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The game as a possibility to rescue mathematical language in an EJA class

Abstract

Teaching young people and adults often presents challenges, since these students often carry traumas related to the subject of mathematics and face taboos rooted in their subconscious. It is therefore essential to adopt different teaching methodologies to ensure meaningful learning. The use of games in math classes offers advantages such as encouraging cooperation and the application of active teaching methodologies. The "Hidden Symbol" game was developed with the aim of using a playful approach to assess the learning of an E.J.A. class. The objective is to identify the level of knowledge of each student and, based on this, implement interventions to promote equity of learning in a heterogeneous class. The game proved successful in assessing learning, providing insights into the students' difficulties and improving the communication of doubts on the part of the students.

Keywords: Method; games; young people; adults; assessment.

O jogo como possibilidade de resgatar a linguagem matemática em uma turma da EJ

Resumo

O ensino para jovens e adultos frequentemente apresenta desafios, uma vez que esses alunos muitas vezes carregam traumas relacionados à disciplina de Matemática e enfrentam tabus enraizados em seu subconsciente. Portanto, é fundamental adotar diversas metodologias de ensino para garantir uma aprendizagem significativa. A utilização de jogos

em aulas de Matemática oferece vantagens como o estímulo à cooperação e a aplicação de metodologias ativas de ensino. O jogo "Símbolo Oculto" foi desenvolvido com o intuito de utilizar a abordagem lúdica para avaliar a aprendizagem de uma turma de E.J.A. O objetivo é identificar o nível de conhecimento de cada aluno e, a partir disso, implementar intervenções para promover a equidade de aprendizagem em uma turma heterogênea. O jogo demonstrou sucesso na avaliação da aprendizagem, proporcionando insights sobre as dificuldades dos alunos e melhorando a comunicação das dúvidas por parte dos estudantes.

Palavras-chave: Método; jogos; jovens; adultos; avaliação.

Introduction

As outlined by the National Common Curricular Base (BNCC, 2018), the presence of Mathematics in the school environment is justified not only by its practical usefulness in individuals' daily lives but also by its relevance in stimulating students' critical and logical reasoning. Mathematics as a discipline is designed to enable students to represent their personal experiences through tables and numerical data, while also allowing them to understand the relationship between numbers and their impact on social dynamics.

Mathematical language is composed of a variety of symbols and expressions that serve to represent the logical reasoning underlying mathematical operations. These include signs such as the equality "=", addition "+", and percentage "%", as well as terms like "double," "triple," "difference," "result," and "sum." Each term has a corresponding symbol and vice versa. According to Lorensatti (2009), mathematical language can be understood as an organized system of interrelated symbols, governed by defined rules, and is widely recognized by the entire community that employs these symbols.

Mastery of mathematical language plays a crucial role in enhancing communicative skills and the ability to construct arguments based on mathematical principles. These skills are essential for understanding and applying mathematics in a global context, facilitating the approach to and solution of challenges in various situations. Knowledge of mathematical language not only fosters critical and logical thinking but also encourages investigation and analysis of relevant problems in contemporary society (BNCC, 2018).

Vallilo (2016), in his experience as an elementary school educator, highlighted students' difficulties in understanding the meaning of mathematical words and concepts. This lack of comprehension made problem-solving more complex, as students could not clearly identify what was being asked or how to approach the

problem. An illustrative example is the case of fractions, in which many students struggle to grasp the relationship between the numbers presented in a fraction or to understand that its symbolic representation indicates the quotient between the numerator and denominator—that is, the “top number” and the “bottom number,” respectively.

The precision of mathematical language may, at times, represent an obstacle for students attempting to express their thoughts and reasoning in mathematical problems. As observed by Silveira (2009), students in Youth and Adult Education (EJA) demonstrate skills in mental calculations but face difficulties in formalizing their reasoning in written form. This difficulty can be attributed to disparities between students’ school experiences and their practical experiences in commercial environments, which demand different sets of skills and needs.

Teaching mathematical language is a challenge in any educational context but becomes even more complex in EJA classrooms due to the mental blocks and insecurity faced by students in this modality. Farias and Costa (2020) argue that a purely formal approach restricted to the school environment may hinder the understanding of mathematical language, stressing that mere repetition of exercises does not effectively promote concept construction.

According to Farias and Costa (2020), learning mathematical language requires more than simple exposure in traditional lessons; it is essential to provide meaning and practice in diverse contexts to develop proficiency in this language. Furthermore, while regular education students may struggle with demotivation, EJA students must also cope with stigmas regarding the difficulty of the subject and with learning gaps in understanding its expression. In this sense, the use of games and playful activities emerges as an effective strategy to present content in a more accessible, less stressful, and more comprehensible way (Pessoa and Paredes, 2004).

In classrooms dedicated to youth and adult education, students’ contact with mathematical language and its symbols often occurred in a disconnected manner, divorced from context and meaning, resulting in difficulties and academic failure. Under a new approach, schools should present representations that establish connections between mathematical symbols, the surrounding environment, proposed activities, and students’ reasoning. In this way, learners are encouraged to relate mathematical concepts to their own experiences both inside and outside the classroom (Porto and Carvalho, 2000).

The game Hidden Symbol was developed to assess the level of mathematical literacy of students in EJA classes, based on the relationship between images and their meaning in Mathematics. Through this, it is possible to understand the player's level of comprehension of mathematical language by means of their score, thereby identifying which mathematical content the student masters and facilitating the leveling of learning within the class, where age heterogeneity among students is common.

Theoretical Perspective

Within the National Common Curricular Base (BNCC), there is no specific area reserved exclusively for mathematical language. On the contrary, its transversal presence is recognized across all curricular components, as it is fundamental for mathematical development in various topics such as algebra, numbers, probability and statistics, geometry, and quantities and measurements. The ability to enhance interpretation and solve mathematical problems is an essential skill at all educational levels. Based on this, the present research proposed an approach that employs games and problem-solving to teach mathematical language in youth and adult education (EJA) classes.

The use of games in teaching strategies for mathematical principles is beneficial in enhancing students' logical reasoning, a skill often employed unconsciously. Furthermore, games serve as an effective tool for fostering social interaction, especially when students debate their results and justify their choices. It is important to emphasize that games should be sufficiently challenging to stimulate interaction among participants, encouraging creativity and promoting a more dynamic and participatory teaching style for all involved (Pessoa and Paredes, 2004).

It should be noted that before introducing a game in the classroom, the educator must first play it personally, observing possible moves, issues, and challenges posed by the game, in order to understand and be able to propose relevant problem situations. It is expected that the use of games will generate a certain level of noise during classes, and the teacher must be prepared for this, understanding that such noise is an indicator of student engagement with the game. In problem-solving methods involving games, the teacher assumes the role of leader, being responsible for managing situations that arise in the classroom and for encouraging students' reflections and discoveries (Silva and Kodama, 2004).

The purpose of the game presented in this text is to assist in assessing the level of competence in mathematical literacy among EJA students, considering the diversity within these classes (in terms of age, social context, and reasons for interrupting their studies). From the scores obtained by the students, it is possible to determine their mastery of mathematical symbols and their corresponding meanings.

Conducting tests through games is crucial, as they allow students to employ their thinking more freely while competing with peers. Hidden Symbol is a game that stimulates memory by associating mathematical symbols with their meanings and images, contributing to the improvement of students' mathematical language. Although it is suggested for EJA learners, it may also be used starting from the 7th grade of Elementary Education.

Research Methodology

First, a bibliographic review was conducted to collect data on the subject, thereby supporting the development of the game as a teaching methodology in EJA. As Sousa, Oliveira, and Alves (2021) highlight, "bibliographic research is fundamental in the construction of scientific research, as it allows us to better understand the phenomenon under study."

Field research was also carried out, which, according to Minayo (2002), represents a crucial stage, since it provides the researcher with direct contact with the object of study, enabling the construction of knowledge grounded in reality and making the production of new insights possible.

Marconi and Lakatos (2007) also emphasize that:

> Theory, as a scientific instrument, is used to conceptualize the types of data to be analyzed. To be valid, it must be based on observed and proven facts resulting from research. The study of practical problems may lead to the discovery of basic principles and, frequently, provides knowledge with immediate application (Marconi; Lakatos, 2007, p. 17).

As further noted by Marconi and Lakatos (2007), the phase of data selection is a procedure that should be carried out in the following manner: "1) Documentary collection; 2) Observation; 3) Interview; 4) Questionnaire; 5) Form; 6) Opinion and attitude measures; 7) Marketing techniques; 8) Tests; 9) Sociometry; 10) Content analysis; 11) Life history." Among these, the methods employed for data collection in this study were: observation, questionnaire, opinion and attitude measures, and content analysis.

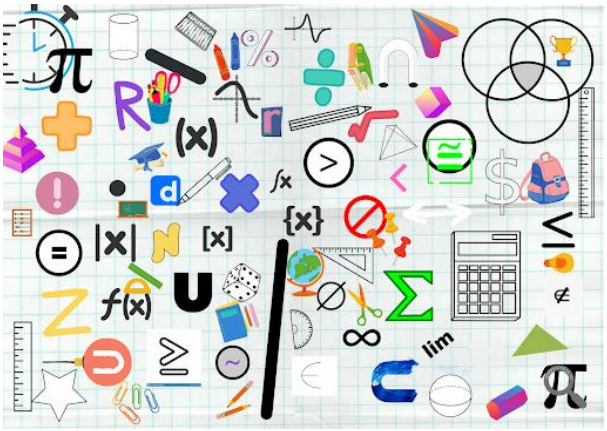
Results and Discussion

The game was administered at a school in the municipality of Passos, with a total of 1,372 students enrolled, covering elementary and middle school, high school, vocational education, and adult education (EJA). The institution's infrastructure includes a library, reading room, computer lab, playground, sports court, office, warehouse, cafeteria, and thirty classrooms.

The game was administered to third-year EJA classes, composed of eight students with an average age of twenty-six, five female and three male. The activity took place in the evening, for two hours, corresponding to the second of a total of five classes scheduled for the day.

A board, game cards (hint cards), a blank sheet of paper, and a pencil or pen for scoring were required. Figures 1, 2, and 3 show the game board, a sample hint card, and a sample game record sheet, respectively.

Figure 1 - "Hidden Symbol" game board

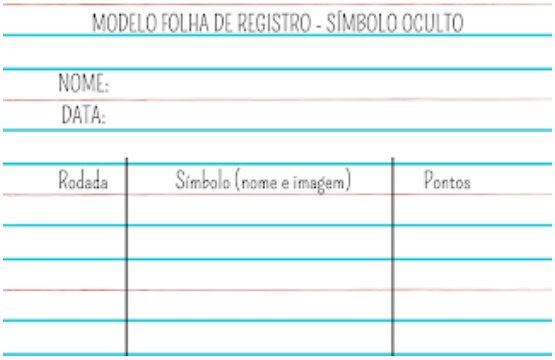


Source: prepared by the author (2024).

Figure 02 - Shows cards from the game “Hidden Symbol”, front of the clue cards (left), joker card (middle) and back of the clue card (right)

Source: prepared by the author (2024).

Figure 03 - Registration sheet template



Source: prepared by the author (2024).

As soon as they entered the classroom, the students were introduced to the class by the teacher. The first question posed to the class was about the students' affinity for mathematics, which received a reasonable response. Next, they were asked if they had participated in game-based activities during class, and 100% of the students said they had not. The students then briefly explained their reasons for using games in mathematics classes.

The activity then began with the students spontaneously dividing into groups, resulting in two groups of three and one group of two. Before starting the game, the students responsible for implementing the game gave a brief introduction to the rules and how the game works. With the board and cards face down on each group's table, the games began. Initially, some doubts arose about the game's playability, but these were dispelled after the third round, when everyone became familiar with the dynamics of the activity.

The students demonstrated excellent engagement during the two-hour game, demonstrating continued progress in their active learning as they discussed the clues to find the symbols and their application in mathematics. When students were unable to identify the symbol requested on the clue card, they requested assistance, and the student instructors helped identify and explain its use in mathematics.

At the end of the activity, the students were asked to complete a form describing their experience with the game and their goals for EJA, and the answer sheets with their scores were collected. To analyze the class's performance, individual scores were first computed, as shown in Tables 1, 2, and 3 below, by group.

Table 1 - Group 1 Score

Symbols Worked	Student score	Student score	Student score 3
Equality	0	10	0
Function (f(x))	5	0	0
Set of real numbers	0	5	0

Belongs	3	0	0
Addition	0	10	0
For all	0	0	10
Does not belong	0	0	5
Square root	5	0	0
Multiplication	10	0	0

Source: prepared by the author (2024).

Tabela 2 - Group 2 Score

Symbols worked	**Student score 1**	**Student score 2**	**Student score 3**
Brackets	10	0	0
Belong	0	0	10
Set of integers	0	0	3
Set of rationals	0	5	0
Intersection	0	10	0
Subtraction	0	10	0
Division	0	0	10
Existence	0	3	0

Source: prepared by the author (2024).

Tabela 3 – Group 3 Score

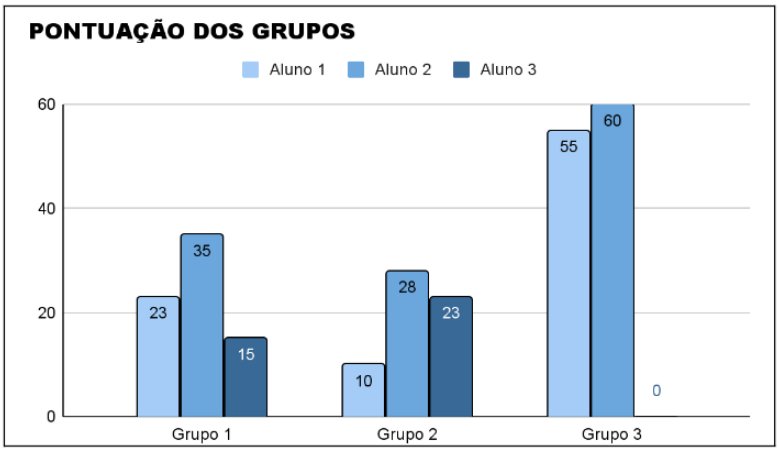
Symbols worked	**Student score 1**	**Student score 2**
Empty	0	5
Set of integers	5	0
Square root	0	10
Greater than or equal to	10	0
Multiplication	0	10
Set. Of Naturals	0	5
Function (f(x))	10	0
Equality	0	10
Percentage	10	0
Belongs	0	10
Does not belong	10	0
Brackets	0	10
Division	10	0

Source: prepared by the author (2024).

Group 1 demonstrated more active participation from the beginning, despite facing considerable challenges. Despite the difficulties, they maintained a serious commitment to the game, demonstrating interest in seeking clarification when questions arose. Group 2 faced greater difficulties and also showed the lowest level of interest in both the game and in learning the unfamiliar symbols.

On the other hand, Group 3, despite the obstacles, showed a high level of interest and engagement with the game, resulting in the highest number of games and the highest score during the game period. Figure 4 illustrates the scaled scores for the groups, as well as the individual scores for each player per group.

Figure 04 – Scores



Source: prepared by the author (2024).

It was observed that the symbols with the lowest scores correspond to concepts covered in the final years of elementary school. Since 75% of the class did not achieve a satisfactory score in understanding the symbols for "set of integers," "belonging," and "existence," it is suggested that the ability to recognize sets and their relationships may be lagging for this group. Therefore, the teacher can intervene in the content of sets and their relationships to promote the development of this skill in the classroom.

Responses obtained through the questionnaire on student perceptions of the game indicated that, initially, many did not fully understand the purpose and rules of the game, as most had never tried math games before. However, after becoming familiar with the game's dynamics, they demonstrated good learning experience.

When asked if they enjoyed the game, the students responded affirmatively and expressed a desire to have more gaming experiences in the classroom. Regarding possible changes to the game, they stated that they did not feel the need for any changes, as they were satisfied with its structure.

When asked if they noticed a significant change in their learning and if they would like to continue using games in the classroom, students responded positively. They highlighted that the game made math more dynamic, interesting, and engaging, thus sparking their interest in further exploring the language of mathematics.

Conclusions

Teaching for Youth and Adult Education (E.J.A.) classes poses a significant challenge due to its specific characteristics, including students' lack of availability to study outside of the classroom, as is common in regular education. Therefore, it is imperative to use alternative methods to ensure that classes do not become monotonous and unpleasant, as is often the case in conventional education.

Although the use of games in Math classes is a frequently discussed topic at conferences, it is not yet widely used in schools, especially in E.J.A., possibly due to the limited time available compared to the amount of content to be covered.

The "Hidden Symbol" game achieved its objective by allowing the assessment of participating students' knowledge, in addition to offering benefits such as active learning, development of logical reasoning, and teamwork.

This game can be used both as a final learning assessment and as a diagnostic activity to identify students' prior knowledge, enabling better organization of teaching methods and necessary interventions. It's essential that the game be used in a balanced way, suggesting its use at the beginning and end of the school year, coinciding with the beginning and end of the content being covered. Furthermore, it's recommended that teachers introduce problem-solving elements to make the game challenging, stimulating the development of skills and interests in E.J.A. classes.

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