Digital Games, Academia and Our Digital Kids

Sinthuja Thesappiriyan, Maiga Chang*
School of Computing and Information Systems, Athabasca University, Canada
*maiga@ms2.hinet.net

Abstract: *Kids today are ready to embrace the wonders of the digital world. Digital games provide an incredible opportunity for learning, socializing, communicating. But, why our 21st century curriculum and teaching methods haven't changed to capitalized on digital games and digital fluency of our kids? Is it because the pedagogical benefits of digital games are unknown? To address this question, we conducted a literature review to examine the impact of digital games on the development of 21st century skills and curriculum achievement. The findings signify that the insertion of digital games within the classroom as an adjunct avenue for teaching can be a valuable tool in promoting 21st century skills and curriculum learning.*

Keywords: digital games, kindergarten education, 21st century skills, improving classroom teaching, play-based learning

1. Introduction

There is a strong relationship between play and learning. Play is an important medium for children development and learning process. It plays a key role in aiding a child understands the wonders of world around them. Since digital games play a crucial role in learning (Felicia, 2011) and our current generation is ready to experiment, it becomes apparent that educators and policy makers should consider the potential for incorporating technology within academia. Such a claim is consistent with Zevenbergen's (2007) argument where he states that early childhood setting needs to be redesigned in order to sustain and support the new generation of learners.

Kids' natural love for play is a proven philosophy. When games are combined with the curriculum, computer games can be pedagogical and the curriculum can be entertaining (Demirbileka & Tamer, 2010). Then, why our current curriculum hasn't changed to capitalize on the pedagogical benefits of digital games and digital fluency of our kids to provide the 21st century learning opportunities? Motivation is the fuel that fans the flames of DGBL. To supply this fuel to all key players involved in the implementation of game-based learning, this paper reviews relevant literature on the impact of DGBL on curriculum achievement. This will provide educators, parents, policy makers and games designer an understanding of the impact of DGBL; such understanding may help accelerate and strengthen the implementation of game-based learning.

2. Digital Games and Curriculum

The Ontario full-day early learning-kindergarten program focus on the six key areas of learning - Personal and Social Development, Language, Mathematics, Science and Technology, Health and Physical Activity and Arts (The Ontario Ministry of Education, 2010). Several research studies have proven that the use of digital games foster academic learning in subject areas such as math (Kebritchi et al., 2010; Panagiotakopoulos, 2011). We examine the impact of digital games on the Mathematics area of Ontario kindergarten program due to the page limit.

There are excess of empirical researches conducted to study the educational impact of digital games. However, those findings have oftentimes contradicted (Rutten, Joolingen, & Veen, 2011; Kebritchi et al., 2010). Literature reviews of these empirical researches to investigate and summarize the contracting results have been slow to emerge; specially, reviews of studies published within the past five years. Taking this reality into consideration, the goal of our

study is to examine the empirical studies published between the years 2009 and 2012 to analyze the educational impact of digital games in fostering students' curriculum (Mathematics, Science, and Language) learning. The result of this study provides robust evidence that digital games can improve traditional learning.

We applied Cooper's (1988) procedure for synthesizing relevant literature, and utilized Kebritchi and Hirumi's (2008) use of Cooper's procedure as an example as follows:

a. Problem Formulation

There are varieties of view on the effect of digital games. Not everyone have positive perceptions on the learning outcome of gameplay. Therefore, to justify the positive effect of digital games, we analyzed empirical studies conducted within the last three years with the following question: "Does the empirical study shows a positive learning outcome on the relevant academic subject gameplay?"

b. Data Collection

The goal of the data collection is to find the relevant empirical literatures published between the years 2009 and 2012 that focused on evaluating the effectiveness of digital games on the selected academic subject (i.e., Math). We conducted the search using various online journals and academic databases available from online university library and Google scholar.

Database search has started on December 02, 2011 and was repeated until Feb 20, 2012. We limited our search by using the following keywords: ["Math and digital Games"], ["Digital games and curriculum"], ["Digital games and learning"] and ["Educational digital Games"].

c. Data Evaluation

After a careful review of those articles, we eliminated articles that are not empirical studies. Studies that evaluated the effectiveness of digital games other than the relevant subjects are also excluded. We selected literatures in which the use of digital game is aimed at measuring the change in knowledge, motivation, attitude, engagement, and self-efficacy. We selected eight literatures that evaluated the effectiveness of digital games on the relevant academic subject (i.e., Math).

d. Analysis and Interpretation

We endeavored to categorize the dependent variables measured by the studies. For example, we grouped the dependent variables "change in knowledge" and "content understanding" as achievement. Moreover, we grouped "enthusiasm" and "inspiration" under motivation. Finally, we grouped satisfaction under "self-efficacy". In addition, we focused on analyzing and summarizing the following dependent variables: the change in knowledge (achievement, problem-solving, problem-positing, reasoning), motivation, attitude, engagement, and self-efficacy.

e. Public presentation

We attempt to discuss the result of dependent variable measured by the studies. Needless to say, most studies do not focus on just one dependent variable, rather endeavored to take several dependent variables.

3. Impact of Digital Games within Mathematical Curriculum: Empirical Review

Students often struggle with learning basic math concepts and motivation for learning mathematics (Panagiotakopoulos, 2011). Lack of motivation hinges students' self-efficacy on their ability to learn mathematical concepts (Gillispie, Martin & Parker, 2009). This, in turn could result in phobia in mathematics education. Nevertheless, this fear can be decreased with the help of mathematical educational games (Panagiotakopoulos, 2011). An educational game may foster positive attitude toward mathematical learning (Coştu et al., 2009).

Kebritchi et al. (2010) analyzed sixteen empirical studies published between years 1998 and 2009 in order to examine the impact that instructional games have on learning processes within the school curriculum subjects such as Mathematics, Reading, Science and Computer. Of the sixteen reviewed literatures, nine focused on the impact of

Mathematical games on learning process. The result of those nine studies shows that mathematical games have a positive learning outcome.

The review of our empirical literatures published between the years 2009 and 2011 revealed that the use of mathematical games, in fact foster mathematical learning. The studies used mathematical games as treatments and measured various dependent variables including achievement, motivation, attitudes, Problem-Solving, Problem-Posing and reasoning. For instance, Coştu et al. (2009) examined the attitudes of students towards the use of game based learning in mathematics. The finding of their study indicated that, the use of computer games makes the learning more enjoyable, and foster motivation and positive attitude towards mathematics. Furthermore, Chang et al. (2012) found that instructional games can improve mathematical problem-posing and problem-solving abilities. Moreover, Fisch et al. (2009) revealed that children's mathematical reasoning can be improved via online mathematical games.

Number of studies has been conducted to evaluate the relationship between mathematical games and student achievement. For instance, Kebritchi et al. (2010), Ku et al. (2010), Panagiotakopoulos (2011), Gillispie et al. (2009) and Nelson (2009) found that the use of mathematical games potentially have a significant improvement on student achievement. We also found contradicting results of empirical studies. For example, Kebritchi et al. (2010) found no significant relationship between students' motivation and the use of digital game. However, Panagiotakopoulos (2011) and Ku et al. (2010) found clear improvement on mathematical motivation. Similarly, the study conducted by Coştu et al. (2009) and Gillispie et al. (2009) showed contradicting result on students attitude toward digital mathematical games.

4. Conclusions

The review of eight empirical studies (published since 2009) on the effectiveness of DGBL provides robust evidence to conclude that digital games can be a vehicle for facilitating academic learning and engagement. The result of our research suggest that teachers recognize the benefit of DGBL and enthusiastic to implement it in the curriculum. However, the lack of hardware infrastructure in the classroom and the lack of teachers' technology proficiency seem to be major barriers that hinder the adoption of DGBL in education. Moreover, the finding shows that parental acceptance is the critical factor that influence all parties involved in the implementation of DBGL.

It is clear from this research findings that DGBL has the potential to foster both academic and essential life skills need to thrive in our modern society. In addition, what is also clear from this research is that the collaboration and communication between parents, teachers, game designers, and school leaders is essential to alleviate the barriers in DGBL adoption and maintenance.

References

Chang, K.-E., Wu, L.-J., Weng, S.-E., & Sung, Y.-T. (2012). Embedding game-based problem-solving phase into problem-posing system for mathematics learning. *Computers & Education*, *58*(2), 775-786.

Cooper, H. (1988). The structure of knowledge synthesis: A taxonomy of literature reviews. *Knowledge in Society*, *1*, 104-126.

Coştu, S. , Aydın, S. , & Filiz, M. (2009). Students' conceptions about browser-game-based learning in mathematics education: TTNetvitamin case. *Procedia Social and Behavioral Sciences*, *1*(1), 1848-1852.

Demirbilek, M., & Tamer, S. L. (2010). Math teachers' perspectives on using educational computer games in math education. *Procedia-Social and Behavioral Sciences*, *9*, 709-716.

Felicia, P. (2011). How can digital games be used to teach the school curriculum? Retrieved April 5, 2013, from http://linked.eun.org/c/document_library/get_file?p_l_id=22779&folderId=24664&name=DLFE-783.pdf

Fisch, S.M., Lesh, R., & Motoki, E. (2009). Exploring children's mathematical reasoning when playing online mathematical games. In S.L. Swars, D.W. Stinson, & S. Lemons-Smith (Eds.), Proceedings of the 31st Annual

Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education, 1489-1496.

Gillispie, L., Martin, F., & Parker, M. (2009, March). Effects of the Dimension-M 3D Video Gaming Experience on Middle School Student Achievement and Attitude in Mathematics. Presented at Society for Information Technology and Teacher Education Conference, Charleston, SC.

Kebritchi, M., & Hirumi, A. (2008). Examining the pedagogical foundations of modern educational computer games. *Computers & Education*, *51*(4), 1729-1743.

Kebritchi, M., Hirumi, A., & Bai, H. (2010). The effects of modern mathematics computer games on mathematics achievement and class motivation. *Computers & Education*, *55*(2), 427-443.

Ku, O. Y. M., Wu, J. C. Y., Yang, B. C. J., Chan, T.-W., & Wu, D. H. (2010). Effects of Digital Game-Based Extensive Mental Calculation Practice. In the Proceedings of the Third IEEE International Conference on Digital Game and Intelligent Toy Enhanced Learning, (1), 240-242.

Nelson, M. D. (2009). The effects of computer math games to increase student accuracy and fluency in basic multiplication facts. Unpublished Master's Thesis. Caldwell College, New Jersey, USA.

Panagiotakopoulos, C. (2011). Applying a conceptual mini game for supporting simple mathematical calculation skills: students' perceptions and considerations. *World Journal of Education*, *1*(1), 3-14.

Rutten, N., Van Joolingen, W. R. , & Van Der Veen, J. T. (2011). The Learning Effects of Computer Simulations in Science Education. *Computers & Education*, *58*(1), 136-153.

The Ontario Ministry of Education. (2010). The Full-Day Early Learning-Kindergarten Program (Draft Version). Retrieved April 5, 2013, from http://www.edu.gov.on.ca/eng/curriculum/elementary/kindergarten_english_june3.pdf

Zevenbergen, R. (2007). Digital Natives Come to Preschool: implications for early childhood practice. *Contemporary Issues in Early Childhood*, *8*(1), 19-29.