Use Gamification to Engage Gen Zers in Learning of Engineering Graphics

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Abstract

Generation Z are current college-age tech-savvy generation who were born between 1995 and 2010, grow up with video games and prefer engaged interactive learning. Gamification, also known as serious game, is the use of game thinking and game mechanisms in a non-game context to engage learners in solving problems. This paper describes an experiential learning experience in a freshmen-level engineering graphics course. By incorporating game-like elements such as point-scoring, and leaderboard into classroom activities, the author hoped to engage student participation in a student-centered learning environment. Positive results were received from the student perception survey at the end of the semester.

Introduction

Generation Z, who were born between 1995 and 2010 are the majority in today's college classrooms. Comparing to millennial predecessors, they grow up with video games, have shorter attention span, and prefer engaged and interactive learning (Rothman, 2016). As college professors, how do we face challenges posed by tech-savvy Gen Zers and engage their learning using new technology? Gamification, also known as serious game, is the use of game thinking and game mechanisms such as points, levels, challenges, leaderboard, badges, or even rewards in a non-game context to engage learners in solving problems (Banner, 2018; Dichev, Dicheva, Angelova, & Agre, 2014; Garris, Ahlers, & Driskell, 2002; Hall, 2014; Jain & Dutta, 2018). It is believed that gamification with careful thought and planning can be an ultimate way to motivate student success (Schwarts, 2019). Since fall 2018, gamification elements including point-scoring, competitions, leaderboard, and rewards have been incorporated into a freshman-level engineering graphics course. It was hoped that through game-like activities, students can be motivated to solve problems in a simulated environment. The paper described a two-semester study involving six-section students in an engineering graphics course. Students' perception survey was conducted at the end of each semester and the results were analyzed to understand the effectiveness of gamification.

Methods

The engineering graphics course covers freehand engineering drawing, and fundamentals of computer-aided design (CAD). Classes meet in a computer laboratory twice a week for one hour and forty-five minutes to fulfill the requirements of the three credit-hour semester-long course. Student' final weighted grade is determined by homework (20%), online quizzes (5%), class participation (10%), final project (20%), test 1(15%), test 2 (15%), and test 3(15%). Once gamification mechanism was introduced, students can earn gamification points through various online and classroom activities including online interactive study, classroom teamwork, polleverywhere individual competition.

Online Interactive Study

The course was implemented as a flipped classroom. Students were required to study materials posted online before coming to the class on the second day. Online materials included videos, audios, PowerPoint file, and interactive study developed under Rise 360 by Articulate. Students can earn up to 2 points if they finished quizzes embedded in the interactive study and earned a score of 80% or above.

Classroom Teamwork

Students formed a team of 2 to 4 in the class time to collaboratively solve various problems in 10 to 15 minutes time window. After the completion, all teams were given the opportunity to pick a number between 1 and 6. TA used a six-sided dice to determine the winning team whose selected number must match generated number on dice. When more than one teams had same generated number on dice, a rock-paper-scissors game was used to determine the final winning team. The winning team got their chance to present their work in front of the class. If the team got fully correct answer, each team member earned 2 points. If the team did not get correct answer at all, the rest of students in the class got an opportunity to steal full points. If the team got the partially correct answer, the rest of students can correct their mistakes and split the points with the team.

Polleverywhere Individual Competition

Polleverywhere was used to encourage individual competition. Multiple choice questions were created. Students can use either classroom computer or their cell phone to answer each question. Students earned more points for responding quickly. After answering each question, real-time responses with correct answer was exposed to the whole class and a leaderboard was generated to show top ten winners with most points earned from that question. Depends on the questions created on polleverywhere, multiple leaderboards gave students opportunities to compete and move their ranking up each time if they can get the correct answers and responded quickly.

Gamification Points

The points students earned from online study, classroom teamwork, polleverywhere individual competition, were accumulated and posted on Canvas. The points helped determine monthly top

three gurus on the leaderboard and were added to student's assignment scores or used to replace their low class participation grade at the end of the semester. All gamification points given would not exceed 3% of final weighted grade.

Leaderboard

By the end of each month, top three students with most points earned during the month were determined and announced on Canvas. All students can find their accumulated points on Canvas in their gradebook. Candies as the reward were given to the top three gurus during the class time. The purpose of the leaderboard was to keep students engaged in the various activities so that they were eager to earn more points next time.

Results

Student perception survey was conducted at the end of each semester in the last school year. There were 107 students from 6 class sections who completed survey questions in two semesters with a response rate of 82%. The average class size is 25. Male to female ratio is 3:10. 5-point Likert scale was used to analyze their perceptions of gamification application in the class. Figure 1 shows students' perception of online interactive study. The majority preferred online interactive study since the animation, videos, flashcards, and embedded quizzes kept them engaged and they could get immediate feedback after the completion of the online quizzes (Kalkhurst, 2018). One student commented, "I felt like the interactive materials and embedded quiz were a great way to help us familiarize ourselves for the impending class it pertains to; it was not like we were going in blindly."

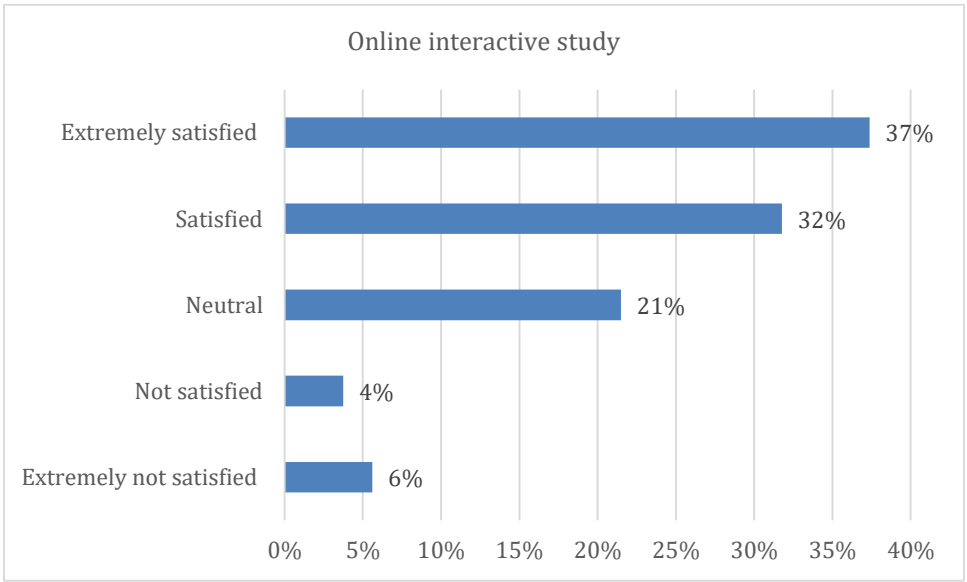

Figure 1. Students' perception of online interactive study

Figure 2 shows students' perception of classroom teamwork. The majority liked to work with their classmates and help each other understand exercise problems. One student commented, "I think that my favorite one was the in-class teamwork. This really motivated me to learn the material because I didn't want to bring town my partner. It also made it simple to communicate with my partner to discuss the problems if I did not understand one." One student also commented the importance of team with equal in knowledge, "For the group work where we volunteered to give our solutions for points please make sure that the groups are equal in knowledge as some groups knew everything while others didn't so it was stacked in the odds of the smartest to win this game."

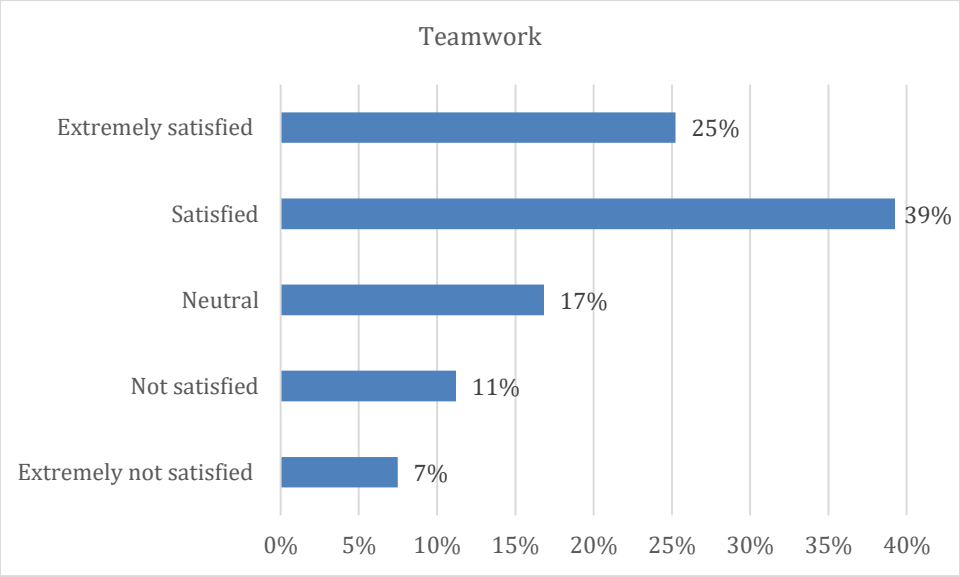

Figure 2. Students' perception of classroom teamwork

Figure 3 shows students' perception of polleverywhere individual competition. Compared to online interactive study and classroom teamwork, this one seemed less popular. Since it was just a trial, only one individual competition was implemented in each semester. Some students showed their interest such as, "i really enjoyed the polleverywhere competition. I wish we would've done that more often rather than just one time in the class. it was definitely helpful towards my learning.", and "I still thought that this was a good activity for class Polleverywhere- I would have liked this if we had done it more often because i thought it was like the online quizzes but timed which could help in practice for the tests."

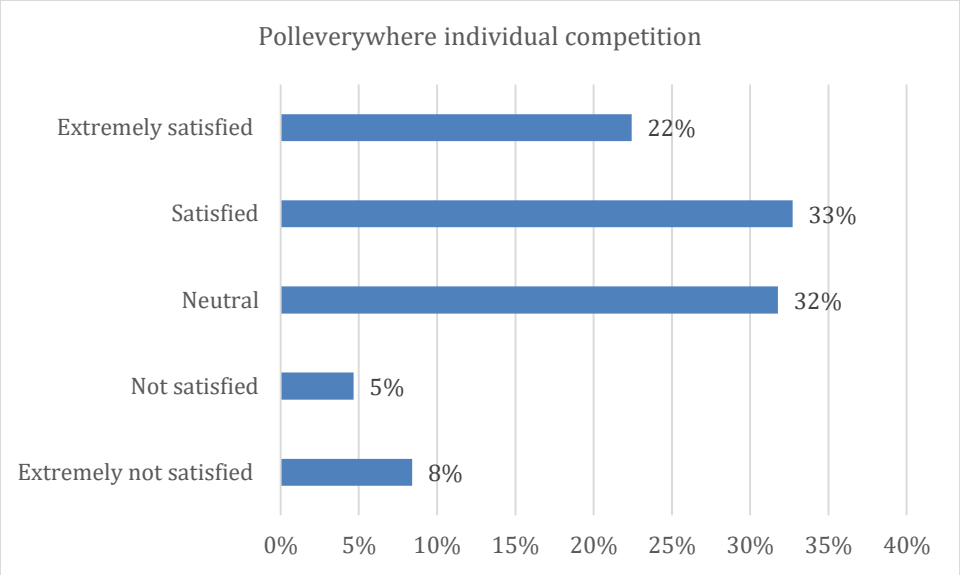

Figure 3. Students' perception of polleverywhere individual competition

Figure 4 shows students' perception of leaderboard. This one became the least popular one comparing to all the other gamification activities. Even though some students commented, "Everything else was great! Definitely felt motivated to work hard to make it unto the leader board.", and "I think the gamification design encouraged students to be more engaged in learning and made it a competition to know more than our peers. When you see the leader board you want to try to earn more points to try to win.", some student indicated that, "I did not like the leader board, it tended to feed peoples ego's making it not fun and making it so I was less motivated to try and win."

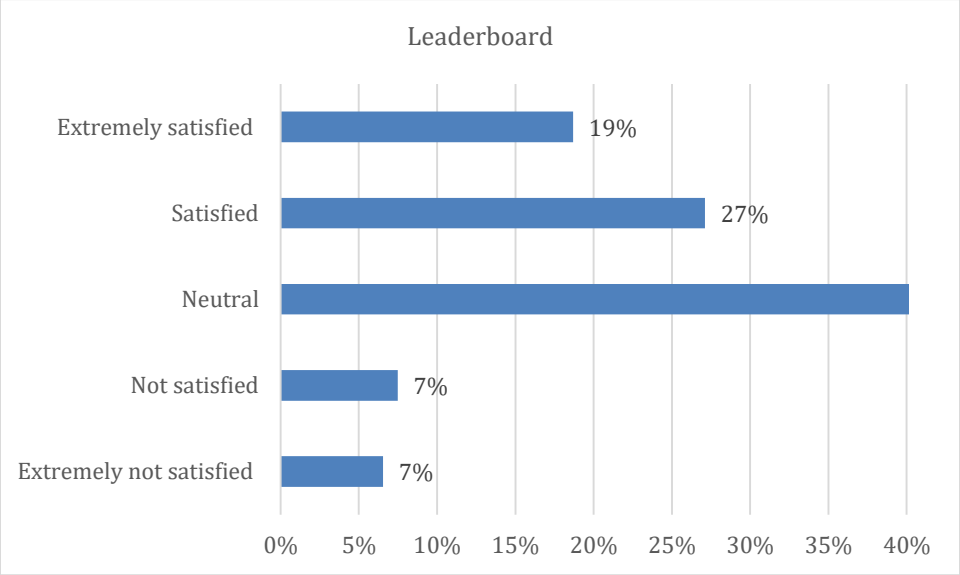

Figure 4. Students' perception of leaderboard

Figure 5 shows students' perception of gamification points. Perhaps this one can be considered the most popular gamification activity. Who do not like free points which can help improve their grades? Especially there were so many different ways to earn points. There was no penalty at all if they got the wrong answer. The only thing they were asked to do was to give it a try. One student said that "I liked the gamification points for answering questions right in class it gave me a reason to raise my hand and made me feel accomplished when i got something right.". The other students mentioned that "Giving gamification points for the interactive online quizzes encouraged me to take advantage of them and go through them. However I felt the leader board was unnecessary, it is not a bad thing just not necessary.".

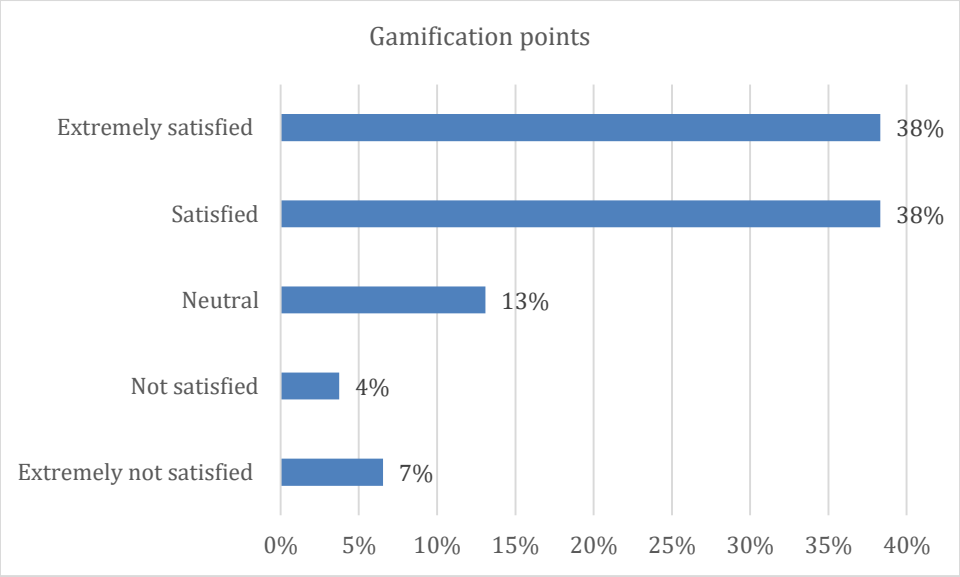

Figure 5. Students' perception of gamification points

Overall students showed their enthusiasm about the gamification activities. Some additional comments are included below.

- "I enjoyed all of the gamification activities, I believe it made learning the material easier. My favorite is the teamwork because it is nice to learn in a group, in order to understand others perspectives."
- "I thought the gratification was approached rather well. I would do more of the polleverywhere thing."
- "I think the polleverywhere is one of the most engaging activities and can be used for both individual and teamwork gamification in conjunction with what was learned from the interactive materials with the embedded quiz."

- "Giving gamification points for the interactive online quizzes encouraged me to take advantage of them and go through them. However I felt the leader board was unnecessary, it is not a bad thing just not necessary."
- "I think the gamification design encouraged students to be more engaged in learning and made it a competition to know more than our peers. When you see the leader board you want to try to earn more points to try to win. The addition of extra credit points further gave more incentive to try to learn more because they help our grade. The online materials with embedded quiz helped us practice the new skills and helped understand the material. Overall I think the gamification design is a great idea, though I don't think there is anything else to add to it due to limited amount of time to work on material for each class in a given day."

Besides positive feedback received from students, there were negative comments which helped the author consider the future improvement. The major issue made students confused was the explanation of the gamification rules and points. Students did not understand how to use the gamification points earned in the class and how the points can help improve their final grade. In the future, an example can be created to show how to use the gamification points to improve a student's final grade.

Conclusions and Recommendations

This paper described how to use gamification to engage Gen Zers in learning of engineering graphics course. Different gamification activities were applied to six sections in two semesters. From online interactive study, classroom teamwork to polleverywhere individual competition, students can earn and accumulate gamification points which can be used to determine top game gurus on the monthly leaderboard and help improve their final grades. A survey was implemented at the end of each semester to understand student's perception. From the survey results, we learned that students highly rated gamification activities. Students believed that gamification can engage their learning and help creating a positive learning environment.

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