

Optimization of analog gamification in graphic engineering courses

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Resumen

La metodología de gamificación ha demostrado mejorar significativamente la motivación y el rendimiento de los estudiantes en asignaturas relacionadas con todos los campos de las carreras de ingeniería. Respecto a la gamificación analógica, son habituales los juegos de mesa en los que los educadores desempeñan un papel protagonista. Sin embargo, esta forma de obrar limita notablemente la evaluación de los alumnos durante las sesiones de juego, ya que los profesores deben centrarse en el adecuado desarrollo de las mismas. Por este motivo, se ha implementado una metodología de gamificación analógica desarrollada específicamente para reducir el nivel de relevancia de los educadores durante las sesiones de juego. Esta propuesta se ha basado en un juego de mesa de preguntas y respuestas relacionado con cuestiones de ingeniería gráfica. Los alumnos se han repartido en equipos de dos miembros, no pudiendo jugar más de tres equipos simultáneamente en el mismo tablero. Debido a la reducción de la carga de trabajo de los educadores, la nueva metodología contribuye a introducir estrategias de evaluación individualizadas para cada alumno; al mismo tiempo que maximiza el tiempo de juego en cada sesión. Por lo tanto, es extremadamente recomendable para abordar asignaturas gráficas desarrolladas en una lengua extranjera, debido a las posibilidades de abordar simultáneamente las dificultades lingüísticas de los alumnos y los contenidos de la asignatura.

Palabras clave: torneo por equipos, tablero de juego, aprendizaje activo, normativa

Title

Abstract

Gamification methodology has proved to significantly improve students' motivation and performance in subjects related to all fields of engineering degrees. Regarding analogic gamification, board games in which educators perform a leading role are commonplace. However, this procedure remarkably limits the evaluation of students during the gaming sessions, as professors must focus on the adequate development of the latter. For this reason, an analogic gamification methodology specifically developed to reduce the relevance level of educators during gaming sessions has been implemented. This proposal was based on a quiz board game related to graphic engineering questions. Students has been spread in teams of two members, with no more than three teams playing simultaneously on the same board. Due to the soften in educators' workload, the new methodology contributes to introduce evaluation strategies individualized for each undergraduate; at the same time that it maximizes the playing time on each session. Hence, it is extremely recommended to address graphic subjects conducted on a foreign language, due to the possibilities of addressing scholars' language difficulties simultaneously with the contents of the subject.

Keywords: team tournament, board game, active learning, standardization

INTRODUCTION

Graphic engineering courses are part of the core of engineering degrees. Furthermore, the principles and contents usually addressed in these subjects are also a relevant background to face artistic degrees with guarantees to succeed. In the technical field, these courses cover a wide spectrum of contents that range descriptive geometry to the adequate application of international standards to the development of precise engineering drawings. Therefore, undergraduates must face an overwhelming amount of standardization. The intrinsic complexity of these texts coupled with the abundance of particular cases lead to major reductions in the learners' motivation. This fact was also boosted by the outdated teaching methodology in most graphic engineering courses, in which the standards were disseminated in oral classes by the professors. To overcome this inherent inconvenience, previous research by the authors aimed to update the teaching methodology while triggering the student's interest in the subject. Particularly, the gamification methodology was selected due to its solid background improving the performance of students in engineering degrees (Alomair & Hammami, 2019; Da Rocha Seixas et al., 2016; Gómez-Jáuregui et al., 2017; Urh et al., 2015; Villalobos & Ríos Herrera, 2019; Yildirim, 2017).

In the previous experiences by the authors, a quiz game with questions developed by students and based on the standards selected by the professors was conducted. All sessions related to the gamification methodology lasted for two hours. During the first hour, students had to elaborate several questions to be implemented in a quiz game based on the standards selected by the educators; whereas during the second hour, undergraduates actually played the game. Students were organized in different teams of four to six members on average, competing all teams simultaneously on one unique board. Hence, the professor was in charge of the whole experience and was responsible for asking the questions out loud and ensuring the correct evolution of the game.

The results from these experiences were extremely positive. In a first experience, gamification proved to be a successful tool to trigger students' motivation, and even to develop their inter and intrapersonal skills in graphic engineering courses (Guerrero-Miguel & Prendes-Gero, 2022). However, the use of virtual resources to address all the stages developed during each session seemed to impede the adequate development of the classes, as a significant amount of time was lost collecting the questions of all teams and organizing them into the screen projected board game. For this reason, involved professors developed a tailored gamification experience for graphic engineering courses in which the main goal was to eliminate all possible virtual resources (Guerrero-Miguel Diego-José and Prendes-Gero, 2024).

After a meticulous analysis of its pros and cons, the authors highlighted that the analog experience may be of particular interest for drawing courses as it triggered students' active participation and minimized the transition times between the different stages (elaboration of questions and playing) of each session (Guerrero-Miguel et al., 2023).

Nevertheless, during all these methodologies the professors were subjected to a massive work overload that impeded evaluating each student individually. Hence, the only possible option was to assign marks to complete groups rather than to the proportional participation of each individual. Besides, the implementation of this last-mentioned methodology highlighted some new features that may be polished to benefit from gamification at the highest possible level. In this text, the new procedure implemented as well as the adequacy of the adopted solutions is carefully justified and evaluated; being its most relevant outcome the workload reduction on the educators, which allows to tailor evaluation of the students during the gamification experiences.

METHODOLOGY

Due to the success of the previous gamification experiences, the combined experience of the

authors was collected and analysed to tailor and optimize gamification methodology that addresses the particular characteristics of graphic engineering courses. In this sense, the analog gamification (Guerrero-Miguel et al., 2023) project was continued, also in the Industrial Organization and Industrial Technologies at the Polytechnic School of Engineering of Gijón, but focused on increasing the active participation of each student during the complete class sessions. Hence, the schedule of sessions was reorganized to develop one rather than two hours sessions. In this occasion, all the time during classes was used to play. Therefore, students were asked to elaborate their questions in the time between consecutive classes.

The main reason to maintain the use of analog gamification was the possibility of using more than one board during the classes. Instead of several teams playing on the same board, which led to long periods of time where the students were just waiting to participate, just two different teams compete against each other on the same board. As a result, many board games were used simultaneously on the same class. Additionally, the number of undergraduates per group was reduced to two, forcing them to take an unquestionably more active role during the different gaming sessions.

After each session, teams were ranked depending on the number of right answers provided. Once the team ranking was defined, different marks were assigned to each position. The winning teams gained an increment in the final mark. Hence, the professors registered the winner in each board to adjust the final marks.

Furthermore, it is worth noting that educators register the development of all the sessions, listing the major weaknesses noticed. Based on these recorded observations, new improvements were made during the actual execution of the whole experience.

RESULTS AND DISCUSSION

Limiting the class time to purely play led to an improvement in the quality of the questions asked. Certainly, the work between sessions let students to elaborate their questions during longer periods of time. Furthermore, another reason that may explain this unexpected result is the reduction of members per team. In previous experiences, learners distribute the work to elaborate one or two questions each, whereas in the new proposed approach two students have to collaborate to develop around ten questions of each selected standard. Therefore, they are forced to go through the whole standard, which let them have a clearer idea of its use, necessity, and eventual utility. Additionally, students showed the best acceptance ratio since the first implementation of the gamification methodology. In this sense, one hundred percentage of assistance was registered on the playing sessions, which included students who do not attend other evaluable tasks or exams.

Another positive outcome of this increment in the number of board games and of this reduction in the number of team members was the possibility for students to directly interact with a wider spectrum of their colleagues. During each session, they will exchange their opponent and, consequently, face a new team. This led to an improvement in the overall performance of students during the theory classes, in which it became commonplace to ask out loud about and discuss about the suitability of the recommendations set by the different standards. These debates were also usual during the gaming sessions, and in most cases they were solved interacting with the educators.

Despite all the aforementioned results, the most relevant improvement implemented in this new methodology was the workload reduction of lecturers. Increasing the number of board games let professors enough freedom to approach each board on demand, to solve students doubts and discrepancies about the standards, as well as to individually evaluate the participation of each student. Therefore, the effort of each student can be evaluated more accurately, as there is no need to assign the same mark to a whole team. This last characteristic of the proposed gamification is of special interest in the case of bilingual courses. Professors are now able to monitor the correct use of technical language and the oral skills of each individual student. In

addition, the small groups and the presence of several boards mean that students have to express themselves more often, either when reading questions or answering them, and therefore the practice of the second language is also enhanced.

CONCLUSIONS

An already successful gamification methodology has been polished to increase the performance of students in graphic engineering courses. The increment of board games and the reduction of team members has led to the following major advantages:

1. A significant workload reduction for professors, which allows to establish new complementary evaluation remarks and individualized the evaluation of students.
2. An increment in the active participation of learners during playing sessions.
3. Its suitability in the case of bilingual courses, as professors not only can evaluate the actual participation of each student but also its correct use of technical language and pronunciation individually.

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