



Strategy for Teaching Numerical Expressions through the Wordwall Platform for EJA Students


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Article Info	Abstract
Received May 20, 2023	This work is a pedagogical practice with students of Youth and Adult Education of a public school in Brazil with insertion of the basic operations of mathematics and numerical expressions. The objective of this research was to analyze the contributions of Gamification in meaningful learning based on the Theory of Didactic Situations with the contents of basic operations and numerical expressions with EJA high school students. The methodology at work is the qualitative approach with descriptive-exploratory objectives, applied to twenty-three EJA students, is composed of dynamic parts that occur simultaneously, following the stages of concept, structuring, application, development, resolution and conclusion of each student from the Didactic Contract and Didactic Transposition inserted in the concept of arithmetic and numerical expressions. Results show that gamification plays an important role in teaching mathematics learning inserted in the EJA high school class, which can be demonstrated at the time of the calculations described in the proposed activity. Finally, it is observed that the study carried out with Gamification and the students' discourse had a positive impact on the learning of all students, especially with regard to basic operations and numerical expressions.
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INTRODUCTION

In mathematics education, several modifications of traditional teaching are carried out with the use of Digital Information and Communication Technologies (DICT), in particular, Gamification, an active methodology that has grown rapidly in several educational institutions, with the aim of encouraging and motivating student action, maintaining the attention of participants and promoting learning.

The arrival of increasingly advanced technologies has allowed new ways of doing interactive activities, readapting the traditional teaching method, with the

teacher including in the classroom the new teaching practices with the use of Digital Technology (DT), in addition to enhancing new ways of organizing and creating learning situations through interactive games according to school planning.

It is important to emphasize that gamification acquires active methodology contours when the teacher provides an interactive environment with clear rules and allows students to feel in a position of developing skills (Moran, 2015). Thus, games have four basic elements: voluntariness, rules, objectives and feedbacks.

Silva, Sales, and Castro (2019), describe that voluntariness is the acceptance of rules, objectives and feedbacks - the objectives indicate the direction of the participant in the concentration and dedication to achieve the goals proposed in the game - the rules develop during the game and the behavior of the players - and the feedbacks are the communication of the performance and postures informed to the participants.

Given this scenario, it is possible to note that, in the educational context, the realization of activities with games can lead students to a meaningful and fun interaction. This represents a strategy that goes beyond traditional teaching barriers, pointing to new methods and visions regarding what it is to learn and teach mathematics.

Gamification, among the contextualized educational options, is a promising active methodology, which includes students of Youth and Adult Education (EJA) who, in their learning, are motivated by the use of mobile technologies in various mathematics contents.

Moran (2004; 2013), mobile digital technologies aim to make educational institutions transform traditional teaching, in which the teacher is the center of knowledge, for meaningful and participatory learning, with face-to-face interactions and other activities with technological resources, maintaining social and personal bonds, being together virtually and expanding the concept of teaching and learning in the temporal field, where knowledge is allowed by the collaborative action between teacher and student.

Thus, having experience with the use of technological resources in teaching and learning, we propose to use the "Numerical Expression" Gamification of the WordWall repository, to create situations that provide knowledge in an investigative way of the concepts of the four operations (addition, subtraction, multiplication and division) using parentheses, brackets and keys for the EJA class of High School Night, of a public institution, in the municipality of Quixeramobim, Ceará, Brazil.

EJA follows a model that is followed by the Secretary of Education (SEDUC) of the State of Ceará. This means that throughout the year, subjects are changed and new ideas are taught. This includes new ways of teaching, such as using digital technologies and educational materials.

The present work is the result of studies and discussions regarding the appropriate use of technological resources in mathematics teaching, which occurred during the development of technical training with teachers from the state network of Ceará. According to Tardif (2007), the teacher cannot work alone on his professional knowledge, that is, it is necessary to establish a partnership with the students for the inclusion of didactic materials available at that interactive moment in the classroom.

This study, of a qualitative and exploratory nature, involved the investigation of a group of students (research subjects), from a comprehensive public educational institution, enrolled in EJA High School (Basic Education). Given the fact that students with different levels of knowledge present in the EJA class are able to solve problems using different mathematical methods, including the mathematical symbols (keys, brackets and parentheses) that are present in the operations of basic mathematics.

When considering the application of Gamification at different levels of mathematics education and in various areas of teaching, this study set out to question: what are the advantages of Gamification to assess the meaningful learning of EJA high school students, based on the Theory of Didactic Situations (TSD), and the contents of basic mathematical operations and numerical expressions?

The objective of the research was to analyze how the WordWall tool can help EJA students, based on TSD, with the contents of basic mathematical operations and numerical expressions.

Theoretical Reference

The word "gamification" has been included since 2002, but it only gained notoriety in 2010, with the Technology, Entertainment, Design (TED) conferences and the Khan Academy platform, which have publicized and inserted new strategies around gamified and interactive activities (Teichner & Fortunato, 2015).

In this context, some authors of the French Didactics of Mathematics were included, who present research and studies focused on the teaching of mathematics, based on the theories of Brousseau (1997) and Chevallard (1991), which address epistemological phenomena such as Didactic Contract, Didactic Situations and Didactic Transposition.

Pais (2001) describes that the Didactics of Mathematics is a trend in mathematics education, whose focus is the structuring of concepts and theories, comparative to the educational specifications of mathematical knowledge in school, which causes strong links with the formation of mathematical concepts at the experimental level of the teacher's pedagogical practice and in the theoretical concept of academic research.

Based on this perspective, Chevallard (1991) defines the "Didactic Transposition", which was first used by the French sociologist Michel Verret in his doctoral thesis *Le temps des études* in 1975, which he defines as "a content of knowledge, having been designated as knowledge to teach then undergoes a set of adaptive transformations that will make it fit to take place among the objects of teaching" (Chevallard, 1991, p. 45).

Lorenzato (2006) states that the use of manipulable Didactic Material (MD) in the teaching of Mathematics is crucial for the teaching and learning process, and it is essential that the teacher properly uses the didactic materials, exploring the concepts of each topic addressed. Explanations do not have the same effectiveness as technological objects or tools, whether concrete or structured movements in digital technology. They help, but are not enough to teach (Lorenzato, 2006) mathematics in the educational context of traditional teaching.

Mathematics, still from this point of view, works with various contents, concepts, definitions and rules to solve mathematical problems, because the method as teachers include in the classroom is of great relevance, because the methodology

that is taught, reflects on student learning. Albrecht and Maciel (2020) say that teachers need to change the way they teach, thinking about how to deal with people's everyday problems.

The didactic activity was structured based on the TSD, and Brousseau (1997) proposes the didactic triangle (Figure 1), which includes three fundamental elements - the student, the teacher and the knowledge--that are fundamental parts of an interactive and complex relationship--the didactic relationship--that takes into account the discussions between teachers and students (human elements), mediated by the mathematical knowledge (non-human element), which determines how these relationships will be realized in the educational context. The didactic relationship involves four phases: action, formulation, validation and institutionalization.

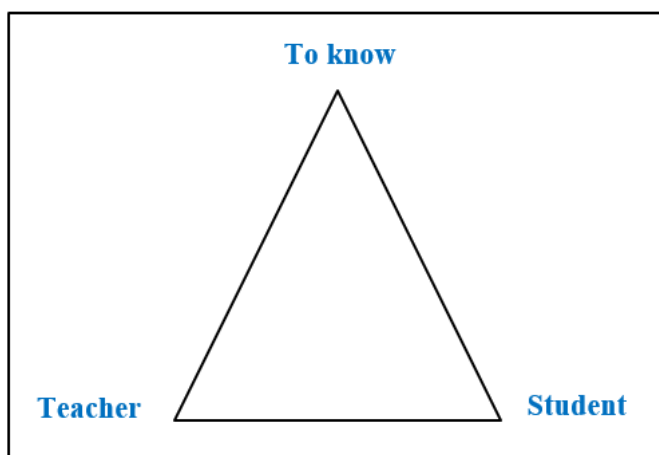


Figure 1. Didactic triangle, Brousseau (1997)

According to Brousseau (2006), the action situation is related to the construction and deconcentration of the student's knowledge processes in the classroom. In the formulation situation, participants organize themselves to share information and communicate well (Brousseau, 2006). According to Brousseau (2006), the validation situation is the exchange of assertions and solutions found by class participants to reach a conclusion about knowledge.

In institutionalization, the teacher's main function is to transform the students' discoveries in the context into "stable, decontextualized and institutionally accepted knowledge means, such as authority and strength" (Gosztanyi, 2017, p. 1737). The didactic contract, the teacher expects the student to follow the rules and complete the proposed steps (Brousseau, 1997).

Saunders, Lewis, and Thornhill (2020) propose that the researcher teacher present new methods not only by observing, but also by presenting aspects that can be adapted, such as the advantages of including qualitative research in the situation presented during the application of the game.

The study of numerical expressions is the focus of this work, since it involves properties that can alter the mathematical thinking of students when dealing with complex problems, which, in general, are perceived in a complex way, being worked on learning the contents of the basic mathematical operations of initial basic education.

According to da Silva and de Arruda (2011), the numerical expression is an operation that uses numbers to calculate other numbers with symbols. The result is

a single number, which is divided into several parts. The authors explain that, "[...] expressions (parentheses), [brackets] and {keys}, what is in the parentheses is done first, then the bracket and finally what is in the key, in the order they appear in the expression" (da Silva & de Arruda, 2011, p. 26).

EJA students have in mind several paths to be followed, questioning whether the process established by these rules is valid for all mathematical operations. But it is not enough to teach everything, it is necessary to attract all students to mathematics and technology in the classroom.

RESEARCH METHODS

The research in question followed the characteristics of applied research, with a qualitative approach and descriptive-exploratory objectives (Gil, 2008). The systematic of studies and activities aimed at the reconstruction of algebraic knowledge is present in the curricular components of Mathematics Teaching, including conceptual and experimental activities using the WordWall platform (<https://wordwall.net/>) for the elaboration of a gamification for EJA students.

Theoretical Assumptions in the Methodology

The research objectives are descriptive due to the description of a given phenomenon, analyzing its characteristics within a group of data; exploratory due to proportionality on the object of study (Gerhardt & Silveira, 2009). The qualitative approach considers the subjectivity and the absence of statistical analysis to measure the data collected in the research (Zanella, 2013).

Development of the Application

During the realization of this study, a bibliographic research was carried out on the theme in question, which consisted of scientific articles, abstracts of scientific events and book chapters extracted from Google Scholar and HAL Science Ouverte that addressed the application of gamified activities in basic education based on TSD.

After an analysis of some theoretical assumptions that guide the application of Gamification, a game was created using the WordWall platform. WordWall is used in classes through games, to present the disciplinary contents, using different types of games. Thus, it is feasible to create an interactive game that combines questions and images that define the topics to be addressed.

Locus and Participants of the Research

The activities were developed at the Assis Bezerra Full-Time School, located in the municipality of Quixeramobim, which operates at night with EJA Qualifica, totaling six hours of classes per week. These classes were divided into six meetings to teach about numbers, their properties and applications. Two meetings we used the WordWall platform to collect information and another four for analysis and description of the data collected.

The research was conducted with twenty-three students of the Mathematics subject in the EJA class of 2021. The activities were designed according to the curriculum plan of Youth and Adult Education, and their elaboration was based on the basic contents of numerical expressions.

Thus, the research began with an activity called Find the Expressions, which is a game with random sequences of numerical expressions that results in a positive or negative integer. The student sees the mathematical representation in the game and the results found during each question, providing the results and discussions described in the next topic of the work.

RESULTS AND DISCUSSION

The didactic contract with the EJA class, proposes a decision making in the classroom, explicitly or implicitly, about any method, conviction or knowledge of mathematics. Brousseau (1986, p. 50) defines the didactic contract as "the rule of the game and the strategy of the didactic situation".

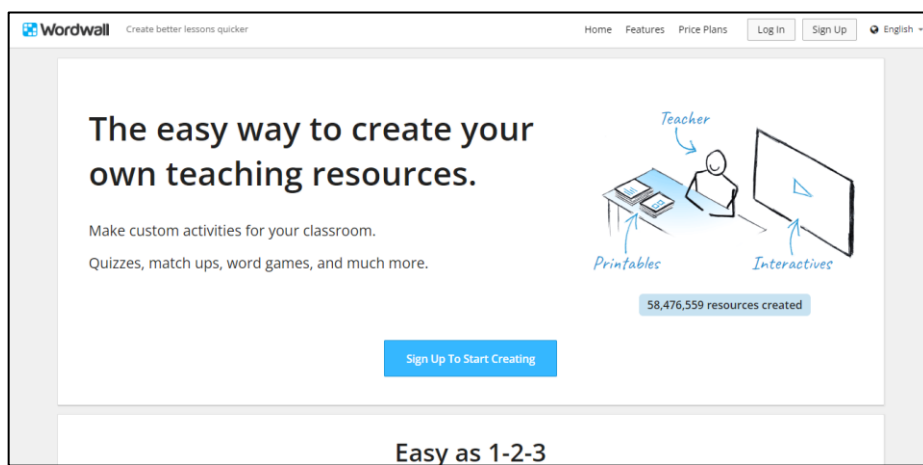


Figure 2. WordWall platform on the home page

Research Results

Digital games were used in this pedagogical practice: the storyline to encourage student involvement in the game, the objectives to direct efforts and point out what should be done during the game; Scores that allow to evaluate how many hits were per student in the cognitive dimension; Feedbacks on the importance of visualizing errors and correcting them, leading to the learning of the contents of the four operations and numerical expressions inserted in the game of the WordWall platform and; the Achievements after the completion of the activity, in the sense of assigning an evaluative note.

The application of gamification is based on the prior knowledge of EJA students, which makes possible a fundamental situation constructed as a didactic situation in the teaching of numerical expressions that promotes interaction with the WordWall platform. The stages of the TSD that are based on the research are:

The action stage is when students make decisions, including their knowledge in practice to solve the problem. It is the moment when we start learning the knowledge that is not expressed mathematically.

The activity showed the basic relationships of the four operations of mathematics. Tolomei (2017), showed how students can interact and learn from mistakes and successes during the application, and how they can receive feedbacks at the end of the game. In the Formulation stage, students create a way to explain the problem, transforming their implicit knowledge into explicit, where the subject

resumes his action at a higher level and appropriates mathematical knowledge in a coherent way.

In the validation stage, the students' strategy is presented to the class. It is the moment when we start learning the knowledge that is not expressed mathematically.

Each group or team proposes a strategy to solve the problem, and may contest with other students in the same class.

Feedbacks on mistakes and successes are included in the institutionalization phase. The mathematical character of the students is proven. This is a description of what was built during the previous stages, with a meaning defined by the research participants.

The teacher has a dynamic role searching and organizing the situations that will be recorded in the classroom. It is evident that, by analyzing the responses of each student, it is feasible to improve skills related to digital fluency, independence and critical thinking (Martins, Giraffa, & Lima, 2018).

During the application of the game in the action stage, when it was possible to verify the mathematical concept of the numerical expression (Figure 3), recorded comments of the interactive moments of the students renamed by E1, E2, E3, ..., E23, were recorded. E23, in particular E6 describes the following mathematical thought "first calculate what is inside the brackets and then perform with the numbers that are outside, resulting in the correct option".

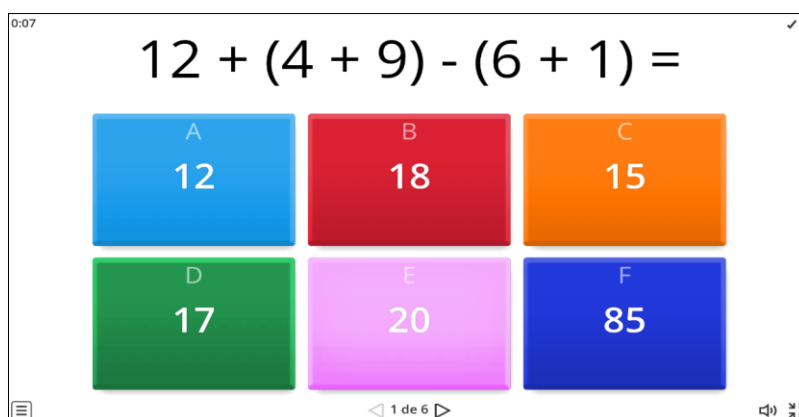


Figure 3. Gamification of numerical expressions in WordWall

Discussion

At that moment, it was possible to analyze the appearance of a level of difficulty on the part of some students, such as: eliminating the signs already used, what is the sequence of the expression and play of positive sign with negative, the following question asked to all, for example "can we use other methods to solve the question, is there an easy way to solve?".

It is noticeable that, when applying the game activity, the teacher had to assume a questioning and mediating posture in relation to the use of the platform. Valente (1997) mentions that, by moving from the level of doing to understanding computers as a pedagogical tool in the classroom, it was possible to build concepts and develop skills resulting from a change in the educational process.

By emphasizing the emphasis on the basic operations of mathematics, during the institutionalization stage, the teacher explained some resolution methods on the

demonstration of numerical expressions and the four basic operations, checking each property related to the content worked during the classes.

With the students' discussions and comments on the inclusion of the gamified activity, it was realized that the game developed brought benefits, such as the motivation of the students in the activity; the reduction of time in the evaluation process in the classroom; raised the understanding of the students and increased the level of student autonomy, with a view to the calculations elaborated.

The class included other demonstrations, extending to the situation of basic content learning. This interpretation is broader, as it apparently requires students to have knowledge about the subject during their study time.

In both answers, it is clear that there is a different interpretation, where the specific content not studied by EJA students can be seen as a different thought when solving numerical expressions. When calculating the expressions, it is possible to notice that the results were determined by the numerical sequence of each question, which results in problems that can be interpreted differently by each student, who prefers to look for methods and ways to solve the mathematical properties that were previously explained by the teacher in the classroom.

Gamification joined the objectives of the lesson plan, evidenced in the results of each participant. First, the student had to "understand the calculations of the four mathematical operations", elaborate their resolutions of each question; the second, the "application of numerical expressions", define what are the orders of resolution of each sign or expression, and the third, "success in completing all the questions", if the student achieved a score between seven and ten points.

When performing the activity, it was possible to notice that the solutions of each student are satisfactory for learning mathematics, since the way they interact and follow each mathematical step of the content was intuitive and meaningful for students and educators during Didactic Transposition.

CONCLUSION

By employing mathematical concepts and numerical expressions with the aid of technologies at different levels of knowledge, it is possible to affirm that the use of digital technologies for educational purposes offers possibilities of satisfactory results for EJA students, in addition to allowing an innovative approach to learning with new digital tools.

Thus, the objective of the work was achieved by applying the contents with interactive methods by the teacher, providing collaborative teaching with the use of technology to improve the teaching and learning process of mathematics. Therefore, it is crucial that the educational institution is an environment in which knowledge is intuitive and interactive for students, being a space for the exchange of knowledge and applications that can be worked with everyday experiences.

The work demonstrated that the methods used by the teacher in the classroom to teach and learn mathematics with EJA students reinforced pedagogical actions structured in the contribution of fundamental content.

It also increases students' interest, motivation and participation. It is important to note that a participatory and intuitive spirit is developed from the hypotheses presented by the students during the resolution of the problem, based on the Theory of Didactic Situations.

It also increases participation in the practice described, facilitating the problematization of the contents addressed in this work with the teaching of mathematics, in order to compare the mathematical contents to their reality to interact and encourage learning in the classroom, contributing to the formation of mathematics.

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