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Behavioral and Psychological Aspects of Students with Special Educational Needs Relevant to the Development of a Virtual Reality Application

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ABSTRACT
This theoretical article aims to discuss behavioral and psychological aspects of students with Special Educational Needs for the development of a Virtual Reality application. It presents theoretical perspectives that support a research involving the design and development of a Virtual Reality application that contributes to the learning of Mathematics by Basic Education students diagnosed with Developmental Dyscalculia, Cerebral Palsy or Visual Impairment. Based on systematic literature reviews carried out to guide the design of the application, considerations are based on issues related to behavioral and psychological variables that can be activated during the use of *software* that involves immersion in a 3D context. It is evident that the use of Virtual Reality applications is efficient in the learning of these students, as it resizes educational communicative actions, activating sensory tools that use simple and functional commands.

Author Keywords
Application; Virtual Reality; Mathematical Learning; Behavior; Psychological Variables; Special Educational Needs.

ACM Classification Keywords
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INTRODUCTION

Mathematics has been a curricular component in which many students face difficulties for years. Based on this fact, several studies and research have been developed with the aim of analyzing the effects of pedagogical resources in the classroom, seeking to help these students improve their performance.

Among these resources, technological resources stand out, as they are increasingly embedded in students' reality. In the educational context, digital technologies have proven to be an important resource, enabling teachers to provide creative and engaging activities for their students.

In particular, learning difficulties can be exacerbated in students who have Special Educational Needs (SEN). According to the Salamanca Declaration, this term refers to children or young people who have needs that are due to disabilities or learning difficulties [1].

With this in mind, the Study and Research Group on Developmental Dyscalculia of the Pontifical Catholic University of Rio Grande do Sul (GEPEDPUCRS), established in 2016, has, since 2012, has been carrying out studies and investigations that aim to develop interventions that effectively contribute to the learning of students with Developmental Dyscalculia (DD). In the last two years, due to the CAPES Thesis Award in the area of Teaching, received in 2021 with the Doctoral thesis entitled “Teaching Mathematics for people with cerebral palsy: an analysis of pedagogical actions in Basic Education”[1], supervised by the group coordinator, the target audience of the studies was expanded to include students with Cerebral Palsy (CP) and Visual Impairment (VI). From this , two research projects, which serve as umbrellas for subprojects developed by

[1] “*O ensino da Matemática para pessoas com paralisia cerebral : uma análise de ações pedagógicas na Educação Básica*” (original title).

researchers from the group, were approved by Brazilian Funding Agencies. The first, entitled "Pedagogical Interventions for Students with Developmental Dyscalculia and Cerebral Palsy: Implications for Learning in Science and Mathematics", with financial support from the Rio Grande do Sul State Research Support Foundation (FAPERGS), and the second, "Science and Mathematics Learning of Inclusion Students in Basic Education: Implications from the Design and Development of Mixed Reality Applications", with funding from the National Council for Scientific and Technological Development (CNPq). Among the interventions that are being implemented, the use of a Virtual Reality (VR) application for students diagnosed with DD, CP or VI stands out, which is being designed and developed by researchers from the group made up of master's and doctoral students in Education with training in Mathematics and Scientific Initiation scholarship holders from Psychology and Computer Science courses.

To guide the development of these projects, several systematic literature reviews were conducted focusing on the use of applications for students with DD, CP or VI. In addition, to recruit students to participate in the research, observations, standardized tests, questionnaires with each of the students and their respective Math and Natural Sciences teachers, and an anamnesis with the students' guardians are carried out. The data collected point to several behavioral and psychological variables activated or that can be activated during the use of applications that, if well analyzed, can serve as subsidies for the design and development of a VR application, the main objective of these projects.

Therefore, this article aims to discuss behavioral and psychological aspects of students with SEN relevant to the development of a VR application, in particular, of students who have DD, CP or VI.

To this end, the article is structured into the following sections: Learning in the context of a student with special educational needs; behavioral and psychological variables in the face of learning; The use of assistive technologies for students with cognitive, physical and motor impairments; Possible articulations; and, Final Considerations.

LEARNING IN THE CONTEXT OF A STUDENT WITH SPECIFIC EDUCATIONAL NEEDS

From a neuropediatric perspective, learning occurs in the brain. However, according to Riesgo [2], it is clear that other factors also influence this process, such as the environment, the learner, the teacher, the emotional state, among others. For the author [2], when new information is received by the Central Nervous System (CNS), it causes a change in its structure, which, from a neurobiological point of view, characterizes learning. In this same perspective, Giffoni [3] states that learning is characterized by a change in behavior resulting from the plasticity of neural processes, being a constant and evolutionary process.

In their studies, Rotta, Bridi Filho and Bridi [4] argue that learning promotes the expression of new behaviors that transform the individual's ability to live in society, and that this learning derives from brain activity. Therefore, renewed behaviors must emerge as new learning emerges, and in this process new associations and inferences are added to the individual's life repertoire.

In particular, this article is dedicated to discussing aspects related to the learning of students with DD, CP or VI.

DD is defined by Kosc [5] as a structural disorder of mathematical abilities, the origin of which is associated with genetic or congenital disorders in specific regions of the brain. In this same perspective, Hasse et al. [6] define DD as a disorder characterized by difficulties in numerical processing and in performing calculations, negatively affecting the student's academic performance and their abilities in activities that involve the use of numbers.

According to the World Health Organization's International Classification of Diseases (ICD-11) [7], DD is: "Developmental learning disorder with impairment in mathematics is characterized by significant and persistent difficulties in learning academic skills related to mathematics or arithmetic, such as number sense, memorization of number facts, accurate calculation, fluent calculation, and accurate mathematical reasoning".

Added to this, DD mainly affects the student's academic performance, which is below expectations for their age group [7].

In a very similar way and in an attempt to achieve a standardization for the definition of DD, the Diagnostic and Statistical Manual of Mental Disorders – DSM-5-TR [8], points to dyscalculia as an alternative term for the specific learning disorder in Mathematics, establishing four domains: "number sense; memorization of arithmetic facts; accuracy or fluency of calculations; accuracy in mathematical reasoning", in addition to impairments in mathematical reasoning or accuracy in reading words.

It is categorized into six types, according to Kosc [5], which are related to impaired mathematical skills, they are:

i) Verbal dyscalculia: difficulty in verbally expressing mathematical terms and relationships, such as naming values and quantities, numbers, digits, numerals, operational symbols and mathematical representations, even if they can name a presented quantity, read a number or write it when dictated;
ii) Practognostic Dyscalculia: difficulty in manipulating concrete objects or mathematical figures, this manipulation includes enumeration of things and comparison in relation to estimation of quantities, such as finding the magnitude of objects;
iii) Lexical Dyscalculia: difficulty in interpreting or reading mathematical symbols, this being the most severe type; the

mildest form is when the student cannot read numbers with more than three digits, and when he/she swaps one digit for another or the order of the digits;
iv) Graphic Dyscalculia: difficulty in manipulating mathematical symbols in writing, similar to Lexical Dyscalculia and occurs when the student has dysgraphia and dyslexia; in the most severe cases, he is unable to transcribe dictated numbers, copy numbers or write them in Arabic;
v) Ideognostic Dyscalculia: difficulty in understanding mathematical concepts and relationships, as well as in performing mental calculations; in more severe cases, the person is unable to mentally perform even the simplest calculations; sometimes they are able to read and write written numbers, but they do not understand this number as a result of other numerical relationships;
vi) Operational Dyscalculia: difficulty in performing mathematical operations, or switching operations, sometimes preferring to write an algorithm or count on one's fingers what one could easily calculate mentally.

Regarding CP, Rotta [9] reports that since 1959 the expression Cerebral Palsy denotes the sequelae of a brain injury, characterized by a persistent disorder, of a non-progressive nature, and which affects the development of posture and movement. Commonly, CP generates sensory, communication, cognitive and behavioral disorders. These disorders often act as impediments to adequate learning, which requires a focus on diversified and efficient resources for the educational guidance of these individuals.

In their studies, Ribeiro and Lara [10] highlight actions that can contribute to the inclusion of everyone, particularly students with CP. One of these actions is to propose activities in which the student is able to deal with the content proposed by the teacher, allowing their inclusion in the classroom by developing the "… same duties and obligations as other students" (our translation). Thus, conditions are created so that students with CP have the opportunity for "… experiences that value their skills, bringing them closer to other students" (our translation) [10].

The authors emphasize the importance of recognizing other forms of language, expressions, strategies or resources used by students with CP who have speech or motor limitations to communicate with others [10]. In this sense, dialogue, gesture, speech, writing and lip reading stand out. This recognition is necessary so that everyone, teachers and students, "… are positively affected by perceiving the way in which others communicate and the possibility of there not being only one form of expression" (our translation).

Another action that favors student learning, particularly with CP, is the use of differentiated resources. The testimony of students with CP [10] pointed to the use of manipulative material, computers and their own bodies. In addition, Ribeiro and Lara [10] reinforce that "… by proposing tasks that value everyone's skills and take into account each person's specific difficulties, inclusion becomes more solid" (our translation).

Regarding VI, according to the Brazilian Decree (Law No. 5,296/2004), any individual who has visual acuity equal to or less than 0.05 in the best eye, with the best optical correction, is considered blind [10]. Furthermore, an individual with low vision is one who has visual acuity between 0.3 and 0.05 in the best eye, with the best optical correction, or when the sum of the visual field measurement of both eyes is equal to or less than 60° or who accumulates the occurrence of any of the conditions mentioned [10].

Prior to this law, it is possible to highlight as a law that marked the right of students with some disability to attend regular schools, the Law of Guidelines and Bases of Education (Law nº 9.394/96), which determined, in its article 59, that schools and education networks should provide access, permanence, specific completion, offer resources and specialized assistance to students, respecting their specificities [11].

Despite this, according to Uliana and Mól [12], not all students with some kind of disability or SEN are actually included in schools, due to the lack of conditions compatible with the implementation of the educational process. In the case of students with VI, the authors [12] reinforce that, based on their bibliographic research, in general these students do not have major learning difficulties, but they need conditions to access school content. Even so, adaptations of materials and an offer of diversified pedagogical practices are necessary.

In addition, Frazão *et al.* [13] state that, in the case of students with VI, the use of computers and digital technologies can complement and assist teachers' work, since there are software and applications that assist in school activities. According to the authors, the use of teaching resources and appropriate methodologies that consider the way students with VI perceive and feel the environment in which they live creates conditions for these students to present great possibilities for personal and intellectual development.

For learning purposes, it is important to emphasize that even if care is taken in defining disability, it is necessary for the school and the teacher to perceive each student as unique and identify their individualities, their potentialities and their impairments. Given an individual profile, conditions are created to provide individual and large group services and situations that include all students.

BEHAVIORAL AND PSYCHOLOGICAL VARIABLES IN LEARNING

Several factors can positively or negatively interfere in the students' learning process. Among them, it is possible to highlight some triggering variables: social; economic; behavioral; psychological; physiological; among others. Complementing this idea, Lara [15] points out the issue of

mathematical language and the meaning of the concept, as well as the variables: psychological; cognitive; socio-motivational ; centered on the school context; associated with Mathematics; and, associated with the Maths class.

DD is recognized as a multifactorial disorder, caused by neurogenetic inheritance and environmental factors [8]. However, it is important to take into account that for the diagnosis of DD to be validated, the primary factor for the existence of symptoms cannot come from "… neurosensory deficiency, poverty and lack of stimulation, inadequate pedagogical experiences, etc." (our translation), according to Haase and Santos [16]. Therefore, it is understood that psychosocial factors such as those previously mentioned, as well as the student's general psychological condition, can aggravate their DD symptoms, but are never the cause.

Regarding behavioral variables, several fundamental factors can influence learning difficulties. Emotional and affective aspects, attention and concentration, self-efficacy, as well as motivation and persistence, are crucial and play a significant role in the impact of DD.

Among the emotional and affective aspects, issues such as anxiety, frustration, fear of failure and insecurity can intensify the challenges that students face when dealing with mathematical tasks. Moreira [17] points out that the academic failure of students with learning difficulties is accompanied by anguish, frustration and suffering, and that repeated academic failure leads these children to become insecure, unstable and anxious. In addition, frequent failure leads to feelings of exclusion, rejection and abandonment which, when associated with high expectations, can lead to resistance, phobias and avoidance of educational activities [17].

In this sense, Lara [15] explains that some students create self-concepts in the face of their failures and successes and that the feeling of defeat and failure increases anxiety and decreases the desire to study Mathematics. Furthermore, the author mentions that the feeling of failure can be subjective at home, when a family member has already experienced some kind of frustration in relation to Mathematics and can project or demand something from the student [15].

According to the DSM-5-TR [8], specific learning disorder is often, though not invariably, preceded by delays in attention, language, or motor skills during the preschool years. These delays may persist and co-occur with specific learning disorder. Furthermore, the manual [5] points out that specific learning disorder is often comorbid with other neurodevelopmental disorders, such as Attention Deficit Hyperactivity Disorder (ADHD), which can significantly impact the ability to concentrate and, consequently, academic performance.

Bandura [18] defines self-efficacy as the individual's belief in their ability to perform specific activities, involving the judgment of their abilities to mobilize cognitive resources and exercise control over events and demands in the environment.

In the context of DD and learning difficulties, self-efficacy is a relevant aspect to be considered. These students tend to develop beliefs of incapacity and show less persistence in the face of difficulties, feeling unmotivated to engage in mathematical operations.

In line with the perspective of Bandura et al. [19], children's beliefs in their efficacy to regulate their own learning and academic achievements contribute to school performance. Successes contribute to the construction of a strong belief in personal efficacy. On the other hand, failures can compromise it, especially if they occur before a sense of efficacy is firmly established [20]. Thus, self-efficacy not only influences how students face academic challenges, but also plays an important role in building and maintaining their motivation and persistence.

Regarding psychological variables, even though there are many differences between SEN and little agreement in the scientific literature about what really characterizes DD, in particular, as a neurodevelopmental disorder, it is possible to highlight the characteristics of specific learning disorder in Mathematics that are listed in the DSM-5-TR [8]: impairments in "… numerical sense; memorization of arithmetic facts; accuracy or fluency of calculations; precision in mathematical reasoning" (our translation). In addition, learning disorders and especially DD are commonly associated with deficits in executive functions.

It is common to observe the following characteristics in students diagnosed with DD: impairments in verbal and visuospatial working memory; attention deficits; difficulties in visuospatial notions [8] and deficiency in phonological processing [21]. All of these executive dysfunctions are also present in other neurodevelopmental disorders, which may explain the high rate of comorbidity in DD.

It is understood that it is difficult to draw a general cognitive profile of people with DD, since the unaccompanied condition is already quite heterogeneous. As mentioned above, several studies indicate that the disorder commonly coexists with other neurodevelopmental disorders (especially dyslexia and attention deficit hyperactivity disorder), which further diversifies the conditions of people with disabilities [8].

According to Haase, Júlio-Costa and Santos [22], only one third of students with DD have primary DD, that is, unaccompanied by other disorders. For example, it is common for students with DD to have difficulties in relation to focus and executive dysfunctions, but these difficulties can be aggravated by comorbid traits of conditions such as ADHD. In cases of DD especially, "… individualized intervention is highly effective in improving the ability to

calculate" (our translation) [16], therefore, it is necessary to observe each student in their different needs and potential, often through a specialized neuropsychological evaluation, in order to meet their psychological and educational needs in the best possible way.

Regarding students with CP and VI, there are alarming data indicating that the educational level is especially low. According to the Brazilian Federal Government [23], 63.3% of people with disabilities (PWDs) in Brazil had no formal education or only incomplete elementary school, while 11.1% had completed elementary school or had incomplete high school. This is due to the lack of inclusion measures, making quality education difficult to access or completely inaccessible to these populations.

It is understood that the lack of opportunities and inclusive education, together with the prejudices experienced by PWDs, can result in a traumatic experience for these students, harming, in addition to their socio-emotional development, their cognitive development. According to Teperino, Ribeiro and Carvalho [24], a PWD must be emotionally balanced for the learning process to occur, "… therefore, the greater and better the affective contact, the greater the sensory experiences, promoting greater cognitive development" (our translation).

This implies that for children with disabilities to be able to make good use of their educational experiences, beyond educational inclusion measures, there is a need for effective and total inclusion, providing a comfortable and stimulating environment for their academic practice.

In the case of students with CP, Testani *et al* . [25] point out that, in the case of children and adolescents with CP, more than 50% experience mental health challenges, highlighting anxiety and depression as the most common.

Thus, considering the consequences that psychological conditions can have on the school environment and on students' learning, it is of great importance that schools and education professionals are aware of these possible comorbidities and are willing to make adaptations for the benefit of students. People diagnosed with depression and/or anxiety do not only present mood symptoms, which already significantly affect the school experience, but also executive disturbances, such as impairment of working memory in cases of depression and attentional focus in cases of anxiety [26] [27], among other symptoms that vary from case to case. It can therefore be inferred that mental health disorders directly affect the engagement of children and adolescents in student activities, which in the case of students with CP can place them in an even more vulnerable position due to the already imminent lack of inclusion resources.

Regarding the cognitive and mental health profile of children and adolescents with VI, it can be inferred that experiences of segregation and deficient inclusiveness in schools and other environments can also cause trauma, and as a result, the development of a disorder or not. However, it is reiterated that in all the conditions mentioned there is a great diversity of personalities, temperaments, desires and needs, making it necessary to actively listen to the student in order to truly understand his or her profile. No disorder is a sentence, and with educational and psychological support strategies, these students can have a development similar to that of their peers.

In line with the previously presented idea that individualized interventions can be of great benefit to students, particularly those with SEN , the GEPEDPUCRS is developing a VR application that is seen as a pedagogical resource for educational intervention for children and adolescents with DD, CP and VI. It is understood that for students who have SEN , especially in terms of attention and resulting from neurodevelopmental disorders, gamification resources can be a great motivator for engagement in educational activities.

According to Tolomei [28], school activities that are often seen by students as boring can have greater engagement when the teacher uses games or gamified activities . This occurs, according to the author [28], due to the possibility caused by games that the learning process comes closer to the student's reality.

When considering the psychological consequences of DD, CP and DV in elementary school students, it is understandable that there is an increasing avoidance by students of contexts that involve learning Mathematics, due to the great burden of anxiety that it causes in children and adolescents with these needs. In this sense, gamification can be thought of not only as a teaching tool, but as a means to redefine the relationship between the student and the school subject, presenting Mathematics education in a more motivating and inclusive way.

THE USE OF ASSISTIVE TECHNOLOGIES FOR STUDENTS WITH COGNITIVE, PHYSICAL AND MOTOR IMPAIRMENTS

To promote the inclusion of students with some type of limitation in the school environment, it is essential to use methods and approaches that facilitate this adaptation. In this context, the use of assistive technologies, aiming at quality education, has proven to be a great ally for these students. With this perspective, Bersh [29] points to assistive technology as a strong addition to inclusion.

In particular, regarding the use of assistive technology for students with VI, Frazão *et. al* [13] state that in addition to sharpening students' interest, "…it broadens the horizons of research and sharing of information and knowledge, stimulates collaborative work and allows the student to be the protagonist of the learning process" (our translation). In addition, the authors emphasize that it is necessary for teachers to be trained to use technology effectively.

VR can be seen and treated as an assistive technology. The use of this technology in education is valued because it

allows the student to interact directly with the content studied, without relying on books, photos, films or lectures [30]. Instead, learning occurs through manipulation and interaction with the environment being explored. Malaquias [30] states that these environments are not designed solely for passive viewing, but rather to allow the student to actively interact with the environment.

A fundamental characteristic of this technology is its ability to adapt to different learning styles, catering to different cognitive profiles [30]. VR can be non-immersive, when observed through a computer screen, for example, or immersive when using glasses or an appropriate helmet, or even when the experience takes place in multi-projection rooms [31].

For students with DD, the use of VR can increase motivation and interest in learning while using the app. Interactive math activities provided by VR tend to facilitate learning for these students, something that can be more challenging using traditional methods. This is because, in traditional teaching, when students start making mistakes and are unable to complete the proposed activities, they can become demotivated and lose interest. In VR, however, the activities are designed to keep the user's attention, transforming mistakes into exciting challenges instead of demotivating ones.

The range of benefits of using VR with students who have PCs is quite broad, from the proven increase in motivation and attention that it triggers, to the operational facilitation provided by interactive commands, within simulated spaces that do not put the physical or mental integrity of users at risk. Simulation in virtual environments allows for the repetition of actions, the analysis of a space from different perspectives and the characteristics of dimensioned objects, allowing for realistic training in pre-defined or programmed conditions, which can consequently qualify the individual's behaviors and reactions when faced with complex situations that require decision-making .

In the case of the project being developed by the GEPEDPUCRS, a VR application is being designed and developed to be used with specific glasses for immersion in a 3D environment. Both the design and development are slow and complex processes, mainly because they take into account the behavioral variables discussed previously and the cognitive profile of the students participating in the research. In this sense, it is important to emphasize that the development of a VR environment is complex and time-consuming, as it requires interdisciplinary knowledge and the demands for testing and adjustments [32].

The VR application developed provides for immersion in an environment inspired by an interactive museum, specifically the PUCRS Museum of Science and Technology (MCT-PUCRS), where students will encounter mathematical challenges involving concepts addressed in the final years of elementary school. Each challenge will present a historical context of the concept addressed so that students can understand the importance and motivation for the creation of that concept throughout history. It is expected that when at least four challenges are completed, the pilot testing phase will begin.

The application will be evaluated by students with DD, PC or DV and their respective Math and Natural Sciences teachers. This will allow for the evaluation of issues related to challenges, object design, layout, user interface, accessibility, among other issues that will enable the refinement of the application's functionalities, ensuring its effectiveness as an inclusive educational tool.

POSSIBLE JOINTS

There is an important connection between the selected approaches to the use of assistive technologies with movement and cognition therapies, since both movement and cognition constitute the human being in his/her field of action as an individual, and his/her learning conditions are intrinsically associated with psychomotor conditions. In this context, it is pertinent to understand that immersive-interactive environments provide important interactions and exchanges between man and machine, producing knowledge.

The use of assistive technologies in education has become a great ally in supporting students with specific needs. These technologies make learning more enjoyable and help improve students' emotional and behavioral aspects. Educational applications, for example, aim to provide differentiated learning, motivating students and encouraging their participation in the proposed activities.

The motivation and engagement that assistive technologies provide to students can be especially beneficial for children and adolescents with SEN , since conditions such as DD and CP are commonly associated with executive dysfunctions of attentional focus and inhibitory control. It is understood that by creating a motivating and conducive environment, these young people will be able to develop their educational skills in a much more satisfactory way in relation to the traditional school environment, which is usually distracting and discouraging for these profiles.

When the teacher promotes more playful activities linked to technologies for students with CP, their sense of belonging in relation to the environment is potentially activated, while the notion of limitation imposed by this pathology, which is often disabling, is redimensioned, as such resources tend to entertain the individual, making the attentional focus be maintained for longer and the psychomotor and cognitive conditions are stimulated sensorially through virtual commands that will not require physical effort, spoken language or great motor skills, which can be an important differential in guiding the learning of these students.

According to Lara [33], “From the moment it becomes possible to identify the type of skill in deficit, the

interventions designed to rehabilitate the mathematical impairments and enhance the detected skills will become more effective" (our translation).

With this in mind, the application is being developed based on an analysis of the cognitive profile of the students participating in the research. The activities are designed with the aim of enhancing deficient skills and developing those that are lacking. In this way, students' learning will be more effective, ensuring that the interventions carried out with the application really contribute to their educational development.

In the studies carried out by Limberger Junior, Gil and Lara [34], during the preliminary screening of the students who will participate in the project being developed by the GPEDPUCRS, they show that there are a multitude of conditions within schools that teachers and staff often have to deal with in their daily lives, without the necessary training and monitoring. In addition to showing that most of these teachers do not have the necessary knowledge to differentiate, for example, a learning difficulty from a neurodevelopmental disorder, it highlights the lack of psychiatric and psychological services in these schools. With this in mind, the project foresees training for the teachers of the participating students on inclusion, SEN and the use of technological resources for students with DD, CP or VI, as well as their comorbidities.

With the advancement of this screening, students who have some comorbidities are being selected. In the case of DD, it is worth noting that a small percentage of students (1 to 2%) have primary DD, that is, pure or isolated Dyscalculia. The rest have secondary DD, accompanied by non-numerical cognitive deficits or psychological development disorders. Among those selected, the following stand out: students with DD + Social Anxiety Disorder; DD + Dyslexia; DD + Autism Spectrum Disorder (ASD); DD + Bipolar Disorder (BD); DD + ASD + BD; DD + Attention Deficit Hyperactivity Disorder (ADHD); DD + Dyslexia + ADHD.

As mentioned above, when there are comorbidities, the behavioral and psychological variables of these students are accentuated. Given this, adaptations that benefit students are necessary. The immersive environment of an application designed for these students needs to take into account that an experience that sharpens students' focus and attention is necessary, since anxiety and/or depression, in addition to interfering with their mood, causes them to lose interest quickly.

In addition, issues related to executive functions, particularly working memory, deserve special attention. Most of the students who will participate in the project have difficulty with the conservation and storage of information, as well as with the recall of stored information. To this end, the activities and challenges that make up the VR application are being designed to explore the repetition of questions asked so that the student can understand the content covered and consolidate working memory. This is not training, but rather repeated evocations of the same concept in different situations, enabling its understanding and abstraction.

This goal may be much more difficult to achieve for the students selected so far, since in addition to the diagnosis of Cerebral Palsy or Spastic Hemiplegic Cerebral Palsy, some of them have significant comorbidities, such as Mild or Moderate Intellectual Development Disorder, ASD, ADHD, among others. Therefore, SEN should be considered during the preliminary assessment required for the research, as well as in the application of the pilot test of the VR application. Within these needs, consideration is given to offering considerable time to perform the proposed mathematical task, use of Alternative Communication (AAC) if necessary, and adaptations in the assessment for students with impaired fine or gross motor skills.

Disability often acts as a limitation on the individual's performance in society, compromising their self-esteem, learning, sense of citizenship and belonging to their surroundings. In other words, there is a stigmatization of this individual that fosters social and personal disrepute, generating negative impacts on their life. The image constructed by the disabled individual about themselves influences their perception of the world, and in the face of the difficulties of access imposed on them, this person tends to isolate themselves, withdraw from their rights, becoming passive in the face of their potential.

The use of the application to which this article refers has the intention of acting in the development of new learning perspectives for students with DD, CP and DV, based on the understanding that Virtual Reality as an educational tool is efficient in conducting learning while entertaining the student, resizing environments, providing experiences that would be impossible to experience in a real environment, in addition to providing interactions with study objects that facilitate the understanding and consolidation of ideas and concepts by students, carrying out experimental, analysis and comparison processes that are fundamental to structuring mathematical knowledge.

The school, through the use of methodologies and methodological tools that provide students with new learning possibilities, collaborates with their behavioral changes, as it helps them to envision new ways of learning beyond the traditional ones with pencil and paper, rescuing new perspectives of the individual towards their learning and their protagonism as a person with rights to an Inclusive and quality Education.

The behavioral variables associated with Mathematics itself, mainly related to the fact that it has historically been the most difficult curricular component [15], have a great possibility of being mitigated through the use of assistive technologies, specifically, a VR application. The level of difficulty of the

proposed activities can be thought of based on the cognitive profile of these students, making them advance as they are able to understand the necessary concept.

Students with visual impairment often have difficulty participating in classes and asking questions due to their visual impairment. In this case, the use of technology can facilitate students' access to activities, enabling independent and thought-provoking use, thus increasing their motivation to participate in classes. Furthermore, in the case of digital activities, the possibility of positive feedback helps to encourage students to continue carrying out the proposed activities without giving up when faced with any difficulty.

Notably, the use of VR with people with SEN acts as a very valid resource regarding the inclusion of these individuals in society, enabling them to carry out activities in a more equitable way compared to those without disabilities, including expanding the scope of capabilities that the disability has made inaccessible.

CONCLUSION

With the advent of technology and the evolution of computing resources, it has even become possible to represent the imaginary and the real at the same time and interact with both, enabling great advances in various areas of society. Examples of this are the educational and health areas, which are constantly benefiting from technology, thus making it possible to break down screen barriers and facilitate people's actions in three-dimensional spaces, through simple voice and gesture commands.

In view of this, it becomes providential to use these technologies to assist those who, given access to them, can have their cognitive, psychomotor and learning conditions improved.

To achieve the objective proposed in this study, it was possible to show that with the development of a VR application designed based on the individualities of each student, it is possible to mitigate, in addition to the obstacles inherent to DD, CP or DV, some restrictions that are caused by the behavioral and psychological variables addressed. In addition, thinking about a technological resource that can be used by students with and without SEN can enable engagement between teachers and all students in their class, the main objective of Inclusive Education.

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