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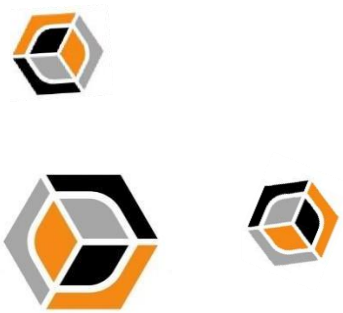

Gamification in Engineering Education after the COVID-19 pandemic

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PURPOSE OR GOAL

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, 2022a; Triantafyllou & Georgiadis, 2022b; Triantafyllou, 2022c; Triantafyllou, 2022d; Triantafyllou & Sapounidis, 2023). 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, 2023). 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 was designed for social learning, with learners gathered around a common screen such as an interactive whiteboard, projector, or a computer monitor. Its main purpose was to create online quizzes, in the form of a game. It enabled participants to respond both through their personal digital device (computer or smartphone), a fact which made it easy to use. The questions on the kahoot could be multiple-choice or descriptive and learners had a predetermined time to answer them. These questions could be changed to award points. Points then showed up on the leaderboard after each question. At the end of the predetermined time, participants were no longer able to participate in this process. Answers to quizzes could be stored directly in excel format and used later for data processing and analysis. 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, 2022d). 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."

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Serafeim A. Triantafyllou is a Computer Science Teacher. He has worked as a Computer Science Teacher in schools of Primary and Secondary Education of the Greek Ministry of Education and Religious Affairs. He is also a Certified Microsoft Innovative Educator and Microsoft Innovative Educator Expert for 2023-2024. He was born in Thessaloniki. Serafeim received his BSc in Applied Informatics at the Department of Applied Informatics of the University of Macedonia, an MSc degree in Continuing Education at the Department of Educational and Social Policy of the University of Macedonia, and a master's degree of Education in Special Education at the Department of Education of the University of Nicosia and the Department of Educational Sciences and Early Childhood Education of the University of Patras. He has completed successfully the (400 hours) educational program in intercultural education at the Department of Economics of the University of Piraeus. He has completed successfully the 1st EURASIP-GAIPDM Seasonal School on "Learning from Signals, Images, and Video" at the School of Informatics of the Aristotle University of Thessaloniki. He holds a certificate of Membership of IEEE Education Society that recognizes him as the Affiliate in good standing, denoting a personal and professional commitment to the advancement of technology. Serafeim is also a Member of the Cyprus Computer Society. Serafeim taught as Teaching and Research Assistant at the University of Macedonia from 2021-05 to 2021-09, and as Teaching and Research Staff in School of Pedagogical and Technological Education (ASPETE), Annex of Thessaloniki (Greece) for the academic years 2017-2019 and 2022-2023 respectively. He has served as a reviewer for academic journals and academic conferences. Serafeim is also a certified trainer for Adults of non-formal education by the National Organization for the Certification of Qualifications & Vocational Guidance – EOPPEP. He worked as a professor of Computer Science in Public Vocational Training Institutes and Lifelong Learning Centres. His research interests are in the areas of Educational Technology, STEAM technologies, Gamification technologies, Artificial Intelligence, Special Education, Lifelong learning and e-learning. Serafeim is also author of computer science and pedagogy books.