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How do students learn in a low-tech gamified flipped learning model? A self-determination theory perspective

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ABSTRACT

This is a preliminary study aimed at examining students' learning performance and perceived motivation between flipped-classroom and gamified flipped classroom instruction in a low-tech information environment. The iSpring Learn LMS was employed as a low-tech tool in gamifying the flipped classroom. This study employed a quantitative research approach, using three formative assessments or a post-test only design to examine students' learning achievement. A questionnaire was employed to support the data collection process in terms of students' perceived motivation based on Self-determination theory approach. Fifty-six students were the respondents involved in a non-randomized experiment with a control group design. The results reveal that assessment 1 showed no significant difference between the two groups of instruction ($t = 1.68$, $p > .05$), while assessment 2 and 3 were significantly different ($t = 5.54$, $p < .05$) and ($t = 10.17$, $p < .05$), respectively. The survey results reveal that the gamified flip-class setting fostered better motivation and engagement. Particularly, students motivated to compete and beat other students during the gamification activities by collecting points and badges as many as possible. This study suggests that the flipped classroom and gamification concept might be possibly implemented in a low-tech information environment - without the requirement of advanced digital platforms.

KEYWORDS

Gamification, flipped classroom, gamified flipped classroom, self-determination theory, motivation, low-tech information environment

INTRODUCTION

The term 'gamified flipped classroom' is derived from the combination of gamification concept and flipped classroom instruction. Gamification is defined as the use of game elements in non-game activities. Baxter and Wood (2016) define gamification as the use of game-based elements or game mechanics, such as points, badges, or leaderboards to enhance people's interest and motivation through competition. The game elements or mechanics can be applied in various forms, including achievement badges, avatars, boss fights, collections, content unlocking, gifting, leaderboards, level progressions, point systems, quests, social graphs, teams' groups, and virtual goods (Buckley & Doyle, 2017). Furthermore, the flipped classroom is often defined as an instructional strategy and a part of blended learning instruction, where the students understand and comprehend the instructional contents before attending class by watching video-recorded lectures (Blau & Shamir-Inbal, 2017). The gamified flipped classroom in this study means that some game-based elements (e.g., scores, points, badges, and leaderboards) were incorporated into the flipped classroom practice through an online gamification quiz. Thus, students in this study not only watched the pre-class video lectures outside of the class, but also they were required to complete a gamification LMS quiz with questions related to these videos and compete to earn scores, points, and badges. The quiz and game-elements were distributed through a low-tech platform called iSpring Learn LMS (https://www.ispringsolutions.com/ispring-learn). This activity is expected to motivate students to watch and understand the pre-class materials before attending class.

SELF-DETERMINATION THEORY

Students' learning motivation in this study is discussed based a self-determination theory approach. In this theory, motivation is distinguished into extrinsic and intrinsic motivation and both of them play a crucial role in promoting students' engagement and learning performance (Abeysekera & Dawson, 2014). The SDT is a motivational theory that offers provisions that improve a student's sense of autonomy, competence, and relatedness, which is supported by the internal factor of motivation or the so-called intrinsic motivation (Ryan, Rigby, & Przybylski, 2006). Therefore, in this study, students who have three main intrinsic needs in their study are considered as intrinsically motivated students. Based on the above discussion, this study aimed at examining students' learning performance and students' perceived motivation, which focuses on three intrinsic needs of competence, autonomy, and relatedness, between gamified flipped classroom instruction and a non-gamified classroom instructional model. Given the aim of this study, two research objectives were formulated to operationalize the targeted goals of this study: (1) to examine students' learning achievement between gamified flipped classroom and non-gamified flipped classroom through the intervention process; and (2) to identify students' perceived levels of competence, autonomy and relatedness between the two groups of intervention.

METHODOLOGY

This study employed a quantitative research design where the data were collected through post-tests quasi-experimental design (formative assessment) and questionnaire surveys. This methodology made conceptual sense to investigate the gamified flipped model of instruction implemented in the science course for secondary school in Indonesia. The participants of this study comprised 56 students selected from two different science classes, 27 students from the gamified flipped class and 29 from just flipped class. Their ages span between 15 and 16 years of age. All 56 students completed the survey questionnaires.

Procedure of data collection

Both gamified flipped-class and flipped classroom were taught once a week (100 minutes) with the same content and instructor. The gamified flipped class was selected as the experimental group, while the non-gamified flipped class was the control group. Students of the gamified flipped class learned by watching educational video lectures from home and later reconvened in the classroom to participate in face-to-face classroom activities, group discussions, and student presentations. Besides, outside of the class, the students in the gamified flipped classroom were also required to answer several quiz questions on the LMS gamification system, related to the pre-class materials. Through this online gamification system, the students were able to compete to earn as many points and badges as possible. In this study, several YouTube video lectures were also uploaded on the LMS for students' learning outside of the class. After watching videos, the students attempted to answer the e-quiz question on this LMS, earn points and badges and track their achievement progress on the leaderboard. So, the more the students accessed and passed the quizzes, the more they received the points and the more they won many badges. Furthermore, for the instruction given to a flipped class was quite similar to that of the gamified-class, but without the online gamification quiz outside of the class time. The students in this control group were only required to watch the video lectures before class, take a note and come to class prepared with a paper-based quiz and discussion activity.

Data collection and analysis

This research was carried out over a period of 12 weeks in the first academic semester (2017/2018). The intervention activities were administered from week 1-11, including eight topics with three post-tests (formative assessments), to examine the students' learning performance. 20 questions provided to each post-test with a score of 5 for each correct answer and the highest score was 100. The last week (week 12) was used to distribute the questionnaire survey to all students in this study. As this analysis attempts to identify and compare students' learning performance and perceived motivation between the two groups (gamified flipped classroom and flipped classroom), the independent sample *t*-test was operationalized with a significant level of 0.05 (2-tailed).

RESULTS

Experimental post-tests

Three experimental post-tests were repeatedly conducted over three months, as an instructional intervention, to examine and compare students' learning performance between the gamified flipped classroom (experimental group) and flipped classroom (control group). The post-tests were based on continued formative assessments with a maximum score was 100. Table 2 reveals the *t*-test scores of the two groups, showing the differences in students' learning achievement for both classroom models. For post-test 1, the independent sample *t*-test reported that there were no significant differences between the two groups ($t = .76$, $p > .05$). However, the second post-test reported significant differences between the scores of the two groups ($t = 2.97$, $p < .05$). This implied that students' academic performance in the gamified flipped class, for the second post-test, was better than that of the flipped class. As for the third post-test, it was reported that there were also significant differences found between the scores of the two groups ($t = .64$, $p < .05$). These results implied that students' academic performance in the gamified flipped class for the third post-test was much better than that of the flipped classroom. Significant differences in the mean scores of post-tests 2 and 3 were found among the two groups, but not in that of post-test 1. This might be partly due to the fact that, at the beginning of the intervention, none of the students in the two groups were familiar with a new instruction and initial assessment. On the other hand, the two subsequent post-tests were reported significant differences due to an iterative instructional cycle or formative assessment received by the students.

	Groups	*n*	*M*	*SD*	*t*	*p*
Post-test 1	Gamified flipped-class	27	71.67	7.60	.76	.45
	Flipped classroom	29	69.66	11.60		
Post-test 2	Gamified flipped-class	27	77.03	5.60	2.97	.005*
	Flipped classroom	29	70	11.10		
Post-test 3	Gamified flipped-class	27	88.15	75.34	.64	.000*
	Flipped classroom	29	9.42	10		

Table 2. Descriptive statistics and independent samples *t*-test results to compare students' academic achievement in the gamified flip-class and non-gamified flipped-class

*$p < .05$

Survey questionnaires

A 15-item survey questionnaire was employed to identify students' perceived levels of competence, autonomy and relatedness in between the two groups. Five items were employed to identify each intrinsic need. The *t*-test was then used to compare the two groups.

Perceived competence

Table 3 depicts that the mean scores of the gamified flipped class in item 1 were $M = 4.08$, $SD = .062$, but the flipped classroom was $M = 3.87$, $SD = .581$. The results implied that the there was no a significant difference ($t = 1.33$, $p = 1.90$, $p > .05$) between the groups regarding students' perceived competence in terms of class performance. The mean score results of Item 2 implied that students from the gamified flipped classroom ($M = 4.22$, $SD = .698$) were more competent to manage their own learning as compared to the flipped classroom ($M = 3.76$, $SD = .872$). The *t*-test results further indicate a significant difference between the two groups ($t = 2.19$, $p = .033$, $p < .05$). The results of item 3 implied that most students in the gamified flipped class were more capable in using technology as compared to another class ($t = 2.48$, $p = .016$, $p < .05$).

Items	Groups	*n*	*M*	*SD*	*t*	*p*
1	Gamified flipped-class	27	4.08	.062	1.33	.190
	Flipped classroom	29	3.87	.581		
2	Gamified flipped-class	27	4.22	.698	2.19	.033*
	Flipped classroom	29	3.76	.872		
3	Gamified flipped-class	27	4.37	.741	2.48	.016*
	Flipped classroom	29	3.86	.790		
4	Gamified flipped-class	27	4.30	.724	2.43	.018*
	Flipped classroom	29	3.80	.819		
5	Gamified flipped-class	27	4.30	.724	2.14	.037*
	Flipped classroom	29	3.87	.790		

Table 3. Descriptive statistics and independent samples *t*-test results for comparing students' learning competence in the gamified flipped classroom and non-gamified flipped-class (5-point Likert, strongly disagree – strongly agree)
*$p < .05$

For Item 4, the results implied that students of the gamified flipped class were more competent in asking critical questions as compared to another class ($t = 2.43$, $p = .018$, $p < .05$). Based on this finding, it can be assumed that watching video lessons out of class allowed students to grasp a gist of the lesson before attending class and prepared for critical questions. Furthermore, in line with the previous item, the mean scores of the fifth item implied that students of the gamified flipped class ($M = 4.30$, $SD = .724$) were more critical thinking skills than that of the flipped classroom ($M = 3.87$, $SD = .790$). The *t*-test also indicated a significant difference between the two groups ($t = 2.14$, $p = .037$, $p < .05$).

Perceived autonomy

Table 4 summarizes the differences in students' perceived autonomy based on SDT. The Table depicts that students from both groups show positive responses towards learning autonomy. However, the mean score results of all Items (6-10) reports were significantly different. For instance, the results of Item 7 implied that most students in the gamified flipped ($M = 4.56$, $SD = .578$ were able to control their learning environment by working when it was convenient for them. The *t*-test result also shows a significant difference with another group ($t = .83$, p = .004, $p < .05$). This suggests that students in the gamified flipped classroom were able to study outside of the classroom, at their own pace, time, and place. For Item 9, the result shows that the students in the gamified classroom were more autonomy to control their own learning speed when outside of the classroom ($t = .29$, $p = .001$, $p < .05$). This Item implied that students in the gamified flipped classroom were able to stop, pause, *fast*-forward, or rewind the lectures at any time, or re-watch as many times as needed. Finally, Item 10 implied that students of the gamified flipped class had improved an intrinsic motivation in terms of better management and control of learning time.

Items	Groups	*N*	*M*	*SD*	*t*	*p*
6	Gamified flipped-class	27	4.52	.580	.086	.024*
	Flipped class	29	4.18	.540		
7	Gamified flipped-class	27	4.56	.578	.083	.004*
	Flipped class	29	4.10	.557		
8	Gamified flipped-class	27	4.52	.580	.029	.012*
	Flipped class	29	4.14	.516		
9	Gamified flipped-class	27	4.63	.565	.113	.001*
	Flipped class	29	4.14	.516		
10	Gamified flipped-class	27	4.60	.572	.064	.003*
	Flipped class	29	4.18	.516		

Table 4. Descriptive statistics and independent samples *t*-test results for comparing students' learning autonomy in the gamified flipped classroom and non-gamified flipped-class (5-point Likert, strongly disagree – strongly agree)
*$p < .05$

Perceived relatedness

Unlike the previous analysis (competence and autonomy), Table 5 depicts that only Item 11 shows a significant different between the gamified-flipped class and the flipped classroom with $t = 3.84$, $p = .000$, $p < .05$. This Item implied that the students in the experimental group were able to interact with peers both in the class and outside of the class. Whereas students in the

control group can be implied that they have a difficulty to interact with peers after the class hours due to a limited technological platform used for online interaction. Furthermore, although the gamified flip-class shows higher Mean score for the Items 12 to 15, there were no significant different responses between the two groups. All items were asked about students' in-class experiences such as classroom discussion, working in a group, and stimulate critical thinking skills. It can be viewed a very small difference between two means for each item. For instance, Item 13 shows that Mean score of the first group was M = 4.11, SD = .751 while the second group was M = 3.86, SD = .441.

Items	Groups	*N*	*M*	*SD*	*t*	*p*
11	Gamified flipped-class	27	4.19	.622	3.84	.000*
	Flipped-class	29	3.48	.738		
12	Gamified flipped-class	27	4.19	.622	1.46	.149
	Flipped-class	29	4	.267		
13	Gamified flipped-class	27	4.11	.751	1.53	.133
	Flipped-class	29	3.86	.441		
14	Gamified flipped-class	27	4.19	.622	1.75	.086
	Flipped-class	29	3.93	.458		
15	Gamified flipped-class	27	4.26	.447	1.64	.106
	Flipped-class	29	4.03	.566		

Table 5. Descriptive statistics and independent samples *t*-test results for comparing students' relatedness in the gamified flipped classroom and non-gamified flipped-class (5-point Likert, strongly disagree – strongly agree)
*p < .05

CONCLUDING DISCUSSION

This study was conducted to compare the impact of students' learning performance between the gamified flipped-class and flipped classroom with a low-tech gamification platform. In terms of students' learning performance, the result of students' post-tests shows that students' scores in the gamified flip-class environment were higher than that of students in the non-gamified flipped class, particularly in the second and third post-test. Accordingly, the questionnaire survey also reveals that students' in the gamified flipped-class were much better in their competency than that of the non-gamified flipped class. The fact shows that the mean scores of most items of students' competence beliefs are higher than that of the non-gamified flipped class. Students in the gamified flipped-class showed more competent in learning and mastering new skills either in the classroom or outside of the class. The result of this study can be implied that students felt more competent as they had more opportunities to take ownership of their learning, as they could prepare and learn pre-class lessons at home before attending the class, as well as competing toward the gamified quiz activities. These out-of-class activities enabled students to understand the subject better because of having prepared before attending class. The findings are coherent with that of Sams and Bergmann (2013), whereby students of flipped classes revealed that they felt more confident and competent engaging in classroom activities because they were prepared before coming to class. According to Deci and Ryan (2002), individuals were more intrinsically motivated when they engaged and interacted in group activities.

Besides students' competent, the gamified flipped-class approach also supported students' learning need for autonomy. This instruction had successfully integrated a flexible learning environment, established student-centered learning, developed autonomous learners, and critical thinkers. They also were able to study outside of the classroom at their own pace; more enjoyable and pleasurable to do the work at their own time and place. Students were also able to control their own learning speed during watching pre-class video lectures; play, stop, pause, fast-forward, or rewind the lectures at any time, or re-watch as many times as needed. This finding is coherent with Keengwe and Hussein (2014) who found that innovative instructional practices used in the teaching reinforced students autonomous learning and improved their motivation. Various studies have sought to determine the benefits that the flipped classroom and gamification model have on learners' autonomy. Hung (2015) found that the flipped learning approach introduced in classrooms improved the learners' academic performance, learning attitudes and their participation levels. In terms of learning autonomy, interactive activities in the flip-class setting gave learners the opportunity to practice and make better progress with their communication skills, and this in turn can have a positive impact on their motivation. In terms of relatedness, students believed that they learnt something new through their gamified flipped classroom experience. It was a simple free technological platform (iSpring Learn LMS) for them to exchange information online with peers and their instructor, and develop themselves in the areas of critical thinking. This finding is coherent with the previous studies that the flipped-class instruction model success-fully enhanced and promoted peer interaction in students' learning (e.g., Chang & Wei, 2016; Kim, Kim, Khera, & Getman, 2014; Wang, 2017).

Meanwhile, the incorporating gamified activity into the flipped classroom shows that students' social engagement was not only related to students-peer interaction through online platform or during classroom discussion, but also engaged in the gamified activities. This means that the gamified instruction enables students to also interact with peers through a competition. Students might be able to compete with other students like playing a game in order to achieve high points and get badges. This finding is coherent with Chang and Wei (2016) that team leaderboards enhanced learner-learner interaction through a competition. Various studies have sought to determine the benefits that the flipped classroom model has on learners' autonomy. Therefore, this study summarized that the implementation of the gamified flip class model has successfully achieved students' three intrinsic needs, namely, competence, autonomy, and relatedness.

We believe that by merging a gamification concept into the flipped classroom practice, the so-called gamified flipped classroom can be a novelty and contemporary model of flipped classroom instruction. In this proposed model, students will develop and deepen their understanding about the pre-class contents (e.g., videos and books) by answering gamified quiz questions and compete with each other to get game elements such as badges, avatars, boss fights, collections, content unlocking, gifting, leaderboards, level progressions, point systems, quests, social graphs, teams groups, and virtual goods. Finally, this study suggests that the flipped classroom and gamification concept might be effective in promoting the 21st-century learning skills in a low-tech information environment, and the implementation is not bounded by advanced technological platforms/ designs.

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