INCLUSIVE SCHOOL:
case study of a student with Spina Bifida and Arnold Chiari Syndrome

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ABSTRACT

This article presents the results of a case study of a 12-year old student who is currently in the 6th grade of Elementary School at a private school in the city of São Leopoldo, state of Rio Grande do Sul, Brazil. He has Spina Bifida and Arnold Chiari Syndrome. The purpose of this investigation was to identify this subject's cognitive difficulties in Mathematics and how the school has dealt with these difficulties. To answer these questions, it was decided to take a case study type qualitative descriptive and exploratory approach and to use structured interviews, filming and transcripts of the study sessions for data collection. The article presents the results of the experiment performed from March to August 2010, lasting 20 hours, with weekly study sessions between the student investigated and the researcher, which indicate a lag between the mathematics concepts worked on at school and the concepts the student has, especially regarding the concept of numbers and the decimal numbering system.

Key-words: Mathematics Education, Special Needs in Education, Mathematics Inclusion, Spina Bifida.

RESUMO

Esse artigo apresenta os resultados de um estudo de caso com um estudante com Espinha Bífida e Síndrome de Arnold Chiari em relação à sua inclusão escolar e cognitiva em Matemática. O sujeito investigado tem 12 anos, cursa atualmente a 6ª série do Ensino Fundamental, em uma escola da rede particular de ensino, da cidade de São Leopoldo, no Rio Grande do Sul. A questão norteadora dessa investigação foi investigar quais as dificuldades cognitivas em Matemática de um estudante com Espinha Bífida e Síndrome de Arnold Chiari. O objetivo da investigação foi identificar as dificuldades cognitivas em Matemática desse sujeito e como a escola tem trabalhado estas dificuldades. Para responder estas questões optou-se por uma pesquisa de cunho qualitativo, do tipo estudo de caso. Apresentam-se nesse artigo os resultados da experiência realizada nos meses de março a agosto de 2010, de 20 horas, com sessões semanais de estudo entre o estudante investigado e a pesquisadora, que apontam uma defasagem entre os conceitos matemáticos trabalhados na escola e os conceitos que o estudante possui.

Palavras-chave: Educação Matemática. Necessidades Educativas Especiais. Inclusão Matemática. Espinha Bífida.

Introduction

In the Declaration of Salamanca, the concept of Inclusive School involves a school that promotes genuine equality of opportunities, acknowledging and responding to the different needs of its students, accommodating the styles and speeds of learning, and ensuring quality education through an appropriate curriculum, educational arrangements, adaptation of teaching strategies, use of resources and partnership with the communities (UNESCO, 2004).

According to Law of Guidelines and Bases of Education nr. 9394 of 1996 (BRASIL, 1996), an inclusive school builds into its Pedagogical Policy Project additional tasks such as an attitude of permanent research in all sectors. In this way it can go beyond its own limits. This school must value quality of education in terms of minimum inputs, be capable of supporting work (qualified teaching body, enough teaching hours, equipment and teaching materials up to date and in good working order) and, mainly, the quality of relationships among people. It must also be able to create a healthy environment for interaction. At the Inclusive School evaluation of learning should be adapted, case by case, and the schools should have sufficient authority to perform the necessary adaptations, according to pedagogical convenience and the students' possibilities.

Cardoso (2007) emphasizes that the foundations of an Inclusive School should be based on clear epistemological assumptions, such as the certainty that knowledge is constructed by the individual, that learning is a process with different rhythms, that the student is at the center of educational action and, therefore, that it is necessary and essential to recognize their possibilities, that the methodological processes should seek significant learning, and that the main purpose of this school should be the autonomy of its students.

The term Special Educational Need (SEN) (in Portuguese, *Necessidade Educacional Especial* or *Necessidade Educativa Especial*), is used for the first time as a law in article 5 of Resolution nr. 2 of 2001. It defines a student who, during their educational formation process, presents any marked learning difficulty or limitation of their development process that will make it difficult to keep up with curricular activities, independent of the student having some problem, congenital or not. According to Coll (2004), the student who during their schooling presents some marked learning difficulty or limitation, that requires more specific attention and greater educational resources than those needed for classmates of the same age, is a student with SEN. For Marchesi and Martin (1995) students with SEN are those whose schools cannot really educate effectively without additional support, and for Kropveld (1987), cited by Landívar (2001), SEN is a student in a difficult educational situation, it is any child that requires special one-on-one attention..

Education is an essential instrument for the full integration of people with some kind of SEN. Therefore, according to Carvalho (2008), inclusive schools are needed, to offer the best quality answers in education for any learner, without privileges or discriminations, whose purpose is to provide good quality education. The fundamental principle of an Inclusive School is that everyone should learn together, and that the schools should recognize and respond to the different needs of their student body.

Inclusive education is not only the teacher's work, but of a guiding and supporting team with tutors, advisers and external professionals acting directly with students who need inclusion. Also, according to Carvalho (ibidem), for the schools to be of good quality for all, with all and throughout life, the education systems must undergo changes, supported by reality, and implementing actions for change according to the specificities of each system, creating a work program that will prioritize needs, such as: promoting and ensuring internal articulations among the managers of education; effective integration among the different public policies that have educational issues in common; reviewing the concepts of teaching and learning, valuing the contributions of educational psychology, psychoanalysis of education and of the neurosciences of learning; ensuring the accessibility of all students to any school; dealing with the invisible barriers, stereotypes and prejudices.

Cardoso (2007) suggests procedures that should be adopted at Inclusive Schools, such as: learning routines; active learning environments; observing the children's actions; encouraging problem resolution and reflection; favoring social interactions; recognizing multiple intelligences; valuing all and any learning; adaptation and supplementation of the curriculum; different teaching strategies; functional curriculum; (re) organization of spatial, temporal and evaluation parameters; different techniques, procedures and strategies; evaluations in context; general objectives, considering the individualities and individualized learning sequences.

Since we are aware of the current demands for adaptation and reformulation of regular schools that are to become inclusive, this article presents a case study with a student who has SEN, showing the results of the survey period which attempted to identify the prior knowledge and the potentials of the student investigated, regarding mathematical logical concepts. Studies focusing on inclusion, that seek additional information to train the praxis of teachers at all levels of education, are considered extremely important and necessary, because, since the inclusion laws were enacted, children, youths and adults with both physical and cognitive SEN have become part of the student body of regular schools.

This study is a section of the joint research performed by the Grupo de Estudos Curriculares em Educação Matemática – GECEM [Group of Curricular Studies on Mathematics Education] at Universidade Luterana do Brasil (ULBRA), Canoas, Rio Grande do Sul, and the group of Educational Technologies of the University of La Laguna (ULL), Tenerife, Spain, as a result of scientific collaboration among these universities.

Methodological assumptions of the investigation

The present study investigates mathematics cognition in a subject with Spina Bifida and Arnold Chiari Syndrome. Studies have indicated that such individuals have difficulties with: logical reasoning and understanding (fundamentals in the field of Mathematics), motricity (fine and gross motricity), acquisition of algorithms, abstract reasoning and problem resolution. Other characteristics present are problems of attention, memory, concentration, passivity, apathy and autonomy (LLORCA, 2003; ORTIZ, 2009; LOLLAR, 2009; BARNES, CHANT & LANDRY, 2005); DENNIS & BARNES (2002).

The studies by Dennis and Barnes (2002) emphasize that children with Spina Bifida have difficulties in Mathematics that are similar to those common to other syndromes, such as problems with retrieving mathematical facts, the development and use of mathematical procedures and working memory. The authors underline that these children's functional independence is limited, since they do not acquire the numeracy required to do shopping or keep a bank account, and opportunities of employment for them are scarce.

This investigation attempted to answer the following investigative question: what cognitive difficulties occur in Mathematics for a student with Spina Bifida and Arnold Chiary Syndrome?

This is an important topic since the literature on it is scarce, because formerly individuals with these diseases had a short life expectancy. This has now changed due to medical advances.

The aim of this investigation consists of looking at the difficulties in understanding the system of decimal numeration, addition and subtraction of the set of Natural Numbers and the time measurement units, seeking to evidence prior knowledge and potentials of action by the individual under study in a problem-solving context.

The methodology chosen was the qualitative method, since the intention was to answer questions of the "how" and "why" type. A descriptive and exploratory case study was performed on a subject, evidencing his unity and identity, seeking to find out what is most essential and characteristic in him, according to Ponte (1992). The methodological option seems to be appropriate because it is a practically new topic (YIN, 1994; CHETTY, 1996).

In 2010 an experiment was performed with the subject investigated, here called G. It took twenty hours, with weekly study sessions, for six months, aiming at identifying G's difficulties with mathematical concepts. The sessions were divided into different phases, each of them with specific objectives. During the first phase, structured interviews were conducted with G. in order to find out his personal information. Next Piaget's operative tests were applied to find out G's operative level. Then, activities on paper were proposed, with concrete material and with ICTs, for the purpose of finding out his knowledge regarding the concepts of classification, series, quantification, number (ordinality and cardinality), decimal numeration system, problem solving in additions (only with units and tens), time units and the Brazilian monetary system.

The data were collected in interviews with the G, his family, teachers and physicians, through an analysis of school and medical documents, filming of the subject investigated, voice tapes, researcher's diary, materials produced by G during the study sessions and the protocols of face-to-face meetings between the person investigated and the investigator. These constituted the primary data for the case study. The secondary data were collected from databases with the results of different kinds of software applied during the experiment.

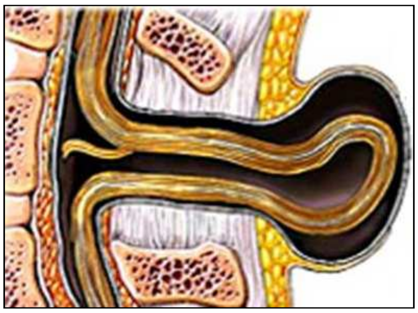
The analyses of the data collected during the probing period helped to construct an electronic teaching sequence, based on his previous knowledge about the mathematical concepts investigated, which will be applied to continue this investigation. The purpose will be to verify the possibility that G could learn more about these concepts.

The subject of the investigation

The subject investigated, here called G., is 12 years old. He studies at a regular school in the private school system, in the city of São Leopoldo. Currently he is in the 6th grade of Elementary School. He has Spina Bifida (a congenital defect) and Arnold Chiari Syndrome. He has a neurogenic bladder with constant loss of urine, amputation of the right lower limb, and required colostomy. He has already undergone several surgeries, and has spent around 700 days in hospitals because of those surgeries and other complications involving infections. This led to a lack of experiences and the restriction of stimuli, causing him to lag behind in basic skills.

Spina Bifida is a congenital malformation of the Central Nervous System[1], which develops during the first month of pregnancy, during the phase called neurulation. This disease causes a defect in the closure of the structures that will form the embryo's dorsum, and it can affect not only the vertebrae but also the spinal cord, meninges and even the encephalus (figure 1). These defects are usually called neural tube defects[2]. This congenital malformation affects 0.5% of the Brazilian population (AEBH, 2010).

Figure 1 – Spina Bifida



Source: http://www.espinhabifida.com

Common characteristics of the physical phenotype of Spina Bifida are spinal cord defects, incapacity to coordinate the lower and upper extremities, often associated with significant paraplegia and reduced mobility, caused by damage in the parietal lobe[3], hidrocephalus and visual-spatial deficiencies. On the other hand, the neural phenotype points at a significant interruption of brain development, while the cognitive aspect, present in some people with Spina Bifida, causes impairment of the academic and cognitive skills related to perceptive aspects, attention and memory. Studies have proved a pattern in the mathematical deficiencies associated with Spina Bifida, that can also be observed in adult life, with major implications for future employment and quality of life in adulthood (BARNES, CHANT & LANDRY, 2005; BARNES, 2002).

Statistics indicate that 35% of the children with Spina Bifida have cognitive deficiency, mostly mild, highlighting difficulties of perception, attention, concentration, motricity, memory and dealing with numbers (REDE SARAH DE HOSPITAIS DE REABILITAÇÃO,

[1] System formed by the encephalus and the spinal cord.
[2] Beginning of the embryonic nervous system (OLIVEIRA, 2005).
[3] Part of the brain responsible for recording numbers and mobility of the fingers (BARNES, CHANT & LANDRY, 2005).

2007). Thus, they often have difficulty at school which requires appropriate attention and guidance.

According to Tabaquim (2007), the abnormal motor development of a child who has this deficiency leads to absence of experimentation in their environment, and may make it difficult for them to achieve the age-appropriate cognitive acquisition.

The Arnold Chiari Syndrome is an anomaly found in some Spina Bifida patients, especially of the myelomeningocele type[4], because the hernia sac may contain parts of the spinal cord, the spinal membranes and cerebrospinal fluid. In this malformation, the structures that would normally be contained in the lowest portion of the skull are partially accommodated within the cervical spine and may affect the circulation of the cerebrospinal fluid.

The cerebral base anomalies result in herniation of some brain structures into the spinal canal. They are characterized by caudal protrusion of the cerebellar vermis[5] and of the inferior portion of the brain stem in the spinal canal. It is commonly seen below the second vertebra of the cervical spine (C_2) (MORO, 2007).

According to Moro (ibidem) the Chiari malformation can provoke dysfunction of the spinal cord with a clinical picture of dysesthesia[6] of the trunk and extremity, paresis[7] of the upper limbs with hypo/atrophy of the hand muscles, spasticity[8] of the lower limbs, dissociated losses of sensitivity[9] in the trunk and upper limbs.

Other symptoms present are strabismus, noisy breathing, altered breathing, sleeping disorders, difficulty in eating and functional alterations in the arms (REDE SARAH DE HOSPITAIS DE REABILITAÇÃO, 2007).

According to Martínez (2004), this syndrome belongs to the group of malformations at the junction between the upper part of the cervical spine and the skull. Therefore, it causes an abnormal sensation of the senses of sensitivity in the arms, hands, legs, feet and fingers. Besides, people who have this syndrome find it difficult to focus on the image when reading, they have loss of memory, states of mental confusion and disorientation.

THE MATHEMATICAL KNOWLEDGE OF THE STUDENT INVESTIGATED

The investigation of mathematical concepts in the student investigated is divided into two phases. The first aimed at identifying G's mathematical knowledge and the second the possibility of expanding this knowledge by applying a didactic sequence developed for G to study and try to solve his difficulties. This article only reports the first phase of the investigation, i.e., the probing phase whose main purpose was to investigate G's mathematical

[4] Protrusion of subcutaneous pouch containing central nervous tissue, ie., the injured spinal cord with nerve roots.
[5] Median, elongated part of the cerebellum with a transversal sulcus.
[6] Disturbance (increase or reduction) of the action of these senses.
[7] Incomplete paralysis of a nerve or muscle, as a consequence of a nerve lesion, mild or temporary paralysis.
[8] Rigidity or muscle spasms. Increased muscle tone, at the time of contraction, caused by an abnormal neurological condition.
[9] Pain/temperature.

knowledge and follow activities in school with regard to the Mathematics classes. It should be pointed out that his school life was followed through his copybook, tests and the descriptive report issued by the school.

In the study sessions, performed between G and the researcher (P) during the first phase of the investigation, activities were applied with the following concepts: number, cardinality, ordinality, quantifiers, system of decimal numeration, operation of addition and subtraction, spatiality, time-measuring units, monetary system and solving problems of daily life involving the aforementioned concepts.

In G's first written interview it could be seen that he did not know the decimal numerations system well, since in his answers he mainly wrote numbers in the decomposed form, as seen in figures 2 and 3.

Figure 2 – Record of G's apartment number


6) Número do apartamento? 3003

The apartment number is 303, but G recorded it as 3003.

Figure 3 – Record of G's date of birth

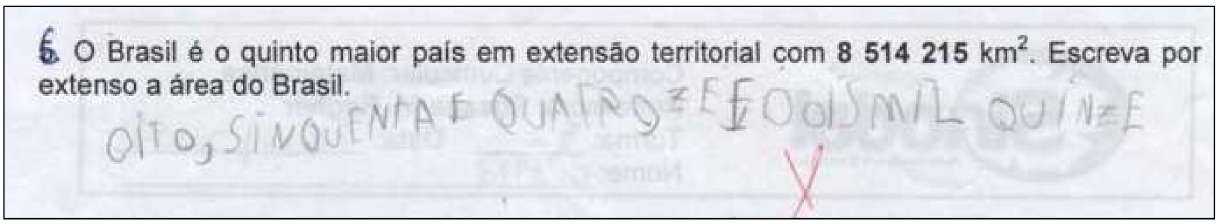

3) Data de nascimento? 24 DE NOVEMBRO DE 10090088

His year of birth was recorded as: 10090088 (G became confused with 1998, which is his correct year of birth).

The same week, at school, G did a Mathematics test. In the test he got 6 questions out of 20 right, including questions that asked for the title of a graph and interpretation of information. The correct answers did not involve mathematical concepts. In all answers that required mathematic knowledge, G failed. Figure 4 is an example of a test question.

Figure 4 – Mathematics test question answered by G

Brazil is the fifth largest country of the world with an area of 8 514 215 km^2. Write out the area of Brazil in words.

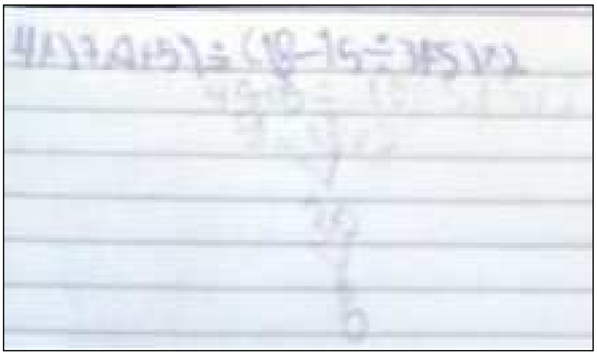

6. O Brasil é o quinto maior país em extensão territorial com **8 514 215** km^2. Escreva por extenso a área do Brasil.

OITO, SINQUENTA E QUATRO ... MIL QUINZE

Eight fifty and four and … thousand fifteen

From the answers given by G, it could be seen that he does not yet understand the concept of the position value of a digit in the decimal numeration system. Therefore, G is not able to answer the test question. In this sense, it is understood that the school is asking for concepts that are beyond his current cognitive capacity, since besides the positional value (order and class), G was studying numerical expressions at school, according to what was recorded in his copybook (figure 5).

Figure 5: Recorded in G's copybook: numerical expressions



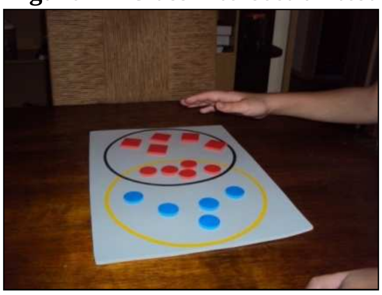
Asked about solving the numerical expression, G answered: "*I copied it from the blackboard. I don't understand* it". It can be seen that he did not even copy the exercise correctly, because there is a parenthesis lacking at the beginning of the expression, and the second letter A was copied in lieu of a number.

As to ordinality, G recognizes the position of objects in a queue, he answers and writes out in full correctly, but makes mistakes in the mathematical representation. For instance, in some activities he represented eighth as: 8, 8º and 1/8. Notation 1/8 was used when he began to study Rational Numbers at school. This shows his lack of understanding regarding these concepts.

Piaget's clinical diagnosis tests were applied, following the guide "*Manual de Provas de Diagnóstico Operatório*" (Handbook of operational diagnosis tests) (MAC DONNEL, 1979), aimed at determining the degree of acquisition of key notions regarding G's cognitive development. In each test, it is possible to evaluate the degree of construction achieved by the child regarding the notion that is being studied. Basically, three levels of this construction can be determined: level one (absence of the concept), level two (intermediate stage or level) and level three (success).

In one of the classification tests, class intersection, the material used consisted of the classes of chips (5 round and red, 5 round and blue), and a card where two intersecting circumferences are drawn, as seen in figure 7.

Figure 7 – Class intersection test



Below, a section of the dialogue between the researcher and the student investigated.

P: G can you give these chips a name?
G: Half moon square (disposition of the squares similar to the half moon) and scattered balls.
P: Why do you think that I put these red chips in the middle?
G: To divide. Small blue ball, small red ball, red square. To separate the colors and shapes.
P: Are there more red chips, or more blue chips, or is there an equal number?
G: Had to count them one by one (correspondence term by term). Understood only the red ones as chips and answered that number.
P: G all the figures are called chips, including the square ones.
G: O.K..
P: Are there more red chips or more blue chips, or is there an equal number?
G: (Counted again). More red.
P: Are there more square chips here, or more round chips, or an equal number?
G: More round.
P: Do you think that there are more, less or the same amount of square chips or blue chips?
G: Same amount (counted using term to term correspondence).
P: Do you think that there are more, less, or the same amount of round chips or blue chips?
G: Round, because they both have the same shape.
P: Why do you think that I put these red chips in the middle?
G: To divide them.

The answers given by G can be classified at level two (articulated intuitive), since he answers some inclusion questions correctly, but has not yet perceived the intersection, ie., he does not perceive that the chips placed at the intersection of the spheres have characteristics in common with the two groups formed, namely, at the intersection are the round and red chips, which have the color in common with one set and the shape in common with the other.

In the conservation tests, both of the quantity of fluid (overflowing) and the quantity of matter, G did not perceive the conservation, when the initial quantity was divided into four parts, even repeating the activities three times, again proving that G is at level 2. Figure 8 shows the summary table of G's performance in his clinical diagnosis tests.

Figure 8 – Summary table of G's performance in Piaget's clinical performance tests

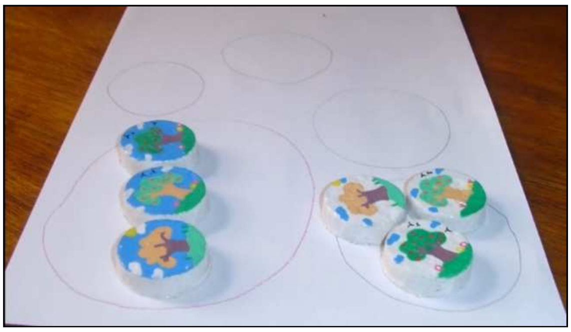
Classification	Change of criterion/dichotomy	Level 2 – uses only one criterion (color) to separate the figures
	Class intersection	Level 2 – does not perceive the intersection
	Quantification of the class inclusion	Level 3
Conservation	Small discrete sets of elements	Level 3
	Quantity of liquid (overflow)	Intermediate level between 2 and 3 – simply does not perceive an overflow.
	Quantity of matter	Intermediate level between 2 and 3 – simply does not perceive a transformation
	Weight	Level 1 – does not have weight conservation
	Width or length	Level 3
	Surface	Level 3

Analysis of the data collected while the operative diagnosis tests are applied, shows that G is at level 2, i.e., in the intermediate phase, since he fluctuates between conservation and non-conservation, i.e., in one test, when a deformation is done, he changes his judgments. His justifications are not very explicit, and at other times he does not perceive the conservation. This thought structure is typical of children aged around 6 or 7 years, showing G lagging behind in these thought structures.

As to the use of series, G finds it difficult to complete a series with more than one criterion, and when a series of elements with different sizes is presented to him, he does not use an organizational strategy to solve the problem. Again, it is not an expected result, since at the age of 7 or 8 years a child must have reached the systematic method that consists of identifying, first, the smallest or largest element of all, then the smallest of those left, and so on successively, since they see that some element X is, at the same time, larger than the preceding ones and smaller than the following ones (in a decreasing order) (PIAGET; INHELDER, 1983). According to the author, it is essential to know the concepts of seriality and quantification, because they give rise to the genesis of the number.

Different activities were applied for classification. Some games allowed separating the set of pieces into up to eight subsets, using criteria of similarity and differences, as the one in Figure 9, which is formed by six pieces that portray a landscape, but that are different from each other as to small details, such as color of the sky, presence of flowers or fruits.

Figure 9 – Classification activity



G had difficulties in classifying the material, as can be seen in the following dialogue between the researcher and the student investigated.

P: G, take a good look at these pieces. How many are there?
G: One, two, three, four, five, six.
P: Ok.
G: Three plus three is six.
P: Great. Doing math in your head. Now separate it for me. Look, separate, and explain why.
G: Here.
P: What did you use to separate? What criterion?
G: (Confused trying to explain). *I used ... Ah! Colors. Like this one. Some have more color. Because it is more...Colors. Sky.*
P: The color of the sky? Because it is more colorful?
G: Yes.
P: Now look at all of them again and see whether there is another way to separate.

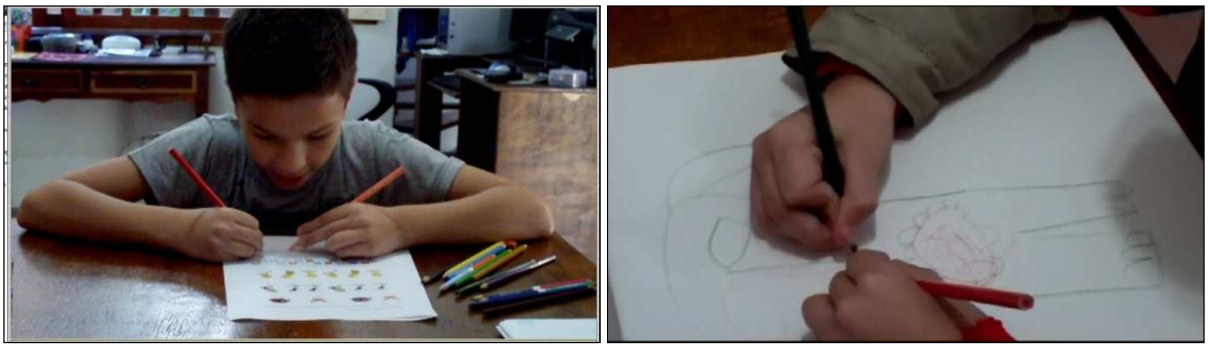
G: One can separate it here. It is exactly the same (puts all in a same group).
P: What is exactly the same?
G: The fruits, the ground, the birds, the color.
P: Have you placed them all in a single set?
G: Yes.
P: Because they are all the same?
G: Yes.
P: Then you have already separated according to color of the sky and because they are all the same.
G: Yes.
P: Is there any other way?
G: No.
P: These two?
G: Yes.

In this activity, G only managed to separate into two groups. In the first group G chose a common criterion (color of the sky). The second group was formed by all parts, and he stated that all parts were the same. G's performance in the classification activities corroborates what was observed in Piaget's classification tests. In the different situations, G does not perceive more than one or two criteria that justify forming subtests.

According to Piaget and Inhelder (1983) it is possible to establish parallels between classification and seriation, i.e., in seriation and classification there is the presence of concepts of comprehension and extension. Comprehension concerns the order of differences in which the elements are in a series, while the extension is the set of its elements. For instance class-inclusion is a type of classification, in which the child shows or not that they understand the relations between a set and its subsets. According to the authors, class-inclusion is essential in order to understand the number. Although G is in the 5^{th} grade, in 2010, he still has difficulty with the concept of seriation and classification.

In one of the sessions G was asked to create a sequence whose criteria he was to choose. When he painted the sequence, G used both hands at the same time, making symmetrical lines, one from the right to the left, and the other from left to right. In free drawing, G used both hands again with dexterity (figure 10).

Figure 10 – G drawing with both hands

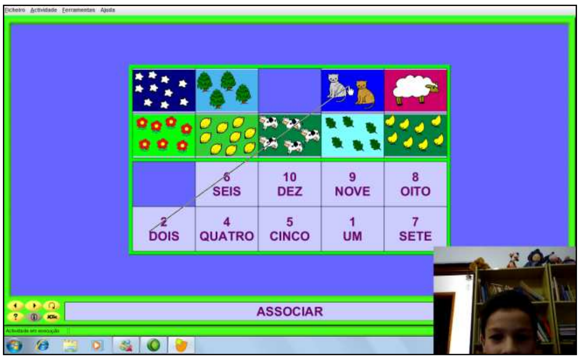


Asked about the use of both hands, G tells that he prefers to use his right hand, but that he manages to do everything he does with the right hand with the left, and that he has had this skill from early on. At this point another question is raised for future investigations: is this a common skill in children with Spina Bifida?

In spatiality activities (far, near, up, down, right, left) G had difficulties only in issues of laterality (left and right). As to size (smaller, larger, short, long, thick, thin) he answered all questions correctly.

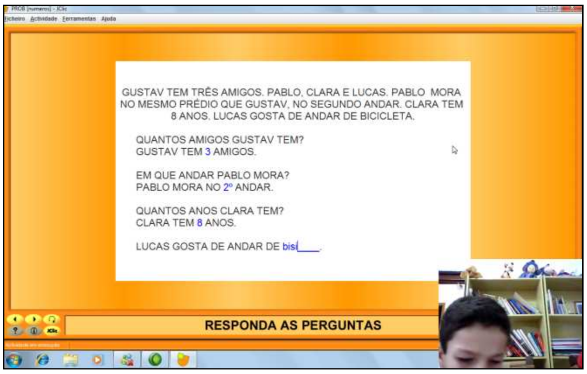
When performing an activity for the association of quantities to their numeral, constructed in JClic software[10] (figure 11), the need for G to count the objects was perceived, to identify the corresponding numeral, even in small quantities, such as 3 and 4. Besides, he counts in a disordered manner and sometimes has to repeat the count.

Figure 11 – Counting activity constructed in JClic software



In problem-solving activities, different difficulties were detected. In one of them, for instance, G did not recognize the number written out in full, as in the example of figure 12.

Figure 12- Problem solving activity



Gustav has three friends, Pablo, Clara and Lucas. Pablo lives in the same building as Gustav, on the second floor, Clara is 8 years old, Lucas likes riding a bicycle.
How many friends does Gustav have? Gustav has three friends.
On what floor does Pablo live? Pablo lives on the 2nd floor
How old is Clara? Clara is 8 years old.
Lucas likes riding a ….
Answer the questions

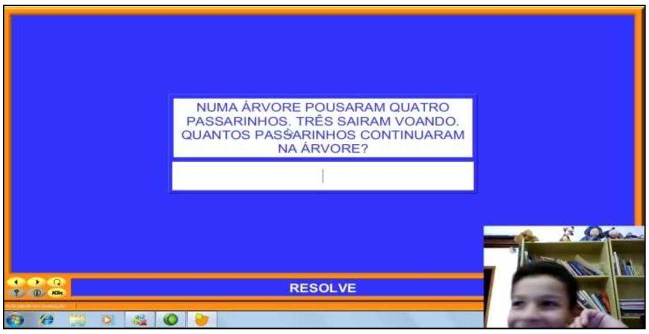
[10] JClic is a program used to create, perform and evaluate multimedia educational activities developed on the Java platform, available at site http://clic.xtec.cat/en/jclic/

Two numerical items of information were presented in this problem: G has three friends and Clara is 8 years old. In the question: How many friends does G have, he answered quickly and without thinking, because he only perceived number 8, which was represented by its numeral. Even when he reread the problem, he did not perceive number three, and with the help of the cursor he counted how many friends he had, counting their names.

In the same sequence of activities, in another problem, G again did not recognize the numbers written out in full (figure 13), and explained:

G: Aunt Tania, that one won't do.
P: Why?
G: There is no number.
P: Let's read it again. Pay attention.
G: I don't know.

Figure 13 – Problem-solving



Four birds landed on a tree. Three birds flew away. How many birds are still in the tree? Solve it.

G shows his pleasure when he manages to solve the problem. But this is only possible because the researcher calls attention to the record of the number and reads the problem again with him.

In the problems that required using the addition, it could be seen that G has few numerical facts, that he needs to use his fingers to count, even for small amounts. After it was explained to him that he could put the largest number "in his head", and use this number to begin adding the other parcel, he adopted this procedure, but would forget it from one week to the next.

Next the transcription of parts of the dialogue between G and P, in a problem-solving activity.

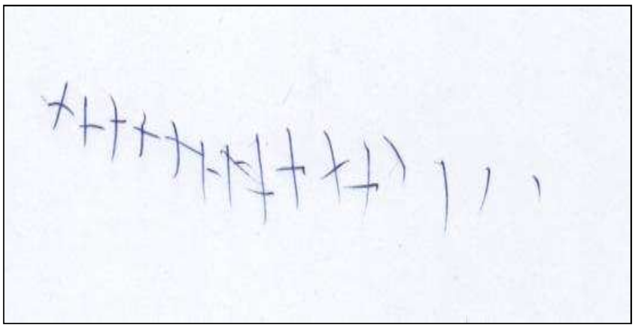
P: (The sum that is to be calculated is 3 + 6). *What is this sum?*
G: Three plus six.
P: Three plus six. What did we see last week?
G: Three in the head.
P: No. Six, why?
G: Six is larger.

P: Right. So?
G: Eight.
P: No. Count again.
G: (Counts using his fingers). Nine.

In order to subtract (15 – 11) G used the resource of drawing vertical lines to represent the minuend (the term from which subtraction was to be performed), crossing out the amount that represents the subtrahend (the term to be subtracted from the minuend), and counting the remaining vertical lines to find the rest (figure 14). This is the method that G prefers to use in subtraction, as can be seen in the dialogue transcribed below.

P: What calculation do you have to perform to solve this problem?
G: A minus calculation.
P: Let's set up the sum?
G: No. I'll cross them out.
P: You can also count from the smallest until you reach the largest.
G: What?
P: Count from the smallest to the largest to see how many elements are lacking.
G: Difficult. I'll cross them out.

Figure 14 – Strategy used by G to subtract



When the amounts were small (3 – 1), G used his fingers to perform the operation.

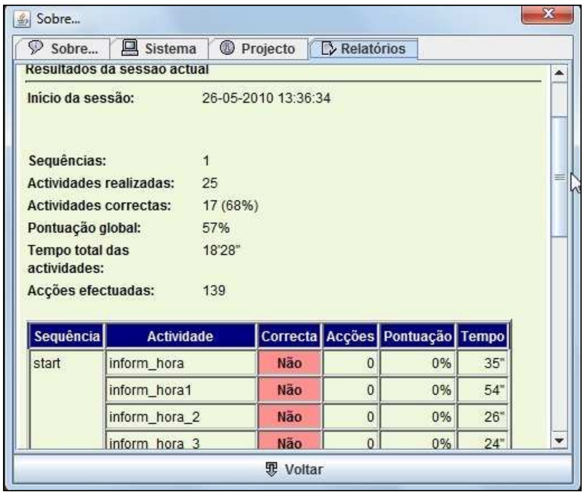
A didactic sequence was created in software JClic, with 25 activities (figure 15) to verify G's knowledge regarding the units of measurement of time (hours, minutes, weekdays, months) and reading analog and digital watches.

Figure 15 – Activities performed by G in JClic software

The clock is showing 15 hours There is an intruder in this list, Put the numbers on the clock.
and 30 minutes (…) who is it? Find the solution.

G did not manage to solve most of the activities. He only managed to identify the time on the watches that showed the exact time. Even so, he did not manage to distinguish day from night. Besides this aspect, G does not answer correctly at what time he performs routine activities such as waking up, making meals, going to school, and others. He also does not fully know the days of the week and months of the year. In figure 16 is the report generated by the database of JClic software after performing this sequence of activities. It is found that he performed 139 actions to solve the 25 activities, which corresponds to a global score of 57% correct answers, showing that he needs reinforcement for these concepts.

Figure 16 – Database of JClic



About … System Project Reports
Results of the present session
Beginning of session: 26-05-2010 13:36:34
Sequence: 1
Activities performed: 25
Correct activities: 17(68%)
Global score: 57%
Total time of activities: 18’28”
Activities performed: 139
Sequence Activity Correct Actions Score Time

In the activities about the Brazilian monetary system, G showed that he did not recognize the banknotes and coins. In figure 17, when asked which banknotes or coins he should take to the supermarket to buy a pot of ice cream, G recognized the number 2 in the price and chose the 2 reais note and a few coins.

Figure 17 – Activity involving the Brazilian monetary system

Asked whether the amount set aside to purchase the ice cream would be enough, or whether he would get change, G expressed his concern: *"I think that I am going to be a poor adult, because I don't know money"*.

With these activities the period of probing G's mathematical knowledge ended.

Conclusion

During the period of the survey, several activities were applied to G, with the common objective of verifying his mathematical knowledge. In the beginning, because he was in the 5th grade of Elementary School, it was expected that his mathematical knowledge would be more elaborate. But, already during the first study session, it became clear that G had not yet acquired the concepts of the decimal numeration system. Therefore, it was decided to apply Piaget's operative diagnostic tests, which indicated that G is not in the phase corresponding to his age, since he presented problems in the classification, seriation and conservations tests, which are basic concepts to form the concept of number.

Another relevant result is G's need to count small amounts, such as two and three, since he does not perceive them visually. On counting larger quantities, he does it in a disordered manner, making mistakes. He has only a few numerical facts and uses his fingers to add, even when the parcels are small, for instance 2 + 3. When subtracting he uses vertical lines to calculate, since he has not yet acquired another strategy, for instance, to count how many elements the minuend has more than the subtrahend.

The studies by Rede Sarah de Hospitais de Reabilitação (2007), Tabaquim (2007) and Martínez (2004) mention the problems of dealing with numbers and the situations related to them as characteristics of some subjects with Spina Bifida. During the study sessions these findings were corroborated, since the student is unprepared to deal with problems involving recognition of numbers and solving calculations.

The studies by Dennis and Barnes (2002); Barnes, Chant and Landry (2005) on children and adults with Spina Bifida as to numbers and arithmetic operations emphasize that, despite their reading status, they have difficulties with numerical estimation, the recovery of facts involving numbers, verbal counting, spatial vision and solving arithmetic problems, both in children and in adults, a fact that can be corroborated by this investigation.

G made a few mistakes because he did not know the meaning of mathematical terms, for instance, successor, predecessor, growing, diminishing and others. He has a small vocabulary for his age.

Besides these mathematical aspects, it is also important to highlight that G is still in the decoding phase for reading, slowly joining syllables to form the words and not obeying the punctuation, which makes interpretive reading difficult and interferes in understanding and solving problems. For this reason the researcher decided to encourage G to read, but in all activities she repeated the instruction so that the reading problems would not interfere in the results of research as regards mathematical concepts.

As to writing, during the school year of 2010 G began to intercalate his way of writing, sometimes choosing stick letters and at others cursive letters. But he makes many spelling mistakes and his sentences are always short, direct and without basic elements such as subject or verb.

As to memory, in different sessions G clearly showed, through his attitudes, that from one week to the next he forgot the meaning of words, concepts and strategies used to count and solve operations, such as putting the largest number "in his head", and using it to begin adding another quantity. In May 2010, his mother told that G had had a photo taken at school and that, besides not telling her, when he received the message to fetch the photo she asked him about it and he said that he did not remember a photo being taken. In the analysis of a filmed study session, it was perceived that one of the activities called G's special attention, because he said that it was beautiful and that it must have been very difficult to construct. In order to check his memory, after two weeks, the activity was repeated. Asked about it, G said that he did not remember performing this activity. Research conducted by Dennis and Barnes (2002), Llorca (2003), Ortiz (2009), Barnes, Chant and Landry (2005) points to working memory problems in children, youths and adults with Spina Bifida.

Another outstanding fact is the difficulty encountered by G regarding the Brazilian monetary system. G cannot recognize the notes and coins, select the money needed to make a purchase and make change, a fact that was mentioned in Dennis and Barnes' (2002) research as a difficulty encountered in youths and adults with Spina Bifida, which compromises their autonomy.

Concerning the physical space of the school, it should be pointed out that there is no concern about G, since the students change rooms after the classes, which makes it difficult for G. to get about, because the school building is three stories tall and has no elevator. As to pedagogical aspects, the curriculum and the instruments for evaluation are not adapted to G's true cognitive level. In the opposite shift the school offers support classes for students with difficulties, but the content and pedagogical approach is the same as in the normal school hours. In this context, G does not manage to retrieve the basic concepts with which he has trouble and therefore does not manage to keep up with his classmates in the classroom.

As to the school that G has attended since Infant Education, it should be emphasized that it does not meet the criteria of an Inclusive School, both physically and pedagogically, since according to Cardoso (2007), Brasil (1996) and Carvalho (2008), in order to be inclusive, a school needs to adapt in terms of physical space and its pedagogical doing. They highlight as assumptions about learning the need to respect the different speeds at which people learn, adapting the curriculum and (re)organizing the spatial, temporal and evaluative elements.

However, many questions remained to be investigated after this survey period, such as: G's ability regarding the use of both hands to draw and write, his long term memory and his capacity to learn in a didactic sequence that takes up again the basic concepts of Mathematics and has the purpose of providing G with social independence. The great question at the end of this phase is to what extent the use of these resources and respect for G's learning time will interfere and help in the process of constructing the concepts that will be studied.

In addition, there is a question about the causes of his cognitive lagging behind. Are all his problems neurological because of the Spina Bifida? May other factors have interfered, such as the time he was in hospital, or the school that does not offer him a curriculum that respects the stage at which he is, since his curriculum is the same as that of his classmates? Can his problems of cognition be overcome, at least partly? What mathematical knowledge should the school prioritize for students with SEN?

Continuing this investigation involves individualized work with G, with the goal of seeking his social autonomy in Mathematics. Social autonomy in Mathematics means ability to understand addition and subtractions operations, the system to measure time, the monetary system, the use of a calculator and solving daily life problems, in which the individual should acquire the mathematical competences needed to perform small purchases and locate themselves in time and space.

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