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ORIGINAL ARTICLE

Gamification as a didactic strategy for teaching Mathematics in elementary education

La gamificación como estrategia didáctica para la enseñanza de Matemáticas en la educación básica elemental

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Abstract The study aimed to develop a methodological proposal by applying gamification strategies to encourage mathematics learning among elementary school students at the Sathya Saim Fiscomisional Educational Unit (Sucre, Bahía de Caráquez, Manabí). The research employed qualitative and quantitative methods; in the qualitative approach, interviews and observations were used, as they were considered the most appropriate for profoundly understanding the topic under investigation. In the quantitative approach, the survey technique was applied, facilitating data collection and interpretation regarding gamification as a strategy in Mathematics. The study involved 30 students and four teachers who underwent a diagnostic process in which gamification strategies were implemented to assess their feasibility in Mathematics. As a result of this investigative process, it was found that gamification is a motivating tool that promotes the use of innovative strategies by teachers, strengthening students' knowledge and enriching the didactics, which improved the teaching-learning process in Mathematics.

Keywords gamification, teaching-learning, didactics, educational strategies, elementary education.

Resumen El estudio tuvo como propósito elaborar una propuesta metodológica aplicando estrategias basadas en la gamificación para incentivar el aprendizaje de Matemáticas en los estudiantes de básica elemental de la Unidad Educativa Fiscomisional Sathya Saim (Sucre, Bahía de Caráquez, Manabí). Los métodos empleados en la investigación fueron cualitativo y cuantitativo; en el enfoque cualitativo se utilizaron la entrevista y la observación, consideradas las más apropiadas para comprender en profundidad el tema investigado, mientras que en el enfoque cuantitativo se aplicó la técnica de la encuesta, la cual facilitó la recolección de datos e interpretación sobre el uso de la gamificación como estrategia en Matemáticas. La investigación incluyó a 30 estudiantes y 4 docentes, quienes fueron sometidos a un diagnóstico en el que se implementaron estrategias de gamificación para evaluar su factibilidad en el área de Matemáticas. Como resultado de este proceso investigativo, se evidenció que la gamificación es una herramienta motivadora que fomenta el uso de estrategias innovadoras en los docentes, fortaleciendo los conocimientos de los estudiantes y enriqueciendo la didáctica, lo que mejoró el proceso de enseñanza-aprendizaje en Matemáticas.

Palabras clave gamificación, enseñanza-aprendizaje, didáctica, estrategias educativas, educación elemental.

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PUBLIS EDITORIAL

Introduction

Gamification was a strategy that sparked growing interest in the educational field, facilitating the acquisition of skills and competencies, especially in Mathematics. According to Cuba and Pérez (2021), projects based on gamification were developed in Chile, such as the "Video Games for the Development of Science Skills through Cell Phones" program, designed by the University of Chile, to stimulate science learning in primary education through role-playing games.

Educational gamification integrated gamification concepts and training, promoting learning through play. Gamification was a key tool for entertaining students in the classroom, allowing their participation in various dynamics that favored the teaching-learning process. Its correct implementation proved to be a valuable resource for improving students' academic performance.

Saadati and Celis (2023) highlighted that learning mathematics is challenging for most students, resulting in a high failure rate in this subject. This issue was reflected in the PISA report from the Ministry of Education of Ecuador (2018), which reported that 70.9% of students failed to reach level 2, which is considered the minimum standard of performance in mathematics.

In this context, a methodological strategy based on gamification was proposed to encourage mathematics learning among students at the Sathya Sai Fiscomisional Educational Unit.

Methodology

This research was conducted at the Sathya Sai Fiscomisional Educational Unit in the Rodríguez Lara neighborhood of the Leónidas Plaza parish, Sucre canton. The institution has an organizational structure consisting of two administrators, 18 administrative teachers, and a janitor, covering levels from early education to the third year of high school. This institution bases its educational model on human values such as love, truth, righteousness, peace, and non-violence, promoting a transformative approach toward spiritual life.

The study adopted a mixed approach, integrating both qualitative and quantitative methods to analyze teaching strategies in Mathematics, particularly those based on gamification. For this purpose, theoretical, empirical, and statistical methods were applied in various stages of the research process. The techniques used included observation, interviews, and surveys, which allowed the identification of the advantages and disadvantages of the pedagogical strategies implemented by the teachers. The target population consisted of four teachers and 90 students from the elementary sublevel in the area of Mathematics, with the entire population selected for the research through a non-probabilistic convenience sampling.

Gamification was explored as a key strategy to improve the learning of mathematics. The study analyzed how teachers use playful tools to avoid student demotivation and encourage learning. The analytical-synthetic method was essential for breaking down and understanding the root causes of the problem, allowing the generation of knowledge and pedagogical proposals (De Sales et al., 2019). The inductive and deductive methods helped clarify educational dynamics and formulate hypotheses about the benefits of gamification. Issa and Khataibeh (2021) highlighted that this approach allows for comparing results with proposed hypotheses, establishing the validity of educational strategies. Hernández-Sampieri and Mendoza (2018) emphasized that statistical methods provide a solid foundation for pedagogical analysis, facilitating the development of proposals that align with the needs and characteristics of students.

Results and discussion

The need to implement creative and innovative pedagogical tools in the classrooms was identified in the interviews with teachers from the elementary sublevel at the Sathya Sai Fiscomisional Educational Unit. Gamification emerged as a promising strategy to foster students' interest and understanding in Mathematics (Maryana et al., 2024). Teachers pointed out that, in some cases, students fail to understand the content explained, leading to demotivation and a lack of interest in the subject, which is perceived as complex. This situation is linked to the limited application of educational strategies that could enhance the learning and active participation of the students.

The interviews' analysis revealed that teachers do not employ structured and effective strategies to strengthen the teaching-learning process in Mathematics. Incorporating playful strategies and dynamics would facilitate understanding concepts and promote a more motivating and effective learning environment.

The teachers demonstrated an empathetic and collaborative attitude while participating in the interviews, adjusting their schedules to facilitate the process. Through these interactions, they highlighted the teachers' opinions and experiences as a fundamental basis for proposing improvements in educational practices. This approach allowed for identifying critical areas and emphasized the importance of implementing innovative strategies, such as gamification, to

optimize learning in mathematics and increase student engagement.

In the observation conducted in the second year of Basic General Education at the Sathya Sai Fiscomisional Educational Unit (Table 1), it was evident that students have difficulty understanding the content in Mathematics. Furthermore, the teacher did not use creative strategies, instead relying on outdated methods that hinder learning. The lack of gamification

Table 1. Analysis of the classroom observation on the use of gamification as a teaching strategy for Mathematics in the second year of basic education

Indicator	Criterion	Classroom observation
Level of understanding of mathematical elements for learning	The teacher makes the students understand when explaining math content.	The classroom observation revealed that some students easily understand the math content, while others face difficulties due to their tendency to get distracted. This highlights the diversity in learning styles and the teacher's limited use of creative and innovative tools to foster a clear and effective understanding of the content.
	The content is appropriate for the grade level the teacher teaches.	During instruction, the teacher selects and adapts the content based on the students' level and age, ensuring consistency with the curriculum. This well-planned approach helps facilitate comprehension and learning of the material presented.
Management of established strategies or those implemented by the teachers	The teacher uses different strategies to help students understand math.	The teacher employs some strategies to teach math, but the lack of creativity and innovation limits student motivation. This can lead to disinterest and hinder learning in the classroom.
	The students enjoy the strategies used by the teacher.	Although the teacher does not use gamification as an innovative strategy, sometimes the teacher gets students to explore their prior knowledge and build their concepts. However, the limited use of this methodology hinders learning in mathematics.
Function of gamification in the classes	Effectiveness of the use of gamification in math classes with students.	The effectiveness of gamification in math classes could not be assessed, as the teacher does not use it. However, it was observed that the students enjoy games, which helps facilitate their interaction and problem-solving. This suggests that gamification could improve content comprehension, but the teacher seems unfamiliar with this tool and how to implement it in the classroom.
Level of understanding of the benefits of using gamification in math classes	Use of gamification in the area of mathematics to motivate students.	The teacher does not use gamification to motivate math learning, though various strategies are employed to aid comprehension. While the teacher guides the students and proposes simple exercises, this tool is not incorporated into lessons, possibly due to a lack of knowledge regarding its impact on motivation and learning.
	The students understand the topics the teacher teaches.	The classroom observation showed that the students understood the topics explained, although some grasped them faster than others. The teacher occasionally uses appropriate techniques and clear, brief concepts to facilitate understanding.

Indicator	Criterion	Classroom observation
Level of development of the class objectives (considering aspects of math and the use of gamification)	The teacher meets the objectives outlined in the math plan.	The teacher fulfills the objectives in the math plan, seeking strategies to reach the students. They base their evaluation on achievement indicators to assess knowledge, identify difficulties, and reinforce comprehension.
Level of use of teaching strategies oriented toward students	The teacher guides the students in the topics he proposes.	The observation showed that the teacher guides students in their learning, adapting techniques and activities when encountering difficulties. Although gamification is not used, the teacher seeks strategies to facilitate topic comprehension.
	Methods the teacher uses to help students solve math exercises.	The observation showed that when students face difficulty with an exercise, the lack of appropriate methods can demotivate them. To improve learning, the teacher occasionally incorporates small games to encourage problem-solving.
Manipulation of techniques and concepts that are comprehensible to students	The teacher uses appropriate techniques for students to understand the concepts.	The teacher uses appropriate techniques to facilitate understanding, although innovative strategies are not employed. However, the teacher instills security and confidence in the students, creating a comfortable learning environment.
	The teacher adapts scientific content.	The teacher uses concepts appropriate to the student's age and level, presenting them clearly and accurately to facilitate comprehension. However, gamification could further enhance learning.
	The teacher provides feedback on the math concepts.	When the teacher notices difficulties in students, they reinforce math concepts using various strategies and activities. They ask open-ended questions to assess understanding and assign tasks for reinforcement at home.
Importance of the learning process of activities	The teacher values gradual learning processes in students.	The teacher values student activities to assess their understanding of math, although gamification is not used. During virtual education due to the pandemic, the teacher checks the work submitted via email or WhatsApp to verify correctness.
	The students solve the exercises in groups.	The observation confirmed that the teacher conducts various activities in math class, although they are not always group activities. It is important to note that due to the pandemic, students are working through the Zoom platform.

in the classes demotivates students, who lose interest in the subject due to the absence of playful dynamics.

For the research, an expert-validated survey was applied to elementary mathematics teachers. It was conducted virtually using Google Forms, collecting information on the pedagogical strategies employed. The results indicated that 60% of the teachers used content appropriate to their teaching level and employed various strategies to improve mathematical comprehension, while only 40% did so occasionally in each case.

Regarding group work, 20% of the teachers implement it regularly, 60% do so occasionally, and 20% do not use it. Sixty percent of the teachers apply creative methods to avoid boredom, although the exact percentage admitted not always doing so. Gamification is poorly known among teachers, as 50% are familiar with this technique. As for its implementation, 50% favor using it in mathematics, 35% disagree, and 33% disagree about its educational impact.

In the triangulation of the results, various dimensions were analyzed. In the pedagogical dimension, it was evident that teachers rarely use innovative strategies, leading to student demotivation. In the gamification dimension, it was determined that most teachers are unfamiliar with this technique, preventing its application in the classroom. Regarding the didactic dimension, it was observed that teachers value students' activities and employ different methods, although they do not always meet their objectives. Finally, in the communicational dimension, it was identified that although teachers value students' activities, they do not always select appropriate content or foster group work.

In light of this issue, the proposal aims to implement gamification as a didactic strategy in teaching Mathematics at the Sathya Sai Fiscomisional Educational Unit. It seeks to verify that the lack of innovative methods affects students' performance and motivation. By integrating playful dynamics into learning, gamification facilitates the development of skills and abilities, turning lessons into more stimulating experiences. Several studies, such as Subiaga (2019), have shown that this technique improves student motivation, interaction, and engagement, contributing to more effective learning.

The use of gamification in the teaching of mathematics can significantly improve students' academic performance as long as the tools used are designed with appropriate cognitive criteria, correctly integrate playful elements, and are guided by the teacher as a learning facilitator (Jaramillo-Mediavilla et al., 2024).

Incorporating gamification into contemporary education requires integrating Information and Communication Technologies (ICT) into pedagogical processes. Its application seeks to transform teaching into a more attractive and stimulating experience for students. According to Ortiz-Colón et al. (2018), this methodology responds to learning needs and allows students to engage actively with academic content, facilitating their understanding and assimilation more effectively. In this sense, teaching performance must be strengthened through innovative didactic strategies, such as gamification, to develop skills and capacities in mathematics.

The results of the diagnosis conducted on teachers and students at the elementary level of the Sathya Sai Fiscomisional Educational Unit in Bahía de Caráquez show that teachers are unaware of gamification and do not apply it in their lessons. Additionally, it was identified that the strategies currently used do not generate meaningful learning, negatively impacting students' development of mathematical skills and abilities. This suggests strengthening diversified didactic strategies to improve the teaching-learning process.

The proposed didactic strategy is aimed at teachers who want to enhance their teaching methods in elementary education. It seeks to encourage the use of gamification as an innovative pedagogical tool that promotes student learning. The proposal also presents recommended technological platforms, their applications in the classroom, and the benefits students can gain in their educational process.

This strategy will help stimulate learning, increase student motivation, and foster a higher commitment to academic activities. It will also contribute to the development of problem-solving skills for real-life situations. For the correct implementation of gamification in Mathematics, the following requirements must be considered:

- Approval from institutional authorities to execute the strategy.
- Authorization from the teachers and students involved.
- Continuous access to the internet.
- Availability of technological equipment for using digital platforms.
- Teacher training in the application of gamification as a didactic strategy.
- Clear definition of the applicability of the strategy in elementary education.

The methodological proposal (Figure 1) comprises three phases aligned with the research objectives. The first phase, "planning," includes the design of the strategy, its socialization, and teacher training. During this stage, a diagnostic assessment is carried out regarding teachers' knowledge of gamification and its use in teaching mathematics. The second phase focuses on disseminating and socializing the proposal's progress with the directors and other educational stakeholders. Finally, the third phase schedules the training sessions, completing the project's first stage. This strategy seeks to transform the traditional approach to teaching mathematics by using gamification to promote a more interactive and stimulating learning experience.

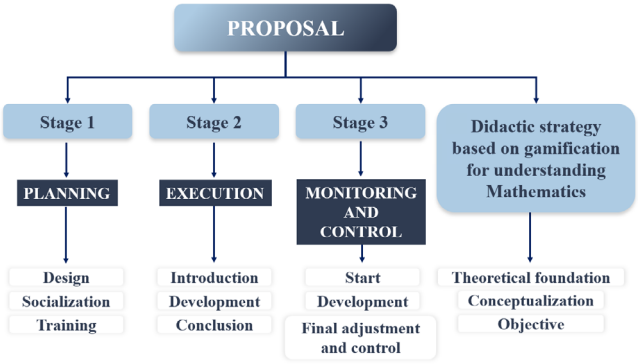

Figure 1. Conception of the proposal.

Stages of the proposal

Stage 1. Planning

Planning teaching strategies in Mathematics is a fundamental process to strengthen teaching and improve student learning. In this stage, a diagnostic was conducted to identify the teachers' main difficulties in teaching this subject. This analysis allowed for the detection of shortcomings, correction of deficiencies in the topics covered, and evaluation of various situations that affect the educational process.

The main objective of this stage was to provide teachers with effective strategies for teaching mathematics, promoting a more dynamic and interactive learning environment through gamification.

The planning phase establishes the procedures to follow in implementing the proposal and defining its objectives, goals, and necessary resources. This planning specifies the actions to be carried out in each training and socialization workshop, which are part of the proposed teaching plan presented for approval.

Action 1. Design

In this phase, the structure and contents of the training were established, and the elements to be addressed in each session were organized. The thematic framework was defined, and the use of interactive platforms such as Wordwall and Quizizz, digital tools designed to enhance teaching through gamification, was planned.

Action 2. Socialization

The proposal was socialized in several stages. Initially, a presentation was made to the institution's administrators, in which the importance of the project was outlined, and their observations and suggestions were gathered. Subsequently, a dissemination system was established in collaboration with the Mathematics teachers at the elementary level during the morning shift at the Sathya Sai Fiscomisional Educational Unit. The final phase of this action involved organizing the training sessions, which were held virtually due to the COVID-19 pandemic.

Action 3. Training

At this stage, the procedures for conducting the training workshops aimed at elementary-level teachers were outlined. The training was structured into two main sessions. The first session (Table 2) covered the theoretical foundations and analysis of the application of gamification in Mathematics, exploring the conceptual bases of gamification as a teaching-learning strategy and emphasizing its impact on student motivation and academic performance.

The second session (Table 3) focused on the use of gamified platforms in teaching mathematics. Teachers were trained in using digital tools like Wordwall and Quizizz, highlighting their benefits and applications in the classroom as innovative teaching resources.

Stage 2. Execution

The objective of this stage was to design a training proposal on how to use the platforms Wordwall and Quizizz to apply gamification in the Mathematics area. In the execution phase, the Sathya Sai Fiscomisional Educational Unit teachers were sensitized to use gamification as a teaching strategy in their educational practices. The gamification training proposal explicitly aims to teach how to use the Wordwall and Quizizz platforms to teach Mathematics through playful activities, thus motivating students to learn this subject, considering it as a teaching strategy within the teaching-learning processes through gamified activities.

Action 1. Introduction

Gamification was proposed by using the Wordwall and Quizizz platforms to motivate students to learn mathematics. This proposal outlined the steps to use the platforms and develop creative and motivating activities.

Wordwall is a platform for creating interactive and printable activities. These can be used as games during classes or assigned as homework for students. It offers a variety of fun and innovative templates that allow for effective learning monitoring. Wordwall is another excellent tool for making the students' learning process visible, allowing for tracking

Table 2. Training workshop on the theoretical foundations and analysis of the application of gamification in Mathematics

WORKSHOP TOPIC Theoretical foundations and analysis of the application of gamification in Mathematics.		
Participants: 3 teachers who teach in the elementary sublevel **Date:** In process **Place:** Computer lab of the educational institution. **Duration:** 90 minutes **Modality:** In-person/Virtual **Workshop objective:** To train teachers on the potential of Gamification as a teaching-learning strategy in Mathematics.		
Schedule	**Activities to be covered – topics**	**Materials**
Working hours	**Starting activities:** • Welcome • Introduction of the facilitator • Introduction of participants (Name and surname, profession, and years of experience) • Preliminary assessment of the teachers • Objective of the workshop	Zoom Slides
	Development activities: • Presentation of the contents ✓ Definition, origin, and benefits of gamification ✓ Gamified activities vs. Traditional activities ✓ Role of the teacher-students in the use of gamification • Break • Discussion – Reflection	Zoom Slides
	Final activities: • Distribution of brochures on the topic	Cards

the acquisition of knowledge and learning objectives.

The Quizizz platform helps assess students through customizable quizzes, which can be created from scratch or with pre-existing questions in the tool.

Action 2. Development

Stages to use gamified activities in Mathematics classes.

Wordwall platform

This is a tool for creating attractive activities in a natural way. Once created, you can change the template and switch the type of activity with a click. You can also use and edit activities created by other users and print access and registration sheets.

Wordwall can be accessed at the following link: https://wordwall.net/es. Before using the platform, you must register; the language can be adjusted in the top right corner. It has both a paid and free version, allowing you to create five resources.

Using resources previously created by other users or designing new, personalized activities is possible. By selecting the "COMMUNITY" option at the top of the platform, you can access a repository of resources shared by other users. A notable feature of this tool is the ability to modify and personalize existing resources, including the option to change the template with one click.

Choosing the template is key in the activity creation process. One advantage of this tool is the flexibility to assign a different template to an already-created activity with one click. Several templates are available, including interactive, multiplayer, and printable activities. Some templates are exclusively reserved for premium accounts.

Once the appropriate template is selected, an intuitive editor is accessed. Its interface changes depending on the type of activity chosen, offering an accessible editing experience

Table 3. Training workshop on the use of the gamified platforms Wordwall and Quizizz as a teaching strategy in the area of Mathematics

WORKSHOP TOPIC		
Use of the gamified platforms Wordwall and Quizizz as a teaching strategy in Mathematics.		
Participants: 3 teachers who teach in the elementary sublevel **Date:** In process **Place:** Computer lab of the educational institution **Duration:** 90 minutes **Modality:** In-person/Virtual **Workshop objective:** To train teachers on the potential of gamification as a teaching-learning strategy in Mathematics.		
Schedule	**Activities to be covered – topics**	**Materials**
Working hours	**Starting activities:** • Welcome. • Workshop objective. **Development activities:** • Presentation of the gamified platforms Wordwall and Quizizz. • Definition of platforms: Wordwall and Quizizz. • Explain the use of the platforms. • Break. • Discussion – Reflection. **Final activities:** • Distribution of manuals on the topic. • Create a gamified activity using the Wordwall and Quizizz platforms in the area of Mathematics.	Zoom Slides Zoom Slides

adaptable to various pedagogical needs.

From the "My Activities" menu, you can access all activities created by the user and those modified from other users' resources. After selecting the template, an editor with an intuitive interface is activated, with settings that vary based on the chosen activity. Templates can be edited, renamed, shared, organized into folders, and deleted. Activities on the Wordwall platform can be shared in two ways. First, they can be shared with other teachers within the Wordwall community, allowing other users to access, use, and modify them as needed.

Alternatively, to share activities with students, various options can be configured to facilitate their use and evaluation. These options include asking students to enter their names before starting the activity, setting a deadline for completion, and deciding whether to show answers and the leaderboard at the end of the exercise. Once these options are defined, activities can be distributed to students via a direct link, email, or integration into platforms such as Google Classroom, social media, websites, or blogs.

After the students complete the activities, the results can be analyzed from the "My Results" tab. This tool provides access to detailed statistics, question breakdown reports, and an individual performance analysis for each student.

Quizizz platform

The Quizizz platform offers a free version for educational institutions. To access its features, you must create an account through the website https://quizizz.com/. The registration process begins by selecting the "Start" option, which leads to a welcome screen. Next, select the "at a school" category corresponding to the educational field. Finally, select the "Teacher" option, intended for education professionals.

For creating quizzes and formulating questions, it is recommended to have a pre-structured questionnaire in a Word document to speed up the creation process on the Quizizz platform. To start, select the "Create" option from the main menu, assign a name to the quiz, and select the corresponding area of knowledge. At this stage, the user can create their questions or incorporate existing questions from other related quizzes using the Teleport feature. To design a custom question, select the "New Question" option and choose

the type of question to develop. Below is a brief description of each question type (Table 4) to choose based on the requirements.

When selecting the Multiple Choice question type in Quizizz, a window is enabled where you can write the question and the answer options. Additionally, multimedia elements such as mathematical equations, images, or audio files can be incorporated to complement the question. Answer options can include text, mathematical equations, or images, although they cannot be combined simultaneously.

Next, you must mark the correct answer and, if necessary, add more answer options. You can set a time limit for answering the question. Once this process is completed, you should select the Save option.

Table 4. Types of questions on the Quizizz platform

Question type	Description
Multiple choice	Question with only one correct answer.
Box	Question that can have more than one correct answer.
Fill in the blank	For one-word or short answers, it allows adding alternative responses that students might write.
Survey	All alternatives are considered correct in the reports. Useful for gathering opinions.
Open	All responses entered by students are considered correct in the reports. When downloading the report, you will need to evaluate each answer.

The quiz is progressively built, including different types of questions according to the teacher's needs. If you need questions from previously published quizzes in Quizizz, you can use the Teleport function, which helps search for and select relevant questions using the Add option. To modify, duplicate, or delete a question within the quiz, you must access the controls at the top of each question.

Additional adjustments can be made within the Quiz Panel, such as adding a representative image for the topic, selecting the language, and configuring privacy. This allows you to decide whether the quiz will be accessible to the entire Quizizz community or remain private. You can also modify the title of the quiz. Once the settings are completed, you should select the Finish option.

The saved quiz will be available in the My Library section of the main menu, where it can be sent to students. Select the Start Live Quiz option, followed by Classic Mode, to start the activity in real time. Finally, copy the generated link to share the quiz with students and send it to the appropriate device.

Once the steps for creating various educational activities are explained, multiple teaching strategies must be applied to optimize the learning process for students. Among the recommended activities are interactive games on platforms such as Wordwall, such as those focused on learning multiplication tables. These tools allow reinforcing knowledge in a fun and motivating way, encouraging active participation and the development of mathematical skills in students.

The "Math wheel of fortune" activity (Figure 2) is an interactive educational resource designed to reinforce mathematical knowledge playfully. The game consists of spinning a wheel with intensity, and once it stops, the student must answer the question indicated by the wheel. As participants answer the questions correctly, they accumulate points that allow for ranking, thus promoting a motivating and competitive learning environment.

This gamified approach facilitated the dynamic and engaging practice of mathematical concepts, promoting the development of logical thinking and decision-making in students. The activity can be played at the following link: https://wordwall.net/es/resource/22924245.

Figure 2. Wheel of fortune for multiplication tables.

The "Balloon Burst" activity (Figure 3) is designed to strengthen the learning of multiplication tables through an interactive and playful dynamic. When the game starts, students must press the start button, after which a moving train

will appear with different wagons containing multiplication operations. Simultaneously, multiple balloons with different numbers will appear at the top of the screen. The student's task is to identify and select the balloon that contains the correct answer for each operation presented in the wagons.

This gamified methodology facilitates learning multiplication tables by integrating visual and dynamic elements that promote active participation and motivation among students. The activity is available at the following link: https://wordwall.net/es/resource/3911426.

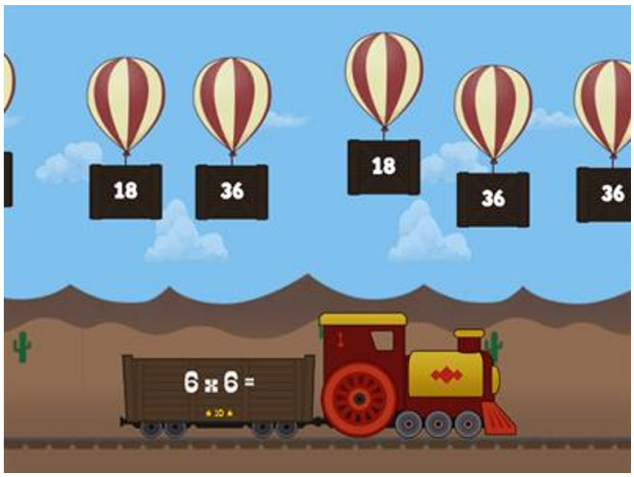

Figure 3. Balloon burst.

Action 3. Conclusion

The elementary education teachers carried out Mathematics activities using the Wordwall and Quizizz platforms to implement them within the classroom and thus improve the teaching-learning process of the students. The teachers had previously received training on using the different gamified platforms.

Stage 3. Monitoring and control

This stage's purpose was to evaluate the implementation of various digital platforms as a teaching strategy based on gamification and analyze its impact on the teaching of Mathematics within the Sathya Sai Fiscomisional Educational Unit.

Action 1. Initial evaluation

In the first stage, a diagnostic exam was administered to the institution's teachers who participated in training on using gamification as a teaching strategy. This tool allowed for the assessment of the teachers' prior knowledge of the covered content and the identification of the advantages and disadvantages of different gamified platforms used in the educational process.

Action 2. Development of the proposal

During this phase, the pedagogical proposal was implemented and evaluated, following a structured approach that allowed for verifying the achievement of the objectives. Continuous monitoring of the teaching process and the teachers' reception was carried out to ensure the effective application of the gamified strategy. In addition, support was provided in using digital tools like Quizizz and Wordwall, facilitating their integration into the planning and development of mathematics activities.

Action 3. Adjustment and final evaluation

Once the intervention was completed, a final evaluation was conducted through a structured survey on Google Forms. This tool measured the proposal's effectiveness and determined the degree of achievement of the formulated objectives. The strategy's impact on the teachers' motivation and willingness to use gamified platforms in their teaching was analyzed. Finally, this methodology's effect on improving the students' teaching-learning process was validated.

Validation of the gamification proposal

The proposal was validated using user criteria, following the methodology of Campistrous and Rizo (2006). They highlighted the suitability of this technique when the evaluators are direct users of the proposal and are immersed in its application context. This approach allowed for assessments that were closely aligned with the reality of the study.

To carry out the validation, an instrument was applied to 12 professionals with a postgraduate degree and experience in the subject. Their expertise contributed to strengthening the credibility and robustness of the research. The evaluation was structured into four key aspects: general conception, proposal structure, functionality, and practical implications (Figure 4).

The instrument included an evaluation scale with the following categories: very adequate, adequate, moderately adequate, slightly adequate, and inadequate. Regarding the general conception of the proposal, 100% of the evaluators rated it as very adequate, highlighting its innovative nature in mathematics teaching and its alignment with the study's objectives. They also emphasized the solidity of its theoretical and academic foundations and the clarity of its objectives,

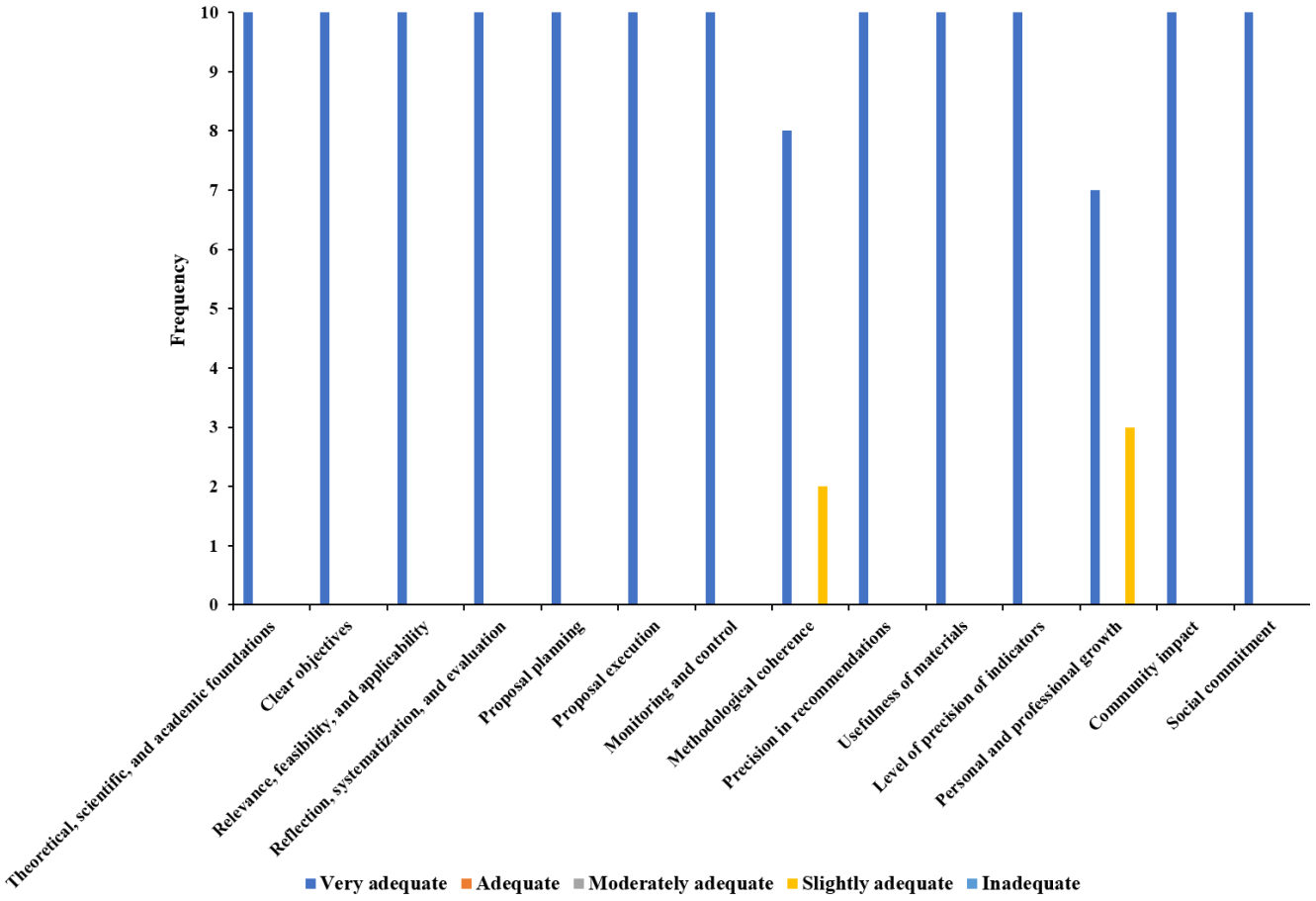

Figure 4. Validation, structure, functionality, and practical implications of the proposal.

which integrate reflection, systematization, and evaluation as transversal axes of the process.

All the surveyed professionals (100%) stated that the proposal was highly adequate, highlighting its effectiveness, innovation, feasibility, applicability, and contribution to the educational and pedagogical field. 100% of the teaching staff considered the proposal's writing clear, precise, and concise. All the teachers (100%) indicated that the document's structure was appropriate in all its phases, including planning, execution, and monitoring or control.

Regarding the functionality of the proposal, 80% of education professionals considered it highly adequate due to the methodological coherence among its various structural components, including phases, actions, and recommendations. They highlighted the precision of the recommendations for the implementation of each action, along with the usefulness of the proposed support materials and the accuracy of the evaluation indicators. Additionally, 100% of the respondents stated that the proposal demonstrated precision in defining actions, the usefulness of the support materials, and the accuracy of the indicators, suggesting a positive impact on its implementation process.

Regarding the practical implications of the proposal, 70% of the professionals stated that it is highly adequate for the personal and professional development of the teachers involved in the project. The entire teaching staff (100%) considered the proposal relevant and appropriate, highlighting the responsibility and commitment to creating learning opportunities. Finally, 100% of education professionals positively assessed the proposal's feasibility, confirming its viability for implementation.

Table 5 shows students' average scores before and after gamification in different academic periods. The results indicate that this tool was effective in teaching Mathematics.

Conclusions

The theoretical-methodological framework was key to developing the bibliographic section of the study, particularly regarding gamification and the teaching-learning strategy. Various classroom issues were identified, concluding that gamification fosters enthusiasm among teachers and students by enhancing educational skills and competencies. The diagnosis of the teaching-learning process revealed deficiencies in the development of mathematical skills, detected through research instruments. A procedural guide was proposed for applying gamification in Mathematics to promote active and efficient learning. After its design, experts evaluated and validated the proposal to determine its feasibility and achieve its objectives.

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Conflicts of interest

The author declares that she has no conflict of interest.

Author contributions

Cruz B. Zambrano: Conceptualization, data curation, research, methodology, visualization, writing the original draft, writing, review and editing..

Data availability statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Statement on the use of AI

The author acknowledges the use of generative AI and AI-assisted technologies to improve the readability and clarity of the article.

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