Concept Paper

Gamification in Engineering Education after the COVID-19 pandemic

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Gamification in Engineering Education after the COVID-19 pandemic

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Abstract: The world of education has changed. And for all the trials and challenges of managing education during a pandemic, we have also learned a few things that can make our teaching and learning experiences even better in the future.The pandemic imposed constant balance exercises in all aspects of our daily life, including education. Suddenly the living room of the house turned into a work space, the kitchen replaced the canteen, the children's office became a student seat. There was a new area of unknown, irregular and unpredictable forced experimentation. Now what is right, beneficial and effective is an unanswerable question in the absence of previous experience, and the only way to answer it is by trial and error.Universities, in the context of "emergency" remote teaching, also had to experiment. Professors and students found themselves inside virtual classrooms, facing digital boards, closed cameras and microphones.How could a professor not be frustrated by low levels of interaction during the lesson, and how could a student understand a problem without disrupting the fragile digital teaching flow? What was the learning outcome after each two-hour e-teaching? Was the learner's attention maintained, the learning objective achieved, knowledge transferred, new skills acquired? The answers had to be given through experimentation, creativity and innovation.To stop digital teaching from being monotonous and boring, we tried to turn it into a game in order to engage students and lead to better learning outcomes. Gamification is the use of game mechanics in non-game situations. It involves the use of video game elements, such as leaderboards, levels and badges in non-game activities aimed at improving the user experience and increasing user engagement. We find examples of gamification in various fields, e.g. in physical exercise and health (Pereira et al., 2014; Johnson et al., 2016), in the promotion of products and services (Huotari, & Hamari, 2012) and, of course, in education (Triantafyllou & Georgiadis, 2022). For example, airlines enable travelers to earn points with each trip that they can later redeem, or sports equipment companies have developed apps on smart phones and watches so that users can celebrate their performance with digital trophies, compete and challenge their running friends.In the learning process, gamification includes direct feedback mechanisms for learners, point systems, ranking tables, prizes, badges, progress bars and avatars among others, with the main objectives of mobilizing, encouraging and guiding the participant to achieve learning progress. Game-based learning makes the most of these mechanisms with an a priori architecture, which clearly defines the goal of the game, its basic functions and scenario, the rules of progression, competition and interaction with the application and teammates (Triantafyllou & Sapounidis, 2023).The reason why gamification is of particular interest is that research shows an increased degree of involvement and interest of participants when an environment or activity incorporates elements of gamification (Triantafyllou & Georgiadis, 2022). Game-based learning therefore activates not only cognitive functions, such as attention or perception, but also feelings of excitement, surprise, joy, sadness or even anger. This experience results in the achievement of meaningful learning objectives, such as deepening knowledge and developing intrapersonal (e.g. project scheduling) and interpersonal skills (e.g. collaboration).

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PURPOSE OR GOAL

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To stop digital teaching from being monotonous and boring, we tried to turn it into a game in order to engage students and lead to better learning outcomes. Gamification is the use of game mechanics in non-game situations. It involves the use of video game elements, such as leaderboards, levels and badges in non-game activities aimed at improving the user experience and increasing user engagement. We find examples of gamification in various fields, e.g. in physical exercise and health (Pereira et al., 2014; Johnson et al., 2016), in the promotion of products and services (Huotari, & Hamari, 2012) and, of course, in education (Triantafyllou & Georgiadis, 2022). For example, airlines enable travelers to earn points with each trip that they can later redeem, or sports equipment companies have developed apps on smart phones and watches so that users can celebrate their performance with digital trophies, compete and challenge their running friends.

In the learning process, gamification includes direct feedback mechanisms for learners, point systems, ranking tables, prizes, badges, progress bars and avatars among others, with the main objectives of mobilizing, encouraging and guiding the participant to achieve learning progress. Game-based learning makes the most of these mechanisms with an a priori architecture, which clearly defines the goal of the game, its basic functions and scenario, the rules of progression, competition and interaction with the application and teammates (Triantafyllou & Sapounidis, 2023).

The reason why gamification is of particular interest is that research shows an increased degree of involvement and interest of participants when an environment or activity incorporates elements of gamification (Triantafyllou & Georgiadis, 2022). Game-based learning therefore activates not only cognitive functions, such as attention or perception, but also feelings of excitement, surprise, joy, sadness or even anger. This experience results in the achievement of meaningful learning objectives, such as deepening knowledge and developing intrapersonal (e.g. project scheduling) and interpersonal skills (e.g. collaboration).

APPROACH

But let's see what exactly we "implemented" in 2022-2023 to freshmen of the EPPAIK program of School of Pedagogical and Technological Education: Annex of Thessaloniki and how we integrated learning elements into a game. Kahoot is a free online tool that allows teachers to easily and quickly create playful quizzes to assess learners in real-time in the classroom. The quizzes are shown in the classroom and each student answers them through their own digital device (computer, tablet, smartphone). Each teacher creates a user account by providing the email and password on the kahoot page (https://create.kahoot.it/auth/login). Immediately afterwards the teacher is taken to the home screen of the service where he can either select an existing quiz or create a new one. Also, the teacher can add multimedia content (eg image or video) to each quiz question to provide some extra information to learners and make the question more attractive for them to answer. Finally, he can rearrange the order of the questions and edit the privacy of the quiz, making it public or private. 247 questions were divided into 2 categories with 20 challenges per day. Each challenge was a 1 minute 'battle' with 8 questions. The 2 categories concerned two lessons. Each lesson implementation plan

was structured according to the specifications of the form used by ASPAITE in the training programs of future teachers (PAD ASPAITE, 2022, www.aspete.gr).

The main goals of this specific game-based learning application were the deepening of knowledge subjects and the appropriate preparation of students to become future teachers (Ikonomou et al., 1999; Fragkoulis & Anagnou, 2014; Kouni & Koutsoukos, 2019; Gougoulakis et al., 2020; Kaimara et al., 2019; Triantafyllou, 2022). At the same time, in the midst of forced isolation and social distancing during the pandemic, we wanted to cheer up our freshmen and strengthen their sense of belonging.

ACTUAL OR ANTICIPATED OUTCOMES

The results of this experiment showed that technology-enhanced learning, if properly designed and purposefully implemented, can successfully lead to meaningful learning. Specifically:

- Registration via the online form was successful, with a total of 90 registrants. Eventually 90 people downloaded the app and had access to the game.
- Participation was very satisfactory, with 90 freshmen activating the game. Participation was optional and had no effect on course grades.
- At the level of understanding and assimilation of the learning material, an increase of 25% was observed over the initial percentage of correct answers. The initial percentage of correct answers was 50%, while the final percentage of correct answers was 75%.

In the light of a qualitative analysis of the learning experiences, we list some indicative responses of freshmen to the question "Share with us your experience of the game and fill in any suggestion or comment you want", which was put to them at the end of the process:

"It was a fantastic experience."

"It was really a very beautiful and clever idea, which in addition to the knowledge it gave us, I felt it brought us freshmen closer together."

"By answering the questions, we learned a lot and at the same time got closer to our fellow students, since we saw it as a form of play."

References

Fragkoulis, I., Anagnou, E. (2014). Teachers' views in relation to the utilization of experiential participatory teaching techniques in the context of their participation in training programs, in: Scientific Educational Journal Educ@tional Cirlcle. pp. 49–64. Vol. 2.

Gougoulakis, P., Kedraka, K., Oikonomou, A., & Anastasiades, P. (2020). Teaching in Tertiary Education-A reflective and experiential approach to University Pedagogy.*Academia*, (20-21), 101-137.

Johnson, D., Deterding, S., Kuhn, K. A., Staneva, A., Stoyanov, S., & Hides, L. (2016). Gamification for health and wellbeing: A systematic review of the literature. *Internet interventions*, *6*, 89-106.

Pereira, P., Duarte, E., Rebelo, F., & Noriega, P. (2014). A review of gamification for health-related contexts. In *Design, User Experience, and Usability. User Experience Design for Diverse Interaction Platforms and Environments: Third International Conference, DUXU 2014, Held as Part of HCI International 2014, Heraklion, Crete, Greece, June 22-27, 2014, Proceedings, Part II 3* (pp. 742-753). Springer International Publishing.

Huotari, K., & Hamari, J. (2012). Defining gamification: a service marketing perspective. In *Proceeding of the 16th international academic MindTrek conference* (pp. 17-22).

Ikonomou, A., Kaldrimidou, M., Sakonidis, C., & Tzekaki, M. (1999). Interaction in the mathematics classroom: some epistemological aspects. *Mathematics Education I*, 168.

Kaimara, P., Poulimenou, S. M., Oikonomou, A., Deliyannis, I., & Plerou, A. (2019). Smartphones at schools? Yes, why not?. *European Journal of Engineering and Technology Research*, 1-6.

Kouni, Z., & Koutsoukos, M. (2019). The Counseling Role of the Teacher in Greek Secondary Schools: Investigating Students' Attitudes Toward It. *Education Quarterly Reviews*, *2*(3).

PAD ASPAITE, 2022, www.aspete.gr

Triantafyllou, S. A. (2022). Constructivist Learning Environments. Proceedings of The 5th International Conference on Advanced Research in Teaching and Education, 2022. https://www.doi.org/10.33422/5th.icate.2022.04.10

Triantafyllou, S., & Georgiadis, C. (2022). Gamification of moocs and security awareness in corporate training. *Proceedings of the 14th International Conference on Computer Supported Education*. https://doi.org/10.5220/0011103000003182

Triantafyllou, S. A., & Sapounidis, T. (2023). Game-based learning approach and serious games to learn while you play. *2023 IEEE World Engineering Education Conference (EDUNINE)*. https://doi.org/10.1109/edunine57531.2023.10102872