile applications and involved the practice of Chinese language teachers at all critical stages of application development.

The existing Chinese character learning e-learning system is eStroke [18]. The view-only e-learning system where students can see only how to write a Chinese character, yet no practice is provided. Only by showing how to write Chinese characters with the correct stroke sequence without any actual practice can it provide guidance to students [18]. The eStroke system also translates phrases in a Chinese text passage into English in addition to showing the stroke order of each Chinese character. Instead of each individual character, this will greatly facilitate foreigners to understand the entire text. In addition, eStroke can display stroke sequence animation for both simplified and traditional variants of the same Chinese character [18].

Several letter tracing games are downloadable on google-play, namely Alphabet board – A fun way to learn writing for your kids; 123s ABCs Handwriting; ABC Kids – Tracing and Phonics. All these games feature a series of tracing games to help kids recognize letters associate them with phonic sounds and put their alphabet knowledge to use in fun matching exercises. Any toddler, kindergarteners or preschool age child can learn English and the English alphabet simply by following the arrows with their fingers. Based on the literature review, a greater understanding of the benefits and constraints of games in the classroom must be considered. It is to be brought to attention to ask such questions as, "What makes an effective gaming experience?" and the articles provided excellent insight regarding that question. Also to conclude that current methods of incorporating games in classrooms should be altered to make students more effective [21]. It is proven that knowledge net framework methods involve every student yet a team approach is still encompassed. It supports the need to prepare outside of the classroom through studying and completing review questions beforehand.

III. METHODOLOGY

Figure 2 shows a three phases methodology: pre-test, post-test and design. In the pre-test phase, a quantitative method is applied to acquire the research testing. The researcher prepared 10 questions for the potential players to outline the need of such educational games in developing counties like Namibia and Malaysia. The Google forms and questionnaires are conducted to develop the questionnaires and the questionnaires come with the results. These questionnaires are for an assessment of an educational game and the use of the Web in the education. In the post-test phase upon the development of the proposed game, it is easier to view the number of players by sharing the link on my social networks between schools and learners. After the implementation of the game, the researcher can view how the target players respond after the game is launched. A user feedback form is made available by then. In the design phase, the storyboard is used to outline and organized graphically the interface and the content of the game with a high-level view of this research.

Fig. 2 Research Methodology

The purpose of the research was to investigate the extent to which a character writing game increases pupil grammar when they are used as a component within and outside the premises of the school. Research design is a strategy to arrange the setting of the research in order to get valid data. The design of this research is conducted based on experimental research design. The kind of research design to be used is based on the significance of experiments i.e. pre-experimental design and true experimental design.

Pre-experimental design consists of one-shot case study, one group pre-test-post-test, and static group comparison while a true experimental design consists of control group pre-test-post-test, randomize to subject, matched group design, randomize pre-test and post-test design, randomize subject with pre-test group control post-tests group experimental, three types of experimental group and control, four groups, group with three group control, time design. Because of the limited time, researcher uses pre-experimental embracing the characteristic of one group pre-test-post-test design. The pre-test and post-test are given to take the score of the student's achievement before and after being taught using developed game as a case study. The study also assessed players' experiences, the support they received, the time they spent using it and details of the game. Score was used with potential individuals but not as a controlled constraint.

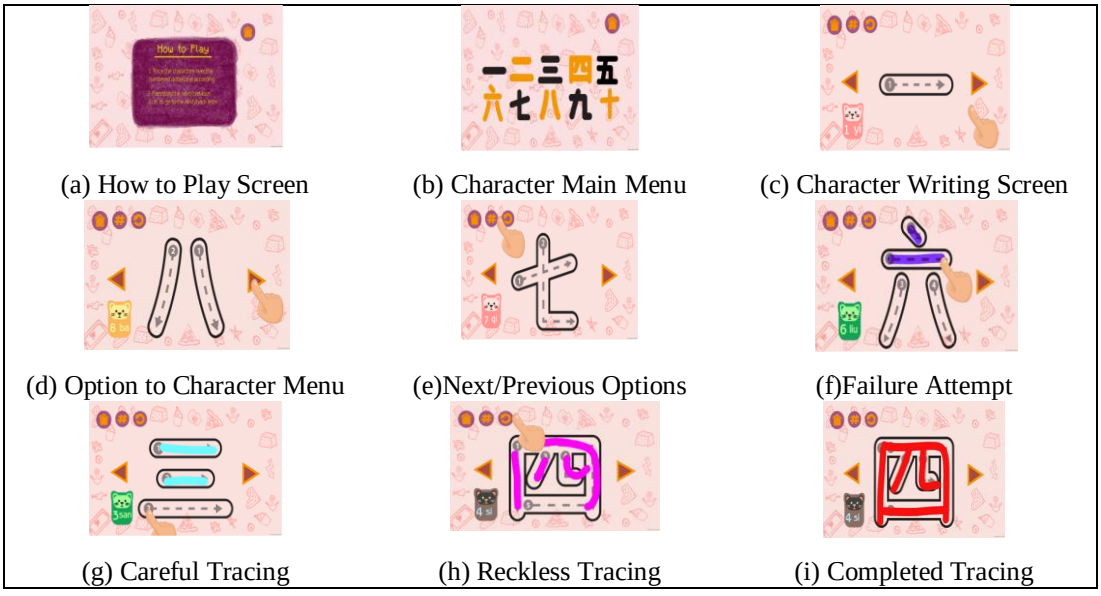
IV. DEVELOPMENT

The Four main stages were undertaken for development and evaluation of the App as shown in Table 1.

Table. 1 Phases of the App Development and Evaluation

Phase	Activities in sequential order
Requirement analysis	(1) Perform critical literature review on methods in learning Chinese characters (2) Collecting requirements from teachers who are teaching Chinese using the English (3) Gain understanding of the expectations from learners based on their experiences (4) Determining the age range of target player
Design	(1) Analyzing the gap of the research through literature review (2) Interpreting results of requirement to determine the system specifications (3) Drafting a storyboard as a template to develop the game (4) Organizing the graphical user interface and functionalities
Development	(1) Making a flow chart for executing the development of the game (2) Translating design into the game
Evaluation	(1) Using the developed game as an instrument in assessing the interface, content and effectiveness of the game for learning Chinese characters

Figure 3 shows a walkthrough on the game developed to introduce the Chinese characters to Namibian and Thai students as a case study to evaluate the effectiveness of learning foreign writing through a sketch-based gamified visual information manner.



(a) How to Play Screen (b) Character Main Menu (c) Character Writing Screen

(d) Option to Character Menu (e)Next/Previous Options (f)Failure Attempt

(g) Careful Tracing (h) Reckless Tracing (i) Completed Tracing

Fig. 3 A Walkthrough of the Developed Game

Figure 3(a) shows the How to Play screen where the play can read instruction and the tutorial to the game. It also includes the option to go back to the Main screen represented by the Home icon. Figure 3(b) shows the Character Menu screen, which allows the player to choose any character to play while Figure 3(c) shows the Character Writing screen, which allows the player to play by tracing the character. Figure 3(d) shows the Character Writing screen, which allows the player to go back to the Character screen to select a different character to play by pressing the Hashtag icon. Figure 3(e) shows the Character Writing screen, which allows the player to go back and forth to another character to play it, simply by pressing the next/previous button to play next/previous character.

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

Figure 3(f) shows the Character Writing screen where the player fails to trace a line. If the player traces a character far out the boundaries then the game will reset the current line and play the audio 'Oops' in the background to show the and the player will have to redraw the same line to move on to the next tracing line, a 'beep' will show the player has completely that specific line. Figure 3(g) shows the Character Writing screen where the player in in progress of tracing the number 3 or in Chinese, sān. The aim of the game is completely trace the entire character over the dotted line accordingly.

Above is an example of tracing the number three, the number is represented by three stripes – the player traces top to bottom – left to right; the first stripe is at the top, medium stroke, then the short stroke, the lastly at the bottom the long stroke. Figure 3(h) shows the Character Writing screen displaying a recklessly traced character. Suppose the player is not satisfied with the tracing of the character, the player can press the restart button to erase and retrace the character from scratch, the player can restart as much as they can till they are satisfied with the result of their final character. Figure 3(i) shows the Character Writing screen display a exclusively completely character. After the player, completely trace the entire character, a cheering sound will play in the background to applaud the player the player can then can go back and forth to another character to play it, simply by pressing the next/previous button to play next/previous character.

V. EVALUATION

The questionnaires are divided into three sections including the personal, the mobile usage and the game. The personal and the mobile usage sections are evaluated before playing the developed game and it is based on multiple choices. The game section is divided into another three parts: the interface, the content and the effectiveness and is in Likert scale 1 to 5. The questionnaire was made available online on Google Forum, 31 people responded after they had downloaded and played the game. The questions asked are as follows:

Section 1: Personal

a) What is your gender? (Male/ Female)
b) What is your age? (5-14/ 15-20/ 21-59/ 60+)
c) Do you own a mobile phone? (Yes/ No)
d) How many times you unlock your phone per day? (>10/ >25/ >80/ >150/ Not Sure)

Section 2: Mobile Usage

a) What do you use your phone for? (Games/ Call and Messages/ Social Sites)
b) Have you install any games on your phone? (Yes/ No)
c) What type of games do you play on your mobile phone? (Action/ Adventure/ Educational/ Racing/ Educational and adventure/ Strategy)

Section 3: Game

(i) *The Interface of the Mobile Game*
a. I like the interface of the game.
b. The interface is user friendly and consistent.
c. The interface is attractive and appealing.

(ii) *The Content of the Mobile Game*
a. I enjoyed playing the game.
b. You've got interests in learning Chinese language or characters or cultures.
c. This game is suitable for anyone that is learning Chinese.

(iii) *The Effectiveness of the Mobile Game*
a. I gained a bit of knowledge about the Chinese number system and its character writing knowledge.
b. I would recommend my friends to be interested or curious about learning Chinese characters by trying out the game.
c. I am satisfied with the overall gameplay and design of the game.

The first section is personal. About 38.7% of the respondents are male and 61.3% of the respondents are female. 3.2% of the respondents are in the age range of 5-14, 19.4% are in the age range of 15-20 and 77.4% of the respondents are in the age range of 21-59. About 100% (30 out of the 31 respondents) own a mobile phone. 49.4% of the respondents unlock their phones more than 80 times per day, 29 % more than 150 times per day and 16.1% more than 25 times per day. The ones that unlock their phones more than 10 times per day and also are not sure of how many times they unlock their phones are less than 5% each.
The second section is mobile usage. This part of the questions assessed the purpose of mobile use of the respondents and the type of games they prefer playing. 25% of the respondents use their phone for games, 25% of the respondents use their phone to call and sent messages the remaining 50% uses their mobile phones for social sites such as Facebook and Instagram. 93.1% of the respondents have installed a game or games on their phones and 13.3% of the respondents play action games, 20% of the respondents play adventure games, 30% of the respondents play educational games, 30% of the respondents play racing games, 3.4% of the respondents play educational and adventure games and strategy game are played by the remaining 3.3% of the respondents.

The third section's questions assessed the game that was developed. The first part is about the interface of the mobile game. It was observed that 29% of the respondents strongly agree, 35.5% of the respondents agree, 22.6% are neutral, 12.9% strongly disagree that they liked the interface of the game. About 35.5% of the respondents strongly agree that the interface is user friendly and consistent, 32.3% of the respondents agree that the interface is user friendly and consistent and 25.8% are neutral towards the user-friendliness and the consistency of the interface and the respondents that strongly disagree are less than 7%. Also, 46.7% of the respondents agree that the interface is attractive and appealing, 26.7% of the respondents strongly agree that the interface is attractive and appealing, 10% of the respondents strongly disagree that the interface is attractive and appealing, and 16.7 % are neutral. This shows that there are about 70% of the respondents agree on the interface of the mobile game.

The evaluation of the second part of the third section is on the content of the mobile game. 38.7% of the respondents agree that they enjoyed playing the game, 29% of the respondents strongly agree that they enjoyed playing the game and 19.4 are neutral towards the game and the respondents that strongly disagree and disagree are less than 7% each. 23.3% of the respondents agree that they have interest in learning Chinese language, characters or culture, 20% of the respondents of the respondents strongly agree, 20% of the respondents strongly disagree, 20% of the respondents disagree and 16.7% of the respondents are neutral that they have interest in learning Chinese language, characters or culture. Also, a total of 80% of the respondents strongly agree and agree that the game is suitable for anyone learning Chinese, 6.7% of the respondents strongly disagree that the game is suitable for anyone learning Chinese, and 13.3% are neutral.

The third part of the third section is about the effectiveness of the mobile game. 43.3% of the respondents agree that they gained a bit of knowledge about the writing of Chinese numbering system and its characters, 30% of the respondents strongly agree, 20 % are neutral and less than 7% disagree that they gained a bit of knowledge about the writing of Chinese numbering system and its characters. Also, 48.4% of the respondents agree that they would recommend this game to their friends to be interested or curious about learning Chinese, 25.8 % of the respondents strongly agree, 16.1% are neutral and less than 10% strongly disagree and disagree that they would recommend this game to their friends to be interested or curious about learning Chinese. This part continues the questions assessed the overall satisfaction that the player gained from the game that was developed. 58.1% of the respondents strongly agree that they are overall satisfied with the game play and design of the game, 25.8 % of the respondents agree, less than 7% of the respondents strongly disagree that they are overall satisfied with the game play and design of the game and 9.7% are neutral.

Overall, this shows that most of the respondents agree that the interface is user friendly and consistent; they also agree that they have interest in learning Chinese language, characters or culture and finally of the respondents agree that the game is suitable for anyone learning Chinese. Besides, most of the respondents agree that respondents agree that they gained a bit of knowledge about the writing of Chinese numbering system and its characters; they also agree that they would recommend this game to their friends interested or curious about learning Chinese and characters or culture and finally most of the respondents agree that they are overall satisfied with the game play and design of the game.

VI. CONCLUSIONS AND FUTURE WORK

In conclusion, a Chinese character writing board game is developed in terms of functionality to evaluate the experience to the player. A character writing game somehow requires users to complete simple tasks on their mobile phone, such as tracing a letter or number on the board. In addition to teaching users characters, tasks are aimed to keep users mentally engaged and physically active during the learning process because learners tend to become bored during class lectures. A character writing game with supporting educational materials designed to extend the vocabulary of pupils in schools in a playful way, is essential. It was brought to attention that many kids and students in school or varsity learning Chinese language face some significant barriers towards becoming either comfortable pronouncing, writing and remembering words of the Chinese language and staying mentally active. It was required to come up with a game application that would encourage students to play character writing game thereby teaching Chinese characters to overcome these issues. Immediately, it was comprehended that going to be difficult to convince users to play a game which tried to persuade them to change their lifestyle. Therefore, during the planning stages of the development process, the focused was on thinking of methods of convincing users to play the entire game. Ultimately, conclusion was made that, in addition to a fun game, is needed to promise the user a significant reward upon completion. In the game, there are practical exercises and record scores to reward players, a comprehendible tutorial within the game play to explicate the idea of the game and information in game play to make players understand game in detail. The game is responsive and can give players the opportunity to explore more characters that they are not familiar with. An outstanding mobile game used to encourage children and teenagers, adults to explore the Chinese characters. Development experience is intended to produce learning activities concerning the factors that influence the Chinese character writing board game. Players can see the change in their experience as they interact with the mobile game interface; the game also provides an opportunity for players to familiarize themselves in the game play.

From the data analysis conclusion that can be made is the objective has been achieved. Respondents are happy with the game and satisfied with all that the game has to offer. In this mobile game there are factors that influence the game. When developing this game, there were several open challenges. Among them are to be able to design an interface and content suitable for all ages. Besides, developing a user-friendly interface that is easy and convenient to use was also difficult as tracing the letters was dreadful. As for the evaluation, only numerals are tested even though the game works with diversified letters and words. Moreover, the developed mobile game cannot test and evaluate to all varieties of cultures and traditions because of lack of interest and cultural differences.

There are some future works to further enhance the game play capabilities and functionalities by having improvements in the navigations, designs and interfaces. To disseminate the availability, recognized platforms, such as Google Play and Apple Store can be utilized.

ACKNOWLEDGMENT

This work presented is supported by the UPSI GPU Short Term Grant.

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