

## Article

# Gamification in mathematics: The Squid Codes, a fun approach to boosting learning and motivation

**Gamificación en matemáticas: Los códigos del Calamar como propuesta lúdica para potenciar el aprendizaje y la motivación**

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## Abstract

This research explored the impact of a gamification strategy inspired by the narrative of Squid Game to enhance the teaching and learning process of mathematics in 55 secondary school students. A quasi-experimental design was used to evaluate how this playful methodology influenced academic performance, motivation levels, and active participation among students. The evidence points not only to an improvement in knowledge retention, but also in the overall perception of mathematics. Consequently, gamification stands out as an effective pedagogical response to overcoming the

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inherent and systemic difficulties in teaching this discipline. Implications, limitations, and recommendations for future educational interventions that promote dynamic, contextualized, and motivating learning are discussed.

**Keywords** Gamification, Mathematical learning, Student motivation, Educational innovation, Secondary education

## Resumen

Esta investigación exploró el impacto de una estrategia de gamificación inspirada en la narrativa de El Juego del Calamar para potenciar el proceso de enseñanza-aprendizaje de las matemáticas en 55 estudiantes de secundaria. Se empleó un diseño cuasiexperimental para evaluar cómo esta metodología lúdica influía en el rendimiento académico, el nivel de motivación y la participación activa de los alumnos. Esta evidencia no solo apunta a un avance en la retención de saberes, sino también en la percepción general de las matemáticas. En consecuencia, la gamificación se erige como una respuesta pedagógica eficiente para superar las dificultades inherentes y sistémicas en la enseñanza de esta disciplina. Se discuten implicaciones, limitaciones y recomendaciones para futuras intervenciones educativas que promuevan un aprendizaje dinámico, contextualizado y motivador.

**Palabras clave:** Gamificación, Aprendizaje matemático, Motivación estudiantil, Innovación educativa, Educación secundaria

## Introduction

Currently, secondary school students in various educational systems are scoring lower on academic mathematics tests. This has been exacerbated by addiction to smartphones and social media, which draw young people's attention to online entertainment and reduce their interest in spending time studying mathematics. The rapid and playful overstimulation provided by these devices creates distractibility and detachment from subjects that involve difficulty and little pleasure, interfering with their participation in class and their grades.

Given the recurring problems in mathematics education, such as lack of motivation or the perception of the subject as difficult, it is necessary to innovate in teaching methods. Current studies show that traditional methods fail to make mathematics interesting and understandable, influencing student performance and participation

(Bernal Párraga et al., 2024; Holguin García et al., 2020). As a solution to this, gamification is an emerging proposal that seeks to incorporate game mechanics into the classroom to make learning more attractive and achieve long-term commitment from students (Deterding et al., 2011; Hamari et al., 2014).

According to Zambrano and Luque (2020, p. 6), “gamification is an innovative strategy that uses techniques and elements from game design in educational contexts, with the purpose of engaging, motivating, and facilitating self-regulated learning. This methodology adapts to the needs of the student, promoting a dynamic and meaningful educational experience that enhances engagement and improves knowledge acquisition.”

Recent studies support that games and gamified dynamics used in mathematics classes increase students' interest and make them feel more involved, favoring not only their academic performance but also the development of digital and soft skills such as teamwork. According to (Chuchuca Tocto et al., 2025), gamification can promote intrinsic motivation and facilitate the acquisition of mathematical skills through challenges, feedback, and progress. Likewise, game-based educational learning platforms such as Kahoot or Quizizz can enrich teaching and learning processes by turning the practice of concepts into interactive and contextualized experiences for students (Villacís Montoya et al., 2025).

Innovative activities drawn from students' current interests suggest creating an interactive mathematical experience based on El Juego del Calamar, with the aim of leveraging its attractive features to foster a dynamic, competitive, and cooperative educational environment. Several studies indicate that when highly interesting thematic integrations are combined with appropriate classroom management, student participation will increase (Carmen NM, 2023; Mora Aristega et al., 2025; Reinoso Molina et al., 2024).

This study is unique in that it implements a gamified experience based on the popular narrative of Squid Game, adapting its elements of competition, collaboration, and progressive challenges to create an innovative educational environment that motivates upper-level general education students through the gamified activity entitled “The Codes of Squid.” In addition, it studies how gamification influences the growth of skills such as teamwork, analytical reasoning, and digital competence, which coincide with the requirements for 21st-century learning outcomes (Anchundia Anchundia et al., 2025).

The main objective of this research is to evaluate the impact of a gamified strategy inspired by The Squid Game on the motivation, participation, and academic performance in mathematics of students in upper secondary education at the Ángel Modesto Paredes Educational Unit in Quito. To achieve this objective, the following question is posed: How does the implementation of a gamified strategy inspired by The Squid Game influence the motivation, participation, and academic performance in mathematics of upper-level general education students at the Ángel Modesto Paredes Educational Unit in Quito?

## Materials and methods

This research adopts a mixed approach, combining qualitative and quantitative methods to explore the impact of a gamified strategy inspired by Squid Game on the motivation and learning of mathematics in 55 upper elementary school students. A pre-experimental design is used with a single group divided into two subgroups (Group A and Group B), following a non-randomized and quasi-experimental scheme, which allows changes to be observed before and after the intervention (Camacho, 2024; Chica, 2024).

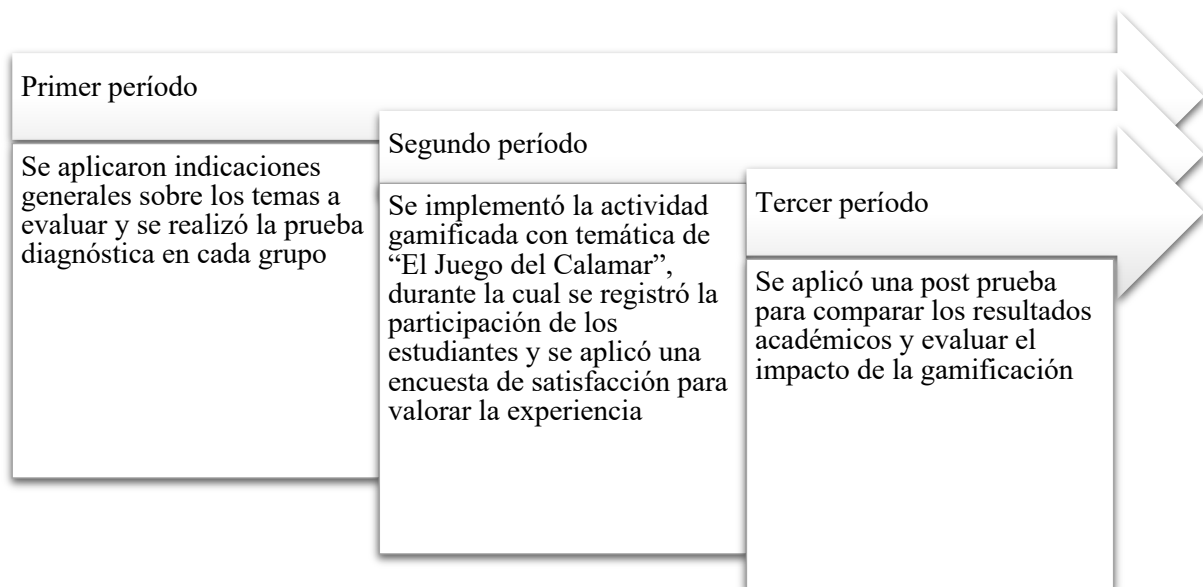
### Instruments and materials

The following were used for data collection and analysis:

- Structured questionnaires to assess motivation and satisfaction with mathematics and gamification, including a post-activity satisfaction survey.
- Academic tests designed in accordance with the content assessed, to apply diagnosis (pre-test) and measure results (post-test).
- Observation records to document participation in gamified activities.

The activities were organized around a thematic session based on El Juego del Calamar, which was an integral part of the diagnostic assessment and gamified intervention.

**Figure 1. Research Procedure**



The playful strategy implemented consisted of a gamified thematic session inspired by the series Squid Game, designed for the recovery and reinforcement of mathematical content. The objective was to create a dynamic, competitive, and cooperative learning environment that would increase student emotional engagement.

The intervention was structured in six progressive levels, where the main playful mechanic was the restriction of movement (students were tied at the feet in pentathlon style) to force collaboration. Passing each level depended on the correct resolution of exercises corresponding to the defined thematic content.

The following explains how the gamified activity was carried out so that students could complete the six proposed challenges.

**Table 1.** *Description of Challenges and Mathematical Content of the Gamified Intervention*

| <i>Nivel Temático</i>                       | <i>Contenido Matemático Central</i> | <i>Objetivo Específico del Reto</i>                                                        | <i>Mecánica Lúdica Adaptada (Acción)</i>                                                                                                                                                      |
|---------------------------------------------|-------------------------------------|--------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Reto 1:</b><br><i>La Primera Luz</i>     | <b>Ecuaciones e Inecuaciones</b>    | Dominar el despeje de variables y la comprensión de conjuntos solución.                    | La <b>resolución grupal</b> correcta permitía avanzar a la siguiente zona de movimiento. La incorrecta penalizaba el avance, haciendo que la atadura cobrara un sentido de dificultad física. |
| <b>Reto 2:</b><br><i>Puentes de Cristal</i> | <b>Teorema de Pitágoras</b>         | Aplicar el Teorema de Pitágoras para hallar lados desconocidos y determinar ángulos.       | Cada equipo tenía que resolver los ejercicios propuestos utilizando el teorema de Pitágoras.                                                                                                  |
| <b>Reto 3:</b><br><i>La curva invisible</i> | <b>Funciones</b>                    | Representar las coordenadas de las funciones planteadas                                    | Cada equipo debía completar la tabla de valores y proceder a graficar la función. Una vez finalizado podría avanzar a la siguiente actividad.                                                 |
| <b>Reto 4:</b><br><i>El Mercado Negro</i>   | <b>Punto de Equilibrio</b>          | Calcular la intersección de funciones de oferta y demanda para determinar el punto óptimo. | Reto de <b>toma de decisiones bajo presión</b> . Los equipos debían calcular rápidamente el punto de equilibrio para "comprar" el tiempo extra o una ventaja en el juego.                     |
| <b>Reto 5:</b><br><i>Las Canicas</i>        | <b>Sistema de Ecuaciones 2x2</b>    | Resolver sistemas mediante métodos de igualación o sustitución para hallar dos incógnitas. | Encontrar los valores de X y Y para dar solución al sistema de ecuaciones que permita encontrar el número de canicas correctas para pasar el nivel.                                           |
| <b>Reto 6:</b><br><i>El Duelo Final</i>     | <b>Razonamiento Abstracto</b>       | Descifrar la figura que continua la secuencia para completar el ejercicio de lógica.       | Resolver ejercicios de lógica que requieran de habilidades de pensamiento crítico.                                                                                                            |

## Results

Upon completing the analysis of data on national assessments conducted by INEVAL (National Institute for Educational

Assessment), it was found that in recent years, average results in mathematics have remained poor among students in general basic education. These results show that over the last four years, there has been little variation in mathematics assessment results, which remain at a basic but unsatisfactory level. This poses a challenge for mathematics teaching in upper-level basic education (INEVAL, 2025).

Below are the average scores out of 10 obtained in the pre-test and post-test in both groups. There was a significant increase in the average scores after the gamified activity intervention. The scores obtained (out of 10) in the pre- and post-tests reflect a notable increase in performance. Group A improved by 23.15% and Group B by 23.34% (Table 1). These data show that the gamification-based intervention had a positive impact on performance and the assimilation of mathematical concepts.

Below are the results of the questionnaires administered before implementing the gamified activity. This allowed us to determine the initial values based on their interest in the subject, confidence and willingness to participate in problem solving, and average satisfaction rating after the gamified activity, on a scale of 1 to 5. Most students rated the experience very positively in terms of enjoyment, usefulness, and motivation.

Before the intervention, the initial motivation (interest, confidence, and attitude) of Groups A and B was moderate, with an average between 3.1 and 3.3 on a scale of 1 to 5 (Table 2). In contrast, the post-gamification satisfaction assessment (Table 3) showed a significant increase, reaching averages above 4.4. This shows a high level of enjoyment, perceived usefulness, and greater motivation for future learning.

Finally, the participation record indicates high and consistent attendance (95%) and active participation (90%) during the gamified sessions, reflecting the students' commitment to the proposed methodology.

## **Discussion**

The findings clearly indicate that the gamified strategy, inspired by Squid Game, contributes significantly to both improved academic performance in mathematics and increased motivation and engagement among secondary school students. This discovery is in line with previous educational studies in Ecuador: gamification, through game dynamics and cultural elements, is a powerful tool for

promoting a favorable attitude toward this subject (Chuchuca Tocto et al., 2025; Tobar-Veas et al., 2025; Conya, 2024).

This research determined a 23% increase in participants' grades after the post-evaluations, which is significant considering the averages in mathematics identified by INEVAL in previous years. For this reason, this work is presented as a guide for implementing active methodologies that reduce problems related to interest and motivation in learning mathematics. However, it is accepted that the effectiveness of this strategy may be limited by factors such as the duration of the intervention, the socio-emotional characteristics of the students, and the training of teachers to apply gamification techniques. Therefore, future research should investigate long-term interventions and analyze the application of game-based learning in other areas of knowledge and in various socio-educational situations.

These findings coincide with and reinforce previous research carried out in the educational field in Ecuador. These studies had already demonstrated that the use of game dynamics and the integration of contemporary cultural references have the capacity to foster a positive predisposition towards learning mathematics.

It is recommended that future research extend the duration and scope of the study in order to determine its positive effects. Likewise, consideration should be given to evaluating the socio-emotional impact and covering other areas of knowledge.

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