Digital Gamification in Third Grade Primary School Mathematics Teaching

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Abstract

Gamification is a term referring to recreational forms or games that can be applied to various organizational contexts. The general objective of this proposal is to improve the learning of mathematics, particularly the resolution of basic operations: addition, subtraction, multiplication and division of the third-grade students of elementary school. The aforementioned is based on a digital vision of gamification applicable to solving mathematical algorithms, maintaining a flexible axis for the diversity students, who are digital natives. The proposed methodology adapts to the different teaching models, although it is always better to be positioned in a paradigm of the reflective professional teacher since the model ideal for the didactic transposition of mathematics.

keywords

Mathematics, Gamification, Teaching.

1. Problematization

Based on the results of the evaluation of the ¨Plan Nacional para la Evaluación de los Aprendizajes¨ (PLANEA) 2018, and during an evaluation meeting in the UPN unit's department of the Tamaulipas state, the last August 17, 2023, it was approved discuss this result with emphasis on the subject of mathematics. From this, three work tables were established corresponding to each of the learning phases at the primary educational level.

It was announced that the results are not favorable in terms of the achievement of the third-grade students, belonging to phase 4 of the current 2022 curriculum the new Mexican school of primary education given that in this ranking we only surpass the state of Veracruz, and such state is in the last position. Third grade students, of public education, from the state of Tamaulipas present difficulties in performing basic operations in relation to the use and detection of standard procedures in each of the operations such as: addition, subtraction, multiplication and division.

Meaning that, they are not able to interpret the mathematical need involved in a certain written approach, most of the time they do not systematize a procedure that leads them to the detection of data and possible ways of solving mathematical algorithms.

Based on the aforementioned, the following problematization question is presented:

How to improve the learning and resolution of basic operations: addition, subtraction, multiplication and division of the students of third grade in federal primary education?

2. Justification

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The teaching-learning process of the basic mathematics operations in third grade students of public education primary school is a challenging and relevant topic. The teaching of the arithmetic operations is fundamental for the development of critical thinking in students. However, is common for students to have difficulties understanding and applying these operations. It is important that teachers look for appropriate teaching strategies to address this problem and promote meaningful learning.

In these sense, generating a dynamic interface, which includes the use of digital technology (aimed at virtuality), and that it is within the reach of the majority of students provides the possibility that students are motivated to experience digital platforms with which they can interact with mathematical analysis base, in this case to verify some results of basic operations which they have previously carried out, or as complementary exercises that contribute to a study technique.

3. Congruence matrix

Chart 1.- scaffolding to identify the congruence of the object of study

Congruence matrix

Objective	Population	Theorical reference
To improve the learning and resolution basic operations: addition, subtraction, multiplication and division of third grade students of primary education.	Third grade students of primary education of Tamaulipas state.	Marguerite Altet (2005) Karl M. Kapp (2012) Yves Chevallard (1998)

4. Conjecture

Third grade public primary school students in the Tamaulipas state are able to solve mathematical problems that involve the use of basic operations, such as addition, subtraction, multiplication and division, using the material from "Programa Estatal de Reforzamiento Matemático Apegado" a la Nueva Escuela Mexicana (PERMANEM).

5. Introduction

The teaching and learning processes have a great history trough educational evolution, as well as the innovative processes that have been developed within the classrooms in different areas. The educational innovation is a process that implies a change in teaching and is based in four fundamental elements: people, knowledge, the processes and the technology. The introduction of educational innovation is crucial to adapt to changes in society and the world of work. educational updating is not only about generating changes in teaching practice, but also about changing beliefs, values and ideas that impact the actions of teachers and students.

5.1. Teaching models

In this sense, Altet, in her work called "The competence of the professional teacher or the importance of knowing how to analyze practices" 2005, reveals that throughout the history of pedagogy there have at least four teaching models, which, in their historical moment had given solution to the societies needs and the training of group members with specific training needs.

These results were made known trough the presentation of the conclusions of research carried out by the Direction de Evaluation y Prospection (DEP; cfr. Altet, 1993) for an international study of the organization for economic cooperation and development (OCDE) about "the quality of teachers". In the training seminars we have invited teachers of all levels to reflect togheter on the skills necessary for the good exercise of the teaching profession.

The teaching models proposed by Altet are:

- The master magister or magician: intellectual model from Antiquity that consider the teacher as a tutor or a magician who knew everything and who did not need specific training or research because his charisma and rhetorical skills were enough.
- The technical teacher: model that emerged with normal schools; the training is based on the imitative learning of the practices of the experienced teacher, who transmits his procedures and his "tricks" to the student; the trainer is a "model" experienced practitioner; technical skills are dominant.
- The master engineer, specialist in technical aspects: in this third model the master uses the scientific contributions of the human sciences, rationalizes his practice and tries to apply theory to practice. The training is provided by theorists who are specialists in pedagogical design or didactics.
- The professional teacher, reflective practitioner: in this fourth model, the theoretical-practical dialectic is replaced by a practice-theory-practice movement; The teacher becomes a reflective professional capable of analyzing his or her own practices, solving problems and inventing strategies. The training integrates the contributions of practitioners and researchers, and aims to develop in the teacher an approach to lived situations of the action-knowledge-problem type by jointly using theory and practice so that the teacher builds the necessary capacities of metacognition and analysis. Of their own practices. (Altet, 2005, p. 4).

With the aforementioned Altet, it offers the possibility of knowing what teaching models have been developed throughout history, therefore, it is necessary to identify the importance of knowing how to analyze the practices of a reflective professional teacher that give the possibility of executing a teaching function that is always relevant to the historical moment that is being experienced.

5.2 Gamification in education

Gamification observed from an educational point of view, and with a digital emphasis, uses certain elements that capture the attention of students and contributes to a conceptual change on the part of learners in relation to a dynamic and fun sense, even more so if the intervention is about mathematics.

Parra & Torres, in their work, Gamification as a teaching resource in the teaching of design, taking up to Kapp, they mention that in gamification certain elements of games are used that we must know if we want to better understand gamification and especially its use in the field of education. Kapp (2012) points out some of these elements:

- Mechanic. La gamification must offer clear goals and play rules well established to ensure that players feel able to achieve their objectives.
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- Aesthetic. The use of attractive images.
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- Motivation. The addition to the game of levels or points that are generally rewards for players. In this sense gamification offers concrete and short terms challenges, with

achievable goals. All of this helps to maintain commitment. Furthermore, people learn trough time and repetition, which is why the challenges must increase. In this way, it is necessary to find a middle ground so that the player does not find himself unable to achieve the objective, and therefore leaves the game.

- Promote learning by incorporating psychology techniques to promote learning through play, such as the assignment of points and corrective feedback.

In this sense, it cannot be ignored that students are part of a generational group in which they are great consumers of social networks and processes of daily life are linked to artificial intelligence such smart phones with virtual assistants.

According to Price Waterhouse Coopers (PWC, 2015):

Hundreds of millions of people around the planet spend millions of hours each month playing consoles, PCs or some type of mobile device. That is why, we can or should, establish similarities between the educational system and video games, which are designed to keep the player motivated for as long as possible, accumulating points and surpassing levels, just as happens in our classes, in which they have to pass exams to pass the courses. (2015).

However, considering the previously mentioned, we cannot forget that each individual is different and that what works excellently for one may not work for another. For this reason, it is essential that a flexible methodology be built that can be used by different teaching models (as mentioned by Altet 2005), as well as by different types of students who attend our classrooms. In this sense, gamification must be thought of as a fragmented and non-universal motivator, that is, the motivations must come from different directions.

So, in this proposal model the element of motivation is not perceived as a stimulus response for the participant, motivation is taken back as a process in which the student enjoys the class and at that moment, he is informed what the learning route, that is, maintaining a firm and directed path, understanding that the teaching and learning process is in itself the evaluation route

Although throughout history it has been detected that video games and digital technological devices generate a constant attraction of people's attention, the focus of these digital interfaces is taken up in this document as one more route to verify results. In basic mathematical operations, that is, enabling collaborative work in which several fellow students can use QR codes to explore applications such as Google Earth, and in this way, check some data on arithmetic operations.

This is how we chose to use a gamification that, according to researcher Andrzej Marzewski, is thin-layer, that is, without modifying all the existing content and that adds a series of elements that serve to achieve the proposed goals.

Returning to what was stated by Smith, 2011, recreational strategies are aimed at achieving several objectives, such as:

- Make the learning progress more transparent, so that the student becomes aware of the pass of time and how their knowledge increases.
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- Promote self-learning by making the student stop being a passive recipient and become an active value in learning.

The work methodology that is proposed has a constructivist basis since it encourages students to become an active agent when learning and is the main actor in their own learning, and that they do not always wait to be attended to by a "magician teacher." " or a "technical

teacher", but is part of the vision of a "reflective professional teacher" teaching model, that is, that the student is not only a receptacle of information, summarizing, that they are the true protagonists.

The fact of including activities that use digital technology invites students to discover new ways of validating results in basic operations, the constructivist pedagogical intervention approach motivates students to discover different routes to the classic algorithmic processes, that is, these are the phase prior to the use and application of applications that gamify mathematics learning.

5.3. Didactic transposition of wise knowledge to taught knowledge

Within the frame of this intervention proposal, didactic transposition exists when elements of knowledge are transferred to taught knowledge; it refers to the process of transforming an object of knowledge into an object of teaching. A content of knowledge that has been designated as knowledge to be taught thereafter undergoes a set of adaptive transformations that will make it suitable to occupy a place among the objects of teaching. The "work" that transforms an object of knowledge to be taught into an object of teaching is called didactic transposition.

Chevallard (1998) mentions that: "didactic transposition is defined as a joint process of teaching and learning, which has as its object didactic creation. For this, he distinguishes didactic transpositions stricto sensu and sensu lato: the first concerns the passage of understand a scientific content that is precise and well defined, to imagine a didactic version of it; and the second, is represented by the creation of the teaching object itself, the didactic object" (Chevallard, 1998, p. 99).

In this sense, it is invited to the elaboration of processes that encourage students to know and live the dynamics of learning as part of the same process of reading the reality in which each of them lives. That is, to build the world in which they live from what is spontaneously considered as "mathematics in daily life". It is common for students to assume that there are situations that are only lived within the school, such as the use of writing, reading, addition, subtraction, devices such as the calculator, the abacus or pieces and cards for the identification of units, tens and hundreds, it is necessary to bring to the reality of the life of the students mathematics as part of the construction of the world in which they live.

within the education field, didactic transposition becomes very important because the contents of knowledge that is taught are not always the same as the contents of knowledge that exist in the discipline. Sometimes, teachers have to create new knowledge content to make it more accessible and understandable to students. Didactic transposition is the process by which this transformation is carried out. In summary, didactic transposition is important in education because it allows the contents of knowledge to be taught in an effective and accessible way for students.

The scientific study of the process of didactic transposition involves taking into account the didactic transposition represented by the scheme "object of knowing - object to teach - object of teaching". In this scheme, the first link marks the passage from the implicit to the explicit, from practice to theory, from the pre-built to the constructed. In short, didactic transposition is the process by which objects of knowledge are transformed into objects of teaching.

6. Intervention proposal

The intervention proposal is composed of a workbook in which activities will be integrated so that the students trained in la Nueva Escuela Mexicana (NEM) develop the skills to achieve the necessary knowledge in methods and technological advancement to achieve lifelong learning. This material intends to promote creative freedom to innovate and transform reality, as well as to understand that the humanities, social sciences, natural sciences, mathematics, arts, technology, care for the environment, are main factors for the integral and harmonious development of the individual and the country.

This proposal is structured by a series of playful and interactive activities related to basic operations of mathematics, having a pedagogical support applicable to students of phase 4, particularly 3rd grade of public primary education

Play and technology are used to promote interaction between students, promote values; It is also an activity that promotes learning in a fun and versatile way, hence the importance of accompanying teachers in the establishment of practices that strengthen the teaching-learning process, through playful activities.

In the case of this proposal, the use of the following topics is proposed so that third grade public education students proceed to the systematization of a logical process based on: data, symbology to be used, operation using the selected symbol, result and verification (in case to be necessary), figure 1.The intention of the "data" is that the student through the reading of the reasoned problem identifies what are the numerical aspects that are mentioned within the problematic situation or hypothesis of the problem.

Figure1: Suggested simbology for solving basic operations.

Finally, the student will write the result in the last section, and if necessary, the student will check if the result is correct to proceed with the review by the teacher who is serving as the facilitator. Below, in picture 2, it shows the procedure that it gives systematization to the above mentioned.

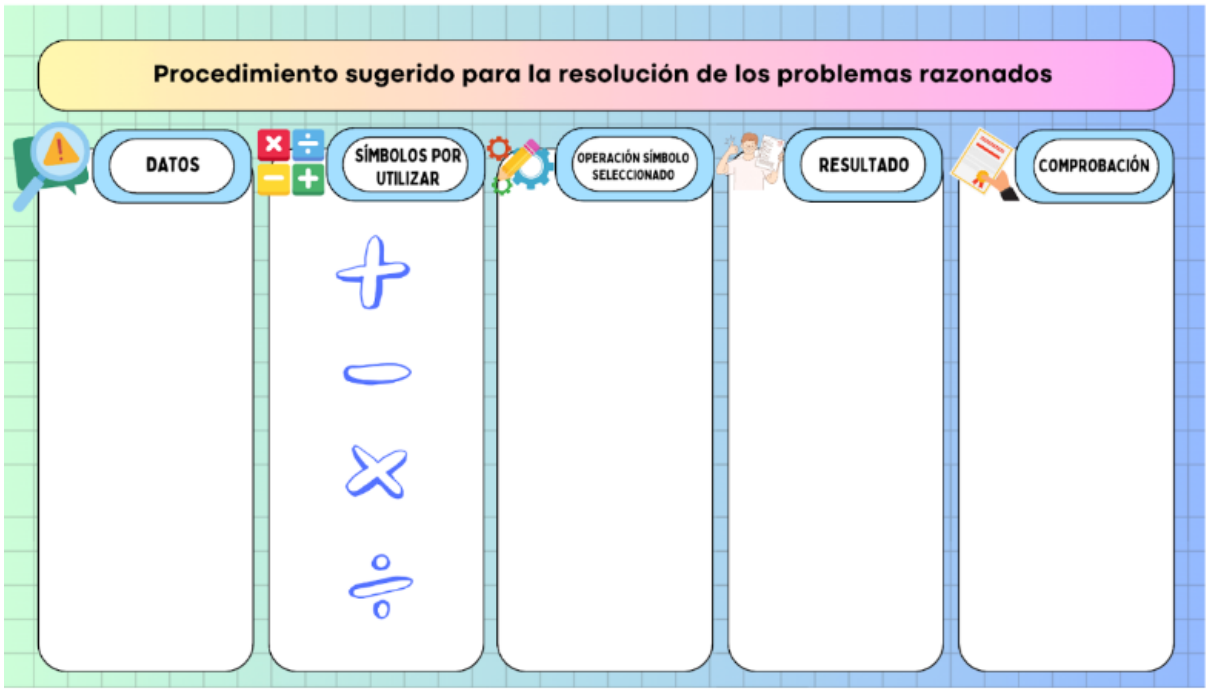

Figure 2: Suggested systematization procedure for solving reasoning problems.

6.1. Propuesta de actividades sugeridas utilizando la gamificación e inteligencia artificial

Activity 1: Based on the procedure table, calculate the perimeter of the airport in the city of Reynosa Tamaulipas, which is shown in the following image.

Figure 3: Reynosa city airport, Tamaulipas, México.

In the following QR code you can see a video with the precise indications that will allow you to corroborate your results using the Google Earth application.

Figure 4: QR code to link Google Earth.

Conclusions

The current research process, in relation to improving the learning of basic operations, is still in the design period, in a short time it will begin with the pilot phase with groups of third grade public education primary school, This selection will be in charge of the Secretary of Education of the State of Tamaulipas, and from this, those aspects to improve in the methodological and instructional process for basic level students can be identified.

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