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INTEGRATED MODEL OF MATHEMATICS PROBLEM SOLVING ADAPTED TO A STUDENT WITH AUTISM SPECTRUM DISORDER

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Abstract

Mathematics problem solving is one of the main axes of mathematical activity and is the cornerstone of mathematics education, so it should be the main source and support of learning throughout Primary Education.
Caballero et al. (2009, 2016, 2020) y Blanco et al. (2015) presents an Integrated Model of Mathematics Problem Solving (IMMPS) that integrates cognitive and affective aspects. The efficacy of this model has been empirically contrasted in teachers in initial training (Caballero et al., 2011, 2021; Blanco et al., 2013), wondering if it would be equally valid in students with certain learning difficulties.
That is why in this proposal we present an intervention carried out around Mathematics Problem Solving with a student in the first year of Primary Education with Autism Spectrum Disorder. In this proposal, the Integrated Model of Mathematics Problem Solving (IMMPS) has been adapted to this type of disorder. IMMPS is composed of five phases in which emotional management techniques and heuristics for Mathematics Problem Solving are integrated.
It is a single case study, where the subject of study has been selected through a non-probabilistic discretionary or judgmental sampling.
The conclusion is that the student is able to carry out a more elaborate and complete process of Mathematics Problem Solving, using different heuristics. However, they do not put into practice the techniques of emotional control in the face of nerves or blockages arising in the resolution of Mathematics Problem Solving.

Keywords: *Autism spectrum disorder, primary education, mathematics, problem solving, learning disabilities.*

1. Introduction

Mathematical problem solving (MPS) is one of the areas in which students may mainly encounter difficulties (Baroja et al., 1991).

Cueli, García, and González (2013) indicate general principles for teaching mathematics to students with learning disabilities: precise sequencing of content, student involvement, concrete feedback, emphasising prerequisite skills, explicit instructions in self-regulation in the use of strategies and the use of self-instructions and self-questioning in problem solving, Tárraga (2011) recommends the following procedures: teaching sequences of cognitive and metacognitive strategies (different phases in which a problem can be solved and the strategies which can be used for each one); identification and elaboration of schemas underlying the problem: understanding the type of problem, understanding that they first have to identify the data, then establish the relationships between them, translate them into mathematical language and operate and analyse whether the result is adequate; teaching problem solving with the support of manipulative materials and then translating it into the abstract language of mathematics.

On the other hand, some authors such as Juidías and Rodríguez (2007) propose that a solution to the language problem would be to show the statements through drawings in order to overcome difficulties generated by language. We consider that all this is included in the IMMPS and that it is necessary to adapt it to students with Autism Spectrum Disorder (ASD) and to use pictograms to apply the last of the recommendations indicated. The IMMPS (Caballero et al., 2016) comprises five phases in which activities for emotional management are integrated, such as self-instructions and muscle relaxation and breathing techniques, and heuristics for Mathematical Problem Solving (MPS) (Caballero, 2020). The efficacy of this model has been empirically contrasted in teachers in initial training (Caballero et al.,

2011, 2021; Blanco et al., 2013), wondering if it would be equally valid in students with certain learning difficulties.

The elaboration of self-instructions must be carried out through pictograms that indicate to the student, before starting the resolution, that he must be calm and think that he/she is going to do well and succeed. During the process, the images will indicate that he will be calm and concentrated and that he will count to ten if he gets nervous. Finally, after solving the problem, he must be happy, not angry and calm.

Regarding relaxation and breathing techniques, Jacobson's progressive muscle relaxation (Schwarz and Schwarz, 2017), diaphragmatic breathing and relaxation games of the Rejoue method (Nadeau, 2007) are used. As for the heuristics, they will also be presented through pictograms that the student will select and paste next to the problem being carried out to internalize the process. These pictograms, in phases, indicate the following aspects:

1st phase: Read, circle (the data), draw, order (the data) and think about what it asks us.

2nd and 3rd phases: Solve the problem and write (or fill in) the solution.

4th phase: Analyzing the process with pictograms of "right or wrong" and "correct or incorrect".

5th phase: Emotional appraisal. For the application of the IMMPS, specific visual mathematical problems were posed for the training of the different phases of the aforementioned resolution model.

2. Objective

The aim of this paper is to assess the suitability of IMMPS with students with Autism Spectrum Disorder (ASD).

3. Method

It is a single case study, where the subject of study has been selected through a non-probabilistic discretionary or judgmental sampling. The pupil is six years old, in the first year of Primary Education and is diagnosed with ASD; he has associated attention deficit and impulsivity and his communication is very basic. He knows many of the basic mathematical concepts, although the higher the level of understanding or abstraction, the greater the difficulty. Recognizes spelling up to 100, makes series of two and three elements and knows geometric shapes (square, rectangle, triangle, circle and rhombus). Begins to order temporal sequences of three images and to associate pairs of given elements. He also carries out numerical serialization, basic addition and subtraction operations and problem solving. The latter must be very graphic. At the communicative level, he shows reduced intentionality and uses gestural and verbal communicative strategies in response to needs that arise. In the motor aspect, he has an autonomous gait, very good general dynamic coordination, he is very agile and with marked motor activity. In fine motor skills, there are difficulties in visual-motor coordination.

For both the initial and the final assessment, the student was presented with the two mathematical problems shown in Figure 1.

Figure 1. Problems posed for initial and final assessment.

1. "There are 8  . 2  are leaving. How many  are left?"

2. "I have 5  . I get 4  for free. How many  do I have in total?"

The solving of these problems was assessed through student productions and an observation scale.

4. Results

An improvement in mathematical problem solving and in autonomy in carrying out this process is observed. There is also an improvement in self-confidence, self-concept as a problem solver and emotional control. Thus, the student's nerves and frustration disappear and there is an improvement in his or her concentration and attitudes towards the MPS. In addition, in the final assessment, the pictograms are dispensed with MPS.

5. Conclusions

The IMMPS is suitable for students with ASD and they can acquire the different phases of the model as long as they are adapted to their characteristics.

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