The effect of a combination of flipped classroom and gamification on university student's perceived teaching quality, subject satisfaction and academic performance
El efecto de una combinación de aula invertida y gamificación en la calidad de enseñanza percibida, la satisfacción con la asignatura y el rendimiento académico de los estudiantes universitarios

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Abstract. Alternative pedagogical approaches such as flipped classroom and gamification have shown improvements in academic motivation and performance in different academic contexts. The aim of this study was to report the effects of the implementation of an activity based on flipped classroom and gamification methods on perceived teaching quality, subject satisfaction and academic performance in university students from the Football subject in the Degree of Sciences of Sports. 102 students participated in the study. The students obtained 0.58 ($\pm$ 0.23) points out of 1.00 in the proposed activity. The scores in the final exam for the answers regarding the contents given in the proposed activity (88% hit) were 17% higher than the scores for the answers regarding the rest of contents (75%) (t= 8.54; *p*< 0.001; *d*= 0.82 [-0.10; 1.74]; "*large standardized differences*"). The student's perceived quality of teaching was higher (6%) than in the previous three courses, especially for questions related to the methodology used during the teaching-learning process and student's motivation. This suggests that implementing a flipped classroom and gamification strategies positively affects student engagement, motivation, and academic performance, leading to an improvement in teaching quality and satisfaction, and a significant increase in academic performance compared to traditional teaching methods.
Keywords: active learning, education, teaching.

Resumen. Enfoques pedagógicos alternativos como el aula invertida y la gamificación han demostrado mejoras en la motivación académica y el rendimiento en diferentes contextos académicos. El objetivo de este estudio fue informar sobre los efectos de la implementación de una actividad basada en los métodos del aula invertida y la gamificación en la calidad percibida de la enseñanza, la satisfacción de los estudiantes y el rendimiento académico en estudiantes universitarios de la asignatura de Fútbol en el Grado de Ciencias del Deporte. Participaron 102 estudiantes en el estudio. Los estudiantes obtuvieron 0,58 ($\pm$ 0,23) puntos de 1,00 en la actividad propuesta. Las puntuaciones en el examen final para las respuestas relacionadas con los contenidos impartidos en la actividad propuesta (88% de aciertos) fueron un 17% más altas que las puntuaciones para las respuestas relacionadas con el resto de los contenidos (75%) (t = 8,54; p < 0,001; d = 0,82 [-0,10; 1,74]; "diferencias estandarizadas grandes"). La calidad percibida de la enseñanza por parte de los estudiantes fue mayor (6%) que en los tres cursos anteriores, especialmente en preguntas relacionadas con la metodología utilizada durante el proceso de enseñanza-aprendizaje y la motivación de los estudiantes. Esto sugiere que la implementación de estrategias de aula invertida y gamificación afecta positivamente la participación, motivación y rendimiento académico de los estudiantes, lo que conduce a una mejora en la calidad y satisfacción de la enseñanza, y un aumento significativo en el rendimiento académico en comparación con los métodos de enseñanza tradicionales.
Palabras Clave: aprendizaje activo, educación, enseñanza.

Introduction

In recent years, there has been growing interest in alternative pedagogical approaches that aim to improve student motivation, engagement and academic performance at university. Two of the most popular approaches are the flipped classroom methodology and gamification in education (Strelan, Osborn, & Palmer, 2020; Sailer & Homner, 2020; Krath, Schürmann, & Von Korflesch, 2021). The flipped classroom methodology, also known as "inverted class" or "inverted learning", is a pedagogical approach in which the learning process is reversed, allowing students to acquire knowledge beforehand through online activities such as educational videos or readings, and then apply that knowledge in the classroom through group discussions, problems, and projects (Abeysekera & Dawson, 2015). This approach is based on the traditional idea that students learn better when they have control over their own learning and can work at their own pace (Foldnes, 2016). Additionally, flipped classrooms allow for students to learn collaboratively, which can improve their ability to communicate and work in teams

(Karabulut-Ilgu et al., 2018).

Flipped classrooms have also been linked to increased motivation and student participation (Karaoğlan, 2022), as well as improved academic performance. Recent literature regarding the use of flipped classroom methodologies shows significant increases in content comprehension and retention compared to traditional teaching approaches, improvements in academic performance and active participation of students and an enhancement of the content comprehension and the ability to apply knowledge in practical situations (Strelan et al., 2020). However, it is important to note that this methodology requires proper planning and effective implementation in order to achieve positive results.

On the other hand, gamification in education refers to the application of game-design elements and techniques in an educational context to enhance motivation, engagement and performance of students. As stated by Werbach and Hunter (2015), these elements can include points, rewards, challenges, competition, achievements, narratives, and storytelling. This methodology has been employed in a variety of educational settings, such as primary, secondary, and

higher education, as well as workplace training, and it has been shown to improve information retention, interest, and motivation of students (Brull & Finlayson, 2016). Additionally, it can also aid in developing key skills such as collaboration, communication, problem-solving, and critical thinking. Gamification can also be used in a variety of formats, from mobile applications and online games to board games and in-class activities. However, it is important to note that gamification should not be viewed as a magic solution for improving education and educators should use gamification strategically and ensure that the game elements are aligned with learning objectives (Landers et al., 2018). Furthermore, it is also important to evaluate the impact of gamification to ensure that it is improving student performance and motivation.

Studies have shown that gamification can significantly improve student motivation and engagement, which leads to increased interest in learning and greater participation in academic activities (Sailer & Homner, 2020; Krath et al., 2021). Furthermore, gamification has also been associated with an increase in academic performance (Arufe-Giráldez, Sanmiguel-Rodríguez, Ramos-Álvarez, & Navarro-Patón, 2022), as students feel more motivated to work hard and achieve goals (Su & Cheng, 2015). Another benefit of gamification in the university context is increased retention and transfer of knowledge (Putz, Hofbauer, & Treiblmaier, 2020). Games and playful activities provide a meaningful context for learning, which helps students relate the knowledge to their real life and work, and apply it in future situations (Grivokostopoulou et al., 2019). Gamification has also been related to increased ability to work in teams and collaborate, since it provides an environment where students can practice social and collaborative skills, such as effective communication, conflict resolution, and teamwork (Zhang et al., 2018; Vegt et al., 2015).

Like for the flipped classroom methodology, the recent scientific literature regarding gamification in the university context has found that it is effective in improving motivation and academic performance among university students (Sailer & Homner, 2020), and effective for improving active participation and collaboration among students, helping to foster a more playful and participatory learning environment (Zhang et al., 2018; Vegt et al., 2015).

This study aimed to show the effect of an implementation of an educational strategy based on the flipped classroom and gamification methodologies in the Football subject of the Degree in Sciences of Sports.

Method

Participants

The sample was composed by 102 students (73% male and 27% female) of the Football subject, included in the second course of the Degree in Sports Sciences at Miguel Hernández University of Elche. The whole sample performed the final exam, and they were enrolled in an activity which mixed the flipped classroom and gamification methodologies.

Study Design

The present study employed an experimental study design to compare the outcomes of two different teaching methodologies (traditional format of delivering class vs an active learning method) within the same sample and during the same academic term. The active learning method mentioned in this study incorporated a combination of the educational methodologies introduced in the earlier section, namely the flipped classroom and gamification. Specifically, this method was employed to facilitate the acquisition of the topic 4 contents within the subject. The approach involved a competitive activity that took place over the course of three in-class sessions, while individual learning of the topic content occurred outside of the classroom environment. This activity was endorsed by the Educational Innovation Program of the hosting university, where the study was conducted (PIEU-B/2022/29).

Flipped Classroom Strategy

The content of topic 4 of the subject referred to "The technique and tactics in football". For the learning of the contents of this topic, the traditional format of delivering class through teacher-centered lectures was eliminated, and the classroom space was used to carry out the described gamified task later on. The learning of these contents took place outside the classroom, and for this purpose, students had access to: (1) The PowerPoint presentation that was usually used as a visual support for the theoretical classes taught with a traditional methodology for this topic; (2) An explanatory video of the content related to the topic (teacher teaching the master class for this topic); and (3) Support videos, in the real field of application of the contents seen in the topic, where the student could see the specific technical and tactical actions that were explained during the topic.

Gamification in Classroom Strategy

During the theoretical classes scheduled to teach this topic (three classes of one hour duration), the students, grouped in teams of 5 members, played the so-called "Football League". The teacher, before the activity, had organized a league, in which each of the theoretical classes scheduled for this activity corresponded to a league day, and on each of them, each team faced another. These crosses were made randomly. During the day, all the matches between the different teams were carried out, which we call "games". In each game, the teacher asked a test-type question, with four answer options, to each of the members of each team, individually (only the member of the group being asked could answer) and alternately (once to each team). In this way, each team could answer 5 questions, one per "player". Each correct question meant a goal for the team. Each wrong question meant the loss of the opportunity to score a goal. In this way, the games could have all possible combinations of results between "0 - 0" and "5 -

5". As in a regular football league, the winner of the game took 3 points, while the loser went with 0 points. In case of a draw, each team received 1 point. In this way, it works with a method that helps understand real aspects of the sport, such as the score in a regular league championship.

Task Evaluation

Once the task was completed, each team had played 3 games, with a total of 15 questions answered. Given that this task had a grade within the final grade of the students of 1 point, each "goal" (correct answer) of the teams was valued at 0.07 points on the final grade of the subject for each of the members of the team. In this way, the matches between teams never had a negative impact on the final grade of each student. In addition to this, to encourage competition, an extra grade was given to the top three teams at the end of the task: 0.3 points for the members of the best-ranked team; 0.2 for the second-best team; and 0.1 for the third-ranked team.

Subject Evaluation

The final mark of the subject was composed by: (1) a final exam (7 points); (2) the task "Football League" (1 point); and (3) other tasks (2 points). The final exam consisted of 30 multiple-choice questions, with four options for answers. Six of the thirty questions (the proportional part in terms of content) dealt with content from topic 4 "The technique and tactics in football". The rest of the questions dealt with content from the remaining topics of the course.

Data Analysis

For this study, the marks in academic quality surveys (provided by the Quality Service of the university) were analysed for the last 4 years, comparing the results of the last 3 years to the current one, in which this study was performed. These surveys indicated the motivation level of students with the teacher and with the subject. Improvements in the marks of these academic quality surveys were reported as percentage (%) using the formula:

*% of change = (Mark in the current year − Average mark in the last 3 years) / Average mark in the last 3 years * 100*

The academic performance was shown as correct answer rate (*correct answers / total answers*) or percentage of hit (*correct answers / total answers * 100*).

In addition to this, a Kolmogorov-Smirnov (K-S) test was used to confirm the data normality. Then, a paired-sample t-test was performed to test the statistical differences in the academic performance of students between the exam questions regarding the topic 4 and the questions regarding the rest of the topics. The standardized differences or effect size (ES) (at 95% CI) for that comparison was estimated in Cohen's *d* units and interpreted trivial (<0.19), small (0.20–0.49), moderate (0.50–0.79) and large (>0.80) (Cohen, 2016). All calculations were performed using Microsoft Excel (Microsoft, Seattle, Washington, USA) and the level of statistical significance was set at $p < 0.05$.

Results

Academic Quality Surveys

The perceived quality of teaching (overall) by students in the course in which the research was conducted was 6.0% higher than the previous three courses. Additionally, questions related to the methodology used during the teaching-learning process in the classroom were the ones that obtained the highest percentage change when comparing the last three courses with the current course (Δ 8.0% for the question "The way the teacher teaches the class motivates me and arouses my interest in the subject"; Δ 4.2% for the question "The methodology used in the subject helps me to learn the contents planned in the program"; Δ 3.9% for the question "The teaching resources used by the teacher favour my learning"). The rest of the questions related to teaching quality, but without relation to the teaching methodologies used, also had a better assessment by the students in the year of the application of the study compared to the previous three courses, but the increase was only 2.2% (min: 0.9%; max: 4.0%).

Academic Performance

The average score obtained in the task that included the strategies of flipped classroom and gamification was 0.58 (± 0.23), being the highest score of 1.21 points (13 total questions answered correctly [*0.07 x 13 = 0.91p*] and the winner team of the task [*+0.3p*]) and the lowest score of 0.42 (6 questions answered correctly during the three sessions of the activity).

In the final exam of the subject, the students had, on average, a correct answer rate of 0.78 per question answered (78% hit). However, this ratio was higher for questions related to topic 4 ("The technique and tactics in football"), for which the methodological intervention outlined above was implemented (0.88; 88% hit). On the other hand, the correct answer rate per question for the rest of the topics (in which the educational strategy based on the flipped classroom and gamification was not carried out) was 0.75 (75% hit). The academic performance on the contents of topic 4 was 17% higher than for the rest of the contents, in which the educational strategy based on the flipped classroom and gamification was not implemented.

The K-S test indicated that the students' academic marks followed a normal distribution. The paired-sample t-test showed a significant difference between the student's academic performance in the exam questions regarding the topic 4 and the questions regarding the rest of the topics (t = 8.54; $p < 0.001$). In addition to this, the ES was 0.82 (-0.10; 1.74) indicating that the standardized difference was large.

Discussion

This study aimed to show the effect of an implementation of an educational strategy based on the flipped classroom and gamification methodologies in the Football subject of the

Degree in Sciences of Sports. The main findings of this study show that the implementation of an activity which mixed both, flipped classroom and gamification methodologies, was effective to increase the student's engagement and motivation, as well as their academic performance.

In this study, the results showed that the perceived quality of teaching by students in the course in which the research was conducted was 6.0% higher than the previous three courses. This is consistent with previous research that has found that students perceive an improvement in the quality of teaching when new teaching methodologies are implemented (Rotellar & Cain, 2016). In particular, the questions related to the methodology used during the teaching-learning process and student's motivation in the classroom were the ones that obtained the highest percentage change when comparing the last three courses with the current course. This suggests that the implementation of new teaching methodologies, such as the flipped classroom (Strelan et al., 2020; Krath et al., 2021) and gamification (Sailer & Homner, 2020; Landers, 2014), have a positive impact on student engagement and motivation. In addition to this, the perceived quality of teaching (and satisfaction with the subject) by students for this subject was higher (for all items) than the average scores of the subjects of the same course, where the main method of teaching is the traditional magistral class. Although this was not analysed as a result of this study, this may indicate that students could appreciate those subjects with this kind of educational strategies to a greater extent.

Traditional literature suggests that the use of flipped classroom and/or gamification methodologies (if they are correctly applied) should enhance the academic performance of students (Strelan et al., 2020; Sailer & Homner, 2020). The results of the present study showed an increase in the student's academic performance in those questions about the topic 4 of the subject ("Technics and tactics in football", in which the flipped classroom and gamification strategies were carried out) in comparison to the rest of the subject contents (0.88 vs 0.75 hit), in which the educational strategy based on the flipped classroom and gamification was not implemented. This result means a 17% enhancement, with statistically significant differences (t = 8.54; $p < 0.001$; $d = 0.82$ [-0.10; 1.74]; "*large standardized differences*") which further emphasizing the impact of the methodological intervention outlined above in academic performance.

These findings are in line with specific literature in the field of education in sports sciences regarding the use of the flipped classroom and gamification strategies at university. Falcón et al., (2021) and Hinojo-Lucena et al., (2018) reported a high and significant association between the use of the flipped classroom method and the marks in Spanish students of the degree in Sciences of Sports. On the other hand, the use of gamification strategies (which were used together with the flipped classroom method) improves the student's motivation, autonomy, and the development of competencies (García-Álvarez et al., 2022). The review of García-Álvarez et al., (2022) also highlight the versatility of gamification, which can be combined with other

pedagogical approaches, as it was used in the present study. Similar to the results of this study, and in the field of sports sciences with university students, Ferriz et al., (2020) showed that the gamification strategy improved significantly the student's intrinsic motivation and academic performance. Flores (2020) also used a gamification strategy with university students of Sciences of Sports, in combination with cooperative learning, showing that this learning strategy improved the student's motivation and participation, as well as the development of competencies. Similar improvements were found by Botha et al., (2018) in a university in South Africa, with improvements in motivation and voluntarily participation of students. In Pérez-López, Rivera & Delgado (2017) and Pérez-López & Rivera (2017), the authors used a similar "voluntarily" and "role-playing" strategy than in the present study, and with a similar sample (students of the degree of Science of Sports), showing that the implementation of this gamification not only improves learning, but also builds critical and reflective thinking in the student.

The findings of the present suggest that the combination of the flipped classroom and gamification strategies increase the students' active participation and understanding, according to (Hinojo et al., 2019) and their psychological needs satisfaction of autonomy, competency and social relationships (Zainuddin and Perera, 2019), according to the Self-Determination theory (Deci & Ryan, 1980), which impact on their final learning.

Conclusion

In conclusion, this study demonstrates that the implementation of an educational strategy based on the flipped classroom and gamification methodologies in the Football subject of the Degree in Sports Sciences has a positive impact on student engagement, motivation, and academic performance. The results suggest that students perceive an improvement in the quality of teaching and satisfaction with the subject when new teaching methodologies are implemented. Additionally, it was found that the combination of flipped classroom and gamification methodologies significantly improved academic performance compared to traditional teaching approaches. These findings are in line with recent literature that suggests that the implementation of flipped classroom and gamification methodologies can enhance content comprehension, information retention, active student participation, collaboration, and motivation. Based on the results of this study, the future prospects strongly encourage the continued use of this educational strategy in the subject, with the expansion of topics and content covered. Additionally, these findings support the need to further explore the potential of these methodologies in other subjects and educational contexts.

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