Building a Graph-Based Database and API for Real Time Analysis of User Behavior

(Technical Paper)

Gamification in Online Learning

(STS Paper)

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction

In this day and age, technology has become increasingly present in our daily lives. Elementary tasks such as communicating with others, setting alarms, and watching videos can all be done through a simple click of a button on an electronic device. Over time, the progression of digital advancements and widespread adoption of technology following the COVID-19 pandemic, gave way to more complex digitized tasks that includes online grocery shopping, tele-medicine, remote work, and of course, online learning.

A critical part of learning, especially in primary education, is the social aspects. Primary school is often one of the first large social environments a student is put into, and it teaches them how to properly behave and interact with others. This socialization provides the student with opportunities to collaborate with teams, become more culturally aware of others and themselves, and have access to engage with peers. However, these in person interactions and encounters disappear with online learning. In fact, according to a study conducted by Muilenburg et al., the most significant barrier students face in online learning was the lack of social interactions (Muilenburg et al., 2005). It was this realization that sparked my interest in gamification.

Gamification is "the usage of game mechanics, dynamics, aesthetics and game thinking in non-game systems" (Strmečki et al., 2021). Its primary objective is to increase user motivation, experience, and engagement. Some of the prominent gamification elements used in online learning are points, rewards, customization, leaderboard, levels, progress bars, challenges, and feedback. These elements play on the basic human behavior to elicit engagement and increase motivation. Gamification has become increasingly prevalent during the last few decades and continues to play a role in the workplace, especially in remote or hybrid workstyles (Borges, 2022). In the technical portion of my project, I will be discussing my hybrid internship last

summer, highlighting my experiences and gamification elements in the workplace. In the STS portion of my project, I will be examining how gamification elements in web design influence user engagement in online learning platforms and identify what design aspects should be targeted for fair and positive use of gamified online platforms among all users.

Technical Discussion

The summer before my fourth year, I had the opportunity to intern as a software engineer in a hybrid setting. This was one of my first experiences working in a professional environment in person, which enabled me to learn as an active participant in a specific organizational operation.

My team and I were tasked with building a custom graph-based database and API to examine user behavior in real time. Half of the team worked on the data ingestion, while the other half developed the graph-based database and building the API. Our project had very loose restrictions and many development choices were left to us. Over the course of my internship, I was assigned a variety of tasks, two of which were particularly important. The first task involved the provisioning of resources to AWS and working on API development. I had never worked with AWS before, so there was a steep learning curve as I learned to build pipelines to provision resources on AWS. It was a different learning process than that which I was used to in school and college, where we are taught one topic and are asked to show mastery in that topic with a specific assignment. With my internship, I had to learn on the job, which was challenging at first, but rewarding as I looked back on my progress.

During the second half of the internship, my task focused on API development, specifically implementing one endpoint. While I had some experience with API development

from a previous internship, the language and framework used were different. It was a valuable experience translating my experiences between technologies in addition to expanding my knowledge and understanding of new technology stacks.

A major part of the company was its culture and retaining that culture by maintaining high employee engagement. Throughout my 10 weeks as an intern, I noticed several aspects of my work life that incorporated gamification elements that increased engagement. Every week on Slack, the company's main form of communication, we had the opportunity to answer a "question of the week" prompt. Everyone that answered would be entered into a raffle to earn a *reward*. Every time I ran a pipeline on Jenkins, and it failed, an integrated Slack bot would give immediate *feedback* by sending a message on Slack indicating the failure. As interns, we also had the opportunity to participate in an intern hackathon (*challenge*). All projects went through bracket style voting and had a *leaderboard* for employees to view and vote on projects. These are a few instances of gamification I noticed in the workplace that served to boost employee engagement and motivation.

My experience as a software engineer intern was particularly meaningful to me. Not only was I able to learn many new technologies and practices, but I also learned how to learn. Learning on the job is an important skill to develop and is not one that can always be learned in a classroom setting. I will retain all knowledge and skills gained through my experience and hope to apply them to future endeavors.

STS Discussion

Many online learning platforms have incorporated gamification elements to improve aspects of student engagement such as motivation, enthusiasm, and participation. Some

important gamification elements used in online learning, as discussed earlier, are points, rewards, customization, leaderboard, levels, progress bars, challenges, and feedback. Points are a crucial aspect of online learning because they can be directly correlated to letter grades. According to Strmečki et al., there are five types of points in gamification systems: A) experience points, which are used to keep track of overall progress a user has made; B) redeemable points, used to unlock additional content; C) skill points, bonus points a student can acquire by completing additional or optional tasks; D) karma points, used to gain status and do not correspond with the student's grade; and E) reputation points, which are associated with trust, and generally are not used in learning systems. Each point serves a different purpose in overall learning but are all aimed towards increasing user engagement and motivation. Rewards, in a gamified environment, are generally associated with badges or trophies as a symbol of personal achievement. According to Enders, rewards must be meaningful to the learner and hard to get (Enders, 2013). Having the ability to earn tokens of achievement is a significant motivation booster. Customization, another gamification element, lets the user control their environment. Simple abilities like changing font, color, or avatar keeps the user engaged. Leaderboards publicly display each student's score or progress, which can be used to motivate users. Levels can be defined as "milestones that a player achieves by completing certain tasks" (Enders, 2013). Having levels with increasing difficulty or levels broken up by topic gives the user immediate reward and keeps the user engaged. Progress bars are often used hand in hand with levels as they provide immediate feedback about a user's progress and motivate them to continue learning. According to Strmečki et al., challenges are elements that are not commonly used in learning systems but are an important gamification element that can be beneficial if integrated into online learning platforms (Strmečki et al., 2021). When used in conjunction with badges or rewards, challenges provide a sense of

accomplishment and value to a user's learning progress. Feedback is an essential gamification element in online learning used to keep the user on the right track throughout the process.

While many agree that having gamification elements in online learning platforms attempts to make up for the loss in person social interaction and addresses the problems of student engagement, others contest and voice certain ethical and social concerns that gamification brings. One main ethical concern to consider is the inadvertent fervor for competing against classmates that gamification evokes. Gamification elements often produce clear winners and losers, fueling a student's raw behavior of comparing themselves with others. This mode of gamification is referred to as "Player Killer" and it corroborates the claim that students have the need for aggression, resulting in competitive behavior (Schulz et al., 2015). This competitiveness can affect students in several ways depending on the type of learner said student is. If a student thrives from competition, this mode of learning can drive them to learn the material better and therefore perform better than their peers. However, if a student is discouraged by a competitive environment, it may reduce their engagement in the online platform itself. Another ethical concern is the privacy of data preservation in online platforms utilizing gamification elements. The application must be designed in such a way that student information and education achievements are stored safely and cannot be accessed by everyone. Moreover, it is important that superiors, like teachers or employers do not misuse this information (Kim et al., 2016). A social concern that comes with these gamified platforms is the inability to distinguish between high engagement and excessive use (Schulz et al., 2015). It is one thing to be fully engaged in the learning material and another to become addicted to the gamification experience. At this point, the user is completing, or re-doing, tasks for the sake of performance and not to learn the content, which was the main objective of gamifying the learning experience.

Research Questions and Methods

While gamification elements are especially useful in engaging the user and motivating them to learn, they introduce some ethical and social concerns. I would like to use previously conducted experiments and studies to learn more about several online platforms and use something known as the Octalysis framework to understand how each gamification element present in online learning specifically plays a role in contributing to increased motivation and user engagement.

Entrepreneur, now CEO, Yu-kai Chou spent 17 years developing the Octalysis framework. It is a human focused gamification design element that lists out the eight core drives responsible for human motivation. The eight core drives are: 1) epic meaning and calling 2) development and accomplishment 3) empowerment of creativity and feedback 4) ownership and possession 5) social influence and relatedness or envy 6) scarcity and impatience 7) unpredictability and curiosity 8) loss and avoidance (Matos, 2018). Most of the gamification elements I found to be present in online learning systems fall under the second, third, and fourth drive. I hope to use this framework to justify how each element plays a role in increasing motivation and engagement of a user.

Lastly, I would also like to identify what design aspects should be targeted for fair and positive use of gamified online learning to address the ethical implications that come with gamified online learning. I will obtain this information using scholarly research and findings from previously conducted studies.

Conclusion

One of the major drawbacks of online education is the lack of in person interactions and engagement. Gamification elements such as points, rewards, customization, leaderboard, levels, progress bars, challenges, and feedback have been incorporated into many online educational platforms to address this shortcoming. However, gamified online learning systems are not always suitable for all types of learners. It may also unknowingly exploit primitive human drives like aggression and achievement. There may also come a point where too much gamification hinders active learning. This area of research is interesting and important as everything is slowly being digitalized. Technology is here to stay - it is valuable to learn and understand how to work with technology to optimize productivity, while at the same time promoting equity through fair practices.

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