A Competitive Study towards the impact of educational games on the Student Motivation and the Development of Self-Directed Learning for Math: A New SDL Model

AHMED DHEYAA BASHA, IRFAN NAUFAL UMAR, MERZA ABBAS

Centre for Instructional Technology and Multimedia (CITM)

Universiti Sains Malaysia,

Penang, 11800

Abstract—Self-directed learning (SDL) has become a major topic within adult education literature. Addressing the impact of various educational games on the student motivation levels and the development of SDL especially for learning math have helped to determine the important resources to be applied in order for monitoring the learner progress. Therefore, this paper was conducted to review different literatures on the use of educational games in motivating students and developing their learning progress which lead us then to characterize a new model for managing such development. The model was designed based on the recommendations by Tan and Gibbons (2011) "Design principles for SDL" in terms of self-planned, self-managed, and self-directed.

Index Terms— SDL, Motivation, Educational Games, Learning Technology

———————————————— ◆ ————————————————

1 INTRODUCTION

DIFFEREENT tools and techniques have been applied for teaching and learning such as computer games which considered to be an efficient part for delivering learning concepts in inspiring way. Although, various instructional schemes help improve learning based on the combination of different technologies for the use and communication of Information. The term is often used in regard to Information Technology (IT), specifically in two sectors: education and government. Moreover, ICT facilities covers all use of computer hardware, disks, monitors, microphones, speakers it also includes phones and technology for broadcasting information such as radio, television; and technology for communicating through voice and sound or images etc. With all these tools the student has the artillery to conquer the field of knowledge and has unlimited source that inspires and motivates the scholar to learn without fear or hesitation [1].

Self-directed learning has been described as "a process in which individuals take the initiative, with or without the help of others," to diagnose their learning needs, formulate learning goals, identify resources for learning, select and implement learning strategies, and evaluate learning outcomes [2-3]. Different scholars have presented different perspectives on SDL. Some scholars [4] see SDL as a process of organizing the instruction, focusing their attention on the level of learner autonomy over the instructional process.

Lowry (1989) estimated that about 90 percent of all adults conduct at least one self-directed learning project per year. Typical learners engage in five, spending an average of 100 hours on each project. Many self-directed learners are attempting to gain new skills, knowledge, and attitudes to improve their work performance. Others conduct their self-directed learning to improve family life and health, enjoy the arts and physical recreation, participate in a hobby, or simply increase their intellectual capital [5].

The emergence of alternative and non-traditional teaching methods that employs an active role, feedback, complexity, repetition, emotions, physiologic events and psychomotor ability, as well as the increasing body of research on the effectiveness of non-traditional teaching strategies in different teaching-learning situations in the classroom, have opened up the opportunity for teachers to utilize non-traditional teaching strategies in conjunction with the traditional methods of teaching [6]. Other teaching methods utilize a more participatory approach between the teacher and the students. Alternative teaching methods that are more widely used now include the use of algorithm, case studies and demonstration. There are also relatively new and non-traditional strategies in teaching that are fast gaining popularity as teachers are constantly looking for new ways of presenting their lessons. One such method is the use of educational games. An educational game is an activity set in a classroom setting governed by specific rules where players compete against each other using knowledge and skill to achieve a desired end. The application of this non-traditional method can be a positive, enjoyable, engaging and interactive for reinforcing information. Student-to-student learning is said to increase motivation and improve active learning, critical thinking and concept retention.

Kolb in [7] further categorized educational games according to their functions. He divided them into `games for self-analysis`, `games for communication and collaboration` and `system games`. Games for self-analysis provide students an insight about other people, situations or problems. Games for communication and collaboration allow students to work together to achieve a common goal. Communication plays a vital role in this category since it requires students to suggest and collate their ideas. Lastly, a system game allows students

to understand how a system functions as a whole. It provides them an idea that a system is composed of, in different parts, each as important as the other [7].

Educational games help to carry a clear idea of how to deal with different situations or sums in the simplest form whatsoever [8], Table 1 presents the different advantages and disadvantages of the educational games. A mathematician views games as models of competitive situations that identify interested parties and stipulate rules governing all aspects of the competitions, used in game theory to determine the optimal course of action for interested parties. Constant changes in society demand changes in educational approaches. Developments in educational technology, however, do not decrease or in any way affect the importance of an educator's role in students' learning [9]. Part of a faculty's role in students' education is to determine an appropriate teaching strategy that would ensure maximum learning and development among students. An assortment of strategies is available to teaching staff aside from the traditional lecture. The use of these strategies is important since their appeal varies to diverse students [10]. It has been accepted widely that students demonstrate variations in learning styles [11].

TABLE 1
THE ADVANTAGES AND DISADVANTAGES OF EDUCATIONAL GAMES [12]

Advantages	Disadvantages
1- *Familiarize children with technical language*	1- *May be abused by terrorist group*
2- *Is knowledge in action and context*	2- *May effects the socialization*
3- *Bring knowledge and practice together*	3- *May result in a detachment from reality*
4- *Alleviate job crisis*	
5- *Families gamer with the e-culture of different professions*	

2 ISSUES & LITERATURE

Lecture-based dissemination of information, although time-efficient, makes students passive and sedentary learners. Background of the topic and concepts are delivered by the teacher, and students become contented with what is provided to them [13]. Non-traditional methods such as usage of algorithms, case studies, dialogues, demonstrations and educational games, on the other hand, transform passivity among students into active and independent learning. These methods try to connect the topic to real-life situations making it relevant to students. The ability to personally relate to the topic increases concept retention in comparison to memorization. This concurs with Confucius who once said, "I hear and I forget, I see and I remember, involve me and I understand". In non-traditional methods, the teacher is not the sole source of knowledge and information. Student's feedbacks and input is as important and informative as well. There are two major key themes common to the development of self-directed learning based educational games. They are stated as follows:

- The ability of games to motivate learners using certain equipment to make learning fun.
- A belief that learning through doing which is in games offers a powerful learning tool.

Most edutainment has failed to realize expectations either because:
i) The games have been too simplistic in comparison to class work or learning.
ii) The task is repetitive which means it is based on continually doing sums and thus quickly becomes boring.
iii) The task is poorly designed and does not support progressive understanding.
iv) The target audience becomes aware that it is being coerced in "learning" in possibly a patronizing manner.
v) The target of any activities is severely limited within the game, which concerns certain skills or accumulation of homogenous content.

The debate on making learning mathematics fun often assumes that students do not enjoy learning; yet, much research evidence contradicts this, arguing that students do enjoy learning when they have a sense of their own progression and where the learning is relevant and appropriate. This focus on fun and games in learning may in-fact be a red herring. Instead, it might be worth returning to some early analysis that describes the pleasures of games played as a flow. The conditions likely to induce "flow "state are characterized by Malone (1980) as:
i) The activity should be structured in a way that the player can increase or decrease the level of challenges faced in order to match exactly, personal skills with the requirements for action.
ii) There should be clear criteria for performance, i.e., a player should be able to evaluate how well or how poorly he or she is doing at any time.
iii) The activity should provide concrete feedbacks to the players so that they can tell how well they are meeting the criteria of performance.
iv) It should simplify the learner's activities along with the perceptual level by customizing the internal and external learner abilities.
v) It should provide a different range of challenges that affect learner's performance by having a broad range of challenges and possibly several qualitatively.

Various forms of research have been carried out by numerous researchers on the development of self-learning to be directed through the use of games and one of the earliest and most cited research works was done by Thomas Malone& Lepper (1987) who identified three main ways in which games

were able to motivate players. These were categorized as "fantasy", "challenges" and "curiosity".

A key concept that frequently emerges in the literature is that of "flow" which was first discussed by [14]. Debates on the issue of "flow" centers around how the "state" can be created in an individual and measuring how it might make a person more receptive to receiving knowledge, comprehending and using educational- based content and skills.

A scholar in [15] stated the considerable enthusiastic thoughts for optimizing the digital educational games paradigms to the learning fields and other educational sectors. They addressed different approaches for achieving integration that shows the difficulties and weaknesses in linking the game-playing activity to transferable social or conceptual processes and skills by indicating the success factors for integrating games into the learning process along with the 'dialogue game' approach to learning in cyberspace. They eventually found that games helped significantly in developing the student performance in learning math.

On the other hand, Meyer in [160 reported the usefulness of using the global game structures for obtaining better learning. He focused on language learning, and teaching students how to learn in more creative ways followed by student's behaviour for learning. He also proposed a new theoretical argument for using the global game theories in facilitating the learning process following the concept of SDL [16].

Yunus, Suraya, and Wan in [17] stated the effectiveness of using games for solving mathematical problems. They identified the students' level of effort' and students 'level of motivation' differed by gender, current cumulative grade point average (CGPA) and year of study. They then administered questionnaire for data gathering purposes. The result revealed a significant difference in overall motivation scores between the female and male respondents. Additionally, a significant positive correlation was found between effort, self-efficacy, and overall motivation with students' overall academic achievement [17].

3 ROLES AND CRITERIA FOR DESIGNING A NEW SDL

The listed recommendations were prepared by several writers such as [18-19] for assisting learner to identify the starting point for a learning project and discern relevant modes of examination and reporting, which give much attention on the applicability of students to learn effectively with using educational techniques such as games in learning. These recommendations can be summarized into the following:

i) Support students to explore new ways of learning and find the truth as contextual, which mostly re-

lied on the value frameworks as cultural constructs, and to decide their world.

ii) Identify the real needs for students to learn based on educational games by determining the learning contract for goals, strategies, and evaluation criteria.

iii) Plan for the main procedures that students need to follow while using educational technologies for them to be directed self-learning.

iv) Assist students get the require assessment techniques necessary to explore the roles while learning is taken place.

v) Offer examples of previously adequate work.

vi) Make sure that learners are aware of the objectives, learning strategies, resources, and evaluation criteria once they are decided upon.

vii) Teach inquiry skills, decision making, personal development, and self-evaluation of work.

[20] believes that SDL take place as a spectrum. He described and imposed different phases in SDL that established from low scale of self-direction to the highest scale of SDL such as:

i) Significant self-directed learning: this scale involves the major activities of SDL that combined individually or with group in a definite courses or programs directed by teacher.

ii) Teaching students to learn without help: this scale presents the standard courses or programs that effect on the individual recreation while learning through investigation, inquiry, problem solving and creative activity.

iii) Self-managed learning: this scale involves a certain programs that carried to the learner by guiders that students complete in parallel.

iv) Self-planned learning: this scale presents the courses or programs in which student's attendee course outcomes based on the personal reaction.

v) Self-directed learning: this scale has been identified by Gibbons as the student's reaction towards courses or programs that carry their personal outcome and activity in their own way. Even so, taking in consideration these scale while planning for educational plans needs to identify the hierarchical and neat order in practice. Figure 1 summarizes Gibbon's spectrum.
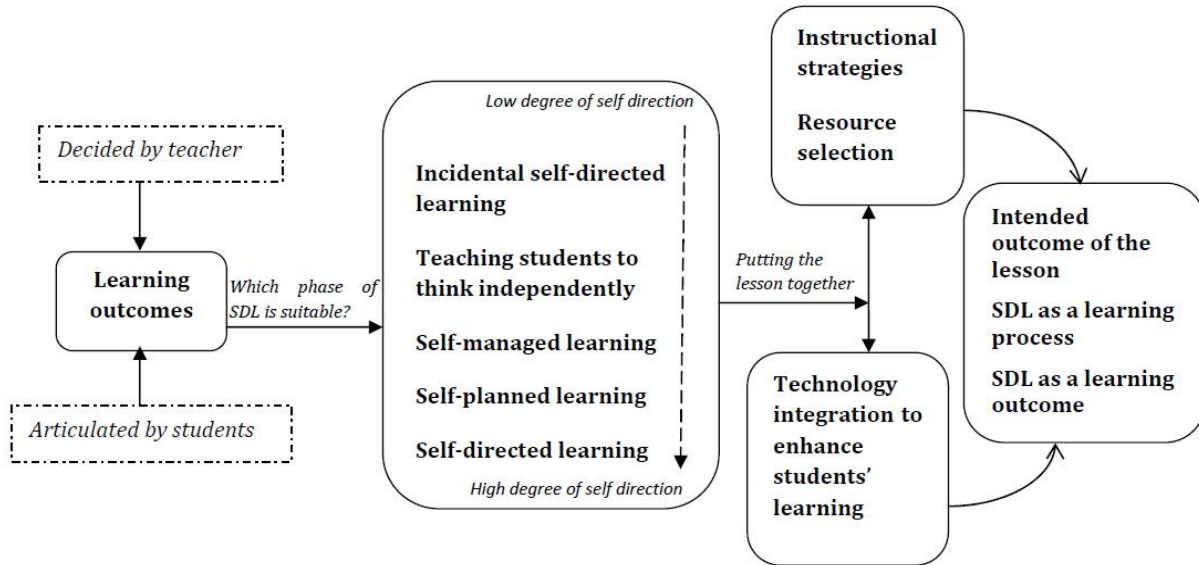
Fig 1. Design principles for SDL[21]

Formerly, when the teachers have decided on the lesson design, they may want to consider the integration of technological tools to enhance students' learning and to assist them in monitoring their students' learning. Most of these considerations were built with bearing in mind the following:

i) What are the main a technology pacts for supporting educational gamed along with the students' SDL? How it will support the students? How can I apply the learning resources and technologies to improve the students' learning?

ii) Are there any significant advantages of applying new SDL model to monitor the student while learning Math?

iii) What are the types of games that need to be used in learning Math? Do I want to use an old fashion of technology that student have already learnt? Do I want to integrate technology which my students are unfamiliar with but are capable of using it?

iv) What is the impact if I let students to decide the suitable educational games?

Therefore, applying games into the educational process helps students to be progressed in the aspect of self-directed. This idea of this paper was mainly constructed based on the design principles for SDL by Tan and Gibbons. A new model was presented based on three prime elements: self-planned, self-managed, and self-directed. Figure 2 shows the proposed SDL model for applying educational games into the learning process.
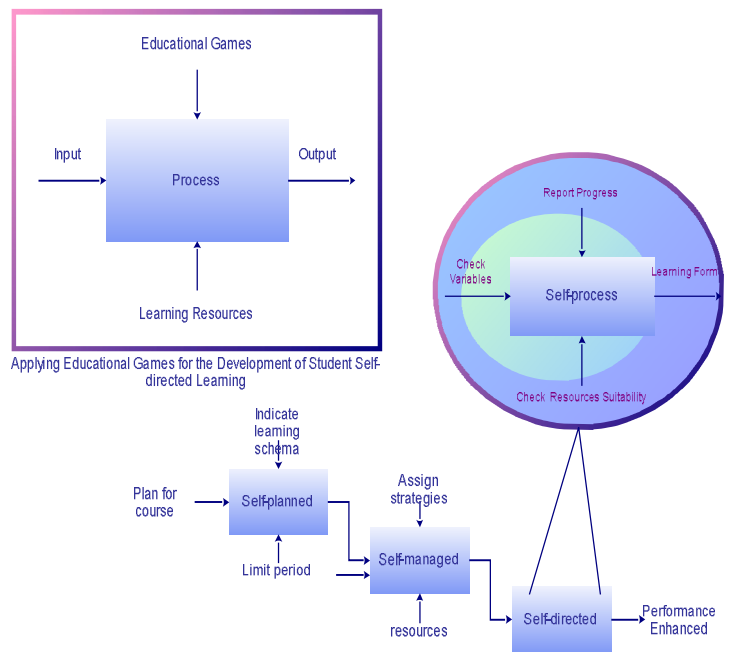

Fig 2. Designed Model for SDL with Educational Games

4 CONCLUSION

The concern of this paper was on the reviewing of the educational games impact on the student motivation and the development of self-directed learning for Math. The paper also introduced a new SDL model for planning, managing, and directing the development of student progress when using the educational games while learning math. The new model is believed to have an impact on the managing process of student SDL practices.

REFERENCES

[1] G. B. Halleck, et al., "Integrating a conference simulation into an ESL Class," Simulation & Gaming, vol. 33, p. 330, 2002.

[2] R. Hiemstra, "Self-directed learning," The sourcebook for self-directed learning, p. 9, 1999.

[3] M. S. Knowles, Self-Directed Learning: A Guide for Learners and Teachers: New York: Association Press, 1975.

[4] R. Harrison, "How to design and conduct self-directed learning experiences," Group & Organization Management, vol. 3, p. 149, 1978.

[5] C. M. Lowry, "Supporting and facilitating self-directed learning," Eric Digest, vol. 93, 1989.

[6] G. Rutishauser-Chappelle, "Assessment and Redesign of Teaching "Theories & Methods of Alternative Dispute Resolution" Online," Humboldt State University, 2007.

[7] D. A. Kolb, Experiential learning: Prentice-Hall Englewood Cliffs, NJ, 1984.

[8] R. Ayyad, et al., "An Optimization of CPS Model in Computer Games Development for Non Programmers," in Paper presented at the 2nd international conference on Computational Intelligence, Modeling and Simulation, Bali, Indonesia., 2010, pp. 125-128.

[9] S. Sengül, "A review on the effects of special teaching methods 2 lesson to teacher candidates in terms of their performances," Procedia-Social and Behavioral Sciences, vol. 1, pp. 2136-2139, 2009.

[10] C. J. Rowles and C. Brigham, "Strategies to promote critical thinking and active learning," Teaching in nursing: A guide for faculty, pp. 283–315, 2005.

[11] E. Sadler-Smith, "'Learning Style': frameworks and instruments," Educational Psychology, vol. 17, pp. 51-63, 1997.

[12] M. A. Salmani Nodoushan, "The Shaffer-Gee perspective: Can epistemic games serve education?," Teaching and Teacher Education, vol. 25, pp. 897-901, 2009.

[13] L. A. Baines and R. Slutsky, "Developing the sixth sense: Play," educational HORIZONS, vol. 87, pp. 97-100, 2009.

[14] M. Csikszentmihalyi, "The domain of creativity," Theories of creativity, vol. 4, pp. 61-91, 1990.

[15] A. Ravenscroft and S. McAlister, "Digital games and learning in cyberspace: A dialogical approach," E-Learning, vol. 3, pp. 37–50, 2006.

[16] B. Meyer, "Serious Games in language learning and teaching-a theoretical perspective," presented at the Proceedings of the 2007 Digital Games research Association, 2007.

[17] M. Yunus, et al., "Motivation in the Learning of Mathematics," European Journal of Social Sciences, vol. 7, pp. 93-101, 2009.

[18] S. B. Merriam, "Andragogy and self directed learning: Pillars of adult learning theory," New Directions for adult and continuing education, vol. 2001, pp. 3-14, 2001.

[19] G. Cunyan, "Adult Educational Philosophy Schools View of Self-directed Learning," Continue Education Research, vol. 6, 2003.

[20] M. Gibbons, "The Self-Directed Learning Handbook: Challenging Adolescent Students to Excel. The Jossey-Bass Education Series," 2002.

[21] S. C. Tan, Shanti, D., Tan, L., & Cheah, H. M. (2011, 20-Aug-2011). Self-Directed Learning with ICT: Theory, Practice and Assessment. Available: Singapore: Ministry of Education. http:ictconnection.edumall.sg/ictconnection/slot/u200/mp3/monographs/self-directed%20learning%20with%20ict.pdf