PERSONALIZED GAMIFIED LEARNING BASED ON LEARNING STYLE

RASHA NAJIB AHMED ABDULLAH ALJABALI

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ABSTRACT

Gamification demonstrates motivation and encouragement that can be gained by people during the use gamified experience. Gamification technology has been successfully applied in several domains including health and fitness, marketing, education and daily activities. It is the strategy to use heterogeneous game elements within non-entertainment context. As Millennial Generation students have dissimilar needs and preferences, the necessity of having personalized learning is increased recently to boost the effectiveness of the educational system. Learning style has attracted researchers to develop a gamified learning with personalization attributes. As Felder-Silverman Learning Style Model (FSLSM) is the most recommended model by researchers, this study aims to investigate the personalized gamified learning based on student's learning style. A Design Science Research approach (DSR) has been adopted to develop a personalized gamified model using 10 game elements and 4 FSLSM dimensions. To evaluate this model, a web-based gamification application prototype has been developed for Data Flow Diagram (DFD) topic within System Analysis and Design course. An experimental study using the prototype has been conducted with 71 undergraduate students from School of Computing, Universiti Teknologi Malaysia (UTM). Participants were divided into two groups: experimental and control. Additionally, the gamification application has two different modes: personalized mode (for experimental group) and non-personalized mode (for control group). Data was collected from the prototype database and perceived usefulness questionnaire. An independent t-test has been used to compare means of scores between groups. Result shows that there is a significant difference between the students' scores within the two groups. Therefore, it was clearly revealed that personalized gamified learning is an effective method in learning process; as well as in boosting student perceived usefulness of the application.

ABSTRAK

Gamification menggambarkan motivasi dan galakan yang boleh diperoleh oleh seseorang ketika menggunakan aplikasi pengalaman gamified. Teknologi *gamification* telah berjaya digunakan dalam beberapa domain termasuk kesihatan dan kecergasan, pemasaran, aktiviti harian, dan pendidikan. Ia adalah strategi yang menggunakan elemen permainan heterogen dalam konteks bukan hiburan. Disebabkan pelajar-pelajar Generasi Milenium mempunyai keperluan dan keutamaan yang berbeza, keperluan kepada pembelajaran *personalized* adalah meningkat kebelakangan ini untuk meningkatkan keberkesanan sistem pendidikan. Gaya pembelajaran telah menarik minat para penyelidik untuk membangunkan *gamified* dengan atribut *personalized*. Oleh kerana Model Gaya Pembelajaran Felder-Silverman (FSLSM) adalah model yang paling disyorkan oleh para penyelidik, kajian ini bertujuan untuk menyiasat pembelajaran *personalized* berdasarkan gaya pembelajaran pelajar. Pendekatan Penyelidikan Sains Reka Bentuk (DSR) telah digunakan untuk membangunkan model pembelajaran *personalized* menggunakan 10 elemen permainan dan 4 dimensi FSLSM. Untuk menilai model ini, prototaip aplikasi gamification berasaskan web dibangunkan bagi tajuk Rajah Aliran Data (DFD) untuk kursus Analisis dan Rekabentuk Sistem. Satu kajian eksperimen menggunakan prototaip telah dijalankan bersama 71 pelajar sarjana muda dari Sekolah Komputeran, Universiti Teknologi Malaysia (UTM). Peserta dibahagikan kepada dua kumpulan: eksperimen dan kawalan. Di samping itu, aplikasi *gamification* mempunyai dua mod berbeza: mod *personalized* (untuk kumpulan eksperimen) dan mod bukan personalized (untuk kumpulan kawalan). Data diperolehi dari pangkalan data aplikasi dan soalan kajiselidik tentang tanggapan kegunaan aplikasi. Ujian t bebas telah digunakan untuk membandingkan purata skor antara kumpulan. Keputusan menunjukkan bahawa terdapat perbezaan skor pelajar yang signifikan dalam kedua-dua kumpulan. Oleh itu, jelas ditunjukkan bahawa pembelajaran *gamified personalized* adalah satu kaedah yang efektif dalam proses pembelajaran; serta meningkatkan tanggapan pelajar terhadap kegunaan aplikasi.

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LIST OF ABBREVIATIONS

DFD	-	Data Flow Diagram
DSRM	-	Design Science Research Methodology
eLearning	-	electronic Learning
GBL	-	Game-Based Learning
ILS	-	Index of Learning Style
ICT	-	Information and Communication Technologies
LSI	-	Learning style Inventory
MOOC	-	Massive Open Online Course
MDE	-	Mechanics, Dynamics, and Emotions
MDA	-	Mechanics Dynamic Aesthetics
MDC	-	Mechanics Dynamic Components
MBTI	-	Myers-Briggs Type-Indicator
PHP	-	PHP: Hypertext Preprocessor
SPSS	-	Statistical Package for the Social Sciences
FSLSM	-	Felder-Silverman Learning Style Model
SDT	-	Self-Determination Theory
SQL	-	Structure Query Language
UTM	-	Universiti Teknologi Malaysia
VLE	-	Virtual Learning Environment
XP	-	Experience Points

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CHAPTER 1

INTRODUCTION

1.1 Study background

Conceptually, gamification is defined as utilizing one or multiple game elements such as points, badges, leaderboard and progress bar in a non-game context. In that vein, gamification can be used as a tool to expand people's participation and involvement to carry out activities that typically could not be fully attractive. The main purpose of gamification is to simulate the engagement and motivation that are found within gamers towards games in a gamified environment. Numerous studies have reported that people could be influenced by gamified systems whether as employees, customers, students, patients etc. (Bunchball, 2010). Therefore, gamification positively influences and motivates people's behavior.

Currently, there is a growing number of the research works in exploring the effectiveness of utilizing gamification in certain areas such as heath, fitness, and marketing (Cai, Dai and Han, 2016; Di Bitonto, Corriero, Pesare, Rossano and Roselli, 2014; Hofacker, de Ruyter, Lurie, Manchanda and Donaldson, 2016). As a result of the optimistic evidence and promising result in the previous domains, practitioners, scholars, and academics have increased their interest in gamification in educational contexts in order to motivate and engage students (Ed and Hutchison, 2014). A variety of empirical researches have proven that gamification strategies have boundless opportunities for improving learning outcomes as traditional learning processes and technologies are no longer as engaging students as they were expected (Shabihi, Taghiyareh and Abdoli, 2016). The recent studies shows a highly positive perception of gamification in the learning process (Aldemir, Celik and Kaplan, 2017). Therefore, some educational institutions tend to adopt gamification technology in the classroom and eLearning systems.

Despite the potential advantages for gamified learning systems, researchers suggested for more pragmatic investigations on the impact of the game elements on not only student's perception , motivation, engagement but also student's performance and self-efficacy. In addition, they recommended studying the game elements effects according to student's personality and learning style (Buckley and Doyle, 2017). The matching between the student's preferences and the appropriate form of instructional intervention is leading to personalized learning. Thus, the personalized learning experience is recommended by researchers to boost the effectiveness of the higher education system. Practically, some extraordinary characteristics such as being confident, team-orientated, goal focused, and socially networked are most popular features of Millennial Generation or Generation Y students. They are considered as being the first digital natives (Buckley and Doyle, 2017). As students from this generation have been wide-open to Information Technology (IT) from birth, introducing personalized and motivating learning is one of the most important issues in the higher education.

Learning style is one of the human factors that gain a great concern from the researchers in order to introduce personalized learning systems that would improve the student's experience (Hwang, Sung, Hung and Huang, 2013). Learning style is the way students perceive and process the information to achieve the course learning outcomes. Although several learning styles models have been developed , one of the most wide-spread learning styles models that has been utilized in many computer-assisted learning applications with its reliability and validity being confirmed is the Felder-Silverman learning style (Soflano, Connolly and Hainey, 2015). Millennial Generation students commonly have diverse characteristics related to the learning style. The differences in learning style influence the individual experiences with a variety of learning environments as a whole and the usage of the learnings tools in particular. The consistency between a student's learning style and the appropriate form of instructional intervention significantly impacts upon the performance of the student and his/her achievement of learning outcomes (Buckley and Doyle, 2017). In one hand, adopting gamification in the higher education is still at an infant stage (Goshevski, Veljanoska and Hatziapostolou, 2017; Huynh, Zuo and B, 2017; Morschheuser, Hassan, Werder and Hamari, 2017). Accordingly, more studies are required regarding a stable and applicable gamified model in the higher education context. Thus, this study aims to

investigate the impact of the corresponding learning style along with suitable game elements on undergraduate students.

1.2 Problem background

Nowadays, Millennial Generation (Dilullo, Mcgee and Kriebel, 2011) or "Generation Y" students have a higher opportunity to join colleges than other generations. As they are exposed to technologies and trends of IT from birth, they are inclined to receive better education technologies (Aviles and Eastman, 2012). Students from Millennial Generation have unique characteristics profile and have heterogeneous personalities, backgrounds and learning styles, which lead to reshaping the higher educational systems (Dilullo *et al.*, 2011). Hence, the changes in the educational systems should be towards convenient, engaging and personalized learning experiences (Dilullo, Mcgee and Kriebel, 2011; Jackson, Cockrill and Dewey, 2017).

eLearning is considered the most widespread information technology that is used to support higher education (Aoki, Kigawa, Nemenzo and Nagata, 2016). By utilizing eLearning, most higher institutions attempt to achieve the expected eLearning goals and objectives, i.e. a high degree of satisfaction, motivation, effectiveness, and efficiency of students (Urh, Vukovic, Jereb and Pintar, 2015). However, some of the eLearning systems lacks in achieving their goals and objectives due to insufficient methods and mechanism for the development of the online information systems (Cakula and Sedleniece, 2013; Urh, Vukovic, Jereb and Pintar, 2015). As a result, the current eLearning systems are ineffective to meet student's needs, expectations and motivations (Soflano, Connolly and Hainey, 2015; Xu, Huang, Wang and Heales, 2014).

However, gamification as a highly prominent potential technology can be used to tackle the problems in higher educations (Ed and Hutchison, 2014; Iosup and Epema, 2014). The growing interests of researchers on gamification is influenced by the engagement and motivation that are provided to students in order to improve learning outcomes (Villagr and Gallego-dur, 2016). Nevertheless, one of the more problematic areas of gamification actually lies in the difficulty in designing gamification mechanics

to encourage an appropriate outcome (Buckley and Doyle, 2017; Butler, 2014). Many game elements can be implemented; however, the impact of these elements could be varied due to the differences in students'learning style (Buckley and Doyle, 2017). In another word, the use of game element is not a one-size-fits-all strategy. Thus, it is essential to identify how certain game elements influence students in terms of their perception and processing the information (Sanmugam, Abdullah, Mohamed, Aris, Zaid and Suhadi, 2016).

This study is resulting from the calls of the researchers to study and answer specific and detailed investigations of the effects of individual game elements (Dichev and Dicheva, 2017; Mora, Riera, González and Arnedo-Moreno, 2017; Nacke and Deterding, 2017; Ricciardi, 2015; Tsay, Kofinas and Luo, 2018). Therefore, this study investigates the relation between gamified learning and student's learning style; which game elements that matches learning style. Adapting gamification according to students'learning style in learning system would be an effective approach to convey the consistent game elements for distinct students'learning style (Hwang, Sung, Hung and Huang, 2013). In other word, personalized gamified learning will lead to increasingly engage students in the field of education and particularly in eLearning system. Accordingly, that would positively affect the effectiveness of learning in general.

1.3 Problem statement

Millennial Generation students have differences in perception and processing information (learning style); however, most eLearning systems do not support these differences. Thus, the learning process is unlikely effective or might be disruptive (Cakula and Sedleniece, 2013; Urh *et al.*, 2015). Millennial Generation students are exposed to the new technologies, so engaging and motivating technology like gamification should be adopted in higher education to fulfill the student's expectation (Jackson *et al.*, 2017). According to Huynh, Zuo and B (2017) recent studies have reported that gamification has heterogeneous game elements that can be implemented in the learning environment, researchers suggested studying the impact of certain game

elements on student based on their learning style (Dichev and Dicheva, 2017).

1.4 Research questions

According to the problem statement, the study seeks to answer the following questions:

i Which game elements suit student's learning style for undergraduate students?

ii What model would be used for personalized gamified learning based on student's learning style?

iii To what extent will the proposed model of personalized gamified learning affect the learning process?

1.5 Research objectives

Hence, the main objectives of this proposed study were to investigate the following:

i To identify the game elements that suit the student's learning style.

ii To propose a model of personalized gamified learning based on student's learning style.

iii To demonstrate and evaluate the proposed model using an experiment to study the effectiveness of the proposed model.

1.6 The significance of study

Malaysian higher education needs to promote learning process by employing the latest trends in pedagogical applications in learning process. Therefore, introducing

gamification in Malaysian Higher Education is considered as a novel concept in terms of this empirical study related to the impact of personalized and gamified learning on student's performance. Consequently, the potential advantages of gamification i.e. increase student engagement, motivate and promote learning and facilitate students in the development of sustainable life skills. In one hand, these benefits will contribute to enhancing the effectiveness of learning activities; as well as, having the engaging learning environment. On the other hand, satisfaction, motivation, and participation are the supportive factors that might affect the learning outcomes. Thus, gamified experiences in the universities will promote these factors positively.

1.7 The scope of the study

The scope of this study was to investigate the impact of personalized gamified learning on the student for undergraduate students of the Faculty of Computing, in Universiti Teknologi Malaysia (UTM). Felder-Silverman Learning Style Model was undertaken in proposing the personalized model.

1.8 The organization of the thesis

This study is structured into six chapters. The report starts with Chapter 1 which addresses the research background, problem, objectives, importance, scope and structure. For the second chapter, the literature discusses the concepts of gamification, personalized learning, learning style and related works. With respect to Chapter 3, it explains the methods that have been used to achieve the study aims. Chapter 4 presents the model development and prototype implementation stage. Next, Chapter 5 explains the evaluation phase including the data collection and analysis phase. Finally, the last chapter of this research is Chapter 6 which comprises a summary of the whole research.

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