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Engaged Cohorts: Can Gamification Engage All College Students in Class?

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ABSTRACT
Many gamification designs in education do effectively mobilize students to some extent. Yet, there is still very little research to account for the specific influence on each student. It is essential to determine whether the students can be engaged by gamification in terms of various psychological factors. In this paper, the game element point was chosen to design the experiment. The experiments were used to engage students to ask more questions in class. The results indicated that gamified designs were effective in engaging people who were bashful or distracted. In addition, students were engaged more easily in social circumstances through a comparison of individual and social interactions. This research provides fertile ground for further gamification designs in education.
Keywords: student engagement, gamification, education, psychological profiles

INTRODUCTION

Many attempts of gamification of students' engagement have been made in education (Dondlinger, 2007; Morris, Croker, Zimmerman, Gill, & Romig, 2013; Stott & Neustaedter, 2013; De-Marcos, Domínguez, Saenz-de-Navarrete & Pagés, 2014; Ibáñez, Di-Serio, A., & Delgado-Kloos, 2014; Nolan, & McBride, 2014; Dicheva, Dichev, Agre, & Angelova, 2015; Su, & Cheng, 2015; Seaborn, & Fels, 2015; Hanus, & Fox, 2015; Buckley, & Doyle, 2016; Fleischmann, & Ariel, 2016) . The crucial step within such an endeavor is to precisely use game achievements to present orientation information in an engaging way and eventually encourage the use of applications (Iosup & Epema, 2014). For example, some researchers used points as a gamification element to discover different effects between adults and middle school students (Attali & Arieli-Attali, 2015). Gamified systems are used for the underlying teaching

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State of the literature

- Many attempts of gamification of students' engagement have been made in education.
- Gamified systems are used for the underlying teaching philosophy in several programing courses or other specified courses.
- However, other attributes are still worth noticing, such as intrinsic and environmental factors that are essential to understand what kinds of students are more likely to be engaged by gamification design.

Contribution of this paper to the literature

- Seven reasons were investigated and summarized for students not asking questions in the class based on questionnaires and interviews.
- Bashful or distractible students were found to be engaged more easily than other students and gamification could facilitate mastering knowledge.
- What inspired the cohorts in class was discovered by comparing to the class conducted without using gamification.

philosophy in several programing courses or other specified courses (Denny, 2013; Li, Grossman, & Fitzmaurice, 2014). The effects of most gamified applications are greatly dependent on the context in which the gamification is being implemented as well as the types of the users, such as classroom and students (Aparicio, Vela, Sánchez, & Montes, 2012). However, other attributes are still worth noticing, such as intrinsic and environmental factors. They are essential to understand what kinds of students are more likely to be engaged by gamification design. Therefore, it is important to understand the students better regarding what kinds of psychological profiles can be engaged by gamification rather than just using one gamification strategy for all the students.

To analyze user engagement and to compare circumstance engagement in gamification designs, the point has been chosen as a gamification element to engage students to ask more questions in class. The point is one of the most widely used elements (points, badges, and leader boards) in gamification designs and is capable of stimulating competition in educational assessments and instructional systems. Providing feedback regarding task performance is one of the most frequently applied psychological interventions (Kluger & Denisi, 1996). Gamification designs were integrated in real classes with several presentations, and the combination of points can fully employ its immediate feedback advantage. The experiment procedure could be divided into two parts, Experiments I and II. In Experiment I, students were arranged to make presentations to classmates with an interesting topic. In Experiment II, students implemented their presentations in different circumstances within the same gamification design. Meanwhile, a questionnaire was provided to obtain feedback on the students' feelings concerning the gamification design at the end of each experiment.

The evaluation of this approach has been carried out based on a set of questions and the engaged cohorts that are used to analyze the engagement effects. A series of studies were

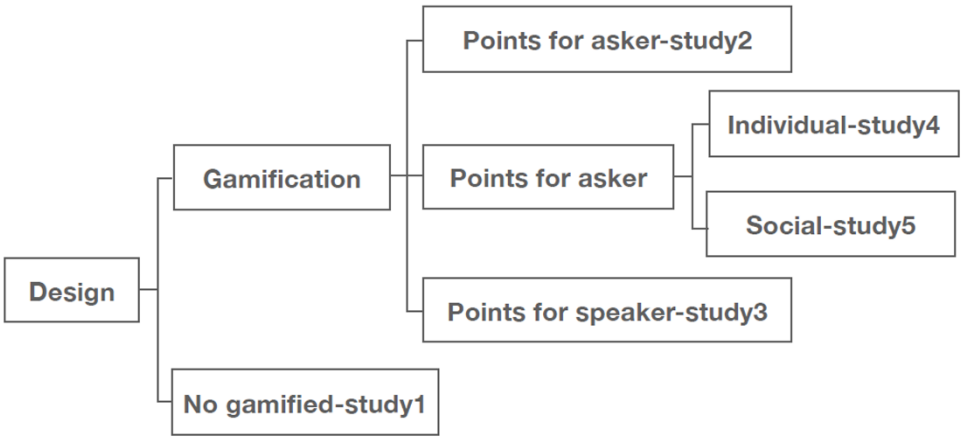

Figure 1. Experimental framework

conducted with different gamification designs. First, seven reasons were investigated and summarized for students not asking questions in the class based on questionnaires and interviews. Then, five different studies in class were carried out. Finally, what inspired the cohorts was discovered by comparing to the class conducted without using gamification. According to the experimental results, bashful or distractible students are engaged more easily than other students; gamification can facilitate mastering knowledge. Students can be engaged in a social rather than individual environment.

DESIGN

The effect of only one course with gamified designs was not convincing enough to determine whether gamification was useful in engagement because most students need to take different classes and meet different teachers in school. The experiment and the conclusion could gain more general meaning if the data were collected from different courses and different teachers. To make the experiment similar to a real teaching class, students were asked to make presentations in front of the class in each study. The student speakers were from different majors and would provide presentations with different content. In each presentation, the speaker was treated as a different teacher, and different presentation content could be treated as different classes. Therefore, the data from the models of the same group of students could be used to analyze the engagement effects. Then, the result of the data showed what kinds of students might change their attitudes or behaviors compared to the traditional classes.

Every presentation not only provided an individual method in which a student used an app to send their questions into the database in private but also provided a social method in which they could send their questions in public and communicate with each other. The individual method meant an asker (a listener who had asked a question) could interact with the speaker both online (using the app) and offline (by raising a hand). When the questions that the askers raised could be seen by both the speaker and other listeners, it was called the social method.

In the design of the experiment, a simple design was made by using only one gamification element to avoid mutual influence. A point could be given to the speaker, the audience, or both to encourage the participants. From the theoretical perspective, points provided feedback to the participants. There were three situations of the gamification design:

a) Gave points only to the askers who raised a question.
b) Gave points only to the speakers if there were questions during the presentations.
c) Gave points to both speakers and askers if they asked questions.

This gamification design was used to make the students ask more questions. The quantity and quality of the questions and the questionnaire regarding students' feelings on the gamification design were the evaluation indices to measure user engagement. All specific experimental designs were arranged as shown in **Figure 1**.

Experimental Design

All studies used an app run on WeChat called Go and Ask Questions (GAQ). It was the app in which students sent questions and received points. During each presentation, students used it to communicate with speakers by asking questions and leaving comments. However, if the student did not leave any questions in the app or raise his/her hand to ask questions, they must choose a reason for not asking questions on the last page of GAQ.

As a preparation, an investigation was made to collect the reasons students were unwilling to ask questions. In total 100 (45 females and 55 males, mean age: 18 years old, SD = 0.2) students were interviewed to reflect the students' opinions. According to the interviews, seven main reasons were summarized (**Figure 2**). On the final page of GAQ, if a student had asked questions during the presentation, they were required to choose 'H' (H: I have asked questions). If not, they should choose the reason they did not ask questions from the following seven options (**Figure 2**).

At the end of each experiment, an anonymous questionnaire was made to understand the students' feelings in the studies. All the questions were related to the gamification design, learning outcomes, and fun. They were adapted from the Motivated Strategies for Learning Questionnaire (MSLQ) and Latin Square Design (Pintrich, P. R., 1991). All items followed a five-point Likert scale (1 as 'not at all true' and 5 as 'very true').

EXPERIMENT I: ANALYZE USER ENGAGEMENT

Participants

There were 50 college students (25 females, 25 males between 17 and 19 with a smartphone) recruited. These students came from the colleges of biology, chemistry, mathematics, and physics. They were placed in the course Introduction to Computer Science launched in the autumn of 2014 and spring of 2015 in a university.

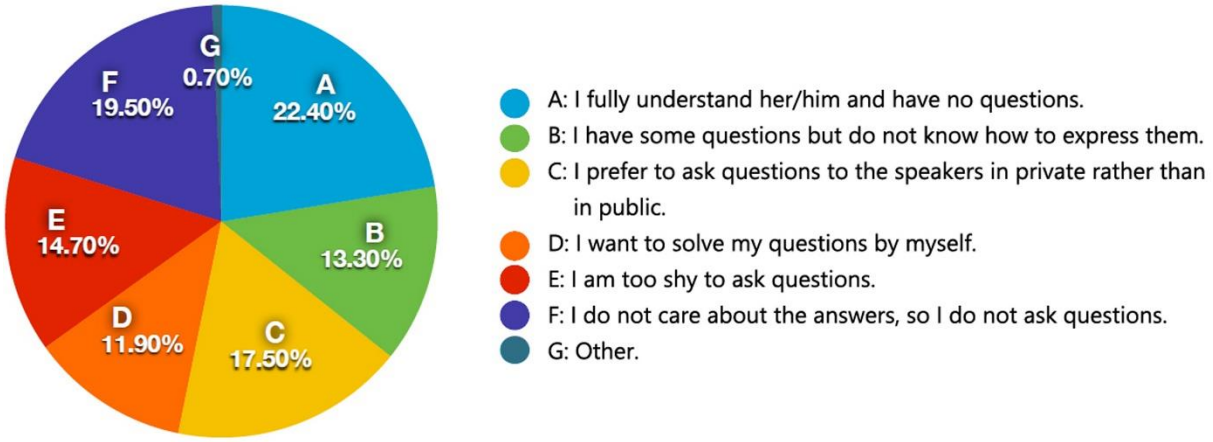

Figure 2. Seven reasons and their distributions

Procedure

During the first week in November 2014, all students in the classroom were told to prepare presentations in the following weeks. The presentation topic should be related to computer science. A student was considered to be engaged in the experiment if they asked questions related to the presentations, whether online or offline.

In Study 1, five volunteers were arranged to make presentations as speakers. First, each speaker made a presentation in 10 minutes. Then, there was a five-minute question and answer (Q&A) period. Students asked any questions by raising their hands (offline) or writing questions in GAQ (online) if they wanted. Finally, students were asked to finish all the pages in GAQ in two minutes. The next presentation repeated the same process of activity. The original process is shown as **Figure 3**.

In Study 2, five volunteers were arranged to make presentations as speakers. They were the same students as those in Study 1. In the Q&A part, students were told if they asked the speaker a question, they would get two points. Other steps were the same as in Study 1.

In Study 3, five volunteers were arranged to make presentations as speakers. They were the same students as those in Study 1. In the Q&A part, students were told if they asked the speaker a question, the speaker would get two points. Other steps were the same as in Study 1.

At the end of this whole experiment, students were asked to finish the questionnaire as a feedback on gamification design and learning capabilities. The questionnaire was designed for participants to rate their agreements on a five-point scale from 1 (agree) to 5 (disagree).

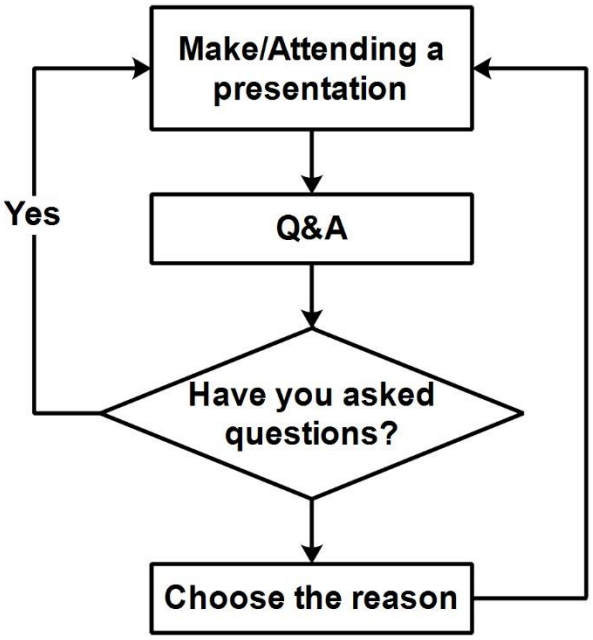

Figure 3. The framework of the process

Table 1. Results of the studies. User number (UN); question number (QN); average of each speaker's vote (ASV); analysis of variance (ANOVA)

	QN	UN	ASV	ANOVA
Study 1	33	185	0.10837	0.00003
Study 2	54	195	0.36185	0.02542
Study 3	81	195	0.37970	0.01884

RESULTS AND DISCUSSION

The question numbers related to the presentations (both online and offline), the attending user number of GAQ, the engaged cohorts, and the results of the questionnaires are displayed in **Table 1**.

Question numbers were collected both offline and online. This was the number of questions that appeared in each study. Results showed that giving points to speakers could result in the best effect in engaging students to ask more questions. In theory, 49 students as listeners joined all five presentations, which could lead to 245 user numbers. However, in practice, the number of users in each study was less than 245. Thus, there was no significant difference among these three studies in engaging students to use GAQ.

Among all presentations, there could be better ones with respect to the topic, content, or speaker's expression. Results showed that there were no significant differences ($p < 0.05$) between the presentations in each study. It means that the gamification design implemented its work by combining different presentation themes and speaker expressions. The average of

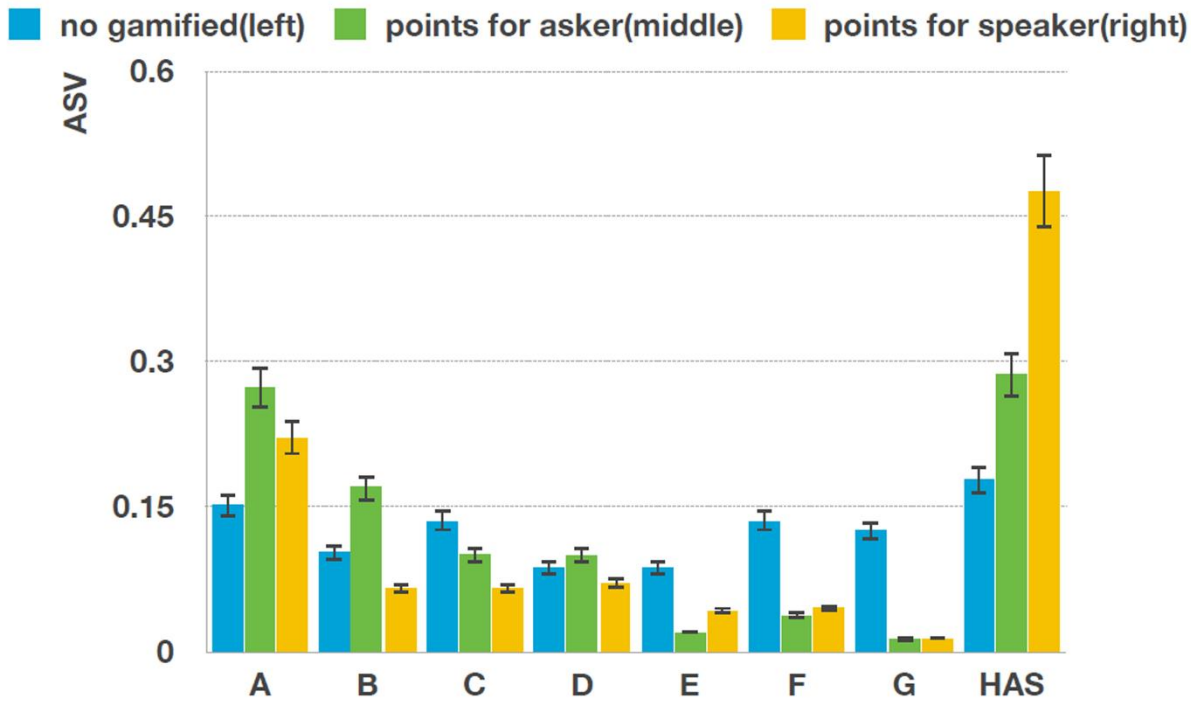

Figure 4. Students' psychological distribution of each study

each speaker's vote (ASV) and the analysis of variance (ANOVA) (p) showed that the gamification design worked in each speaker's presentation. The calculation of ASV is as follows (Equation 1):

$$ASV = \frac{\frac{QN_1}{UN_1} + \frac{QN_2}{UN_2} + \cdots + \frac{QN_n}{UN_n}}{n} \quad (1)$$

There were seven reasons students did not ask questions. All the data were collected to analyze what kind of students had been engaged by the gamification design. If students asked or left a question, they would be included in 'H' (H: I have asked questions); if not, students must choose other options. Students who chose 'H' (H: I have asked questions) and 'A' (A: I fully understand her/him and have no questions) were both considered engaged (**Figure 4**). Data in this figure are calculated as follows (Equation 2):

$$Vote = \frac{option\ number}{study\ GAQ\ user\ number} \quad (2)$$

These gamification designs, which awarded points for askers and speakers, had engaged many more students compared to the study with no gamification. Students choosing 'C,' 'E,' 'F,' and 'G' options were easier to engage by the point design. Those choosing 'C' preferred to ask in private rather than in public, and those choosing 'E' were too shy to ask

Table 2. Gamification design and learning outcomes in Experiment I

Options in the questionnaire on gamification design and learning outcomes	Median
I do not care whether the speaker will answer my questions in the system.	2.48
Giving points encourages me to raise questions.	3.28
Compared with giving points to the speaker, I prefer to get the points myself.	3.12
Using gamification in teaching (such as giving points to someone) is fun.	3.88
This point design inspired me to find problems and issues during each presentation.	3.42

questions. Students choosing 'F' had questions but they did not care what the answers were, so they did not ask questions, and students choosing 'G' indicated that it was something else (other).

Comparing Study 2 with Study 3, points for speakers engaged the listeners much more. One possibility was that helping others could stimulate students' intrinsic motivation, and another reason may arise from the speaker's attitude. If a speaker wanted to seize the opportunity of getting points, he/she would prepare a more interesting and engaging presentation to attract others. Gamified design made students ask more questions and especially worked on those people who were bashful or distracted.

In the final questionnaire of Experiment I, a One-sample Wilcoxon Signed Ranks Test compared the data to the following hypothesized median results. The results of each option on gamification design and learning outcomes are shown in **Table 2.**

The results of the questionnaires were positive. Most of the students were satisfied with the point giving design. They believed that this kind of design had an incentive effect for them to think and question.

EXPERIMENT II: ANALYZE CIRCUMSTANCE ENGAGEMENT

In Experiment I, the results showed that students could be engaged by the gamification design. In this experiment, studies show the effects of different circumstances within a gamification design.

Participants and Events

All studies were finished with the same group of students in Experiment I. The GAQ was used in each study in this experiment in the same way as Experiment I. In Study 5, sending a bullet screen (sending message across the screen like bullets) as social media was developed in the first page of GAQ. It provided a chance to send messages at any time during the presentation, and those messages could be seen by others on the screen. Students could choose to turn off this function and send questions in private like Experiment I.

Table 3. The results of each study. User number (UN); question number (QN); average of each speaker's vote (ASV); analysis of variance (ANOVA)

	QN	UN	ASV	ANOVA
Individual	216	662	0.3372	0.0219
social	127	539	0.2364	0.0068

Procedure

In Study 4, 17 volunteers were arranged to make presentations as speakers. Other steps were finished in the same way as Study 2 (giving points to the askers).

In Study 5, 17 volunteers were arranged to make presentations as speakers. They were the same students as in Study 4. From the beginning of each presentation, students could leave any messages at any time. In addition, everyone could see these messages both on their smartphone and on the class screen. Other steps were finished as in Study 4. A questionnaire was collected to attain student feedback.

RESULTS AND DISCUSSION

The question numbers related to presentations (both online and offline), the attending user number of GAQ, the engaged cohorts, and the results of the questionnaires are illustrated in **Table 3**. In addition, 1,047 messages were collected in the sending bullet screen. In individual circumstances, students asked more questions.

In **Table 3**, individual circumstances attained a better effect compared to social circumstances in engaging students to ask more questions. The user number and question number showed that students prefer using GAQ in individual circumstances. The average of each speaker's vote (ASV) and ANOVA showed that, in individual circumstances, each speaker would be able to receive more question votes than in the social method. There were not so many questions in the social circumstances because many questions appeared on the bullet screen.

Data in **Figure 5** were calculated as per Equation 2. If the student chose 'A' and 'H,' they were engaged. In social circumstances, students of all various psychological personalities were engaged. However, the vote of 'H' was less in the social method.

In the final questionnaire of Experiment II, the results of each option on gamification design and learning outcomes are shown in **Table 4**.

The students in Experiment II showed that they were more accustomed to expressing themselves in private. Although they wanted their questions (their thoughts) to be noticed, they still did not like to be exposed in front of others. These bashful or distracted students were more likely to be engaged.

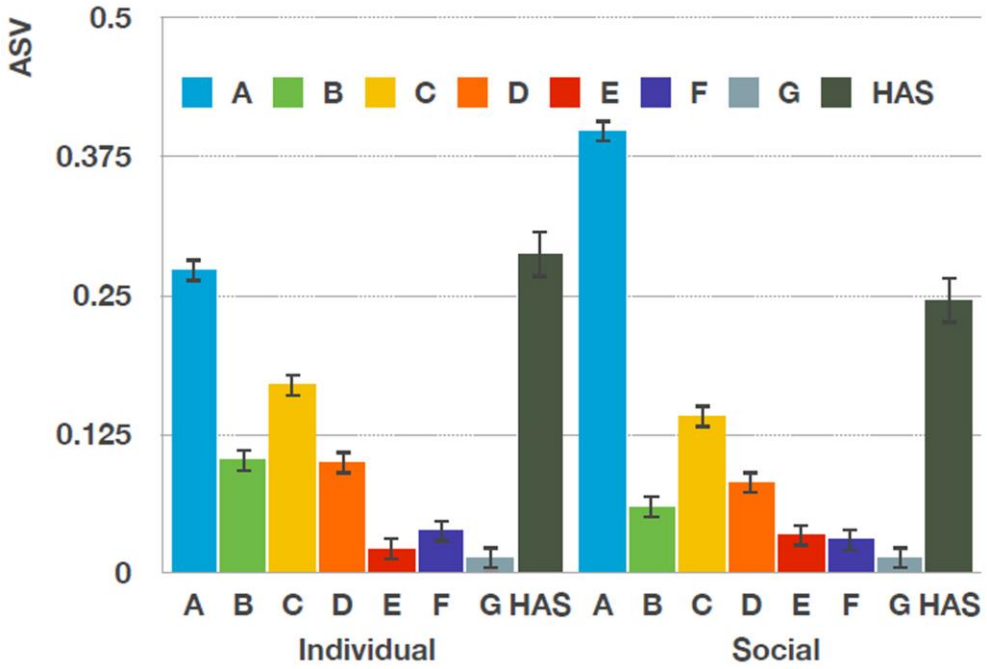

Figure 5. Students' individual and social psychological distributions

Table 4. Gamification design and learning outcomes in Experiment II

Each option in the questionnaire on gamification design and learning outcomes	Median
Compared with sending questions to the system, I would rather send them on the bullet screen.	0.81
Instead of using a mobile phone to watch the bullet screen, I prefer to watch the questions on the class screen.	0.8
Real names on the sending bullet screen reduced my enthusiasm.	2.66
I chose to send to the bullet screen because I wanted my questions to be seen by others, no matter whether it could be answered.	2.11
Sending questions in the system and sending to the bullet screen all engaged me to ask more questions.	1.5
Sending in the system further inspired me to find problems.	1.4
The quality of the questions in the bullet screen was not as good as those in the system.	2.4

LIMITATIONS

This experiment had some limitations in design. Experiment II showed that students were more easily engaged by social circumstances. Because all experiments were conducted with the same group of students, the students should be more familiar with each design. Compared with individual interaction, social interaction was fresher for them. This had a certain effect on the results. It was the reason that carry-over should be considered, which usually happens in within-subject experiments. A study with different groups of students would help verify the conclusion.

CONCLUSION AND FUTURE WORK

In this article, a gamification design using points was introduced to encourage students to ask more questions. There was some evidence that giving points to speakers could result in a better effect in engaging students to ask more questions. In the above two experiments, the bashful or distracted students (choosing 'C,' 'E,' 'F,' or 'G') were more likely to be engaged in the class. They were ashamed of expressing or hardly knew how to express questions, but they wanted to be noticed. They need something to be a motivator. Gamification is a good choice. Moreover, students were found easily to be engaged in social circumstances through a comparison of individual and social interaction. Individual circumstances attained a better effect in engaging students to ask more questions.

This paper can serve as an exemplary study for gamification in education. It proposes the indications of gamification designs on making cohorts focus. It is important to understand which kinds of students can be influenced when people design and implement gamification in education. This is the contribution of this article.

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