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Meaningful Gamification: A Conceptual Model of Discrete Math in a Blended Classroom

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Abstract

Mathematics is embedded our lives in many ways. However, mathematics is often challenging for adult learners to master. The purpose of this paper is to identify problems encountered by the students after using gamification features implemented through Kahoot! questionnaires in a blended mathematic classroom. The gamification process in the study is based on Kevin Werbach's framework for gamification. A qualitative research design using interviews was applied in this study to find out the students' problems in learning after using Kahoot! questionnaires. Ten students were involved in the study and five major problems have been identified. Finally, the study proposed several gamification features to solve the mentioned problems. Future study will focus on implementing the proposed features and design a questionnaire to evaluate the feedback mechanism.

Key words: Mathematics; gamification; Kevin Werbach's framework.

1. Introduction

Mathematics is commonly embedded our lives in many ways. However, mathematics is often challenging for learners to master as demonstrated by the Trends in International Mathematics and Science Study (TIMSS) 2011 report. The report revealed a plummeting trend in the position of Malaysia in the Mathematics subject. Malaysia's ranked fell from 16th (1999) to 10th (2003), 20th (2007) and 26th (2011). Thus, empowering adult learners to learn mathematics, especially when they have encountered low mathematical performance in their past and the only reason to undertake the subject is because it is a prerequisite for obtaining a degree or diploma can be very difficult.

2. The Influence of Learners' Difficulties in Mathematics

Students' preceding negative experiences in learning mathematics could discourage them from choosing careers in STEM (Science, Technology, Engineering, and Mathematics) fields (Petrillo, 2016; Ogden, 2015). In addition, Petrillo (2016) mentioned that more than 40% of engineering students in some universities eventually leave their disciplines mostly because of their underperformance in mathematics courses. In the same stance, 70% of the U.S. college students taking remedial mathematics failed their course and thus could not continue their studies (Weng, 2015).

Difficulty in understanding and retrieving concepts, formula, facts and procedure are among the reasons as to why learners in Malaysia find mathematics difficult (Zahrah, Jamaliah, Rohana, Badariah & Jaafar, 2003). They also lack the ability to visualize mathematical problems and concepts (Tarzimah, 2005). In order to succeed in today's challenging world, the learners require the "21st century skills". Lecturers face the challenge to start shifting from the 20th to 21st century classroom. As such, there is a need to improve the teaching and learning of mathematics.

3. Mathematics & Blended Classroom

The advancements of technology added to the growing interest in the blended classroom approach to mathematics education. Naccarato & Karakok (2015) highlights that this technology-enhanced pedagogy is now frequently used in many undergraduate mathematics and statistics courses. Blended learning is defined by Graham (2013) as the integration of face-to-face and online instruction. Blended learning is generally used because research has found that leaning through this method results in improvement in student success and satisfaction (Dziuban, Hartman, Cavanagh, & Moskal, 2011; Means, Toyama, Murphy, & Baki, 2013) when compared with face-to-face courses.

4. Meaningful Gamification

Gamification refers to the use of various elements from games in non-game contexts (Deterding, Dixon, Khaled, & Nacke, 2011). Gamification has proven to be effective in education as it increased determination and students engagement on tasks like learning. Moreover, students enjoyed themselves during the task. It also can be used as a tool to motivate students and increase their engagement as they need motivation to study and exchange ideas (Elshiekh & Butgerit, 2017).

Nowadays, university students are more exposed to gadgets and games and they are most likely are motivated to learn through them. This is proved by a research done by Kasurinen and Knutas (2018) where they suggested the latest approach to engage students for learning in education domain is through gamification. However, the studies also mentioned that designing features for the game needs more attention because it is not easy to do.

This study aims to discuss on problems encountered after the implementation of a conceptual model that embeds gamification based on Kevin Werbach's framework to a discrete mathematic blended classroom.

5. Research Methodology

The study is based on Kevin Werbach's framework for gamification. According to Werbach's framework, before any gamified application is created, the development must be approached with a game design-like thinking (Werbach, 2012). In addition, Werbach (2014) has categorized these elements as follows:

1. Define objectives
2. Delineate target behaviours
3. Describe your players
4. Devise activity loops
5. Don't forget the fun!
6. Deploy the appropriate tools

Table 1 shows the steps in the framework and the steps being deployed in the blended classroom:

Table 1

Elements	Description and Deployment Steps
Define objectives	Study the nature of discrete math learning objective Steps: 1.Choose the topics that would be utilizing gamification approach. 2.List down all the learning outcomes for the topics.
Delineate target behaviours	Identify gamification elements that suitable to be applied in the learning process 1.The researchers conduct a literature review on the gamification elements to obtain a list of suitable elements. 2.An educational apps known as Kahoot! was used to gamify the classroom.
Describe your players	Understand what sorts of game elements (the Kahoot! questionnaire) and other structures are likely to be effective for this population 1.Conduct the normal class. 2.Conduct the gamified class. 3.Conduct interview to obtain feedback from students.
Devise activity loops	Identify motivation for students engagement and progression loops. 1.Obtain feedback mechanism from the interview session.
Don't forget the fun!	Check to ensure that your gamified system is fun. 1.Conduct a questionnaire to access the feedback mechanism.
Deploy the appropriate tools	Test and evaluate with numerous platform. 1.Use other educational apps.

The qualitative research design using interviews was applied in this study to find out the students' problems in learning after using Kahoot! questionnaires.

6. Finding and Discussion

The following is the findings obtained from the interview session after four weeks of classes. Kahoot! was applied in the discrete maths class as a blended integration to normal class. The lecturer applied the game using Kahoot! questionnaires with different contents according to the syllabus. Consequently, the students still need to attend the theoretical lectures, in which, at the end each lesson, a Kahoot! questionnaires was proposed on the contents addressed as an exercise. All students worked on the exercises but the frequency with which they played the games after the first trial in class depended on them. The interviews were conducted with ten of these students who voluntarily participated; of these 4 were male and 6 were female. Their ages ranged between 19 and 20 years (Table 2).

Table 2 Number and Percentages of Participants by Gender

Gender	n	%
Male	4	40%
Female	6	60%
Total	10	100%

They were asked about their problems in learning this topic during their studies. As a result, five major problems have been identified, as follows:

1. Does not really understand the concept.
2. Have problem in memorizing the concept.
3. Do not know how to apply calculations to real life problem.
4. Easy to lose focus in class.
5. Did not get instant feedback from lecturer for assignment.

These problems occurred consistently among the ten students who have been interviewed. To encounter the learning problems, the researchers then match the listed problems with its nature of discrete math together with its appropriate gamification features. Table 3 shows the selection of gamification features based on problems and nature of discrete math.

Table 3

Problems in learning discrete math	Solution	Gamification features proposed to solve the problem
P1. Does not really understand the concept	Must make them understand the concept clearly	Narrative, Storytelling
P2. Have problem in memorizing the concept.	Help them to memorize the concept.	Narrative, Storytelling
P3. Do not know how to apply calculations to real life problem.	Teach them the steps of calculations using real life scenarios	Levels, Hint, Challenges
P4. Easy to lose focus in class.	Make the students compete for each other	Point, Achievements, Leaderboard
P5. Did not get instant feedback from lecturer for assignment	Provide instant feedback	Feedback

The gamification features chosen to solve P1 and P2 is narrative and storytelling. This is because P1 and P2 are both theoretical problem. Narrative is a storyline in a game and it provides a context for learning and problem solving as well as helps to illustrate the applicability of concepts to real-life (O'Donovan, Gain, & Marais, 2013).

P3 involves integrating both theory and practical knowledge. Therefore, the relationship between both discrete maths and real-life usage need to be considered. Calculation steps will be gamified into level because it is the most suitable game elements for it. This is because according to Crumlish & Malone (2009), levels represent evidence of the whole progress. Consequently, the levels and challenges can be viewed as learning objectives for learners. Thus, if a user is faced with the same challenge, just at a higher difficulty level they might soon lose interest (O'Donovan et al., 2013).

In order to encounter P4, experience point and leaderboard are implemented. A leaderboard shows which users are leading in the gamified activities. Leaderboard can trigger competition between students in the class (Wood & Reiners, 2012). Using experience points is even more attractive than giving the students a grade (Deterding et al. (2011). It provides direct feedback on how successful students are being and also serve as instant gratification, which was previously shown to be successful in motivating college students (Natvig, Line, & Djupdal, 2004).

Instant feedback will be used to encounter P5 as it is important as it give students chance to improve what they did not understand. Feedback is an nformation of user's performance in the game and it can be used for improvement. Students might already forget about what they did not understand in previous class, therefore, an instant feedback from lecturer is needed to make sure students can understand it faster.

7. Conclusion

Kevin Werbach's framework for gamification has helped to identify the problems encountered by the students during the trial phase of this study. One worthy outcome in this phase is that since the students are not forced to use the Kahoot! questionnaire in the learning process, therefore the learning process happens voluntarily. The next step is to implement the proposed features and design a questionnaire to evaluate the feedback mechanism.

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