2023 **Annual Conference & Exposition**
Baltimore Convention Center, MD | June 25 - 28, 2023

The Harbor of Engineering
Education for 130 Years

ASEE

Paper ID #37954

Engaging Students with Gamification in Online Engineering Graduate Courses

Dr. Md Abu Shohag, University of North Alabama

Dr. Md Abu Shohag is an Assistant Professor in the Department of Engineering and Industrial Professions at the University of North Alabama. He is passionate about teaching and mentoring students. He likes to use innovative pedagogical techniques to facilitate student learning. Dr. Shohag's expertise is in the broad area of manufacturing particularly in developing sensors for structural health monitoring, additive manufacturing, multifunctional materials and composites, and data analytics. He maintains a Certified Manufacturing Engineer (CMfgE) administered by the Society of Manufacturing Engineers.

Engaging Students with Gamification in Online Engineering Graduate Courses

Md Abu Shohag

Department of Engineering and Industrial Professions, University of North Alabama, Florence, Alabama, 35632, United States

Abstract

Gamification is becoming increasingly popular in engaging students in the classroom. The value of games is in their scoring system. Unlike traditional graded assessments, games start from zero and add up for success, motivating the player to keep playing. In addition, games provide achievable, short-term successes, enticing the player with constant rewards. Although there are many game-like elements implemented in in-person classes, there is a lack of reports on the efficacy of the technique in online asynchronous graduate classes. *ClassTools* is a gamification platform where many educational tools such as 'Fling the Teacher' are freely available. The online interactive game - 'Fling the Teacher' is used in this study. 'Fling the Teacher' is modeled after *Angry Birds*, a popular casual puzzle video game, and provides 15 multiple choice questions for the user to answer in an engaging environment. If the players answer all 15 questions correctly, they get to fling an avatar of a teacher with a slingshot in one minute. This study focuses on asynchronous online graduate courses where core classes of the applied manufacturing engineering curriculum were tested with the game - 'Fling the Teacher'. The gamified tool was implemented in the middle and end of the course with each having 15 multiple choice questions. An online survey was conducted to gather students' perceptions of the gamified tool on i) engagement in an online learning environment and ii) the effectiveness compared to traditional assessments such as quizzes. The survey data showed that the gamified tool made the online learning environment more engaging. In addition, students considered that the gamified tool was more effective in facilitating their learning compared to traditional quizzes.

Keywords: Gamification, Online Student Engagement, Evaluation, Online Learning, Engineering Education

Introduction

Online learning has become a prevalent mode of delivering education, especially in higher education. However, the lack of physical interaction and engagement in online learning can result in decreased student motivation and performance [1]. Gamification could be a solution to this issue, by incorporating elements of game design to online learning environments, such as rewards, challenges, points, badges, leaderboards, and feedback [2, 3]. Gamification has become a popular trend in recent years, and its popularity has spread across various fields such as education [3, 4], health [5], employment [6], commerce [7], and environment [8]. Using Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) methodology, Manzano-León et al. [4] concluded that there is an increasing research interest towards investigating the implementation of educational gamification strategies. The power of games lies

in their scoring mechanism. Unlike conventional graded evaluations, games commence from a zero-point and accumulate success, which drives the player to persist in playing. Furthermore, games offer attainable, short-term successes, which keeps the player engaged with continuous incentives. The concept of gamification involves the incorporation of game design elements into non-game settings with the aim of engaging and motivating students [3]. Research studies show that the implementation of gamification results in student engagement and motivation [3, 9-11]. The implementation of gamification is a crucial factor in determining its effectiveness, as various aspects of gamification have varying effects on motivational outcomes [12]. The impact of game design elements is contingent on the quality and aesthetics of their implementation [12]. However, further research is necessary to ascertain whether the benefits of gamification are only temporary or if it will have a lasting impact on student learning.

Kahoot! is an online gaming platform designed to pose multiple choice questions in an interactive setting. The software employs vivid colors and captivating sounds to generate an enjoyable atmosphere in the classroom. Furthermore, *Kahoot!* offers dedicated apps for both iOS and Android, making it easily accessible to students. Various past studies [13-16] utilized this platform in science and engineering education. Classcraft® is a gamification tool that can be used to improve skills such as critical thinking, communication, collaboration, and creativity. Parody et al. [17] employed a gamified tool to study the enhancement of student motivation in an engineering mathematics course. To streamline the gamification process across all courses, Zakaria et al. [18] employed the learning management system Moodle incorporating gamification elements such as badges, experience points (XP), leaderboards, levels, and quizzes.

Although there are many game-like elements implemented in in-person classes, there is a lack of reports on the efficacy of the technique in online asynchronous graduate engineering classes. In this study, a freely available interactive educational tool called 'Fling the Teacher' [19] is used to examine the students' perceptions on engagement and effectiveness of the online gamified tool.

Methodology

'Fling the Teacher' is modeled after *Angry Birds*, a popular casual puzzle video game. The game provides 15 multiple choice questions for the user to answer in an engaging environment. Although students can view their playtime, there is no time restriction for answering all 15 questions. If students answer any question incorrectly, they need to start over from the beginning. Upon correctly answering all 15 questions, players receive grade points as well as the opportunity to fling an avatar of a teacher with a slingshot within a minute for entertainment purposes. The instructors can easily create their own game by clicking "Create your own game!" and write questions and answer choices. Answer choices are shuffled automatically. Figure 1 displays a screenshot of the 'Fling the Teacher' quiz. While playing, the player has the option to seek help from the game through three options: "Ask," "Vote," and "-2 Take." Each option can only be utilized once by the players. The students can track their progress in the right sidebar.
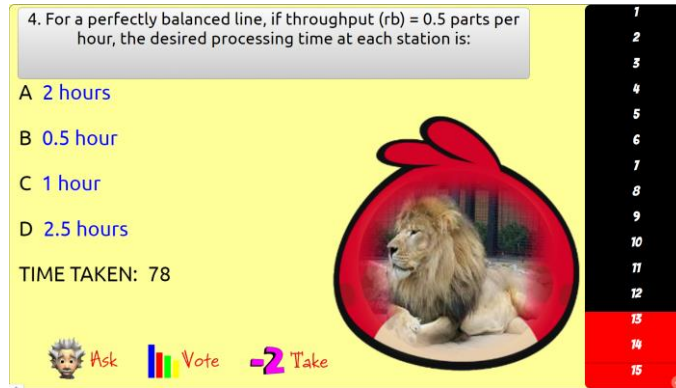
Figure 1. Screenshot of the 'Fling the Teacher' quiz.

Three graduate level online courses (ENMF 603, ENMF 608, and ENMF 609) in master's in Applied Manufacturing Engineering curriculum in author's institution were tested in this study. Students get compensation as grade points upon completion of the 'Fling the Teacher' quiz. To evaluate whether the gamified courses effectively enhanced student motivation and engagement, a Qualtrics survey questionnaire was distributed online to gather feedback from the students. Qualtrics survey is anonymous and there is no compensation at all for the survey. Students may choose to participate; it's completely voluntary. Table 1 displays the survey questions for the students, which are adopted from the article [13].

Table 1. Briefed Qualtrics survey questionnaire.

No.	Questions	Possible Answers
Q1	Students used this quiz previously	Yes or No
Q2	'Fling the Teacher' makes online learning more engaging	True, False, or Neither True nor False
Q3	'Fling the Teacher' quiz helps students to learn more effectively	True, False, or Neither True nor False
Q4	'Fling the Teacher' quiz is at least as engaging as traditional quizzes	True, False, or Neither True nor False
Q5	'Fling the Teacher' quiz is at least as effective as traditional quizzes	True, False, or Neither True nor False
Q6	Recommend the use of 'Fling the Teacher' quiz in every module	Yes or No
Q7	Recommend the use of 'Fling the Teacher' quiz in the middle and end of this course	Yes or No
Q8	Recommend the use of 'Fling the Teacher' quizzes in future iterations of this course or other graduate courses	Yes or No

Results and Discussion

A total of 39 samples were collected in 3 graduate level online courses. Each graduate level course is designed to be offered in 8-week format.

Figure 2 depicts the students' responses to the 8 survey questions. One student used the 'Fling the Teacher' quiz or similar technologies previously as per Q1 response in the survey. In order to investigate the student's engagement due to the 'Fling the Teacher' quiz, 2 questions were asked to students. A significant portion of total students (82.1%) thinks that the 'Fling the Teacher' makes online learning more engaging, where only 17.9% students have no opinion. None of the students oppose this. In addition, 79.5% of students think that 'Fling the Teacher' quiz is at least as engaging as traditional quizzes.

To examine the effectiveness of the 'Fling the Teacher' quiz, 2 questions were asked to students. 79.5% of students consider that the quiz helps them to learn more effectively, while only 17.9% of students have no opinion and only 2.6% oppose this. Additionally, 84.6% of students consider that the 'Fling the Teacher' quiz is at least as effective as traditional quizzes.
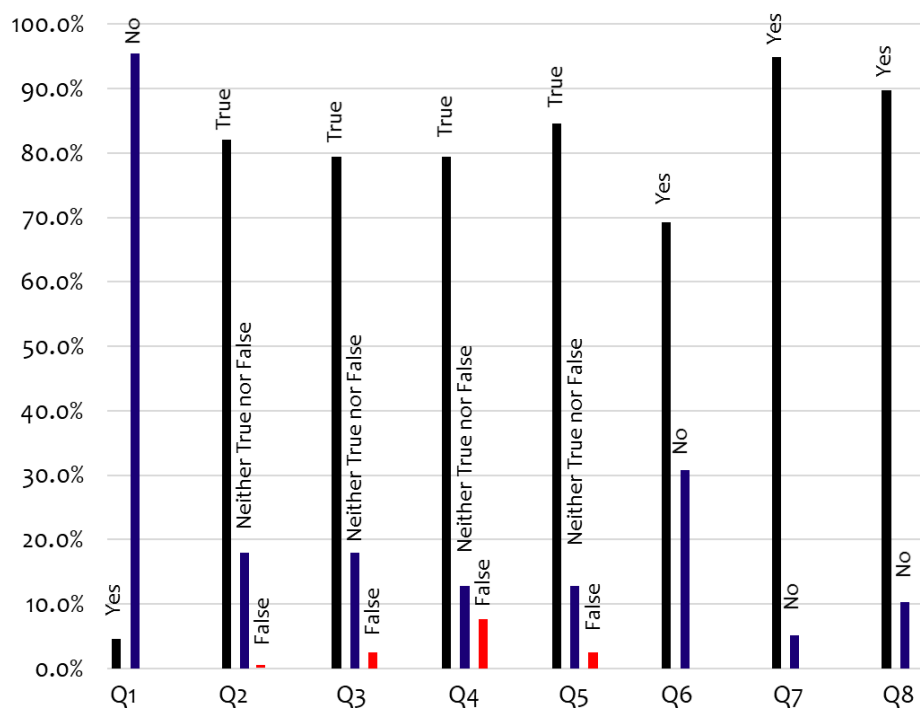

Figure 2. Students' responses to the Qualtrics survey questions. Questions Q1-Q8 correspond to the Table 1.

3 questions were asked to the students whether they would recommend the 'Fling the Teacher' quiz more frequently in the courses and in the future iterations. 94.9% of students would like to have the quiz in the middle and end of the course. 89.7% of students recommended the quiz to be offered in future iterations. Although, 69.2% of students would like to have the quiz in each

module, however, implementing it may be challenging in the 8-week format as the quiz requires at least 15 questions. With five modules in each course, having five quizzes with at least 15 questions each may be overwhelming. A longer format, such as a 16-week format, may be better suited for implementing the quiz in every module.

One of the limitations of the 'Fling the Teacher' tool is that it only allows multiple choice question (MCQ) and no other higher level assessments such as 'creating' is possible. In addition, the tool requires at least 15 questions which may not be possible to implement in some cases. Another limitation of this study is that it only surveyed students perceptions. This study does not compare results with other methods of engagement.

Conclusion

A freely available online interactive game called 'Fling the Teacher' was used in this study to investigate the students perceptions on engagement and effectiveness of the online gamified tool. The majority of the students consider that the 'Fling the Teacher' quiz is more engaging and helps them to learn more effectively. Students strongly recommend the 'Fling the Teacher' quiz more frequently in course and in future iterations. The gamified tool helps to increase student engagement and effective learning in course activities as in line with other research [9]. While these surveys are valuable, they only reflect the students' perspectives. Eventually, some form of assessment of student learning must be performed to determine if there is a significant improvement when gamification is employed.

Acknowledgment

References

[1]   E. Meşe and Ç. Sevilen, "Factors influencing EFL students' motivation in online learning: A qualitative case study," *Journal of Educational Technology & Online Learning,* vol. 4, pp. 11-22, 2021.

[2]   R. N. Landers and A. K. Landers, "An Empirical Test of the Theory of Gamified Learning: The Effect of Leaderboards on Time-on-Task and Academic Performance," *Simulation & Gaming,* vol. 45, pp. 769-785, 2014/12/01 2014.

[3]   C. Dichev and D. Dicheva, "Gamifying education: what is known, what is believed and what remains uncertain: a critical review," *International Journal of Educational Technology in Higher Education,* vol. 14, p. 9, 2017/02/20 2017.

[4]   A. Manzano-León, P. Camacho-Lazarraga, M. A. Guerrero, L. Guerrero-Puerta, J. M. Aguilar-Parra, R. Trigueros*, et al.* (2021, Between Level Up and Game Over: A Systematic Literature Review of Gamification in Education. *Sustainability 13(4).*

[5]   L. Sardi, A. Idri, and J. L. Fernández-Alemán, "A systematic review of gamification in e-Health," *Journal of Biomedical Informatics,* vol. 71, pp. 31-48, 2017/07/01 2017.

[6]   K. Robson, K. Plangger, J. H. Kietzmann, I. McCarthy, and L. Pitt, "Game on: Engaging customers and employees through gamification," *Business Horizons,* vol. 59, pp. 29-36, 2016/01/01 2016.

[7]   A. Behl, P. Sheorey, A. Pal, A. K. V. Veetil, and S. R. Singh, "Gamification in E- Commerce: A Comprehensive Review of Literature," *Journal of Electronic Commerce in Organizations (JECO),* vol. 18, pp. 1-16, 2020.

[8]   K. Larson, "Serious Games and Gamification in the Corporate Training Environment: a Literature Review," *TechTrends,* vol. 64, pp. 319-328, 2020/03/01 2020.

[9]   J. Hamari, J. Koivisto, and H. Sarsa, "Does Gamification Work? -- A Literature Review of Empirical Studies on Gamification," in *2014 47th Hawaii International Conference on System Sciences*, 2014, pp. 3025-3034.

[10]   R. Smiderle, S. J. Rigo, L. B. Marques, J. A. Peçanha de Miranda Coelho, and P. A. Jaques, "The impact of gamification on students' learning, engagement and behavior based on their personality traits," *Smart Learning Environments,* vol. 7, p. 3, 2020/01/09 2020.

[11]   C.-Y. Tsai, H.-s. Lin, and S.-C. Liu, "The effect of pedagogical GAME model on students' PISA scientific competencies," *Journal of Computer Assisted Learning,* vol. 36, pp. 359-369, 2020/06/01 2020.

[12]   M. Sailer, J. U. Hense, S. K. Mayr, and H. Mandl, "How gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction," *Computers in Human Behavior,* vol. 69, pp. 371-380, 2017/04/01/ 2017.

[13]   J. Palmore, "Evaluation of evidence-based teaching techniques in a graduate fluid dynamics course," in *2020 ASEE Virtual Annual Conference*, 2020.

[14]   R. Cutri, L. R. Marim, J. R. Cordeiro, H. A. Gil, and C. C. T. Guerald, "Kahoot, a new and cheap way to get classroom-response instead of using clickers," in *2016 ASEE Annual Conference & Exposition*, 2016.

[15]   S. A. Licorish, H. E. Owen, B. Daniel, and J. L. George, "Students' perception of Kahoot!'s influence on teaching and learning," *Research and Practice in Technology Enhanced Learning,* vol. 13, p. 9, 2018/07/21 2018.

[16]   M. Pascu, D. C. Petculescu, and I. P. Stupariu. (2023, Investigating Students’ Perception of Online Assessment as a Result of the Interaction among the Extrinsic Assessment Factors on Students Psychological Characteristics. *Education Sciences 13(2)*.

[17]   L. Parody, J. Santos, L. A. Trujillo-Cayado, and M. Ceballos. (2022, Gamification in Engineering Education: The Use of Classcraft Platform to Improve Motivation and Academic Performance. *Applied Sciences 12(22)*.

[18]   Z. Mahmud, P. J. Weber, and J. P. Moening, "Gamification of engineering courses," in *2017 ASEE Annual Conference & Exposition*, 2017.

[19]   R. Tarr. (2014). *https://www.classtools.net/*