https://doi.org/10.36315/2024v1end064
Education and New Developments 2024

SCREENING FOR DIFFICULTIES IN MATHEMATICAL LEARNING: ELABORATION AND PILOT STUDY

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Abstract

In Brazil, there are few studies describing early identification and intervention of difficulties in mathematical learning. Objectives: To develop a screening process to identify the difficulties in mathematical skills in students in early school grades and verify the applicability of a pilot plan. Methods: from a bibliographical survey, 8 mathematical skills were selected based on the Triple Code Model in order to create the screening process composed by number sense skills, number line, position value, addition, subtraction, multiplication, division and problem-solving. The screening process was elaborated to be applied in four 45-minute sessions, twice a week during class period collectively. 51 students in early school grades at a public school in Sao Paulo city, Brazil, took part in the pilot study. The study showed the necessity to reduce the number of skills to 5 numerical sense, numerical line, positional value, addition and subtraction. This reduction occurred due to the observation of the necessity to first develop the basic knowledge related to addition and subtraction in students in early school grades. Conclusion: The adjustments made based on the results of the pilot plan will enable the screening process application to identify the mathematical skills in students in early school grades.

Keywords: *Learning, tracking, skills.*

1. Introduction

Every student need and deserves to have knowledge, comprehension and competency to be able to acquire mathematical learning. However, many students show difficulties in mathematical learning according to data presented in the Results Report of National System of Basic Education Evaluation (SAEB) in 2019 (National Institution of Study and Educational Research Anisio Teixeira (Powell & Fuchs, 2015).

The early identification of these mathematical difficulties may detect students who need educational support or intervention before the learning difficulties occur (Jordan, Kaplan, Locuniak & Ramineni, 2007). This early identification can be done through a diagnostic of mathematical skills which helps teachers identify the strong and weak points in students and the comprehension of these weaknesses enables teachers to identify and adjust one or more intervention programs that address the difficulties the student presents (Powell & Fuchs, 2015).

Those difficulties may involve one or more areas in Mathematics due to cognitive deficits, inadequate instructions, or a combination of factors (Geary, 2004). Studies have shown that students participating in high quality preventive programs have obtained positive impacts in development and these benefits extend to academic, sociability and employability aspects (Carneiro & Heckman, 2003; Butterworth, 2005).

One of the most cited preventive programs in literature is the Response to Intervention Model (RTI) that also provides early interventions in levels to students at risk of academic failure (Fuchs & Fuchs, 2006). The RTI model is a multilayer system, divided in 3 levels, or three layers: Level 1 is a universal screening of difficulties in students, and it is performed by everyone in the classroom. Level 2 is composed by students that showed low performance in Level 1, identified as students at risk for academic learning and in this phase, they start to receive specific, progressive and effective interventions in small groups giving the students the opportunity to develop academic knowledge. Level 3 is for students who don't respond to the intervention in level 2 and need an individual intervention, this time in clinical

context, and the risk being confirmed, they are referred to an interdisciplinary team for the confirmation or exclusion of the diagnostic (Andrade, Andrade & Capellini, 2014; Fuchs & Fuchs, 2006).

Therefore, this study is justified by the fact that there is still a gap in studies regarding the respond to intervention program with mathematical skills in Brazil, as well as the lack of effective instruments for identification and intervention in students at risk of problems in mathematical learning. This way, the objective of this study was to elaborate a screening process to identify difficulties in mathematical skills in students in early school grades and verify the applicability of a study pilot.

2. Methods

This study was approved by the committee for Ethics in Research of the University of Philosophy and Sciences – FFC/UNESO – Marília – SP (number CAAE 40514615.8.0000.5406). As procedure, bibliographical research was conducted regarding the theoretical basis to elaborate a screening process to identify difficulties in mathematical skills in students in early school grades.

The databases consulted to elaborate the screening were Pubmed/MEDLINE, SciELO *and ERIC* and the descriptors selected were listed in the vocabulary indexing of Health Sciences Descriptors, in both Portuguese and English languages combining two terms: Response to Intervention" OR "Remedial Teaching" OR "Remedial teachings" OR "Teaching Remedial" OR "Teachings, Remedial") AND (Math OR Mathematic OR Arithmetic) and 399 studies were located.

The pilot study was carried out with the aim of verifying the applicability of the screening elaborated with 51 regularly enrolled students in early grades at a public school in São Paulo, Brazil. The screening was applied to all students in early school grades, in four 45-minute sessions, twice a week during class period collectively.

3. Results

In Table 1 we can see the skills that composed the protocol for screening difficulties in mathematical skills composed of 8 abilities: number sense, number line, position value, addition, subtraction, multiplication, division, and problem-solving.

The number sense was composed of 11 tasks and each task was composed of 5 activities; the number line, position value and problem-solving skills were composed of 1 task with 5 activities each; addition, subtraction, multiplication, and division tasks were composed of 2 tasks each, with 5 proposed activities.

Table 1. Distribution of skills, tasks and activities per school year.

SKILLS	TASKS	ACTIVITIES	1st year	2nd year
Number Sense	Magnitude	More points, less points,	x	x
	Cardinality	Correct quantity of objects	x	x
	Ordinality	Position of an object in a conjunct	x	x
	Comparison	Difference in a category	x	x
	Length Measurement	Length	x	x
	Volume Measurement	Volume	x	x
	One to One Correspondence	One to One correspondence		
	Estimate	Approximate quantity without counting	x	x
	Image-Symbol Transposition	Image-Symbol	x	x
	Symbol-Image Transposition	Symbol-Image	x	x
	Verbal number	Name Number	x	x
Number Line	Number Sequence	Number Line	x	x
Position Value	Position - Value	Hundred/Ten/Unity		x
Addition	Addition - Concrete Addition - Operations	Concrete - Operations	x	x
Subtraction	Subtraction – Concrete Subtraction - Operations	Concrete - Operations	x	x
Multiplication	Multiplication - Concrete Multiplication - Operations	Concrete - Operations		x
Division	Division - Concrete Division - Operations	Concrete - Operations		x
Problem-Solving	Problem-solving	Problem-solving involving simple addition and subtraction	x	x

In relation to the implementation of the pilot study, it was possible to observe that the students did not present any difficulties regarding the instructions, and performed the tasks with good

understanding. However, the apllication of the screening protocol revealed the necessity to reduce the number of skills. Therefore, the screening protocol was reformulated, now having 5 tests tasks: number sense (magnitude/verbal/arabic transposition); number line, position value, Addition and subtraction. The protocol reformulation was necessary due to the fact that the multiplication, division and problem-solving tasks required more cognitive and learning demands which the students in early school grades don't master.

4. Discussion

Fuchs and Fuchs (2006) considered the necessity of screening tools with reference standards for early evaluation and identification of students at risk for any type of learning difficulties. According literature (Andrade, Andrade & Capellini, 2014; Fuchs & Fuchs, 2006), two components are important for choosing a screening to identify difficulties: the ability to measure the students' responsiviness to instruction and the student's non-responsiviness to the stimuli applied in the screening.

Therefore, the importance of the screenings is to identify safely, quickly and at a low cost which skills measure the students' performance identifying the risk of learning difficulties, more specifically in this study, the difficulties in developing mathematical skills.

Thus, the results of this study showed that the need for adjustments to the screening protocol for the mathematical difficulties elaborated in this study, based on the results of the pilot study, made the protocol more robust for investigating the mastery of basic knowledge related to addition, subtraction and, thus, capable of identifying students at risk for mathematical learning in early school grades.

These studies will be conducted to define the reference standard for the population of this study, so that this screening protocol will be able to be used for an early identification of difficulties in the development of mathematical skills.

5. Conclusion

The results of these studies allowed us to conclude that it was possible to develop a screening protocol through the Response to Intervention Model (RTI) based on bibliographical research considering the main mathematical skills to identify students in the early school grades at risk of mathematical difficulties.

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