

# APPLICATION OF GAME MECHANICS TO IMPROVE STUDENT ENGAGEMENT

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## ABSTRACT

The new generation of students poses a challenge to educators. Given their obsessive use of online social networks and video games, they have shorter attention spans and are more easily distracted, making it harder to engage them in class. In this paper, we describe how we experimented with game mechanics to engage students enrolled in CS1101S, an introductory programming methodology course taken by first year undergraduates in the School of Computing. To investigate how well the use of game mechanics can encourage students to work consistently and improve their learning process, we built *JFDI Academy*, an online learning platform that supplements CS1101S. The platform is used by students to submit their assignments and to discuss their solutions with tutors. As students complete assignments, they are awarded experience points, and "level-up". Students are also motivated to work hard via other game mechanics such as a leaderboard and a storyline that advances as they complete missions. We evaluated the effectiveness of our approach by administering surveys to them, once during the middle of the course and once at the end. We found that the average assignment submission times improved from less than a day (15.5) hours before the deadline to more than two days (51.2 hours) before the deadline. The students also claimed that the game system made the course interesting and motivated them to work beyond what is minimally required. This shows that the use of game mechanics can indeed help to engage the new generation of students. However, our survey results also show that game mechanics work best only when the fundamentals of the course, such the lectures and the quality of the teaching staff, are already sound.

## KEYWORDS

Game Mechanics, Student Engagement, E-Learning

## INTRODUCTION

The current generation of youth is growing up in an increasingly digital world because of the ubiquity of the Internet and other products of modern technology such as the iPhone and the iPad. The pervasiveness of Facebook, YouTube, and video games, has had an impact on their attention spans. Given that they spend a disproportionate amount of time in front of a computer or a mobile device screen, it comes as no surprise that they are also called the *screen generation* (Richtel, 2010). They are easily distracted and they expect instant gratification. The challenge now is for educators to find an effective way of engaging this new generation of students.

In traditional forms of teaching, students are expected to sit in a classroom and listen to a teacher. They are then expected to work on their assignments when they are at home. Given the mindset of the new generation of students, such methods will likely prove to be less effective than in the past. These students may not be as attentive during class and at home, they would likely spend more time on the Internet or on their games, and rush to complete their assignments at the last possible moment.

We had observed this problem in CS1101S, an introductory programming methodology course taken by first-year undergraduates in the School of Computing at NUS. In CS1101S, students were typically given 7 problem sets over a span of 13 weeks. As each problem set was large and tested how deeply the material had been mastered, students had to start working on the problem sets early. However, we found that students often started the problem sets late and submitted only when deadlines were close. Upon checking past records, we found that on average, they would submit their solutions about 15.5 hours before the deadline. There were also some who submitted "just on time" for every problem set. In most cases, students who finished their homework in a rush would typically not have learnt optimally and neither would they have absorbed the material well.

In recent years, there have been suggestions on how the ability of games to engage people can be harnessed positively. For example, Jane McGonigal, in a TED talk titled "Gaming can make a better world", explained *Urgent Evoke*, a game where players work together to solve real-world problems (McGonigal, 2010). Tasks that need to be done are fashioned as missions in the game and by completing them, players earn both in-game recognition and real-world perks such as sponsored trips. Similarly, Ali Carr-Chellman, in another TED talk titled "Gaming to re-engage boys in learning", suggests using games to engage boys in schools and counter the trend of them dropping out (Carr-Chellman, 2010).

Given the promise of games, we decided to experiment with game mechanics as a means to better engage students and improve their learning process. In the rest of this paper, we describe how we introduced the game mechanics in CS1101S and evaluate their effectiveness in keeping students engaged.

## OUR APPROACH

We started by developing a sci-fi adventure storyline set in a "Star-wars"-like universe for the course, and hired a freelance artist to draw a series of comics to narrate the story. The 7 problem sets were divided into 22 smaller assignments called "missions" and were framed around the storyline. We then developed JFDI Academy, an online learning platform to support the narration of the story (via the comics) and the dissemination of the missions. The following are the key features of JFDI Academy:

- **EXPs and Levels.** Students are awarded experience points (or EXPs) for performing various tasks throughout the course. They gain EXPs from completing missions depending on how correct their submissions are, and by participating in tutorials and in the course discussion forum. When students accumulate sufficient EXP, they "level-up". That is, the numerical counter associated with their competency in the course, known as the "level", is incremented. A student's level also represents the amount of marks the student would obtain for the assignment portion of the final course grade.
- **“Vanity” Mechanics.** JFDI Academy also includes a leaderboard and students are awarded badges when they complete certain tasks. The platform is integrated with Facebook, so feeds are posted to Facebook when students level up and complete certain milestone missions.
- **Side Quests.** These are optional assignments that students can attempt for further practice or for making up for EXP "lost" in the missions.
- **Shorter Feedback Cycle.** A student's mission attempt is graded typically within 24 hours of submission. The student is also then provided with feedback on his or her attempt. This is done so that they have a quicker opportunity in correcting mistakes in their understanding of the material.
- **Feed-based Discussion System.** Students can seek clarification on their missions and discuss with their tutors by posting comments on our platform. Tutors will receive notifications from the system when students post new comments, allowing them to quickly respond to their students.

## EVALUATION

We evaluated our new pedagogical approach by conducting a mid-course survey and an end-of-course survey on all 51 students taking the course. The following are the key findings from our evaluation:

- **Improved engagement.** 86.3% of our students felt that the game mechanics helped them generate interest in the course. They highlighted how the element of fun in the game mechanics motivated them to spend more effort in CS1101S and go beyond the minimal requirements. Some of them also stressed how they like the concept of EXP and levelling up in missions because they avidly play video games. These findings

show that game mechanics can indeed help with engaging the current generation of learners.

- **Improved learning process.** The small size of the missions helped to improve the students' learning process. Although there is some increase in work load, as only a short time is available to complete each mission, students generally found the approach to be pedagogically helpful. The students felt that having to work consistently means that they do not rush work at the last minute. Their sentiments are reflected in the average assignment submission times, which improved from less than one day (15.5 hours) before the deadline to more than two days (51.2 hours) before the deadline.

64.8% of our students felt that the shorter feedback cycle also had a positive impact on their learning experience. They found it beneficial to receive feedback while their assignment submissions were still fresh in their minds, as it helps them correct their mistakes quickly.

Side quests were also a hit with the students. They liked how there is a way for them to earn back EXP they lost in missions due to their mistakes. One student commented how he or she, in the absence of the side quests, would copy other students' work just to get a perfect score in missions since doing so would give him or her an advantage. Others said that the side quests, combined with the missions, gave them more opportunity to practice their skills.

- **Improved interaction with tutors.** 74.5% of students expressed that JFDI Academy has positively affected interactions with their tutors. They found that they can easily clarify their doubts with their tutors, have their mistakes explained to them in a clear step-by-step manner, and discuss alternative strategies to solving questions. Some of them suggested that this is possible because JFDI Academy is a "less formal setting" compared to a traditional classroom and provides them with a "relaxed atmosphere" in which they can casually interact with their tutors. One student summed up the sentiments as follows: "Perhaps the best thing about JFDI is a more informal channel in which one can interact with one's tutors".

## CONCLUSION

Based on the feedback from students, it is clear that game mechanics can engage students effectively. By making them interested in a course, they will be naturally inclined to study consistently and learn the course material. However, our survey results also reveal that game mechanics are not a silver bullet that will automatically solve all the issues associated with teaching. As highlighted by Palmer, quality teaching "cannot be reduced to a technique" (Palmer 1998, p. 12); game mechanics work best only when coupled with a strong teaching staff who are able to design effective assignments, grade students' work relatively quickly, and interact with students closely.

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