

Technical and Implementation Barriers to Adapt Digital Game-Based Learning in Remedial Education: A Needs Analysis

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Abstract: Over the last decade, Digital Game Based Learning (DGBL) has been widely adopted in the education field. The implementation of DGBL is in high demand as it facilitates remedial education and helps in enhancing slow learners' mastery in learning. However, there are many drawbacks, especially in terms of technical and implementation issues in existing DGBL courseware. In turn, these drawbacks affect the learners' performances in education. This paper focuses on technical and implementation issues which restrict the effective integration of DGBL in remedial classroom. The aim of this study is to investigate the critical issues and develop the effective DGBL courseware in order to fulfill the slow learners' needs. Therefore, a needs analysis was conducted among 30 slow learners to investigate their perception on DGBL and issues related to its use in the classroom. The findings revealed that there are many technical and implementation issues that restricted slow learners from adapting DGBL in the process of teaching and learning. The findings of this research can assist designers and educators to improve the development of DGBL and fulfill the present gap by incorporating relevant pedagogical approaches and game-based features in the development process.

Index Terms: Digital Game-Based Learning, Remedial Education, Slow learners

I. INTRODUCTION

In line with the Industrial Revolution 4.0, the education field has undergone drastic changes especially in the way we teach and learn (Achim & Al Kassim, 2015). For one, the overcrowded curriculum with busy classroom settings are not conducive towards the learning process for slow learners (Chiu, 2017). Slow learners refer to students with inability to master basic learning skills (Kaur, Singh, & Josan, 2015). They need a longer time to master the basic learning skills (Shute, 2017). In remedial classes' teachers' adapted different learning strategies to allow slow learners to master content of learning. Thus, using Information and Communication Technology (ICT), educational technology has evolved throughout years and invented many new strategies to facilitate teaching and learning in remedial classrooms. One of these strategies is the use of Digital Game-Based Learning (DGBL). Game-Based Learning (GBL) is not new in education field as teachers have utilized

this approach in non-digital context in the classroom (Mishra & Kotecha, 2017). Prensky (2014) stated that GBL in digital context is related to ICT which includes the use of hardware (machine) and software (application). GBL plays a huge role in creating a desirable learning space for slow learners (Muhamad et al., 2018). However, many learning institutions venture into DGBL courseware without being aware of the challenges that they have to face (Shute & Rahimi, 2017). This study has uncovered the critical issues in existing DGBL namely in the realm of technical and implementation issues and has taken steps to overcome these barriers to maximize the utilization of DGBL. In this study, slow learners refer to students with problems in mastering basic numeracy skills. These participants are in the range of 7-12 years old and screened into remedial classes to learn basic numeracy skills.

II. DIGITAL GAME BASED LEARNING IN EDUCATION

Game-based learning is a type of teaching approach practiced in the classroom to foster student's understanding on learning topics (Kumar Bhowmik, 2018). Game-Based learning methods used in class can be in the form of physical or digital settings (Lu, 2018). In a physical setting, teachers practice existing physical game-based materials by incorporating gamification elements, as it integrates fun and excitement in learning (Vasalou, 2017). Usually, the ideas of the physical game-based learning practice in school includes hide-and-seek, ball games, card and board games, playground game and role play games which can stimulate learning among slow learners (Kumar Bhowmik, 2018). In contrast, digital game-based setting commonly utilizes computer mediated programs. For example, in DGBL, games are widely accepted in online orientated learning, courseware based learning and mobile learning

III. ISSUES IN DIGITAL GAME BASED LEARNING

The research focuses on overcoming the existing problems in DGBL. The drawbacks of the DGBL will be discussed below. These issues widen the gap of DGBL usage in remedial classroom.

A. Technical Issues in Digital Game Based Learning

Existing DGBL courseware in the market are designed without undergoing relevant testing (Muhamad et al., 2018).

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This usually creates technical defects in the programming of the DGBL courseware such as resolution changes, bugs, advertisements, shut down and late responses (Darling-Hammond, Zielezinski, & Goldman, 2014). These technical defects contribute to failure in the use of DGBL courseware in remedial classrooms. Developers also fail to implement alpha and beta testing of DGBL courseware before launching such courseware to users (Tsai, 2018). Failure in testing the design and usability of DGBL courseware beforehand allow such technical defects to manifest in classrooms and restrict slow learners from achieving their learning goals (Ussher et al., 2014). Eventually, these defects will frustrate the slow learners and teachers, causing both to prefer conventional methods of teaching and learning.

Furthermore, the educational courseware in the market are complex and complicated to play (Zielezinski & Darling-Hammond, 2018). This is because most of DGBL courseware are created using open-source software, which are readily available on the internet (Hubber et al., 2016). Typically, such open-source software are free to use, but restrict designers and developers from accessing and customizing all of its available features (Hong, Chen, & Lan, 2012), which results in rudimentary designs of DGBL courseware. This is supported by Johansen (2011), who discussed that the open-source software has minimal features to design and develop the games. Designers or developers can only access or customize all software features by a paid-subscription. It has been said that the existing features in open-source software are usually incompatible with the need of learners (Ussher et al., 2014). Not only that, the DGBL features on the internet sometimes uses other languages rather than English (Xu, 2017). Therefore, DGBL courseware users, especially slow learners, struggle to play the educational games. This ultimately results in the failure of the DGBL approach in remedial classroom settings.

Another technical issue is the lack of interface design in current DGBL courseware (Paris, 2017). Interface design refers to the graphics, animation, or motion of objects which enable users to be engaged by games (Bendak, 2018). Failure of acclimating interface design features will produce poor interactivity in games (J. C. Yang & Quadir, 2018). Without an interface design, the developers merely transform the content of hardcopy (or physical materials) into electronic formats (Lu & Yang, 2018). The resulting contents are static and fail to attract learners to explore the games (Spence & Usher, 2007). Hence, slow learners may easily get bored and fail to adopt said DGBL courseware in learning. As a result, this limits usage of DGBL in remedial classroom.

Moreover, existing DGBL courseware tend to be plagued with copyright issues (Perini et al., 2017). Realistically, the content of most DGBL courseware are taken from several of resources. Due to their inadequate knowledge in a particular subject, the courseware developers or designers tend to use other learning resources in order to create the game (Lai & Hwang, 2016). Usually, they would replicate the learning contents, pictures, videos, sound, music and language from other learning resources (Koohang & Paliszkievicz, 2016), which may be copyrighted. Consequently, the DGBL courseware may be restricted on online platforms if it or its

developers are facing copyright issues. In such situation, the developer should seek relevant expertise in all related field. For instance, content expertise, graphic expertise, music and sound expertise, and language expertise should be consulted if the developer wants to prevent copyright issues (Booth et al., 2017). Such expertise might help developer to design and develop original and authentic DGBL courseware.

B. Implementation issues on Digital Game Based Learning in classroom

DGBL in school failed to accommodate slow learners' needs (M. H. Chen, Tseng, & Hsiao, 2018). Slow learners in this research possess different learning abilities in subject matters. Therefore, without proper understanding on learners' needs and wants, it is a challenge for teachers or researchers to develop DGBL materials (Yang, Li, & Lu, 2015). This is another factor affecting remedial classroom teachers to prefer the conventional methods rather than DGBL (Bendak, 2018). DGBL courseware which anticipates learners' needs will allow learners to master the tailored content of a subject. DGBL courseware which map learner needs will creates a meaningful learning experience (Koohang & Paliszkievicz, 2016).

Lack of pedagogical knowledge in DGBL courseware causes its unsuccessful implementation in remedial learning (All, Nuñez Castellar, & Van Looy, 2016). The content of DGBL courseware is derived from developer's own experiences (All et al., 2016). Some of these DGBL developers' and designers' does not possess experience in teaching slow learners or even teaching. Thus, without relevant experience in pedagogy, their ability to matching slow learners needs is questionable (Perini et al., 2017). Often, developers assume that the learners already have fundamental knowledge in the relevant subject areas. Hence, the resulting DGBL courseware is not suitable for slow learners, whose subject mastery may be varied.

The poor quality of subject matter content also restrict slow learner's engagement in utilizing game-based materials (Spence & Usher, 2007). Developers whom embark on DGBL projects without proper understanding on content materials will lead to failed usage of games in remedial classrooms (Mishra & Kotecha, 2017). In such cases, the developer simply structures the content in games, without proper guidance. Unfirms content structure causes school teachers and administrator reluctant to practiced DGBL in classroom (X. Yang et al., 2015).

Not only that, limited computer-self-efficacy is also one of the contributor for low usage of DGBL in classroom (Hung, Huang, & Hwang, 2014). Computer self-efficacy is defined as the willingness of learners to adapt to computer features to play the games (Lai & Hwang, 2016). Bandura (1975) stated that incorporating mastery experiences attributes allow one to overcome obstacles in learning by way of 'trial and error'. Failure in mastering experiences relatively demotivates slow learners in playing educational games. Research by Anderson (2015) revealed that computer experience significantly correlated to usage of games in classroom. The data showed that out of 148 slow



learners only 34 %, N = 51 slow learners adapt computer as a medium of learning without hesitation (Lu & Yang, 2018). The study indicated that learners with basic computer skills gained confidence to adapt DGBL. Levina (2017) supported this by stating that basic computer skills are fundamental for learners to run and practice the games during lessons. Therefore, computer literacy facilitates slow learners' computer self-efficacy on subject learning. Lack of such literacy will reversely affect the computer self-efficacy of slow learners.

Current DGBL coursewares are lacking in verbal persuasion elements. Verbal persuasion is defined as the usage of motivation words which encourage slow learners to perform well in learning (Norfadilah, 2015). These encouraging words elevate slow learners' self-efficacy to play the game until the end. Bandura (1975) mentions that verbal persuasion in learning materials will stimulate learners belief system and allow them to participate in learning activities (Aziz & Mutalib, 2018). Therefore, games with reward points, score elements and timing elements keep motivating users to accomplish the target outcome of a game. Thus, slow learners should feel motivated to continue playing the game and ultimately understand the content.

Apart from that, educators face difficulties in trying to draw the attention of slow learners towards DGBL usage (All, Nuñez Castellar, & Van Looy, 2015). Thus, the existing DGBL does not deliver a vicarious experience to learners to adapt games in classroom. Vicarious experiences refers to games with learning features that allow user to visualize the content of learning (Pellas, 2014). Based on computer self-efficacy scale proposed by Murphy, et.al, (1989), it is revealed that user should be confident to run model-observation activities, hearing, and iconic instruction etc. to ensure one to engage with learning.

Previous studies showed that current DGBL failed to promote slow learners' interest in learning. This is caused by various reasons as discussed above (Kumar et.al, 2018). Other than that, the existing DGBL is concentrated with content of learning (Samuel et.al, 2017). This means the educational games (or DGBL courseware) for slow learners lacks the interactive game-based elements (Raja & Bahar, 2017). Prensky (2015) mentioned that interactive game-based elements will promote usability of the games among learners. Research by Rima (2016) also indicates that the existing learning courseware is more focused on multimedia elements like text, audio, animation, sound and music rather than game-based elements. Prensky (2015) argued that DGBL is different compared to Interactive learning courseware. Interactive learning courseware emphasizes on content pages, text, audio, graphic and simple assessment (Proulx, Romero, & Arnab, 2016). While game courseware is highly interactive which stimulate learners with customized features and allow learners to think beyond the box to solve certain problems (Chen & Hwang, 2015). In a nutshell, integration of game-based elements will allow for greater organization of content with appropriate manner. Hence, the DGBL interface design is more engaging for learners.

IV. METHODOLOGY AND FINDING

Needs analysis in this research refers to the preliminary study to identify learners' needs before designing the materials and activities in the courseware: DGBL. The information obtained from this process will enable the researcher to determine and refine the content of the courseware to suit the needs of target learners.

The needs analysis was conducted to obtain information from the slow learners regarding their learning need and perception towards existing DGBL. There are 30 slow learners from a primary school ask to answer questionnaire answer. Before conducting the questionnaire, implementer clearly explains each items in the questionnaire. It allows slow learners to understand each items in the questionnaire. The questionnaire consisting of 14 items was prepared by researcher and used to collect information. This questionnaire was adapted from Tsai's (2018) paper titled Development and Evaluation of a Computer-Simulated Science Inquiry Environment Using Gamified Elements. During the process of answering the questionnaire, the teacher will act as the facilitator to help students understand the item.

The items cover issues related to technical factors and implementation factors. The questionnaire uses the Turnstone scale, which means the slow learners have to answer 'Yes' or 'No' statement. The data collected is reported in the Table 1.

The items 1-7 in the questionnaire were concerned about the technical issues which restrict usability of DGBL in classroom. The data from item 2 and 3 indicates that 94 percent of learners agree that the games have poor accessibility and are difficult to run in computers. Slow learners could have been demotivated to use the games or to proceed to a further level in learning due to these problems. Grance & Miller (2017) stated that the existing games are difficult to install and run in outdated computers. In Malaysian context, most schools fail to upgrade their computer to newer or updated version, which ultimately limit the use of current DGBL. Due to this, eventually, teachers and learners prefer conventional teaching practice.

The item 8 to 14 identify implementation issues of DGBL in classroom settings. Item 14 and 12 reflect poor interaction of DGBL learning in classroom, specifically the lack of challenging elements and fun learning elements. Both of these elements impact the usability of games in classroom. The lack of these elements causes disengagement of slow learners towards DGBL practices or courseware. This finding aligns with the study conducted by Kim & Leng (2012), which shows digital based learning material has a deficiency of game-based elements. This restricts the slow learners' engagement from exploring and practicing the game to achieve learning goals.

Table 1: An Analysis of Technical and Implementation Issues DGBL by Slow Learners

No	Items	Yes		No	
		N	%	N	%
1	Enough of computer in the classroom	10	33.33	20	66.67
2	Games allow to access in different computers.	2	6.00	28	94.00
3	Games are easy to run in computer.	2	6.00	28	94.00
4	The graphics in game is attractive.	8	27.00	22	73.00
5	The charts or diagrams in games are clear.	7	23.00	23	77.00
6	I can use the games by myself	15	50.00	15	50.00
7	The menu available in game is easy to use.	5	17.00	25	83.00
8	Navigation and interaction are easy to use.	6	20.00	24	80.00
9	The game runs smoothly when function the game.	8	27.00	22	73.00
10	The game is attractive.	8	27.00	22	73.00
11	I can interact with all activities in games.	8	27.00	22	73.00
12	I feel fun during playing games.	3	10.00	27	90.00
13	I can understand the topic.	6	20.00	24	80.00
14	The game is challenging to use.	2	6.00	28	94.00

Note: Total sample of this research N=30

V. CONCLUSION

The discussion above detailed the technical issues and implementation issues that prevent DGBL from being a popular teaching method or practice in the classroom, especially remedial classroom. The needs analysis uncovers some essential information of the target learners' perception on DGBL. In this research, the researcher will tackle the identified technical issues and implementation issues of DGBL and produce a DGBL courseware which is more engaging and suit the needs of the slow learners to achieve better learning using DGBL. The courseware design focuses on engaging learning theories, engaging instructional strategies and engaging game-based elements to narrow the gap of identified issues.

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Declaration of Conflicting Interests

The author(s) declare(s) that there is no conflict of interest regarding the publication of this paper.

Data Availability

The datasets generated during and/or analyzed during the current study are not publicly available due to restriction from the relevant school authorities but are available from the corresponding author on reasonable request.

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