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Mathematics learning by students with intellectual disabilities: discussions from the perspective of the cultural-historical theory

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Abstract: This article analyzed how the conceptions of development and learning from the cultural-historical theory can stimulate the mathematical learning of students with intellectual disabilities. The investigation used data from a master's degree research project and preliminary analyses of an ongoing doctoral research work. In the master's research, we identified that the tasks offered only considered students' current level of development. In the doctoral project, we observed that the mathematical tasks applied in a regular classroom were outside the zone of imminent development and disregarded students' previous knowledge. Given this context, the subsequent stages of the doctoral research will be planned according to the zone of imminent development. These two studies contain proposals for students to acquire new mathematical concepts based on the perspective of development and learning of the cultural-historical theory, thus disregarding intellectual disability as an impediment.

Keywords: Intellectual Development Disorder. Inclusive Mathematics Education. Zone of Imminent Development.

Aprendizaje de matemáticas por estudiantes con discapacidad intelectual: discusiones desde la perspectiva de la teoría histórico-cultural

Resumen: Este artículo analizó cómo las concepciones de desarrollo y aprendizaje desde la teoría histórico-cultural pueden estimular el aprendizaje matemático de estudiantes con discapacidad intelectual. La investigación utilizó datos de un proyecto de investigación de maestría y análisis preliminares de un trabajo de investigación de doctorado en curso. En la investigación de maestría identificamos que las tareas ofrecidas solo consideraban el nivel de desarrollo actual de los estudiantes. En el proyecto de doctorado observamos que las tareas matemáticas aplicadas en un aula regular estaban fuera de la zona de desarrollo inminente y ignoraban los conocimientos previos de los estudiantes. Dado este contexto, las etapas posteriores de la investigación doctoral se planificarán de acuerdo con la zona de desarrollo inminente. Estos dos estudios contienen propuestas para que los estudiantes adquieran nuevos conceptos matemáticos basados en la perspectiva de desarrollo y aprendizaje de la teoría histórico-cultural, desconsiderando así la discapacidad intelectual como un impedimento.

Palabras clave: Trastorno del Desarrollo Intelectual. Educación Matemática Inclusiva. Zona de Inminente Desarrollo.

Aprendizagem matemática por estudantes com deficiência intelectual: discussões na perspectiva da teoria histórico-cultural

Resumo: Este artigo analisou de que maneira as concepções de desenvolvimento e aprendizagem da teoria histórico-cultural podem contribuir para estimular a aprendizagem matemática de estudantes com deficiência intelectual. Utilizou-se, para tanto, dados produzidos em uma pesquisa de mestrado e análises preliminares de uma pesquisa de doutorado em andamento. Identificou-se, na pesquisa de mestrado, que as tarefas oferecidas ao estudante consideraram apenas seu nível de desenvolvimento atual. Na pesquisa de doutorado observou-se que as tarefas matemáticas aplicadas em sala regular estavam fora da zona de desenvolvimento iminente e desconsideraram o que o estudante já conhecia. Diante desse contexto, as próximas etapas da pesquisa de doutorado estão sendo planejadas de acordo com a zona de desenvolvimento iminente. Essas duas pesquisas contêm propostas para que os estudantes se apropriem de novos conceitos matemáticos, sendo fundamentadas na perspectiva de desenvolvimento e da aprendizagem da teoria histórico-cultural, desconsiderando, desse modo, a deficiência intelectual como impedimento.

Palavras-chave: Transtorno do Desenvolvimento Intelectual. Educação Matemática Inclusiva. Zona de Desenvolvimento Iminente.

1 Learning of students with intellectual disabilities: changing scenarios

As mathematics education researchers whose work emphasizes an inclusive perspective, we have been concerned about the relevance historically attributed to people with disabilities in society. The global movement in favor of human rights influenced the drafting of national legislation to guarantee the rights of people with disabilities. Brazilian Inclusion Law (LBI) n. 13.146/2015 is a milestone in this regard. It was drawn up based on the assumptions of the UN Convention on the Rights of Persons with Disabilities and amended some existing laws to align with the Convention. Article 1 advocates "ensuring and promoting, under conditions of equality, the exercise of fundamental rights and freedoms by people with disabilities, aiming at their social inclusion and citizenship" (Brasil, 2015). This text reaffirms that the place of people with disabilities is not separated from other people, confined in their homes or specialized institutions, but as participants in social processes, valued and respected as citizens. In fact, the terms ensure and promote demarcate a position of commitment towards people with disabilities, indicating the need to develop public policies and promote changes in how social groups have dealt with historically marginalized people, including people with intellectual disabilities.

Given this reality, the emphasis of analysis in this text is art. 27, which, in its sole paragraph, reinforces the duty "of the school community [...] to ensure quality education for people with disabilities, keeping them safe from all forms of violence, neglect, and discrimination" (Brasil, 2015). For that, the LBI established the specialized educational service and determined the creation and operation of an inclusive educational system at all levels and modalities, which must be improved to guarantee access, permanence, participation, and learning of people with disabilities. Thus, there must be services aimed at eliminating barriers and providing full inclusion, as all services must aim to "meet the characteristics of students with disabilities and guarantee their full access to the curriculum in conditions of equality, promoting the achievement and exercise of their autonomy" (Brasil, 2015, Art. 28, item III). In this way, all actors in the school space are responsible for promoting learning for that group. Kaleff and Rosa (2019) also recognize the advancement of legislation to benefit inclusive education but point out that, given the difficulty of promoting a truly inclusive school environment, actions in this direction are necessary. Given this, educational institutions must

comply with legal provisions, the environment must be physically and pedagogically inclusive, and people with disabilities must have adequate conditions to learn with equity and equal opportunities.

The guarantee of the right to learning, including access, retention, and school learning for all students, with emphasis on those with intellectual disabilities, has been analyzed by Corrêa and Thiengo (2023), Corrêa, Milli, and Thiengo (2022), aiming to expand discussions in the field of inclusive mathematics education. Even so, this field of investigation has few contributions. Thus, Park, Bouck, and Josol's systematic literature review (SLR) (2020) on the retention of mathematical concepts by students with intellectual disabilities identified research predominantly aimed at teaching numbers and operations, geometry, and algebra; however, a small number addressed retention. Corrêa, Thiengo, and Souza's (2023) SRL also found few investigations involving the mathematical learning of students with intellectual disabilities enrolled in regular schools. When the authors included studies based on the theory of mental actions from the perspective of the cultural-historical theory, the results were very scarce. These surveys indicate that little has been dedicated to this audience's mathematical learning, and there are few records on the topic.

Given this scenario, this article sought to analyze how the concepts of development and learning belonging to the cultural-historical theory can contribute to stimulating the mathematical learning of students with intellectual disabilities. To this end, we discussed data produced by Corrêa's research (2017) and the initial analyses of a doctoral project in development by one of the authors of this article and researcher at the Research Group on Mathematics Education, Difference, and Inclusion (Grupo de Pesquisa em Educação Matemática, Diferença e Inclusão - DEVIRes) from the Federal Institute of Espírito Santo (Ifes).

2 Development and learning: cultural-historical perspective

Lev Semionovitch Vigotski was born in Orcha, near Gomel, in the Russian Empire. With a diverse background and an intelligence capable of impressing everyone who had the opportunity to meet him, he dedicated himself, among various topics, to studying the different schools of psychology and undertaking approaches between psychology and Marxism in the first decades of the 20th century (Vigotski, 2023). Together with his collaborators, he focused on the development of the higher psychological functions: attention and voluntary memory, active memorization, abstract thinking, deductive reasoning, and planning and language skills. The work he undertook gave rise to the cultural-historical theory.

His work arrived in Brazil in different translations; that is why some terms are described with different meanings. Thus, to present his ideas about development and learning, we adopted the terminology used by Zoia Prestes in her translations of Vigotski's work directly from Russian to Portuguese (Prestes, 2010).

Vigotski analyzed three conceptions about understanding children's development and its relationships with learning that existed at the time and made propositions that promoted significant advances in this field (2010a). The first conception argues that development that does not depend on learning and is linked to the biological processes of formation of the human organism will occur independently of the learning that precedes it. This conception has direct implications for the organization of school teaching, as there is a process of waiting for development to favor teaching. The division of students by age group and grouping of children with intellectual disabilities according to the severity of this disability (Vigotski, 2021) are also materializations of this premise.

The second idea discussed by the author argues that learning is development. Unlike the first theory, in which development precedes learning, the thinking that prevails for authors who support this conception is that, although they are separate and different processes, development goes hand in hand with learning as juxtaposed and identical processes. According to its premises, education should organize behavioral habits, and development consists of storing reactions. Furthermore, natural laws govern development, and this should guide the teacher's work since teaching does not alter these laws. Vigotski problematizes the lack of clarity in this theory about what happens first, development or learning. Furthermore, it indicates similarities between the two approaches. As established by the first conception, we believe the second perspective considers that teaching depends on development.

The third group of theories presented by Vigotski attempted to reconcile the extreme views of development and learning, considering the reciprocal influence of both: maturation, which is dependent on the development of the nervous system, influences learning, and learning interferes with maturation. This point of view expands the role of learning. However, it considers that the improvement of a capacity in a specific field would automatically be recognized in another field, for example, concentration. Vigotski showed research by his contemporaries that refuted this principle. According to him, these investigations

> demonstrate that intellect is not precisely the gathering of a certain number of general capacities — observation, attention, memory, judgment, etc. — but rather the sum of many different capacities, each of which is, to some extent, independent of the others (Vigotski, 2010a, p. 108).

By analyzing these three different views of development and learning, Vigotski identified points of convergence and opposition and sought a new way to resolve issues involving the links between learning and development. One of the aspects that underlies his theory is the assumption that children's learning precedes school learning. For example, the child's experiences with mathematics and their mother tongue in their interactions with adults show that, upon arriving at school, they have already learned several concepts relating to these two fields of knowledge. To better understand this association, he presented the results of research that resulted in the development of the theory of the imminent development area. Vigotski defended the principle that to better establish these connections, one must "determine at least two levels of development of a child" (2010a, p. 111) and not stick to measuring mental age, as was traditionally done.

Vigotski called the current level of development the signs of what the child concludes with independence and autonomy, showing what they have already appropriated, what they have already achieved, what they have matured, making up their learning repertoire. Under this parameter, he assigned tasks according to what was expected in the child's age group, indicating the child's stage of development. This customary assessment of mental development disregards any possibility of imitation by the child, a behavior that naturally occurs when interacting with other people. By proposing tasks that demanded more from children of the same mental age but with adult help, whether with guiding questions or demonstrations, he verified that children achieved better in carrying out the tasks. For Vigotski (2010b), children of the same mental age demonstrate different possibilities of achievement when they have help, indicating different levels of development that are not restricted to that factor, thus considering "The difference between the level of tasks achievable with the help of adults and the level of tasks that can be developed with an independent activity defines the area of potential development[1] of the child"

1 Zone of imminent development

(Vigotski, 2010a, p. 112).

With those verifications, Vigotski emphasizes the social nature of knowledge and how much interactions influence learning. This field of action for the child goes beyond the field of measurement of development that has already been completed, moving towards that which is still in process. This completely changes the way we evaluate a child's mental development. When considering only the current level of development, the gaze turns to the past, to what has already been achieved. In this way, identifying the zone of imminent development, a space conducive to new learning, indicates the child's possibilities for achievement –directs toward the future, fundamentally modifying pedagogical practice.

In education, reviewing only thoughts before the cultural-historical theory, the mathematical learning of children with intellectual disabilities was considered limited by their biological nature, which, consequently, would also limit pedagogical action. Thus, when it is established that this group has restricted abstract thinking, they are not offered experiences that expand this type of reasoning. The child will think the way thinking is conducted, and, to Vigotski, reality conducted in this way consolidates this condition. For example, Horstmeier (2004) developed research with children with Down syndrome in whom intellectual disability tended to occur with different characteristics. She observed that this group had fewer mathematical experiences than others with typical development, which generated significant negative impacts on their mathematical learning. Martins and Curi (2022) discussed the belief systems of teachers who teach mathematics in relation to this area of knowledge and the different contexts in which they work. They argue "that teachers' beliefs define their practices in the classroom" (p. 4).

To better understand and alleviate this problem, among the various existing theories, the cultural-historical perspective inaugurated a new way of acting in relation to the development of children, especially those with intellectual disabilities. In this sense, learning will drive development: the former will lead, not vice versa. That is why it is up to the school to take all necessary actions to direct the child to develop what they lack. Moreira, El-Hani, and Gusmão (2000) also questioned genetic determinism. In studies with people with Down syndrome, they found that following psychopedagogical and neuromotor stimulation programs provided significant cognitive advances. In this way, with its real demands and needs, the environment drives development and suppresses what the biological environment did not provide, as "the development of higher forms of behavior only happens under the pressure of necessity" (Vigotski, 2011, p. 866). This point of view presents a significant change concerning working with children with intellectual disabilities.

Vigotski believes that higher psychological functions first appear in collective activities as interpsychic functions and only later as intrapsychic functions (Vigotski, 2010b). This reinforces how important the nature of social relationships is to develop higher psychic functions, as this will only be possible "through the paths of cultural development, be it through the line of mastering the external means of culture (speech, writing, arithmetic), or along the lines of internal improvement of one's own psychic functions" (Vigotski, 2011, p. 869).

Currently, discussions about how to include people with disabilities in schools (Mantoan, 2004, 2022) reinforce the importance of the coexistence of all audiences at school. In fact, in describing V. S. Kiassuski's notes on grouping children with intellectual disabilities, Vigotski (2021) observed that, naturally, they gathered at different levels according to the severity of the existing disability. The researcher found that in these groups, children tended to seek interaction with more active others and that "other moments that characterize the life of the collectives indicate that, due to their intellectual level, heterogeneous ones are the most

desirable" (Vigotski, 2021, p. 219). The author emphatically criticized the division into levels of development, demonstrating how the coexistence of children with ID in a community with diverse possibilities was enriching, as, for them, their personality "rises to a higher level in the process of collective activity and in collaboration" (2021, p. 220). The researcher emphasizes that depriving a child of coexistence aggravates the incomplete development of higher functions.

Given the above and the peculiarities inherent to people with disabilities in their learning processes, it is necessary to identify the zone of imminent development and not just check the current level of development to create conditions that boost learning and, consequently, the development of students with intellectual disabilities, in particular.

3 Intellectual disability

According to the 2022 School Census, on page 32 of the results release, the number of students with ID enrolled in Brazilian schools was 914,467, more than double the number in second place, autistic students.

Furthermore, in our research, we have observed that in mathematics specifically, this group is one of the most discriminated against, facing much exclusion because its members are considered unfit to learn it. Russian researcher Nina Talizina discussed the difficulty attributed to mathematics due to its abstract contents (Talizina, 2001). In her analyses, she presents several reasons for these difficulties, including the psychological bases that explain development and learning and underlie teaching. In this sense, one can infer that when the conception that development conditions learning prevails, students with intellectual disabilities are perceived according to their genetic condition; that is, it defines their abilities and determines their learning.

Among the various existing disabilities, intellectual disability, also called intellectual development disorder, is part of the group of neurodevelopmental disorders and manifests itself in the initial period of child development, even before children enter school, and can be caused by some injury occurring at this stage. The Diagnostic and Statistical Manual of Mental Disorders (DSM-5) characterizes intellectual disability as a deficit in "reasoning, problem solving, planning, abstract thinking, judgment, academic learning, and learning from experience" (American Psychiatric Association, 2014, p. 31). These occurrences create difficulties in adaptive behavior, which can cause losses in various aspects of social life, including academic development.

The DSM-5 presents four levels of severity for the disability: mild, moderate, severe, and profound. The behaviors combine the conceptual domain, related to academic learning; the social domain, which encompasses relationships and social communication; and the practical domain, which involves meeting everyday needs, such as eating, dressing, and carrying out household tasks, among other everyday tasks. The independence and development of combined skills in each field will indicate the severity of the disability.

By agreeing with the reasoning of the Russian researcher, who considers the importance of biological conditions but recognizes social experience as having the most significant influence on development (Talizina, 2001), this will undoubtedly offer more learning opportunities for students with intellectual disabilities due to the pedagogical consequences that arise from this understanding.

It is worth highlighting that, in education, people with intellectual disabilities are part of the public served by special education, a type of teaching that can be offered by specialized

schools but preferably provided for in the regular education network, under the Law on Guidelines and Bases of Education (Lei de Diretrizes e Bases da Educação Nacional - LDB), since its promulgation in 1996. The law that approves the 2014 National Education Plan (Plano Nacional de Educação - PNE) also includes as one of its guidelines the "overcoming of educational inequalities, with an emphasis on promoting citizenship and eradicating all forms of discrimination" (Brasil, 2014, art. 2nd, item III) and, to this end, establishes as Goal 4 to universalize access to basic education and specialized educational services for this group and other students covered by special education, preferably in the regular education network.

Also motivated by these deliberations, we will present some analyses of ongoing research within the validity period of this PNE, which will be completed in 2024. Although the legal provisions have been in force for some time, and the ideas developed by Vigotski date back to the beginning of the 20th century and are the basis for research throughout this period, we consider it necessary to reflect on how students with intellectual disabilities have experienced mathematical learning opportunities at school.

4 Mathematics learning versus intellectual disability

To conduct the proposed discussions, some aspects of Corrêa's (2017) research on the appropriation of concepts from the decimal number system by a student with Down syndrome were used, comparing them with initial doctoral research analyses in the development phase. The data listed refers to the perspective of development and learning supported by the cultural-historical theory. Pseudonyms replaced the names of research participants to protect their identities.

Corrêa developed a case study with a student with Down Syndrome and intellectual disability, enrolled in the third grade at a private elementary school. The study objective was "to discuss the appropriation of concepts and meanings of the decimal number system by a child with Down syndrome, from the perspective of the theory of planned formation of mental actions and concepts" (Corrêa, 2017, p. 18). The theory was developed by Piotr Galperin and was based on the development and learning assumptions of Vigotski's cultural-historical theory. Galperin's theory was not the subject of analysis for the discussions presented in this article.

At the time of the investigation, Marcos was 11 years old, spoke little, remained silent most of the time and participated in the regular classroom routine with other children. He also had the support of an assistant teacher trained in pedagogy, who remained sitting by his side. During mathematics classes, he received tasks with simplified challenges regarding what was expected for the 3rd grade and, according to the teacher, adapted by her to his level of development. According to the National Curriculum Parameters for Mathematics (Parâmetros Curriculares Nacionais - PCN) in force at that time, during elementary school, knowledge about numbers and operations must be "constructed and assimilated by students in a dialectical process, in which they intervene as effective instruments to solve certain problems" (Brasil, 1997, p. 39). Thus, for the initial years, this knowledge is expected to be applied as the student is in contact with problem situations related to addition, subtraction, multiplication, and division.

Marcos's notebook had tasks related to reading, writing, and tracing natural numbers, which were different from what was proposed by the PCN, but considering what he could accomplish. Counting involved small quantities of one or two decimal places, and the assistant teacher sometimes helped by taking some pencils from the student's own pencil case so that he could rely on these resources during the count. These data presented by Corrêa make it possible to reflect on the predominance of offering mathematical experiences according to the

development of students with intellectual disabilities, considering only what they can already accomplish. Pedagogical actions that only act at the current level of development do not contribute to students' advancement, as teaching should drive development (Vigotski, 2022) and not the other way around.

According to the researcher, during the observations, it was impossible to identify whether he recognized the positional value of the numbers, a necessary condition to understand the concept of numbers and carry out different operations, as this was not proposed in the tasks the teacher offered. Furthermore, the assistant teacher reported to Corrêa (2017) that Marcos only got involved in tasks that used games.

Corrêa (2017), like Horstmeier (2004) and Castro and Drago (2013), calls weaknesses the characteristics related to Down syndrome that indicate deficits and obstacles to learning. However, in addition to this, the researcher emphasizes the strengths, characteristics that indicate possibilities of action for students' benefit. For example, a deficit in auditory memory is considered a weakness because it makes it difficult to acquire and retain information that predominantly explores oral expositions. On the other hand, generally preserved visual memory is recognized as a strength because it can favor learning situations by being more explored.

To increase Marco's engagement, during the research, Corrêa created a sequence of games adapted according to the theoretical-methodological framework used, aiming to appropriate the concepts of the decimal number system. To this end, she introduced the game "Ganha 100 primeiro" [Win 100 First] (Corrêa & Thiengo, 2017) for him and his classmates with typical development. This game aims to build the notion of groups by tens. Each player gets dice, popsicle sticks, and elastic bands. After rolling and counting the dice, the player must take the corresponding number of sticks and set them aside. As they obtain ten sticks, they must group them with an elastic band. The player who gets the 100 sticks first wins the game, that is, ten groups of ten. The "Win 100 First" game uses manipulative materials to explore counting and groupings in a meaningful context. According to Corrêa (2017, p. 107), the research proposal "aligns with Vigotski's concern with the development of abstract thinking, in the sense of not depriving people with intellectual disabilities of the stimuli necessary for this development." Marcos's use of oral language increased throughout the meetings, supporting counting, together with other resources. The researcher observed improved numerical sense, increasing independence in the perception of groups every ten units, and Marcos's greater ease in counting and the game stages when his classmates participated.

The research raised the need to use counting and make base ten groupings. Furthermore, the scarcely expressive verbal language the student presented in interaction with the researcher took on new characteristics when playing the game with two children with typical development in class. He began to speak more and verbalize more quickly and more understandably. As already identified by Vigotski as one of the important elements present in the zone of imminent development, imitation offered the student opportunities to expand his actions. Marcos started reporting how one of his classmates played. Another significant detail in Corrêa's research was that the other children wanted to participate in the game with Marcos, which may indicate the children's predisposition to interact with a peer with a disability. A relevant factor that may have contributed to this interaction was the game planning aimed at challenging all of them, not just the one student with intellectual disabilities. As they only depended on the random numbers indicated by the dice to win or lose, they participated in equal conditions of opportunities in the planned moments. In this way, these constituted inclusive moments as they met the participants' characteristics –whether with intellectual disabilities or typical development–, providing learning for all.

Corrêa's (2017) description shows that Marcos's actions involving counting out loud or speaking to himself, as well as his initiative to make groups when obtaining ten sticks, were assisted by the orienting-activity base, the first stage of Galperin's planned formation of mental actions, and an accessible form indicating the steps to follow. The student also received help from his classmates and the researcher through regulations and demonstrations during the rounds. The student's performance in this circumstance indicated his zone of imminent development.

Corrêa emphasizes that, according to Vigotski, what the child does today with help, he can do independently in the future. Corrêa recognized indicators of student progress regarding the concept of numbers according to the parameters observed. However, the researcher needs more time, continuity of studies, and new research to reach other conclusions.

Given this and the reality of special education in Brazil, the doctoral research analyzed below proposes investigating the appropriation and retention of mathematical concepts by students with intellectual disabilities. The study is being conducted with a student with intellectual disabilities –alias Lucas– enrolled in the first grade of a federal network high school. He is 17 years old, communicative, interacts with his classmates, and has friends in another class. A pedagogy-trained assistant teacher assists him during classes, encouraging him to complete the tasks and copy the mathematics teacher's records on the board.

Based on the assumptions of the cultural-historical theory, the initial phase of data production, starting at the end of the first semester of 2023, involved getting to know the student and identifying his current level of development in mathematics. To this end, we observed classes in this curriculum component, analyzed Lucas's tasks in his notebook, analyzed his assessment tests, and conducted a semi-structured interview with the mathematics teacher and professionals from the specialized educational service center who accompanied him. The aim was to recognize what mathematical knowledge was being mobilized during classes and identify his strengths, what he had already appropriated, and his weaknesses in doing so. The assessment tests could be done in other spaces, including the library or the specialized educational service room, so the student could be more comfortable expressing his reasoning and reading the questions aloud. He would also have more time to complete them when necessary. It is important to note that Lucas performs the same tasks as the other classmates in the class. According to the teacher, the changes are related to the way he is assessed and not to the assessment instruments themselves. He states that he intends to check the student's progress in relation to himself. Despite this, Lucas's grades in mathematics were low, and, according to the specialized educational service team accompanying him, until the moment under analysis, he was likely to fail again, as he had not achieved the grades necessary for progression.

During the observation stage, Lucas copied the teacher's notes on the board during classes and spent all his time with these records, encouraged by the assistant teacher to keep focused. The researcher noted that the time was insufficient for task completion, so she also copied the corrections from the board. When asking the teacher what mathematical content he identified as weaknesses that could be the object of research action, he said that any basic content would be important, as Lucas would forget what had been studied. Even with this characteristic and the support of the LBI, which indicates the right to reasonable adaptations so that people with disabilities have the full right to education (Brasil, 2015), no curriculum or methodological adaptation was made during mathematics classes.

It is worth highlighting that the Common National Curriculum Base (BNCC), a document that guides the curriculum organization of education systems, presents the area of mathematics and its technologies in high school with the proposition of consolidating,

expanding, and deepening the essential learning that was developed in elementary school (Brazil, 2017). From what was observed, the previous essential learning was not considered when carrying out interventions with the student.

Given the above and resuming the research, the researcher and the student with intellectual disabilities held meetings outside the classroom so the researcher could identify the student's current level of development in some mathematical concepts. The educational assistant was not present in these meetings, and the interaction took place in a private setting. Thus, aiming for better interaction with the student and identifying the mathematical knowledge mobilized, the researcher proposed the track game developed by Villar and Kistemann Jr. (2017). Whether in strategy or entertainment games, intentionality when using the game is essential to make it a resource in mathematics education (Grando, 2015).

The suggested board game aims to explore situations that require calculations and problem solving involving addition, subtraction, multiplication, and division of natural numbers. It consists of a track numbered from 1 to 39, with each space alternating between red, yellow, and blue. The track must be followed according to the values indicated on the die. The colors of each house, i.e., each space on the track, correspond to the colors of the cards that will be chosen. According to Villar and Kistemann Jr. (2017, p. 20), "The color of the card defines the difficulty level of the operation. Basic level: blue color, intermediate level: yellow color, and advanced level: red color." When applying it with Lucas, we observed that the game kept his interest and concentration in solving the operations that appeared with each card.

During the resolution of the propositions, we verified the ease of the student with intellectual disabilities in making mental calculations involving small quantities, his understanding of multiplication as successive additions, and the use of calculation strategies different from those conventionally used. The initial analyses considered Lucas's doubts about using algorithms for subtraction, multiplication, and division operations, as well as the need to ungroup the tens and hundreds in subtractions, as weaknesses. As indicated by the BNCC, these are elementary learnings, but preliminary observations indicate that they are not yet consolidated for the student. Therefore, high-school-specific mathematical concepts are far from Lucas's current level of development. It is worth emphasizing that during the game, as the calculations were proposed, mathematics was explored from the track itself and as a condition for advancement and reaching the finish line, which is the final objective of the game.

As a result of the preliminary interventions, Lucas demonstrated interest in participating, concentration during the game, confidence in testing hypotheses to resolve issues, and willingness for the following meetings. Often, the student did not notice time passing during the meetings and was surprised by the alarm set by the researcher when the end of the time approached.

In this section of data production from doctoral research, the researcher observed that the student's current level of knowledge suggested approaching concepts before working with functions, including the calculation of the unknown, which also involved solving operations such as addition, multiplication, subtraction, and division, which may characterize the zone of imminent development. The next stage will be planned to appropriate the calculation of the unknown.

To date, the cultural-historical perspective of development and learning has outlined researchers' approach to intervening with students with intellectual disabilities. As Vigotski presented, the path of possibilities indicated by the zone of imminent development dialogues with the concepts already acquired and moves towards new learning. At this stage, the assistant teacher's presence can help, the mathematics teacher's interventions can add, and developing

tasks together with other classmates who have already advanced in the acquisition of concepts can collaborate to establish connections between what students have already accomplished and what they are still in the process of acquiring.

This ongoing doctoral research has points of contact with the research by Corrêa (2017), which has already been completed: both use Galperin's cultural-historical theory as the main reference and study the appropriation of mathematical concepts by students with intellectual disabilities. Both studies also use the game as a resource, encouraging student involvement in the proposed tasks. There is also a concern in getting closer to these students to get to know them and identify their characteristics. Furthermore, both contain proposals based on what students already demonstrate they know and offer them opportunities to grasp new mathematical concepts without considering the intellectual disability as a barrier.

It is essential to highlight that the developmental perspective directly impacts the pedagogical work undertaken at school at its different levels and modalities. Therefore, when considering people with intellectual disabilities, these conceptions will result in the quality of mathematical experiences offered to them in the future. As socio-historical subjects, learning is linked not only to inherited genetic conditions, such as the characteristics arising from intellectual development disorders, but also to the quality of the cultural experiences lived by them. Even Horstmeier's (2004) work, published a significant time ago, becomes relevant, as her report on the few experiences with mathematics available to children with Down Syndrome considers that, due to their intellectual disability, they would not be capable of learning mathematics. We must remember that this narrative persists today.

Thus, if experiences are limited to the current level of development, providing only what the student already knows how to do, there is stagnation. However, if they are beyond the zone of imminent development, they are not accessible, and, in Lucas's case, there is a risk we train a copyist without autonomy to carry out the proposed tasks, prevented from advancing in the development of mathematical thinking.

In Lucas' case, the game showed indicators of what is already part of his knowledge collection. This is because, as he presented difficulties in the calculations, the researcher provided information regarding the procedure. During the meetings, he started using algorithms and performing reverse operations to check the results, which was initial evidence of how a sequence of assisted tasks, starting from the current level of development and acting in the zone of imminent development, can provide the appropriation of mathematical concepts and contribute to the advancement of students with intellectual disabilities.

A point to be considered, however, is how much students with intellectual disabilities need to be challenged in relation to the future, considering what they are about to mature to advance toward the acquisition of mathematical concepts, as defined by doctoral research as future referrals. Therefore, strategies that offer the students only what they can do independently, without offering mathematical experiences that mobilize other skills, can reinforce the condition established by genetics, which would limit the advancement of people with intellectual disabilities, keeping them at their level of development. Still, considering the presence of an assistant teacher, as in the studies cited above, which aims to meet the specific needs of students supported by special education, we must reflect on how interaction with other students in mathematics classes and other school dynamics also supports the natural movement of imitation and can promote these students' progress.

Given the analysis and the existing reality, we agree with Kaleff and Rosa (2019, p. 22) when they state, "There is no possibility of thinking about homogeneous classrooms in which a teaching approach will resolve all difficulties." The inclusive movement must include all

people, not just those with disabilities. Therefore, it is urgent to reflect on how much pedagogical practices presuppose that all students in the same class must be at an equal level of development and, therefore, the same teaching and assessment strategies are offered to everyone. In this sense, knowing students' current level of development but acting in the zone of imminent development involves undertaking new pedagogical initiatives, as already signaled by Vigotski. This involves going through a heterogeneous environment that values the nature of social interactions and provides situations to develop memory, attention, language, and other higher psychological functions. These propositions can enrich discussions in inclusive mathematics education and generate advances in mathematical learning for students with intellectual disabilities.

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References

American Psychiatric Association. (2014). *Manual diagnóstico e estatístico de transtornos mentais: DSM-5* (5. ed.). Tradução de M. I. C. Nascimento et al. Porto Alegre, RS: Artmed.

Brasil. (2014). *Lei n° 13.005/2014, de 25 de junho de 2014*. Aprova o Plano Nacional de Educação - PNE e dá outras providências. Brasília, DF.

Brasil. (2015). *Lei nº 13.146, de 6 de julho de 2015*. Institui a Lei Brasileira de Inclusão da Pessoa com Deficiência (Estatuto da Pessoa com Deficiência). Brasília, DF: Edições Câmara.

Brasil. Ministério da Educação. Secretaria de Educação Fundamental. (1997). *Parâmetros curriculares nacionais: matemática*. Brasília, DF.

Brasil. Ministério da Educação. Secretaria de Educação Básica. (2017). *Base Nacional Comum Curricular: Educação é a Base*. Brasília, DF.

Castro, M. G. L., & Drago, R. (2013). Síndrome de Down: características e possibilidades de inclusão nas salas de aula da escola comum. In R. Drago, E. Pantaleão, & S. V. Lopes (Orgs.), *Educação Especial: Indícios, registros e práticas de inclusão*. São Carlos, SP: Pedro & João Editores.

Corrêa, G. (2017). *Apropriação do conceito de sistema de numeração decimal por uma criança com síndrome de Down na perspectiva da teoria da formação planejada das ações mentais*. 146 f. Dissertação (Programa de Pós-Graduação em Educação em Ciências e Matemática). Instituto Federal do Espírito Santo, Vitória, ES.

Corrêa, G. A., & Thiengo, E. R. (2017). *Jogos do SN Decimal para crianças com Síndrome de Down - Jogo 1: Ganha 100 primeiro*. Vitória, ES: Editora do Ifes.

Corrêa, G. A., Thiengo, E. R., & Milli, E. P. (2022). Educação Matemática Inclusiva no Cenário Capixaba: experiências de pesquisa no Programa Educimat. *Revista Eletrônica Sala de Aula em Foco. Edição Educimat*, 151-165.

Corrêa, G. A., & Thiengo, E. R. (2023). Apropriação do conceito de sistema de numeração decimal por uma criança com trissomia do cromossomo 21 na perspectiva da teoria da

formação planejada das ações mentais. In M. P. M. Araújo & R. Drago (Orgs.), *Educação especial na perspectiva da educação inclusiva: um caminho em construção* (pp. 126-141). Itapiranga, SC: Schreiben.

Corrêa, G. A., Thiengo, E. R., & Souza, M. A. V. (2023). A teoria das ações mentais e aprendizagem matemática de estudantes com deficiência intelectual: uma revisão sistemática de literatura. *Revista Paranaense de Educação Matemática*, *12*(28), 46-62.

Grando, R. C. (2015). Recursos didáticos na educação matemática: jogos e materiais manipulativos. *Revista Eletrônica Debates em Educação Científica e Tecnológica*, *5*(2), 393-416.

Horstmeier, A. (2004). *Teaching math to people with Down Syndrome and other hands-on learners* (1. ed.). USA: Woodbine House.

Kaleff, A. M. M. R., & Rosa, F. M. C. (2019). Ações em busca de um ensino de Matemática mais inclusivo. *RIPEM*, *1*, 8-24.

Mantoan, M. T. E. (2004). O direito de ser, sendo diferente na escola. *Revista CEJ*, *8*(26), 36-44.

Mantoan, M. T. E. (2022). Uma escola hospitaleira. *Revista Estudos Aplicados em Educação*, *7*(13), 5-14.

Martins, P. B., & Curi, E. (2022). Conhecimentos e crenças manifestados por professores que ensinam Matemática e fazem uso de materiais manipuláveis em suas práticas. *RIPEM*, *12*(4), 1-16.

Moreira, L. M. de A., El-Hani, C. N., & Gusmão, F. A. F. (2000). A síndrome de Down e sua patogênese: considerações sobre o determinismo genético. *Revista Brasileira de Psiquiatria*, 96-99.

Park, J., Bouck, E. C., & Josol, C. K. (2020). Maintenance in mathematics for individuals with intellectual disability: A systematic review of literature. *Research in Developmental Disabilities*, *105*, 1-11.

Prestes, Z. R. (2010). *Quando não é quase a mesma coisa - Análise de traduções de Lev Semionovitch Vigotski no Brasil - Repercussões no Campo Educacional*. 295 f. Tese (Programa de Pós-graduação em Educação). Universidade de Brasília, Brasília, DF.

Talizina, N. F. (2001). La formación de los conceptos matemáticos. In N. F. Talizina (Org.), *La formación de las habilidades del pensamiento matemático* (pp. 07-39). Traducción del ruso al español por Y. V. Solovieva & L. Q. Rojas. San Luis Potosí, México: Facultad de Psicologia, Universidad Autónoma de San Luis Potosí.

Villar, J. M. G., & Kistemann Júnior, M. A. (2017). *Situações-problema e atividades lúdicas para discalculia na sala de aula de matemática*. Produto Educacional. UFJF, Juiz de Fora, MG.

Vigotski, L. S. (2010a). Aprendizagem e desenvolvimento intelectual na idade escolar. In L. S. Vigotski, A. R. Luria, & A. N. Leontiev, *Linguagem, desenvolvimento e aprendizagem* (11. ed.). Tradução de M. P. Villalobos. São Paulo, SP: Ícone.

Vigotski, L. S. (2010b). *Psicologia pedagógica* (3. ed.). Tradução de P. Bezerra. São Paulo, SP: Martins Fontes.

Vigotski, L. S. (2011). A defectologia e o estudo do desenvolvimento e da educação da criança anormal. *Educação e Pesquisa*, *37*(4), 861-870.

Vigotski, L. S. (2021). *Problemas da defectologia: volume I* (1. ed.). Organização, edição, tradução e revisão técnica de Z. Prestes & E. Tunes. São Paulo, SP: Expressão Popular.

Vigotski, L. S. (2022). *Obras Completas – Tomo Cinco: Fundamentos de Defectologia*. Tradução do Programa de Ações Relativas às Pessoas com Necessidades Especiais (PEE). Cascavel, PR: EDUNIOESTE.

Vigotski, L. S. (2023). *Psicologia, desenvolvimento humano e marxismo* (1. ed.). Tradução de P. Marques. São Paulo, SP: Hogrefe.