

The Effects of Digital Game-Based Learning on Early English Literacy Task for Non-Native Speakers

Norehan Zulkipli¹⁾

Afina Abd Aziz

Universiti Malaysia Sarawak

Abstract

Despite the growing evidence for the benefits of digital game-based learning (DGBL) in promoting learning in various contexts, the effects of DGBL on early English literacy learning for non-native speakers remains unknown. The present study examined the effectiveness of using DGBL in enhancing student learning in an early English literacy task for non-native speakers. In the experiment, 66 Malay pre-school students who were identified as having low literacy in English (determined using a prior-conducted pre-test) were instructed to learn the English alphabet and words using either digital game-based or traditional flash card methods. The results from the independent t-test conducted on the post-test scores showed that the digital game-based group performed significantly better than the traditional flash card group, indicating that learning through digital game-based activities was more effective than traditional flash card methods in enhancing the students' learning on the early literacy task. The present findings provide empirical evidence for the effectiveness of DGBL in facilitating an English literacy task among the non-native speakers.

Keywords: digital game-based learning, early English literacy, traditional method, flash card

Corresponding author, ¹⁾ znorehan@unimas.my

Introduction

Digital game-based learning (DGBL) is a learning tool that integrates technology, educational content, and principles of learning (i.e., sound models and theories of learning) into a game format with the goal of engaging the learners in interactive instruction. Students in the 21st century are termed “digital natives” and they are noticeably more fascinated by learning that utilizes multimedia and technology-related learning tools to obtain meaningful learning experiences. This is entirely different from the traditional learning methods of “chalk and talk” (Prensky, 2007). Other common traditional learning methods that are generally used in various contexts of learning involve students listening to a teacher’s lecture, being presented with the textual learning materials or being highly dependent on printed textbooks; these approaches may not have general appeal for all learners, especially the “digital natives” of the current era who may find such materials uninspiring and less enjoyable (Hussain, Tan, & Idris, 2014; Hwang, Wu, & Chen, 2012; Kao, 2014; Sung & Hwang, 2013; Yang, 2012).

The presentation of DGBL has both a learning dimension and an entertainment dimension; the learning dimension seeks to impact the cognitive processes of DGBL users, whereas the entertainment dimension addresses the playful nature of DGBL (Rooney & Whitton, 2016). Research has shown that DGBL promotes a wide range of cognitive abilities such as spatial visualization, attention, and knowledge mapping (Van Eck, 2015). DGBL affords remarkable changes to the cognitive processes of children which are capable of enhancing their learning (Sung & Hwang, 2013) and which can motivate students to approach learning cheerfully and without anxiety (Ke, 2008; Sung & Hwang, 2013). As a result, students are more likely to be capable of paying greater attention to their learning. DGBL is also more useful when the learning material is tedious and technical and, not intrinsically motivating yet, it needs to be learned; for example, vocabulary and language learning, multiplication tables, and learning that involves rules and regulations (Prensky, 2001a). The presence of the following main factors — fun, play, and games – in the DGBL environment is what makes it engaging (Prensky, 2001b). Multimedia refers to the combination of media that comprise images, sound, video animation and text and which are supported by advanced technology. The information delivery hypothesis supports

multimedia learning; it presents the same information to learners via many routes (rather than using any single means) such that it facilitates better learning and retention (Mayer, Heiser, & Lonn, 2001). For example, presenting new words to learners using two delivery paths such as spoken words and picture (rather than using spoken words only) is likely to result in better learning of the vocabulary items (e.g., Samur, 2012). In addition, in parallel with modality principle (Mayer, 2001), the DGBL environment allows the learners to integrate information from different sensory modalities (e.g., visual and auditory). It is argued that the usage of different sensory modalities in learning medium increases the presentation of educational content (Lee & Lee, 2018). In the context of the DGBL environment, it allows for cognitive interaction on multimedia-based learning material through various sensory modalities engagement. The different multimedia instructions presented in verbal and visual forms are likely to place a high demand on the working memory, requiring the learners to switch their attention, for example, between the text and picture. Nevertheless, the two modality-specific subsystems (phonological and visuospatial) of working memory are both addressed in processing text and picture, thus reducing the memory load to process the multimedia instructions and leaving more space for the actual learning process (Mayer, 2001). The use of multimedia presentations and games as in the DGBL environment can foster cognitive processes such as attention, memory, and spatial visualization, thus making the learning process more meaningful (Moreno & Mayer, 2005).

Further, the Multiple Intelligence Theory proposed by Howard Gardner in 1988 states that there are at least seven elements of intelligence that play an important role in promoting human cognitive development. These are verbal-linguistic, visual-spatial, musical, logical-mathematical, bodily-kinesthetic, interpersonal, and intrapersonal (Roblyer, 2006). Becker (2005) has noted that Gardner's multiple intelligence theory bears a strong connection with DGBL. He believes that if a game is to be taken seriously, it should incorporate as many of the seven types of intelligence promoted by Gardner as possible. This can be achieved by tapping into the learner's various senses and learning styles. An eclectic design should feature words both written and spoken to direct and guide the learner in the completion of the task. It should also include rich and sophisticated visuals in the form of static or dynamic motion graphics, music with sound effects, and kinesthetic elements such as hand controls. Additionally, it is desirable to integrate interpersonal aspects such as collaboration with others and those aspects that address the intrapersonal

aspects of self-esteem, emotional responses, self-evaluation, and reflection (Becker, 2005).

In relation to intrapersonal intelligence, the DGBL environment allows learners to learn more by exploring knowledge on their own; thus, it is likely that learners exercise metacognition (Wolfe & Flewitt, 2010) – monitoring and reflecting their own thought processes, for example, in connecting the different pieces of information learned earlier and to those learned later during the learning process and making meaning out of them. The use of digital technologies such as those used in DGBL introduces new dimensions into the early literacy learning of young children and such experiences support the development of metacognition and strategic thinking (Wolfe & Flewitt, 2010).

Generally, in any learning process, learners must focus their attention on what they must learn. The presence of multimedia elements in DGBL is capable of engaging learners' attention. This idea is supported by Gagne's learning theory which highlights the importance of gaining learner's attention in the early stage of the learning process and maintaining it throughout the process (Becker, 2005). Information that is presented in several variations of presentation (e.g., using multimedia presentations) can be represented using various elements such as color, animation, and arrows throughout the screen to attract learners' attention and influence them to process the information. Gagne's learning theory also addresses the fact that people learn better and are more motivated to learn if their attention is linked to the learning purpose and the intended learning outcomes (Becker, 2005).

A plethora of studies has suggested that using DGBL as an instructional method could improve students' motivation compared to traditional methods such as giving a lecture, using flash cards, and utilizing text-format materials (Hussain et al., 2014; Kao, 2014; Sung & Hwang, 2013; Yang, 2012). Previous studies have also indicated that DGBL methods could help to improve students' learning performance in various disciplines and contexts such as mathematics (Hussain et al., 2014; Kermani, 2017), science-related subjects (Li & Tsai, 2013; Sung & Hwang, 2013), programming (Wang & Chen, 2010), computer science (Papastergiou, 2009), and problem solving and learning motivation (Yang, 2012). Previous investigations of the role of DGBL in these disciplines and contexts have focused primarily on school-aged learners and university students. Some of the primary factors that limited the investigation of the effects of games including digital games in the early-childhood

context are insufficient standardized learning content, poor integration of the game activities, and poor feedback and evaluations from young children (Plowman & Stephen, 2005).

Despite a growing development in the use of DGBL in literacy learning in early childhood, particularly in western countries, the effectiveness of DGBL has not been documented in academic research (Peirce, 2013). In general, literacy skills refer to fundamental reading and writing skills upon which all formal education depends. The pre-schoolers are expected to master the literacy skills, and that begins with learning early literacy tasks such as knowing the alphabet and phonology of each alphabet letter, recognizing and naming letters, and writing their own symbols (National Early Literacy Panel, 2008). Fostering the initial literacy skills in early childhood helps to minimize reading difficulties and avoid frustration, thus enhancing students' self-esteem and motivation in learning (National Early Literacy Panel, 2008; Sloat, Beswick, & Willms, 2007).

Interestingly, the effects of DGBL on second or foreign language learning have not been investigated comprehensively. In several meta-analyses studies, it was reported that the role of DGBL in learning English (among other computer technologies) as a second language is not yet established (Kao, 2014). A study on Iranian children who learned English as a foreign language showed that they benefited from the use of DGBL compared to using traditional methods; however, the study focused on examining English vocabulary in students at the elementary level (aged 6-7) (Aghlara & Tamjid, 2011). Nevertheless, it is not known whether DGBL could help in facilitating early English literacy learning in early childhood (pre-schoolers) in the context whereby English is learned as a second language or foreign language.

In the context of Malaysia, for example, the use of English language in recent times has become more important (Abdul, Muhammad, & Puteh, 2005). In 2013, less than 50% of the students who had completed six years of primary education were literate in the English language (Azman, 2016). Further, considering the critical period hypothesis which states that second language learning is relatively fast, effortless, and successful at an early age and before the onset of puberty (Birdsong, 2005), it is clearly important to develop English literacy from early childhood. Language and vocabulary learning via traditional methods is

often intrinsically demotivating (Prensky, 2001a) and when it involves learning a second language that someone is not familiar with, a more interesting and fun learning method such as DGBL may be able to increase the student's motivation and interest to learn and may be helpful in engaging the learners in acquiring English proficiency. The elements of playing and gaming are considered as interactive activities and with the inclusion of multimedia, DGBL creates a fun learning environment which seems to suit the nature of young children who love to learn via play (e.g., Johnson & Christie, 2009; Lieberman, Fisk, & Biely, 2009). Incorporating the element of play will make children more engaged in their learning and this heightened engagement can assist in their cognitive development such as in learning language (Peirce, 2013). According to Cunningham, Perry, Stanovich, and Stanovich (2004), the implementation of best practices in providing the literacy instruction is important and one of the best practices in literacy instruction is the use of DGBL tools. It is likely that DGBL can enhance students' learning on an English literacy task. Early English literacy learning in early education settings in Malaysia, such as pre- and primary schools, often involves traditional methods such as the use of flash cards (e.g., Hussaini, Fong, Suleiman, & Abubakar, 2016). While some schools may have introduced some game-based learning approaches, nevertheless to date, no empirical research evidence about the effectiveness of using DGBL in facilitating the learning of an early English literacy task in non-native speakers is available and documented. Thus, the present study aimed to determine the effectiveness of using digital game based-learning (DGBL) to enhance students' learning in an early English literacy task. The specific objective was to compare DGBL with another traditional instructional method; namely, using flash cards.

Method

The present experiment examined the effects of DGBL on students' learning in an early English literacy task for non-native speakers.

Participants

The participants were 66 Malay students from two local pre-schools comprising 41

females and 25 males who were conveniently selected due to accessibility and proximity factors. Of a total of 66 participants, 29 aged four years and 37 aged five years ($M = 4.56$, $SD = 0.50$). The participants' first language was Malay and each participant was known to have a low-level knowledge of the English alphabet (as determined by a pre-test which is explained further under the procedure section).

Design

The experimental research design (see Table 1) involved three stages: (i) pre-test, (ii) treatment (flash card vs DGBL), and (iii) post-test. The present study utilized the same research design as has been used in previous studies investigating the role of DGBL (e.g., Hussain et al., 2014). Participants were randomly assigned to either the control group or treatment group. Participants in the treatment group undertook the early English literacy task using DGBL, whereas those who were in the control group learned English literacy using flash cards. The treatment (of either DGBL or Flash Card) and both tests (pre- and post-test) were administered individually. The identical tests were used for both pre- and post- tests.

Table 1. *Research Design*

Groups	Before Treatment	During Treatment	After Treatment
Control	Pre-Test	Flash Card	Post-Test
Treatment	Pre-Test	DGBL	Post-Test

Materials

Identical learning material content (i.e., letters, pictures to be matched to each letter, and labels for each picture) was used for both the digital game-based group and traditional flash card group except that participants in the control group learned by using flash cards (which only includes elements of text and picture); whereas, those in the treatment group learned using a DGBL approach which incorporated multimedia components such as visuals, sound, on-screen text, and animation and was interactive in nature. The interactive features allowed the participants to go back to the previous stage, move to the next stage, and

enlarge the visual image of the letters. The DGBL video application and the test questions were taken from an open access website for educational games for kids (ABCYa.com) and upon advice from the preschool teacher in terms of the content. Figure 1 shows selected frames used in the treatment group, which used DGBL. The flash cards were made based on the content of the digital game. For the control group, flash cards featuring the same letters and pictures were used (the flash cards look like the ones in Figure 1).

Upon advice by the pre-school teacher, a paper and pencil type test was utilized for data collection (pre-and post-test) purposes for both the digital game-based and traditional flash card groups, because it was easier to manage and the use of the following questions formats such as matching question, and letter identification are suitable for assessing pre-school students' comprehension. The same 26 questions based on the English alphabet were included in the pre-test and post-test. An open-ended question was added to the post-test which asked for the participants' feedback about the specific learning method they had received and whether they found it to be helpful.

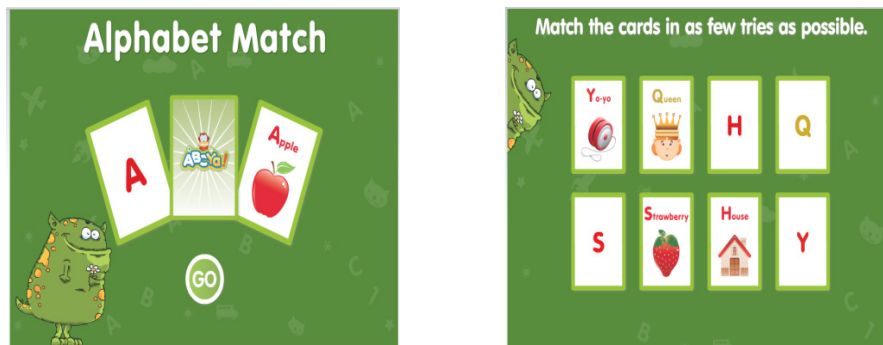


Figure 1. Selected Frames from the Treatment Group Who Learned via Digital Game-Based Method

Procedure

Before commencing the experiment, participant consent was obtained (this was sought from their teachers since the participants were pre-school students) and a briefing on the instructions was conducted with the students. During the individually administered pre-test, each participant was presented with a set of early English literacy questions. Only those

who scored below eight (about one third from a possible 26 correct answers) were selected for the treatment session to ensure that the participant had a low level of knowledge of the English alphabet. Participants were told in advance that the researcher would later inform them as to whether or not they were selected to participate in the next stage (treatment – flash card vs DGBL). As it turned out, all 66 participants scored eight and below (which was the qualifying criterion) and thus proceeded to the next stage.

Participants were then randomly assigned to either the control group or treatment group. Participants in the treatment group undertook the early English literacy task using DGBL, whereas those who were in the control group learned English literacy using flash cards. Considering that the participants were pre-school students who had very little knowledge about an early literacy task and that they did not know how to read and write yet, a researcher facilitated the learners in both groups during their learning process. However, this facilitating role was kept to a minimum; for instance, the researcher assisted in reading the letters and words to the students (concept of letter knowledge), associating the letters with sounds and sounds with words (phonological awareness), and instructing them on what were they expected to do throughout the study phase. The early English literacy tasks allowed the participants to learn the concept of letter knowledge (i.e., learn the shape of the letter and recognize them in print) and aspects of phonological awareness (i.e., learn to associate letters with sounds and sounds with words). The instructors used both English and Malay languages in delivering the instructions to help students comprehend the instructions. Later in the test phase, the participants were presented with the same pre-literacy questions that had been administered during the pre-test session; this served to probe their knowledge of the English alphabet (i.e., concept of letter knowledge) that they had learned in the treatment session. These questions were prepared in both English and Malay languages and the researcher also facilitated the students during this post-test by reading the instructions for them and guiding them on what they needed to do with the given test. Participants were also required to answer an open-ended question which asked for their feedback about the specific learning method they had received and whether they found it to be helpful. The question was asked orally to each participant and participants' answers were recorded by the researcher, considering their incapability to write at this stage. Finally, the participants were debriefed about the experiment. The whole experimental procedure took

approximately 60 minutes. In particular, the implementation of each treatment (DGBL versus flash card) lasted for about 30 minutes and the participants took about 30 minutes to complete the pre-test and post-test.

Results

First, independent sample t-tests were performed on the data to examine whether there was any significant difference in terms of students' pre-test and post-test comprehension scores in the literacy task between the traditional flash card group and digital game-based group. The results indicated that there was no significant difference in the pre-test score between the two groups, $t(64) = 3.01$, $p = .210$, which shows that the level of English literacy in all participants was almost equivalent. In particular, all 66 participants obtained scores of eight and below (out of 26), showing that they had very little knowledge about the English alphabet. Interestingly, there was a significant difference between the two groups in the post-test, $t(58) = 6.44$, $p = .000$, whereby those in the digital game-based group performed better than those in the traditional flash card group. The means and standard deviations for each pre-test and post-test in each instructional method condition (traditional flash card group vs digital game-based group) are shown in Table 2.

Table 2. *Means and Standard Deviations of Pre-Test and Post-Tests for Each Condition*

	Traditional Flash Card		Digital Game-Based	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Pre-Test Score	6.10	0.66	7.05	0.57
Post-Test Score	13.06	1.11	19.52	2.61

From Table 2, it can be seen that at post-test, participants from the digital game-based group scored higher in the early English literacy test ($M = 19.52$, $SD = 2.61$) than those from the traditional flash card group ($M = 13.06$, $SD = 1.11$). To investigate whether the difference was significant when compared with the pre-test retention test results for each group, an additional analysis using a paired-samples t-test was conducted. In the digital game-based group, the post-test scores of the English literacy test were significantly higher

than the pre-test scores, $t(32) = 6.22, p = .000$. The present study also found a significant difference between the post-test and the pre-test scores on the English literacy test for the traditional flash card group, $t(32) = 2.95, p = .038$. Although there were significant differences between the pre-test and post-test mean scores in both groups, the notable difference between the pre-test and post-test mean scores of the digital game-based group ($M = 12.47$) compared to the differences observed in the traditional flash card group ($M = 6.96$) seems to highlight the important role DGBL has played in facilitating participants' learning in an early English literacy task.

Discussion

The information delivery hypothesis could account for the findings observed in the present study. Based on this hypothesis, presenting the same information in several ways facilitates better learning (Mayer et al., 2001). In the present study, the English alphabet letters were presented to the digital game-based group participants in several additional ways and this has likely contributed to the better learning of the English alphabet by this group. In particular, the addition of multimedia elements such as animation, on-screen text, and sound (as in the digital game-based group) may have helped the process of learning of the English alphabet letters and the participants may have successfully integrate information presented from different sensory modalities (Mayer, 2001). The present findings are consistent with the notion that young children can learn and develop their early literacy skills through different means such as using visual and auditory learning (Meek, 1991; Saracho & Spodek, 2006; Tsao, 2008; Williams & Rask, 2003). The positive impact of DGBL on learning performance observed in the present study concurs with many previous findings which have confirmed the benefits of the DGBL approach in other contexts such as in the learning of mathematics (Hussain et al., 2014; Kermani, 2017), science-related courses (Sung & Hwang, 2013), and English vocabulary learning for the elementary students (Aghlara & Tamjid, 2011).

The present finding also seems to be consistent with Gardner's theory of the relationship between the design of games and human intelligences, which states that in order to engage

learners in the learning process, the games should address as many intelligence types as possible in order to provide rich experiences and to give each learner a chance to take advantage of his or her own particular strengths (Becker, 2005). The better performance in learning early English literacy via DGBL compared to using flash cards that was evident in the present study could be attributable to the additional features of the games featured in DGBL such as the on-screen text, the visual images, the audio/musical effects, and the animation; these address the following intelligence types respectively: linguistic, visual, musical, and spatial. Specifically, the combination of those features within interactive game-based learning is likely what makes DGBL more interesting, hence engaging students in the learning process. DGBL also allows one to exercise intrapersonal intelligence — that is, using insight and metacognition while undertaking the learning, which is in parallel with Wolfe and Flewitt (2010)'s ideas on the relationship between metacognition and digital technologies. The nature of DGBL as used in the present study allows the students to self-explore the learning environment, more on their own (with a minimum facilitation by the researcher) and this is likely to encourage them to think more about the learning involved, that is, to think about their own thinking processes (metacognition) and to develop more curiosity during their learning process as they explore knowledge. Tsao (2008) argued that children tend to use their memory to remember their previous experience through playing and then create a new meaning for the new condition. In relation to the development of metacognition, some of the learners in the DGBL group might have experienced this, resulting in a better early literacy learning. For the control group, who learned using the traditional method (flash cards), their learning environment was not as rich as DGBL (not interactive and lack of multimedia elements), hence limiting the aspects that they could explore and cogitate on their own. It was likely that the participants in the control group had less opportunity (as compared to those in DGBL group) to exercise metacognition such as reflecting on their own learning processes.

The present findings also comply with some of the elements necessary for learning as proposed in Gagne's learning theories (Becker, 2005). The DGBL used in the present study provides the following conditions; it attracts the learners' attention (using audio/music and visual elements) and it presents the materials in an interesting and encouraging form using animation elements and interaction. As argued by Moreno and Mayer (2005), the use of

multimedia games can foster the cognitive processes of selection (images and words) and organize and integrate the information in a proper manner, thus making the learning process more meaningful. Additionally, the materials were presented in an unambiguous way that allowed the user to navigate easily and maintain control.

Furthermore, most participants from the digital game-based group felt that learning was more fun and interesting. Of a total of 33 participants in the DGBL group, 30 (90.9%) claimed DGBL was helpful and three (9.1%) judged DGBL did not help them much in the early English literacy task. Majority reported that it was like “playing a game” where they could take charge of their own game (learning) and explore most of the learning on their own (after receiving some instructions and facilitation from the researcher). On the other hand, there were mixed views from those participants who learned using the traditional method (flash cards); of a total of 33 participants, 16 (48.5%) reported the flash cards method was helpful and 17 (51.5%) claimed the opposite that flash cards method did not facilitate the learning of the alphabets. Specifically, some of the participants in the traditional method reported that it was fun while others reported that it was a bit difficult to remember the letters. Given that participants in both conditions were given the same amount of time to learn, the superior learning performance in DGBL was likely due to the nature of the DGBL environment which was more fun, interesting, and engaging, thus attracting and motivating the learners to learn.

Conclusion

The findings of the present study offer a valuable insight to educators desirous of enhancing learning for the modern students; those who could be termed “digital natives.” Using the DGBL approach has not only been shown to result in relatively better learning of the English alphabet letters, but also to have elicited more positive feedback from the participants in this study. Although DGBL utilizes features of the modern technology, it remains connected to well-supported theories of learning and cognitive development.

In terms of practical implications, based on the present findings, it is suggested that students and teachers consider the use of DGBL in the teaching and learning process,

particularly, in enhancing early English literacy learning in non-native speakers. Language learning can be perceived as boring; nonetheless, the use of DGBL in language learning, especially, in second language learning may motivate students to learn and engage in their learning processes. It is recommended that further studies explore the possibilities of utilizing DGBL strategies in a broader range of learning tasks as well as within more diverse groups of participant learners. It is also recommended that further studies explore the role of DGBL in learning English among non-native speakers within more diverse groups of participant learners and use a more representative sample to increase the degree of generalizability of the research results. Further examination could explore utilizing DGBL strategies for literacy tasks that are more complex than an early literacy task within these diverse groups of non-native speakers.

In terms of limitations of the present study, the effect of using DGBL in facilitating the non-native speakers in early English literacy was found in the short-term retention condition (i.e., the post-test was given shortly after the study phase). It is believed that DGBL has considerable potential in improving the non-native speakers' performance in early English literacy tasks in the long term; thus, it is suggested that future studies test the participants' performance on early literacy task after a delay interval (e.g., ranging from days to weeks) which measures long-term retention. In addition, the present study only examined the participants in terms of concepts of letter knowledge in the pre- and post-tests. It is recommended that further studies examine other early literacy skills such as phonological awareness, vocabulary, and narrative skills.

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