Acta Pedagogia Asiana

Research Article
Volume 2(2), 2023, 54-63
https://doi.org/10.53623/apga.v2i2.192

Gamification to Improve Participation in an Environmental Science Course: An Educator's Reflection

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SUBMITTED: 15 January 2023; REVISED: 24 January 2023; ACCEPTED: 25 January 2023

ABSTRACT: Reticence prevalent among East Asian students has prompted educators to attempt different methods to engage them. Gamification of courses has gained popularity as an avenue to encourage students' participation, and it is facilitated by the roll-out of diverse online gamification platforms. This study aims to reflect on an educator's experience of incorporating elements of gamification in an environmental science course delivered in a micro-campus established through a Sino-American educational collaboration. Gibb's Reflective Cycle was adopted to guide the reflection practice. Gamification was implemented with three online interactive platforms, namely Poll Everywhere, Kahoot, and Quizizz. Poll Everywhere was mainly used for short polls and activities during lessons, while Kahoot and Quizizz were used for quiz-like competitions whose scores did not contribute to students' grades. Kahoot created a lively atmosphere in class but was constrained by limits on players' numbers, internet control, and the lag between sending and receiving responses. Quizizz had more game elements, which thrilled individual players but was less able to create the lively classroom the educator desired. It was more stable, perhaps because it was less subjected to internet control. Poll Everywhere had a less attractive scoreboard and was more appropriate for short classroom activities. Students' interest in the platforms tended to wane with each repeated use of the platforms. To improve the gamification experience, a mix of platforms could be used, and locally developed platforms could be sourced for stability and diversification.

KEYWORDS: Engage; gamification; Kahoot; Poll Everywhere; Quizizz; reticence

1. Introduction

A common challenge that faces educators in East Asia is the reticence and passivity of students in class. Educators frequently reported silence from students when questions were posed. Similarly, when East Asian students are asked if they have any questions, it is frequently followed by a long waiting time [1]. The degree of reticence and passivity may differ among students of East Asia geographically and culturally, but these traits are generally more frequently observed among East Asian students than non-East Asian students. Studies have indicated that reticence is especially prevalent among Chinese students [2, 3].

Reticence has been interchangeably used with passivity to define the reservation and shyness that prevent students from engaging in class [4]. However, passivity might be an overarching trait that encompasses numerous sub-traits, including reticence. Students' passivity could be a

result of passive learning, which is frequently characterized by a one-way flow of information from instructors to students, and students are expected to internalize the information without actively participating in the learning process [5]. It might also stem from a lack of motivation to learn, which is demonstrated by detachment from classroom activities, frequent distraction, and disinterest [6]. In line with this, a reticent student may not necessarily be unmotivated to learn, and such reticence does not fully explain the passivity of a student. Students have been observed to take notes and listen attentively, but they tend to restrain from asking questions, answering questions posed, or providing their comments [7].

It is thought that sociocultural influence has a big role in students' reticence. The "face culture" prevalent among Chinese students is a deterrent to in-class participation since students are concerned about losing face in front of their classmates when they get the answers wrong [2]. Besides, reticence is associated with the influence of 'Confucianism' among East Asian students that emphasizes the respect for hierarchy, leading to the reticence in class as a sign of respect for teachers and the fear that making comments and asking questions could be interpreted as disrespect. These might have prevented students from speaking up, providing opinions, commenting, and asking questions [8]. However, the reservation of students to express themselves in class has been perceived as a lack of critical thinking and originality, hence the misconception on the constraining influence of Confucianism on critical and creative thinking [9].

The rise of gamification in learning has provided an invaluable avenue to address reticence and even the overarching passivity among learners, as gamification makes learning more interactive and interesting through games aiming to consolidate students' understanding of a subject matter [10]. Many gamification and interactive platforms are now at the disposal of educators. Popular gamification platforms, such as Kahoot, have been widely used in classrooms to create a fun learning environment while engaging learners in purposeful games and interactions [11]. It was claimed that gamification allows students to take on an active role during which they are motivated or compelled to put in continuous effort to achieve the aims of the educational games [12]. Gamification platforms often provide continuous feedback, which permits students to reflect on or get hints for course contents. Furthermore, gamification enables educators to review course contents in a light-hearted manner and to continuously gauge students' understanding of the course contents [13]. Gamification platforms invariably come with analytic functions that highlight the questions or concepts that students tend to make mistakes on. This facilitates the quick recognition of the misconceptions among students by educators for timely feedback and corrections [14].

However, the application of gamification might not be equally effective under all circumstances because gamification platforms are nuanced in their designs and they rely on internet connectivity [15]. Internet access and regulation differ geographically, thus affecting the accessibility of and response time of gamification platforms. In China, for instance, strict internet regulation may decrease the performance of certain gamification platforms, thus decreasing their effectiveness in delivering the desired interactions [16]. Gamification has been employed in teaching and learning in China as well as other regions, especially when online classes were resorted to during the implementation of COVID-19 restrictions [17, 18]. However, the responses to learning gamification were mixed. A study found gamification was able to create an environment where college students in an English Listening and Speaking class felt at ease to engage and move along with the learning goals, but complicated game

designs could be a drawback. Besides, gamification did not provide a one-size-fits-all solution to the different challenges they faced in learning English, and the beneficial effect was minimal in addressing anxiety arising from introversion or a lack of preparation [10]. Another study revealed gamification employed in a college technology course was successful in improving evaluation indexes year over year [19].

Gamification may take on different forms on the continuum, from heavy course gamification, with an entire course designed to include substantial gamification during which students collect points or rewards in games embedded throughout the course, to light course gamification, where gamification is applied for certain aspects of a course as an auxiliary [19, 20]. At any point on the continuum, gamification relies heavily on interactive online platforms. Some platforms are specifically designed for gamification purposes, while others are pulled together by educators in gamifying courses [19, 21]. While course gamification has gained popularity in China, there are not many studies that reflect on such gamification experiences. Most of the extant studies in this domain seem to focus on foreign language courses [22, 23]. This reflection, therefore, aims to evaluate the effectiveness of different gamification platforms used in the delivery of an environmental science course called Pollution Science from an educator's viewpoint and observations. It aims to provide recommendations for better deployment of the platforms to optimize the outcomes of gamification in the course.

2. Methods

A course called Pollution Science has been designed and delivered in the fall semester of 2022. The course was taught in English on the microcampus of an American university in China, mainly via face-to-face mode. Some classes were conducted online in the semester in line with the regional COVID-19 control policy [24]. The course covered the following contents: 1) introduction to global pollution; 2) risk assessment related to pollution; 3) pollution of the atmosphere, surface water, soil, and land; 4) physical, chemical, and biological processes affecting the fate and transport of contaminants; and 5) remediation of pollution. Assessments of the course comprised formative quizzes, written assignments, presentation and a final exam [25, 26]. Gamification was incorporated into the course to review the course contents, identify the common misconceptions of students, and get them to engage.

Gamification was conducted with three major online gamification platforms, namely Kahoot, Poll Everywhere, and Quizizz. Kahoot and Quizizz were used to engage students in quiz-like competitions, whereas Poll Everywhere was used to gauge students' understanding and facilitate brainstorming during course delivery since it enabled polling to be conducted in between lessons. The three platforms have been chosen because they are widely used to promote students' interaction in lessons and have desirable features for course gamification such as enabling friendly competitions, awarding high-scoring players, conducting polls, and analyzing responses. Besides, they provide alternatives for free and paid versions that users could choose according to their needs [27, 28]. Poll Everywhere was occasional used for quiz-like competitions for a change in gamified learning experience. The quizzes delivered through these platforms did not contribute to the assessment marks. The formats of questions in the quizzes mainly comprised fill-in-the-blanks, multiple-choice, as well as true-or-false.

A qualitative reflective approach was adopted to evaluate the effectiveness of the platforms for gamification of Pollution Science. The Gibbs' Reflective Cycle is popularly used to guide reflective practices by examining certain experiences in a structured manner to permit

continuous improvement of the experiences due to its cyclic nature (Figure 1) [29]. Gibbs' Reflective Cycle is an established qualitative instrument that systematically and uncomplicatedly guides reflections. It has clearly defined components that significantly facilitate reflective practices [30]. It consists of six cyclical elements. In relation to this study, it started with the description of what took place in the class with the implementation of gamification, followed by the thoughts and feelings about those events (Figure 1) [29]. Subsequently, evaluation of the good and bad experiences was made, and, in this study, it was from the educator's perspective. This was followed by an analysis of the events and experiences during the implementation of gamification, particularly in drawing inferences as to the reasons behind the good and bad experiences [31]. From this, conclusions on the lessons learned and recommendations for further improvement were made. The reflection ended with action plans for the challenges encountered that led to the negative experiences of gamification. They aimed to improve the future experience of the learners. The narration of the events that took place is already provided in this section. The subsequent section focuses on the other stages of Gibb's Reflective Cycle.

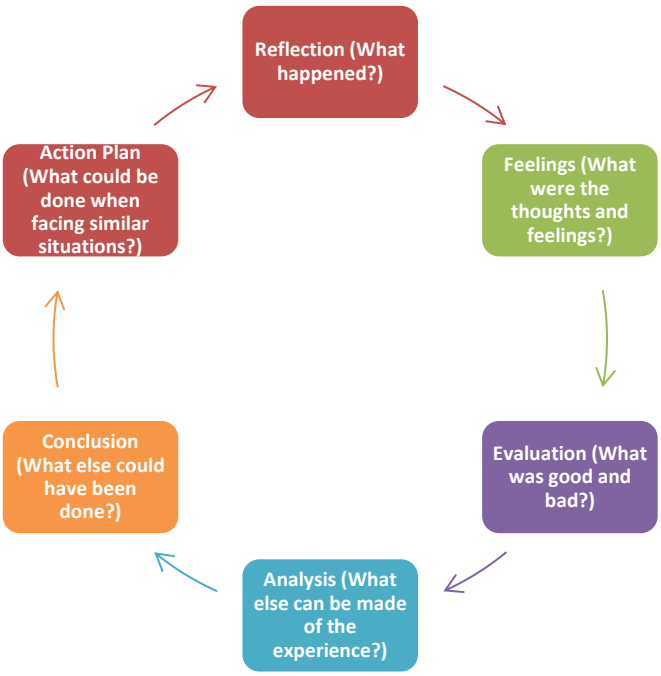

Figure 1. Gibbs' reflective cycle.

3. Results and Discussion

3.1. Feelings.

The gamification of certain parts of the course produced a positive vibe in the class. In this particular setting, the learners felt it was something new, as they had never been exposed to these platforms before. This implies that the conventional model of teaching and learning characterized by passive lectures and a largely one-directional flow of information from educators to learners is still prevalent in education in China, including tertiary education [32]. It was observed that there was curiosity in the platforms; for instance, during the use of the word cloud in Poll Everywhere, learners experimented with the word input to change the word cloud, and it pointed to a good level of engagement occurring. As with Kahoot, learners were

observed to be excited about getting the answers correct within a short timeframe to move up the scoreboard. Learners were attentive to the questions posed and the time to answer the questions. The atmosphere was relaxing yet full of thrills as the learners attempted the questions in an interactive manner, knowing that these attempts did not contribute to their assessment scores. This is in line with the previous findings that gamification positively impacts classroom dynamics and learning engagement [11].

When Quizizz was used, the classroom was not as lively as that of Kahoot. There was a moment of silence in the beginning as the learners were figuring out how to use it. There was a scoreboard that was displayed in front of the class, but the game was designed to be played individually, with the learners being able to see the rank changes on the scoreboard. While not as animated as Kahoot, learners seemed to be absorbed in the game once they got a hold of it, and there was individual excitement that was not shared since the layouts of the game differed among individuals even though the questions were the same. Poll Everywhere was used mainly for testing students' preconceptions and understanding, as the platform has the advantage of allowing short polls and questions to be inserted when class is conducted. This created variation from the monotony of physical question-and-answer as well as lecturing, which the students seemed to appreciate, and it gave them breaks from the constant receiving of information while permitting them to think about the questions posed. An attempt at using the quiz gamification function of Poll Everywhere was made when classes were temporarily shifted online, but it did not seem to generate the lively atmosphere desired, probably due to the online nature of the classes or the inherent design of the platform.

From the educator's viewpoint, the use of gamification platforms was satisfying as it imparted liveliness to the classroom, particularly when Kahoot was used. Upon the introduction of Quizizz, the responses from the students were welcoming, with the majority of the students preferring it over Kahoot, though it did not give the satisfaction of cheering up the entire class that an educator might look for. The reason was that Quizizz was designed to be more game-like, where the learners could be prompted with a selection of treasures, for instance, to enable the doubling or tripling of scores upon answering a question. In other words, there are more game elements to it besides getting the correct answers in the shortest possible time. However, such excitements are often confined to the individual players. In view of this, there is likely to be a dissonance between what the educator and what the students perceived as an ideal atmosphere that gamification should bring [33]. Either way, such an atmosphere was more prevalent with Kahoot and Quizizz than with the similar function of Poll Everywhere, and for physical classes than for online classes. With repeated use of the platforms, the excitement seemed to wane, though students still participated.

3.2. Evaluation and analysis.

The evaluation and analysis are presented in Table 1 to enable a clearer presentation of the elements associated with these two stages. Based on Table 1, it can be seen that Kahoot was better at bringing about a lively physical class in comparison to Quizizz and the gamification function of Poll Everywhere, probably because it permitted all students to compete over the same questions within a limited timeframe, thus creating an excitement of competition to answer each question correctly in the shortest possible time. However, there were problems encountered, such as the lag in the responses sent by players and received by the system, the stalling of the games, and the expulsion of players while the games were in progress, which

might be caused by the regional internet regulation. The performance of the platform therefore tended to vary with the strictness of internet regulation at different timepoints.

Table 1. The evaluation and analysis of gamification experiences with different platforms.

	Kahoot	Quizizz	Poll Everywhere
Evaluation			
Good experience	It made classroom lively with clear gestures of anticipation. There was a clear sign of participation and interaction.	Most players were able to join the games and there were fewer players who found their games stalled after joining. Players were observed to focus on the games once started. Participation in the games was good and it permitted a larger pool of players to join.	The use of short polling alongside lessons broke monotony while creating rooms for interactions. A large pool of players was allowed for its gamification function.
Not-so-good experience	Not all players could join the games. Some players found their games stalled along the way and they could not proceed to complete them. Some players were not able to join the games from the beginning. There was a lag in between responses sent by the players and those received by the system and this rendered the timer not so useful. There was a stringent limit on the number of players for free version.	It did not create the lively effect anticipated by the educator. Time was needed for players to understand how the games worked.	Players needed to manually enter a link to join the games instead of just scanning the QR codes. The link might not work for some players. Therefore, not everyone could participate. The gamification function did not create a lively atmosphere in an online session.
Analysis			
The reasons for good experience	The design of the games created anticipation. The scoreboard was well designed showing players the high scorers and those making good progress. The scores were awarded based on the time taken to provide the correct answers. As such, the scoreboard was dynamic. All players attempted the same questions in the same sequence, which were publicly displayed. The feedback for each question was immediately provided after the time was up followed by the updated scoreboard.	The design of games had many interesting elements. Joining and staying in the games were relatively more stable probably because this platform was created in India, which makes it less subjected to regional internet control. Players could complete the games at a more flexible individual pace. The scoreboard was well-designed to show dynamic changes in ranks. A larger group of players was allowed.	The gamification function enabled players to join at any point of time during the games. Scores were awarded based on the time taken to provide the correct answers. As such, the scoreboard was dynamic. All players attempted the same questions in the same sequence, which were publicly displayed. The feedback for each question was immediately provided after the time was up followed by the updated scoreboard. A larger group of players was allowed.
The reasons for not-so-good experience	The free version limited the number of players that could join each game. The use could be constrained by the regional internet regulation, resulting in lagging, stalling and expulsion of players.	Gamification experience could be different for different players as they might get different game elements and sequences of questions. This led to greater individual focus on the games.	The scoreboard lacked interesting features. The link to join the games might not work for certain players owing probably to regional internet regulation. This platform was used during an online class, which might limit classroom vigor.

In contrast to Kahoot, Quizizz seemed to allow the players to join and stay in the game more smoothly, probably because there was less regulation on its activities. The gamification design of Quizizz is fundamentally different from Kahoot and Poll Everywhere in that different players might have different game experiences because they might get different game elements and sequences of questions. In this manner, Quizizz was better at engaging individual players in the games than the entire class via an open competition where everyone competed to answer the same questions correctly in the shortest possible time. The scoreboard changed regularly as players played their games individually, as with Kahoot and Poll Everywhere, but there was a lack of classroom liveliness that the educator looked for. Quizizz was challenging in the beginning, but once the players understood the mechanisms, they accepted it very well, perhaps better than Kahoot. The same was reported by Basuki and Hidayati, who found that Quizizz was better able to arouse students' interest in learning [27].

Poll Everywhere was used when classes were shifted online as an alternative to Kahoot, whose free version imposes a strict limit on the number of players allowed. The design was less attractive than Kahoot and Quizizz since gamification is only one of the many functions of Poll Everywhere. Similar to Kahoot, some students were not able to join the games using the link provided, and that could also be due to regional internet regulation. Gamification with the platform did not create the animated environment desired, and one of the reasons is likely because it was implemented in an online class. Generally, students perceive online classes to be challenging, as they tend to get distracted more easily, and internet connectivity fluctuates [34]. The latter might have limited the responsiveness of the platform. However, the short polls and questions on Poll Everywhere added to the lessons were useful to regain students' focus and attention while garnering their participation [35].

4. Conclusions and Action Plans

Gamification could be perceived as an effective way to break students' reticence in class as it could engage them through games without the need to speak up. The gamification experience with different platforms has conferred valuable lessons, particularly in terms of which platforms worked best in different situations. Poll Everywhere worked well for short activities interspersed in lessons. With the current regional internet regulation and the limit on the number of players, the ability of Kahoot to function optimally has been greatly constrained, and it is uncertain if it can work consistently and reliably every time a game is held. Quizizz has, by far, performed stably under the regional challenge and has been welcomed by students, though it seems less able to generate an animated classroom. Gamification relies heavily on educators to thoughtfully include interactive elements into classes, and this requires much time and effort. Another important lesson is to look for alternative platforms developed in China that are comparable to Kahoot and Poll Everywhere since locally developed platforms tend to perform more stably under the regional internet regulation. The interest of students in the gamification platforms waned with each repeated use, and it might be crucial to explore different platforms that could work successfully in China. The use of a mix of platforms is always better than one single platform since each platform is better suited for a certain setting or purpose.

As such, the action plans encompass the followings:

- Continue using Poll Everywhere for short interactions in lessons.
- Continue using Quizizz to gamify the review of course contents.

- Search for an alternative, locally developed platform comparable to Kahoot.
- Search for other locally developed gamification platforms for more diverse experiences with gamification.
- Use a mix of platforms for optimal gamification experiences.
- Dedicate time to gamify more components of the course.

Acknowledgments

The author wishes to thank the University of Arizona at Northwest A&F University, Yangling, China, for the support provided in completing the reflection.

Competing Interest

No competing interest has been identified.

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