

## Intro

Gamification is the process of adding game-based elements to an environment in an attempt to increase user engagement. Some examples include awarding badges, using level systems, having leaderboards, and introducing challenges (or quests). Note that there is a distinction between adding game based elements and converting the process to a game. A game's central focus is on producing a winner whereas a gamified process's central focus is augmenting the player's experience [5]. The measure of success for a gamified process should be based on engagement, not end results.

Gamification can be applied to a variety of environments. Currently, it has seen success in fields like business and marketing. By adding a progression system with certain "levels", customers are more likely to stay loyal to a specific company. Airlines are a common example: most have a loyalty rewards program where your money spent can increase your level and unlock more benefits like free checked luggage. This incentivizes the customer to stay with a single airline, and spend a little extra money when they're close to the next level. Because of its success, researchers are experimenting with gamification in other fields, one of which is education.

Motivating students has been a long-standing problem in the field of education. Consequently, researchers have started to explore the effect on engagement that applying gamification to education has. In most cases, this involves a web based platform in which each student's progress is tracked. They are able to earn badges, increase their level, take on challenges in the form of practice problems, see a leaderboard, among other popular game elements. These platforms often provide metrics to the professor as well, highlighting areas of struggle for individual students as well as the class as a whole.

Gamification holds great potential for its application in the education system. If it truly can augment the learning experience, it would benefit not only the current generation of students, but also future generations. However, this also means that any potential ramifications would have as broad of an effect. Thus, it is imperative that gamification in education is studied thoroughly before trying to implement it at full scale. At the current time, there is not enough diversity in the research to draw sound conclusions about the manner of implementation. There is also a lack of discussion on the feasibility of gamifying education on a large scale. As a result, gamification applied to education should not be implemented until further, more diverse, research is done on the matter. It would be irresponsible to violate the natural duty of ensuring a good education for children, which makes the gamification of education in its current state unethical by deontological standards.

## Summary

As it is a relatively new idea, the gamification of education is still being researched. The majority of experiments follow the same structure: They begin by establishing a baseline for

performance (usually historical test score data or something of that nature), then they compare that baseline to the results after applying game elements to the learning process. Success is measured by increases in performance. It is also common for studies to include a questionnaire, polling the students' opinions on how they felt their motivation changed in response to the gamified experience.

The majority of these experiments are run in a tech-related course. Studies are often conducted using a professor who is in the computer science/IT field and is proficient in navigating technology. The studies lack instances that incorporate instructors with varied areas of expertise. This is problematic because not all teachers are technically experienced like the professors in these studies. Furthermore, these studies are conducted upon a similar sample of students (usually college-level and in a tech-related field).

A standard example would be an experiment run by Ben Leong of National University of Singapore [4]. He worked with a team from MIT and Facebook to create a platform that students would use to gamify their learning experience. Through this platform, they had access to their assignments, "challenge problems", their general progress, leaderboards, and feedback. This platform also allowed professors to see metrics on their students' performance, both as a whole class, and on an individual basis. When the students submitted an assignment, it was often autograded and student's could see their results immediately. Also, most assignments could be submitted multiple times. The overall course of the semester incorporated a storyline, and the assignments were labeled as "missions" while bonus questions were labeled as "side quests". This was done to give the course more of a game-like feel. Around three-quarters of the students reported increased motivation and felt that the system was helping them learn. The instructor also reported that the system was helpful to the staff, as it allowed them to better identify areas of struggle, it increased the communication with students when they had questions about an assignment, and the metrics helped plan the curriculum delivery schedule.

An important element of the gamified experience exhibited in this example is the repeatability of activities. This provides a "freedom to fail" for students, which alleviates the pressure and fear typically imposed by assignments that only allow a single submission. It allows students to take risks and experiment, which are tenets of the learning experience. However, this element is often misinterpreted. It does not imply that students should get unlimited attempts at a multiple choice question. Rather, students should be offered attempts at alternative variants or be given the opportunity to reflect on their incorrect answers [9].

Another example of a typical experiment would be the study conducted by Lee Sheldon, an assistant professor at Indiana University at Bloomington. In this experiment, regular class activities were renamed with game vocabulary: presentations became "completing quests", exams became "fighting monsters", and writing papers became "crafting". Other class elements were similarly rebranded. On average, student's grades improved by an entire letter grade [10]. Interestingly, the subject for the course in this study was none other than "Multiplayer Game Design", a course that focuses on the design elements of online multiplayer games.

The results of the experiments have generally been consistent and positive [7]. As in the examples provided, students have both reported and demonstrated improvement in motivation and performance. The majority of experiments are conducted in a similar manner. Roughly the same “game” elements are used between experiments. However, there are a few discrepancies in the results. For example, the effectiveness of incorporating a leaderboard is inconsistent. In some cases, students have reported it to be the most effective motivator [7]. Other experiments have reported it to be the least effective element [4]. In some cases, it has even been reported as detrimental to the learning process [3]. In these cases, students can be discouraged by the gap between themselves and the leaders, especially as the semester progresses and it becomes impossible to close the gap.

The experiments have done well in testing the addition of game elements as a whole, but fall short in exploring the effect of individual elements [1]. This is highlighted by the example with the leaderboard. The performance measures cannot be correlated with the leaderboard alone because of all of the other elements added. While the studies report improvements in performance, it is unclear which elements are contributing most to that improvement. Currently, only the questionnaires offer insight into this, and their usage is not well-defined or even existent in most experiments.

In its current state, the research into gamifying education is incomplete. There is substantial evidence to suggest that adding these game-like elements increase performance and motivation, but the effectiveness of each individual element has not been adequately tested. Additionally, the samples are not representative of the entire population. The problem of motivation is especially prevalent in younger students, but that population is largely ignored in research.

## Conclusions

Gamification should not yet be applied to education because the current state of the research is incomplete. As it is, it fails to address education as a whole and instead focuses on a small subset of the population. It often commits a post hoc ergo propter hoc fallacy by assuming causation from correlation. Additionally, it fails to address the potential inequality in education experience brought by gamification.

A significant oversight in the research is the tendency to use subjects in tech-related fields. The experiment by Leong was conducted in an introductory programming course [4]. Recall that Sheldon’s experiment was for a course focused on none other than game design. In fact, a systematic mapping study by Dicheva et al. (2015) found that around one half of its explored cases studied the application in a “CS/IT” setting, around one sixth studied it in a “Game Programming” setting, another sixth studied it in a “Math/Science/Engineering” setting, and the final sixth was attributed to all other subjects [1]. Clearly, these experiments overrepresented tech-related subjects. Students from these subjects are likely to be more proficient in navigating the web portals or platforms for their gamified experience. It’s possible

that they are more likely to be engaged by a gamified environment because people in technical fields tend to engage in online gaming more than the average person.

The professor is also an important factor to consider. A professor with technical experience will be able to better navigate and utilize the platform. Gamification necessitates, albeit limited, experience with technology. Teachers may require retraining, which is costly in terms of time and money. However, it is unlikely that instructors would be required to develop the gamification process as was the case in these studies. Also, the online shift due to the COVID pandemic has likely bridged the gap for incorporating technology into lessons, and it has made all instructors more familiar with technology. Regardless, studies should still be conducted with subjects whose field of study exists outside the realm of technology.

An important issue to deliberate is whether the findings are actually a result of gamification. The elements added to the learning environment exhibit characteristics of educational essentials such as feedback, ordering by complexity, and the setting of timelines. “From an educational point of view, it would be unnatural to consider them as ‘game mechanisms’ making their way to education.” [1]. It is unclear whether these successful additions are because of the gamification process or because they are educational essentials. In order to differentiate between the two, further research should be conducted with these “educational essentials” as a baseline and then incorporating strictly game elements like leveling and badges into the experimental group.

The studies also failed to address the issue of overfitting brought about by the introduction of repeatable activities. Repeatable activities can emphasize the memorization of a process rather than an understanding of the concepts [2]. As a result, if the exams are closely structured to the practice, students may perform highly without actually learning the content. These results are used as a metric for the success of gamification, and can lead to the incorrect conclusion that the gamification has augmented the learning experience. This can be rectified by studies further detailing the “repeatable activity” process as well as how the exam differs from it.

An ethical dilemma with gamification lies in the marginalization of students. This problem first emerges with the aforementioned technology barrier. Specifically, educational institutions with more resources will be better able to implement gamification. At a base level, the implementation would likely require internet access and a computer, which excludes the populations that may not be able to afford access. There is currently a policy vacuum regarding monetary barriers to education. As technology advances, access to the internet is evolving to be a basic necessity. Currently, the Equal Educational Opportunities Act (EEOA) of 1974 does not cover monetary barriers to education, meaning that gamification is not universally affordable [10]. This would further the gap between under-resourced institutions and well-resourced institutions.

Students who are not engaged by games are also marginalized by gamification. Students who are adverse to competition will not receive the same increase in motivation as their peers. It is entirely possible that the focus of learning methods will shift towards the game elements, and these students will receive less attention than their peers.

Interestingly, the addition of competition does not seem to have an effect on the motivation to cheat overall. However, there is evidence that those who are struggling become more likely to cheat with the introduction of competition [8]. When students resort to cheating, it becomes harder to identify them as struggling, so their learning experience suffers as a result.

There is a universal obligation to ensure that students have equal access to education and an equal standard of education. Gamifying education at this point in time would apply potentially detrimental elements to the learning environment, and it could further the divide between institutions of different socioeconomic classes. Thus, by deontological ethical theory, gamification should not be applied to education until more diverse research is conducted and monetary barriers have been mitigated.

## References

- [1] Dicheva, D., Dichev, C., Agre, G., & Angelova, G. (2015). Gamification in education: A systematic mapping study. *Journal of Educational Technology & Society*, 18(3), 75-88.
- [2] Dubois, D. J., & Tamburrelli, G. (2013, August). Understanding gamification mechanisms for software development. In *Proceedings of the 2013 9th Joint Meeting on Foundations of Software Engineering* (pp. 659-662).
- [3] Furdu, I., Tomozei, C., & Kose, U. (2017). Pros and cons gamification and gaming in classroom. *arXiv preprint arXiv:1708.09337*.
- [4] Huang, W. H. Y., & Soman, D. (2013). Gamification of education. *Report Series: Behavioural Economics in Action*, 29, 12.
- [5] Kiryakova, G., Angelova, N., & Yordanova, L. (2014). Gamification in education. *Proceedings of 9th International Balkan Education and Science Conference*.
- [6] Laster, Jill (2010). At Indiana U., A Class on Game Design Has Students Playing to Win. *The Chronicle of Higher Education*. Retrieved from: [tinyurl.com/bv5s5bx](http://tinyurl.com/bv5s5bx)
- [7] Nah, F. F. H., Zeng, Q., Telaprolu, V. R., Ayyappa, A. P., & Eschenbrenner, B. (2014, June). Gamification of education: a review of literature. In *International conference on hci in business* (pp. 401-409). Springer, Cham.
- [8] Schwieren, C., & Weichselbaumer, D. (2010). Does competition enhance performance or cheating? A laboratory experiment. *Journal of Economic Psychology*, 31(3), 241-253.
- [9] Stott, A., & Neustaedter, C. (2013). *Analysis of gamification in education*. Surrey, BC, Canada, 8, 36.
- [10] "Types of Educational Opportunities Discrimination." The United States Department of Justice, 25 Mar. 2021, <https://www.justice.gov/crt/types-educational-opportunities-discrimination>.