LUMEN ET VIRTUS

Reflections on the teaching of mathematics from a perspective of universal design: An action mediated by games

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ABSTRACT

The work is the result of discussions between teachers who teach mathematics at the State Center for Training and Assistance to the Deaf - CAS Natal, who realized the importance of working with play, but precisely with card games, for the acquisition of basic mathematical content, in this case, multiplication. Thus, the study in question aimed to reflect on the process of teaching and learning mathematics in a more dynamic perspective. This dynamism makes it more interesting and motivating and learning is more pleasurable. This work is part of the research line Teaching and Learning Processes in the Perspective of Deaf Education and presents as dynamic the use of the game as a pedagogical resource in the teaching of mathematics. According to Chiummo and Oliveira (2016), games play a very important role in Mathematics Education, because of three aspects: the playful character, social relationships and the intellectual development of the student. Namely: playfulness as a moment beyond fun and yes, discoveries. Social relations as construction and reconstruction of oneself and the world and, finally, intellectual development in a total perspective, that is, considering the cognitive and emotional dimensions. The present work is based on at least three fronts: studies of Historical-cultural psychology (Vigotsky, 2001), studies on games in the teaching of mathematics (Selva, 2009) and studies on Universal Design (Zerbato and Mendes, 2018). The methodology used in the study was exploratory research of a bibliographic nature, since it offered a better understanding of the theme, with the contribution of bibliographic references about the use and role of games in the teaching of mathematics, through readings of books and scientific articles. The results indicate that the use of the game favors the learning of mathematical concepts, as well as provides an attractive, humane and inclusive environment.

Keywords: Playfulness, Mathematical games, Pedagogical resource, Education of the Deaf.

INTRODUCTION

Above all, what moves education in the twenty-first century is the influence and relationship of technologies in our lives. In the past, education aimed only at mastering the content and, today, the

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need is to know the learning process in such a way that it aims to contribute to the global development of a historical subject, regardless of the particularities of these subjects.

It is thinking about the philosophical assumptions of an inclusive education that presumes access, permanence and participation, that the Universal Design of Learning - UDL emerged. A priori, the UDL was created from the concept of Universal Design – DU, by architect Ronald Mace, who argued that spaces should be designed in such a way that they were accessible to the majority of people.

In general terms, UDL is an approach that aims to minimize any barriers to learning, from physical to methodological. That is, they are accessibility strategies for all. According to Hedero (2020), the principles of UDL are:

- ✓ Principle I: Provide Multiple Modes of Presentation (the *What* of Learning). It refers to different ways of presenting a certain content, ensuring that the main information is passed on in the same way to everyone. In other words, the greater the possibilities of presenting knowledge, the greater the possibilities of learning it.
- ✓ Principle II: Provide Multiple Modes of Action and Expression (the *how* of Learning). It refers to different ways of learning and expressing knowledge by students.
- ✓ Principle III: Provide Multiple Modes of Engagement, Engagement, and Involvement (the *why* of Learning). It refers to the encouragement given to the students' learning in order to challenge them.

In short, the principles of UDL permeate named dimensions: knowledge networks, strategic networks and affective networks, which encompass the way the content will be presented; the way learning will be assessed and how to make students more interested.

COLLABORATIVE LEARNING IN A PERSPECTIVE OF INTERACTIVITY

Although we found different definitions for collaborative learning, we refer to the authors Correa (2000), Torres, Alcantar and Irala (2004). And, according to the common aspects addressed by them, work in small groups stands out.

For Torres (2007, p. 339), "collaborative learning can be defined as a learning methodology in which, through group work and exchange between peers, the people involved in the process learn together". Therefore, it is understood that the effectiveness of collaborative learning is mediated by equal participation and effort in the search for achieving the common goal.

SOCIAL LEARNING IN A VYGOTSKIAN PANORAMA

In relation to the learning process, this work is based on the studies of Historical-cultural psychology, which conjectures a social nature of learning, that is, it takes into account social interactions and that through them, the subject develops his higher psychological functions.

Considering the specificities of the public in this report (deaf and deaf-blind students), the need for interaction for a real dissemination of the language becomes a challenge for teachers who work in the public school system, especially in Service Centers – in our case, which is to serve a diversity of students, from the cultural and emotional to the cognitive points of view.

In this sense, the historical-cultural perspective brings in its contribution, opportunities to redirect the conception of inclusive education, insofar as it comprises deaf and deafblind individuals in a social and cultural context. That is, it considers them beyond a disability, in whose processes they are mediated by relationships between peers, between peers and the world, being constructed and reconstructed. In this way,

> [...] The defect is an element that participates in the subjective constitution of the subject who possesses it. However, the way in which the defect is subjectivized is highly differentiated due to the social contexts and relational systems in which the defect is signified and experienced (Mitjáns Martìnez, 2007, p. 102).

It is inferred that the exchange of knowledge mediated by collaborative activities contributes not only to the acquisition of cognitive competence, but also to socio-emotional skills permeated by healthy relationships that enhance the integral development of the student.

COLLABORATIVE AND SOCIAL LEARNING MEDIATED BY GAMES

Regarding the teaching of mathematics, the common narratives of the students are that the discipline is practical, but difficult. From this context, the search for new methodologies must be continuous, not only due to the narrative presented by the students, but also to try to demystify the accuracy of mathematics and to make the relationship between theory and practice more dynamic.

For Agranionih and Smaniotto (2002) *apud* Selva (2009, p. 2), the mathematical game is:

> [...] a playful and educational activity, intentionally planned, with clear objectives, subject to collectively constructed rules, which provides the opportunity to interact with mathematical knowledge and concepts, socially and culturally produced, the establishment of logical and numerical relationships and the ability to build strategies for problem solving.

In short, and according to Miguel de Guzmán (1986), the purpose of games in education is not limited to fun, but to the fact that this activity (game) enables the acquisition of knowledge and motivates students to learn.

DEVELOPMENT

METHODOLOGICAL ASPECTS

In addition to the exploratory research in order to better understand the theme, we also have the bibliographic research, to the extent that the collection of references on the use of games in the teaching of mathematics was mediated by the readings of scientific articles. In this vein, regarding bibliographic research, Gil (2002, p. 44) states that "[...] is developed based on material already prepared, consisting mainly of books and scientific articles".

This study was carried out in a class of the 6th grade of Elementary School II, at CAS Natal[4], an institution belonging to the State of RN and located in Natal. This work is a report of the application of a card game, the deck, as a resource for assimilating mathematical knowledge of multiplication.

Study site

It is a Specialized Educational Service Center (AEE) for the deaf and D.A.[5] of Rio Grande do Norte. It is considered small, that is, with approximately 75 students. Such service is complementary and/or supplementary to regular education. Therefore, it is necessary for the deaf student to be regularly enrolled in public schools.

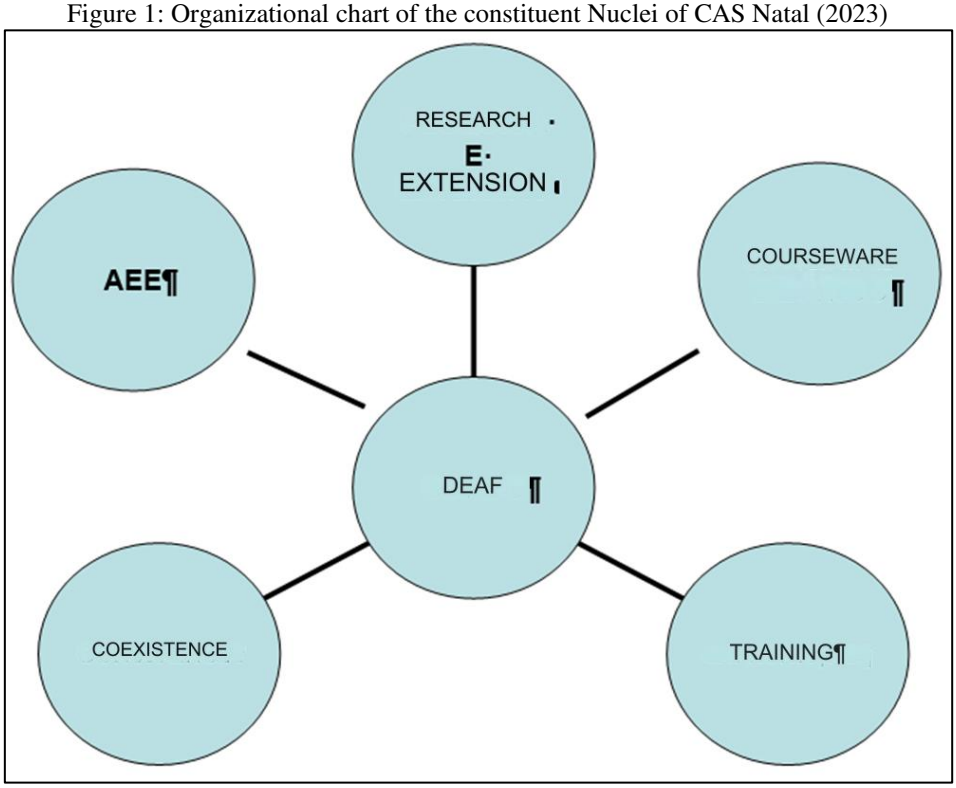
The consultations are carried out in groups, individual and mixed, that is, when there is a special education teacher in collaboration with the teacher of a specific discipline, and occur twice a week (Mondays and Wednesdays/Tuesdays and Thursdays).

The center works for the deaf community, a space that is more than educational, social and political, since it is a bilingual space in which every action is designed with and for the deaf.

In general terms, CAS Natal develops its activities and actions in 5 nuclei and, for a better understanding, we have organized the actions of each nucleus in figure 1.

[4] State Center for the Training of Educators and Assistance to the Deaf.
[5] Hearing impairment.

Figure 1: Organizational chart of the constituent Nuclei of CAS Natal (2023)



Source: prepared by the authors (2023).

All centers form the support network for deaf students and therefore, each center has attributions and responsible professionals who manage such actions/activities. Namely:

Training: teachers from the public school system who have deaf students in schools;

Coexistence: family and guardians of deaf students enrolled in CAS Natal;

Research and extension: group of CAS Natal professors and network professors (former CAS Natal students) who meet to study and research themes related to deaf studies;

Production of didactic material: CAS professors who prepare virtual and physical materials used internally at the Institution.

SEA Nucleus: And finally, the SEA Nucleus, of which the participating students are part.

Primary objective: to ensure quality care for deaf students and D.A. in a complementary and/or supplementary way.

Methodological and didactic organization: starting from an inclusive premise and from a bilingual perspective that considers Libras as a language and not a mere accessibility resource for the deaf community, the services are organized as follows: there are 4 sessions carried out in groups and individualized in the day shift. Methodologically, the services are carried out by rotation of the areas of knowledge. Portuguese services as L2; Libras as L1; of educational mathematics and arts, culture and diversity.

Participants

In this study, 2 bilingual teachers and 8 students aged 13 to 14 years participated

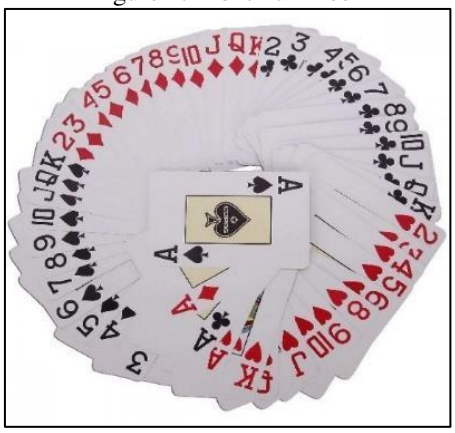
Instruments

Considering the specificity of the participants, a collective record diary was used, where each student recorded their doubts about the theme - multiplication. In all, there were 2 videos.

Getting to know the game deck

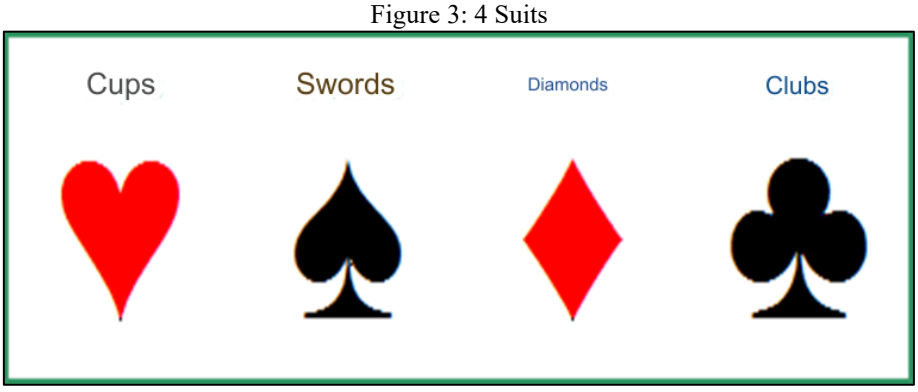
The complete deck (see figure 2) consists of 52 cards, four suits (see figure 3) (heart, diamond, clubs and spade) and each suit has 13 cards (Ace to 10 and jack - J corresponds to the number 11, queen - Q corresponds to 12 and king - K corresponds to 13). See Figure 4.

Figure 2: Front Full Deck



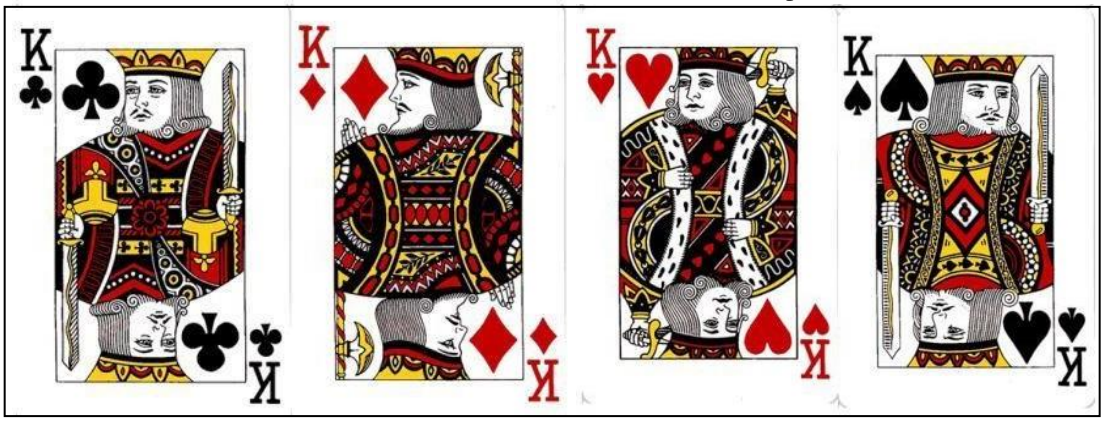
Source: prepared by the authors.

Figure 3: 4 Suits



Source: prepared by the authors.

Figure 4: Front card King of the deck - worth 13 points



Source: prepared by the authors.

Modified rules

- Each pair draws 13 cards from the table;
- The pair that answers the calculation made by the teacher on the blackboard begins and thus follows the order of play, always clockwise;
- The pair turns over two cards on the table and will have to multiply and respond. Example, 3x5=15; If you answered correctly, you continue in the game and if you answer wrong, you pass the turn in the next round.
- The pair that runs out of cards on the table wins.

Playing

The rules and layout of the deck were modified (see figure 5) to better meet the proposal, since it is necessary to consider the particularities of the public served at the CAS – at that time, deaf and deaf blind. Considering that the deaf-blind assisted at CAS Natal does not use braille, only tactile Libras, the classes/consultations are carried out from the perspective of collaborative work, that is, with the help of the guide-interpreter.

Figure 5: Front - Modified Card Deck



Source: prepared by the authors.

The rules of the game were written on the board: performed by pairs, where each pair has only pencils, erasers and draft for the calculations on the table.

In the end, the calculations were checked and socialized. Steps of verification of the calculations:

1st step: collection of all drafts;

2nd step: writing, on the blackboard, of the multiplications;

3rd step: together, calculate the results;

4th step: return of the scratch sheets so that the students could check the results of the blackboard with those of the paper.

RESULTS AND DISCUSSIONS

The execution and application of this game took place in a Specialized Educational Service - AEE room, currently consisting only of deaf and deafblind people aged 13 to 14 years, attending the 6th grade of elementary school II in the regular school.

Mathematics classes at CAS are mostly classes thought, planned and organized with a focus on the practicality and functionality of the discipline, in an attempt to soften the distance between the contents explored and learned in regular schools.

As perceived, the use of games brings great benefits to teaching and learning, to the teacher and student. To teaching, it makes it more didactic; learning makes it more attractive; to the teacher, more dynamic and to the student, more stimulated.

Undoubtedly, the use of Libras in every educational space made a difference when it came to acquiring mathematical knowledge. It is in this sense that we believe in a School that meets the linguistic and social specificities of the deaf and deaf-blind. This school, called bilingual, is provided for in Law No. 14,191/21, but we believe that the common school can offer teaching processes to the deaf in a bilingual way, as already highlighted in Decree No. 5626/05. We also remember that a

specific curriculum is necessary to guarantee Libras as the language of instruction of knowledge, evaluation, and materials that meet the teaching and learning of the deaf and deaf-blind. It was in this sense, to promote discussions about the schools of the deaf, that Santos Filho; Bezerra; Silva *et al*. (2024) published a book with relevant aspects to think about the bilingual school or Education in Libras. The book was the result of an activity developed in the discipline of the Graduate Program in Special Education focused on the discussion of the education of the deaf in the bilingual perspective at UFRN, promoted by professor Pedro Luiz dos Santos Filho.

FINAL CONSIDERATIONS

From the work presented, it was found that mathematics, despite being conceived by the listeners as a boring discipline, is, for the deaf, a legal but difficult discipline. According to the narratives of the deaf, mathematics is a visual and practical discipline and "**certain**", in this case, the sign of certain used by the deaf refers to "**exact**", unlike the Portuguese language. Thus, mathematical knowledge becomes more accessible for learning. The language of instruction at the time of the game favored the comprehension of the deaf students, being perceived by the answer used above by the student. This reinforces that, in order to understand the subjective issues of the disciplines and other concepts, learning must occur, rigorously, through the student's first language (natural language).

In addition, the use of the deck was presented as a tool to help teachers and students. To teachers, since it facilitates the teaching process, as well as, in relation to the verification of the content, whether or not it has been assimilated by the student. As for students, it serves to create an attractive and encouraging space for them to feel motivated to want to learn.

From this perspective, it is understood as fundamental that, regardless of the teaching strategy, the curricular component, the content worked and the resource used (game), there is an intentionality to be considered (Krans, 2014), understanding that the resource alone does not guarantee the quality of pedagogical practices.

In short, the use of mathematical games in mathematics teaching is an excellent didactic resource that promotes improvements to the teaching and learning process.

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