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GAMIFICATION AS AN EDUCATIONAL STRATEGY TO INCREASE MOTIVATION AND ACADEMIC PERFORMANCE

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KEYWORDS

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ABSTRACT

This article presents the design and implementation of an educational strategy based on gamification, whose objective was to motivate students and encourage active participation in virtual classes. The experience was developed with 35 undergraduate students of the National University of Ucayali in the subject of Systems Design. A diagnosis of the students' needs and interests was conducted, the technological tools were selected to design and implement gamification scenarios, and finally, the results demonstrated a high level of acceptance of the strategy, which favoured learning and improved the pass rate with respect to previous years.

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1. Introduction

In the context of the abrupt transition to virtual education induced by the global pandemic of 2019, the education sector has faced unprecedented challenges. In Peru, the transition from face-to-face to virtual learning has been a crucial measure to ensure the academic continuity of young people. However, this radical change has not only required immediate technological adaptation on the part of teachers and students but has also revealed significant problems. These include a decrease in student participation, an increase in distractions due to the use of mobile devices, and a notable decrease in academic performance (Nieto-Escamez & Roldan-Tapia, 2021). These circumstances have highlighted the need to investigate and implement innovative educational strategies that effectively respond to the challenges of learning in virtual environments.

Gamification, defined as the incorporation of game design elements and principles in non-game contexts (Hong et al., 2024), emerges as a promising strategy to address the aforementioned issues. Previous research has demonstrated the efficacy of this approach in motivating and encouraging students' active participation in the classroom. This approach offers a promising avenue for revitalising the teaching-learning process and improving academic outcomes in the online modality (Sharma et al., 2024).

This study is situated within the context of virtual education, which was initially implemented as an emergency measure but is now projected to become a permanent component of the educational landscape. Despite the benefits that digitisation offers in terms of accessibility and flexibility, the inherent limitations of online interaction have prompted concerns about the engagement and effectiveness of learning (Lee et al., 2024). In this context, gamification represents not only a mechanism to capture students' attention but also a pedagogical tool that, through the gamification of content and healthy competition, seeks to overcome the barriers of digital isolation and promote a collaborative and motivating learning environment.

The investigation of gamification in the Peruvian educational context is pertinent due to its capacity to offer insights on the adaptation of innovative pedagogical strategies to specific realities, taking into account both cultural particularities and technological and connectivity challenges (Peña et al., 2021). Furthermore, the case study on the subject of "Systems Design" at UNU (National University of Ucayali) provides a unique opportunity to assess the effectiveness of these methodologies in fostering essential digital and cognitive competences, as well as their impact on academic performance and student satisfaction. This analysis contributes to the existing body of knowledge, offering practical insights for educators and instructional designers seeking to incorporate gamification into their teaching strategies, with the ultimate goal of enriching the educational experience in virtual environments.

2. Design and Method

The methodology, population/sample size, and the design of the implementation strategy for gamification are described in the following sections.

2.1. Method

The research methodology employed a quantitative approach at the descriptive level.

Table 1. Table of variables

Variable	Dimensions
Gamification as an Educational Strategy	Dynamics
	Mechanics and components
	ICT platforms and tools
Motivation and academic performance	Motivation
	Academic performance

Source: Own elaboration (2021)

2.2. Population and Sample

The object of analysis in the present research is the student cohort of the Systems Engineering specialisation, attached to the Faculty of Systems Engineering and Civil Engineering of the National University of Ucayali. This approach allows for a comprehensive understanding of the educational dynamics and the impact of pedagogical innovations in a specific field of professional study, characterised by its academic rigour and its relevance in the current technological context.

A sample of 35 students in the sixth cycle of the programme, specifically enrolled in the course "Systems Design" during the academic semester 2021-II, was deliberately selected for the development of this study. The pedagogical intervention was implemented during the sessions corresponding to the four principal didactic units of the course, with a particular focus on the most crucial content. The central objective of this strategy was to enhance motivation and academic performance through the implementation of active teaching methods, including competency-based learning and gamification, as innovative approaches for fostering a dynamic and participatory learning environment.

2.3. Gamification Strategy Design

The educational strategy, which applied the principles of gamification, was divided into four parts.

The first of these was to identify the academic performance of the students of the subject "Systems Design" in previous years by evaluating the final transcripts of the last three years.

Table 2. Identification of subject results in previous years

AÑO	MODALIDAD	APROBADOS	DESAPROBADOS	TOTAL
2018	MODALIDAD PRESENCIAL	37	10	47
2019	MODALIDAD PRESENCIAL	39	7	46
2020	MODALIDAD VIRTUAL	25	23	48

Source: Own elaboration, 2021.

The second was to make a diagnosis of the classroom context, the needs and interests of the students and the pedagogical practice developed by the teacher of the subject, making use of interviews and questionnaires through the Google Forms tool.

Chart 1. Question related to the diagnosis of students' needs and interests

Source: Own elaboration (2021) based on data obtained from 1

Thirdly, the technological tools for implementing gamification in educational contexts were identified. A total of ten applications used in virtual teaching were analysed, of which four were selected to implement the scenarios of the educational strategy in different moments of the class (before, during, at the end of the class and to reward the student's effort).

Table 3. Table of selected applications

N°	Ict tools	Stages of implementation	Objectives
1	Menti	At the start	Measuring prior knowledge
2	Mural	During	Collaborative space between teacher and student during the lesson
3	Kahoot	At the end	To assess learning and reinforce knowledge
4	Kudobox	At the end	Rewarding effort according to results.

Source: Own elaboration, 2021.

Fourth, the gamification-based learning scenarios were designed and implemented, taking into consideration the information obtained previously. This included the identification of participants, recurrent behaviours, desired objectives, available resources, technological tools, dynamics, rewards, the dynamics of the game, the unit, classes and theme to be gamified. They were identified as follow:

- **Actors (participants):** It was applied in the professional career of systems engineering, with the students of the subject "Systems Design" of the VI cycle (semester 2021 - II), a total of 35 students.
- **Recurrent behaviours** were observed: Non-attendance, lack of participation in class, failure to submit work and poor quality of work.
- **Objectives**: To motivate students to actively participate in class, to dynamise the development of thematic content in class, to improve some recurrent student behaviours and to improve academic performance in the subject (to increase the percentage of passes compared to previous years).
- **Available resources**: Technological tools and gamification tools.
- **Technological tools**: 04 Tics Tools used: Mentimeter, Mural, Kahoot and Kudobox.
- **Dynamics**: For each class, selected for each unit (quizzes, word cloud and sorting) were used.
- **Suggested rewards:** 1 point for the lowest mark on an assignment, 1 point for the lowest mark on a graded practical, eliminating a no-show, and 1 point for an exam (mid-term or final).
- **Game mechanics:** Gamification will be applied in the following order:
    - *At the beginning* of the class to assess prior knowledge and answers will be given individually using the application (Menti).
    - *During* the class to carry out cases and practical work, in group mode (groups of 5 students).
    - *At the end* of the class to assess the knowledge acquired and the answers will be given individually.
- **Unit, class and subject to be gamified**: The subject "Systems Design" is divided into four units and it has been decided to apply gamification in one class per unit, selecting the topic with the most relevant content for the students.

Table 4. Unit and topics to be gamified

Unit	Theme	Ict tools
I	Basic fundamentals of software development	Mentimeter (at the beginning) Mural (during) Kahoot (on completion) Kudo box (reward)
II	Software development cycle	
III	Database concepts and relational model	
IV	Input and interface design	

Source: Own elaboration, 2021.

- **Gamification scenarios:** According to the strategy to be applied, the scenarios were established as follows:

Figure 1. Gamification scenario design

Source: Own elaboration, 2021.

- **Implementation of Gamification scenarios:** The implementation of the strategy was carried out in 3 phases:
    - At the beginning of the semester, the interaction characteristics, dynamics and mechanics of the game were presented, with emphasis on how to accumulate points and the prizes to be obtained, as shown in the following tables.

Table 5: Ways to accumulate points

Item	Reward
1	Attendance at all classes
2	Class participation
3	Punctual delivery of work
4	Good quality of the work presented

Source: Own elaboration, 2021.

Table 6: Rewards set

Item	Reward
1	1 point on the lowest mark for a commissioned work
2	1 point for the lowest mark in a graded practice
3	Eliminate a non-attendance
4	1 point in an exam (midterm or final)

Source: Own elaboration, 2021.

- The students were introduced to the Gamification Tics tools. The following tools were employed: Mentimeter Mural, Kahoot and Kudobox. Additionally, the Blackboard Open LMS Platform (which is provided by the university and already known to the students) was utilised.
- The individual and group game dynamics were developed around the thematic content being developed in the subject. These included questions on the teacher's knowledge and activities such as quizzes, word clouds, relationships, and others.
- Furthermore, a guide to the ICT tools that may be employed in the context of gamification was compiled. The publication, entitled "Technological Tools for Gamification - A Guide for Teachers", will be of benefit to all teachers who wish to implement a gamification-based educational strategy in their classes.

3. Objectives

The general objective and specific objectives are set out below:

3.1. General Objective

To determine how the application of Gamification as an educational strategy, increases motivation and academic performance in students of the subject "Systems Design" of the professional career of Systems Engineering - UNU.

3.2. Specific Objectives

3.1 The general objective of this study is to ascertain whether the implementation of gamification as an educational strategy can enhance motivation and academic performance in students enrolled in the Systems Design subject within the Systems Engineering professional programme at UNU.

Specific objectives:

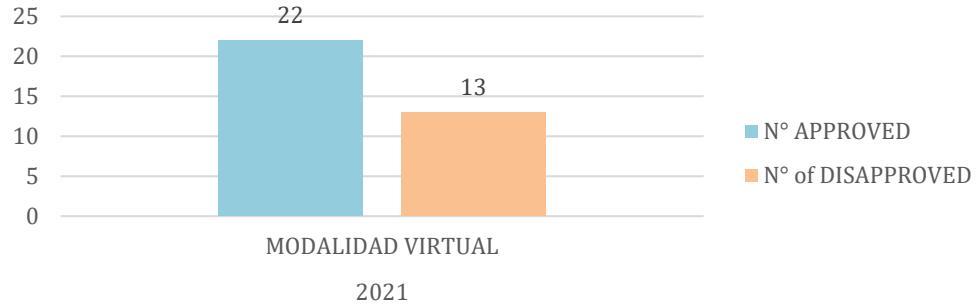
- To identify the academic performance of students in the subject prior to the implementation of gamification.
- To diagnose in the classroom context the needs and interests of the students and the pedagogical practice developed by the teacher of the subject "Systems Design". - To identify and analyse the dynamics, mechanics, components and technological tools that can be employed to implement Gamification in educational contexts.
- To design and implement gamification-based learning scenarios for the subject "Systems Design".
- To evaluate the motivation and academic performance of students of the subject "Systems Design" after the application of Gamification.

4. Results

With regard to the evaluation of students' motivation and academic performance, the following results were obtained:

- Regarding motivation, the following results were obtained: In terms of the efficacy of the strategy in enhancing motivation for the development of thematic content across the units, over 90% of students demonstrated engagement and participation, although not necessarily accuracy in marking responses.
- Academic performance was also evaluated. Following the implementation of the educational strategy (gamification), it was observed that 22 students (out of a total of 35) passed the subject, while 13 students (out of the same total) failed the subject. This is illustrated in the following figure.

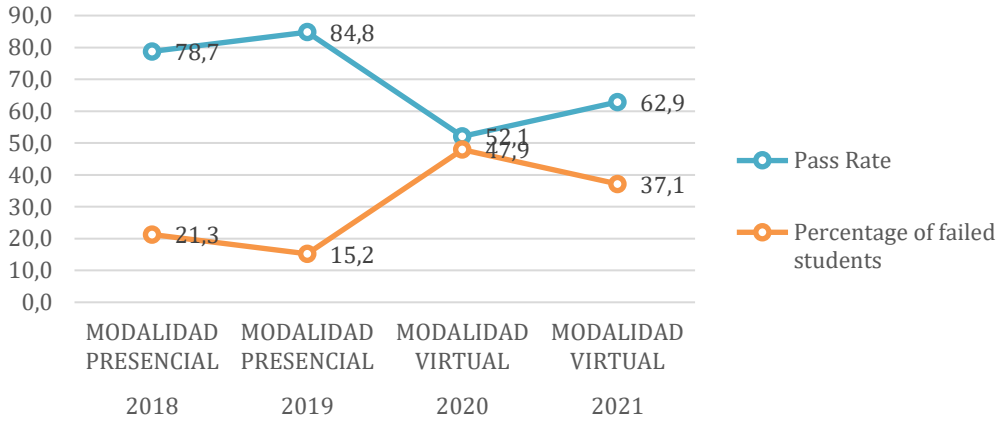
Chart 2. Subject results in the academic semester 2021 -II



Source: Own elaboration, 2021.

The data, presented in percentage form, indicates a notable increase in the number of students who passed the subject in the virtual modality through the implementation of the gamification strategy, when compared to previous years. This is illustrated in the subsequent figure:

Chart 2 Pass and fail rates



Source: Own elaboration, 2021.

5. Conclusions and Discussions

The abrupt transition from face-to-face to virtual mode, triggered by the COVID-19 pandemic, has highlighted the urgent need to incorporate Information and Communication Technology (ICT) into educational processes. This situation revealed the structural and technological limitations of our university, in particular the lack of adequate infrastructure to support an efficient virtual education model. Despite the continuous efforts made by the University authorities to improve these conditions up to this year (2024), major challenges remain in terms of access and the quality of the technological resources available to teachers and students.

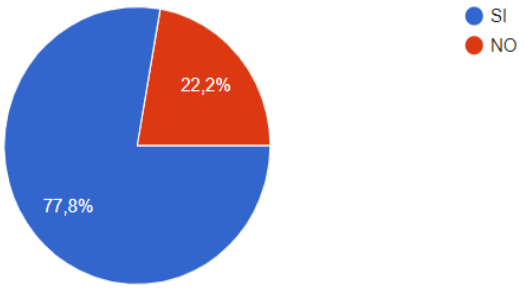
The implementation of gamification as a pedagogical strategy has proven to be a valuable resource for the dynamisation of content and the encouragement of student participation. However, its effective application is limited by the existing digital divide, particularly in terms of unequal access to the Internet by students. This obstacle underlines the importance of investing in technology and in the development of a comprehensive technological infrastructure to enable the effective implementation of virtual classrooms and universal access to internet service on campus.

Moreover, the outcomes of the gamification strategy implemented demonstrate that although an enhancement in student motivation was achieved, the issue of a lack of prior and necessary knowledge for specific subjects persists. This indicates the necessity for a review and update of the professional career curriculum, with particular attention to the structuring of subjects and their prerequisites, in order to ensure that students are adequately prepared for the academic challenges.

6. Discussion

In terms of the efficacy of the strategy for enhancing motivation in the creation of thematic content within the classroom setting, 77,8% of students surveyed indicated that it is beneficial, while 22,2% expressed the view that it is not. This discrepancy can be attributed to the fact that some students are reluctant to embrace change and continue to view the traditional strategy as a viable option. Additionally, other studies have corroborated the effectiveness of the strategy. (Hong et al., 2024).

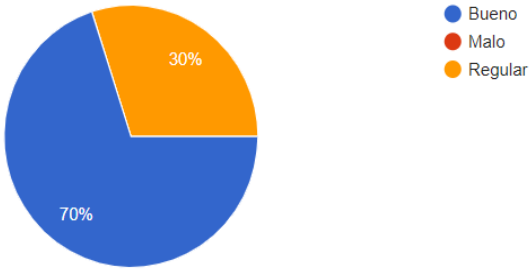
Chart 3 Assessment of the usefulness of the strategy



Source: Own elaboration, 2021.

In terms of the functionality of the technological applications employed for gamification, 70% of respondents indicated that they found them to be effective, while 30% stated that they believed them to be fair. This is due to the fact that, as a pilot test, the functionality of the ICT tools was not utilised in its entirety. Consequently, as a means of improvement, this strategy will continue to be applied in other subjects under the responsibility of the teacher responsible for this research.

Chart 4 Assessment of the functionalities of ICT tools



Source: Own elaboration, 2021.

The results of the study indicate that this type of strategy is conducive to motivating students in the classroom and enhancing academic performance. It is possible to learn and have fun simultaneously, provided that a balance is maintained between these two elements.

6. Acknowledgements

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