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Intervention in counting principles: teachers' perceptions on students' learning profile

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Abstract: The research field about teachers' perceptions on students' performance highlights the importance of understanding this approach in order to help students to improve their learning outcomes. This study aims to contribute to this discussion. It involved 136 first-grade students, from 10 classes of 3 Brazilian public schools. The teachers participated by filling out a questionnaire about the students' learning profile, including aspects such as: behavior, attention, social interaction and knowledge by area (mathematics, reading and writing). The teachers' answers were related to the students' achievement in a counting principles task. The results show that teachers have correct perceptions about the students who master the counting principles, but the same is not true for the ones who did not consolidate or were still developing the principles. The educational implication of the study is pointed out.

Keywords: Teachers' perceptions. Counting principles. Learning profile.

Teachers' role in the learning process of the students is often recognized by researchers in the mathematics field, especially when they present the research outcomes and reflect on its educational implications (Hoge & Coladarci, 1989; Südkamp, Kaiser, & Möller, 2012). Studies focusing on this perspective provide important data concerning teachers' perceptions on students' learning which brings implications for the way teachers plan their pedagogical actions (Hoge & Coladarci, 1989; Südkamp, Kaiser, & Möller, 2012). In this sense, the knowledge provided by this field of research allows to better comprehend and favor the teaching and learning processes.

This research involves the investigation of teachers' perceptions about the learning profile of first year students and seeks to verify if there is a relation between the teachers' perceptions and the students' actual performance in a counting principles task. The counting principles, established by Gelman and Gallistel (1978), are the basis for children's learning how to count with success. The principles are: stable order, one to one correspondence, cardinality, abstraction and order irrelevance. As evidenced by Stock, Desoete & Roeyers (2009), children with good achievement in counting by the end of kindergarten presented good performance in arithmetical abilities in the first year, pointing to the predictive value of the counting principles.

In 1989, Hoge and Coladarci conducted a systematic review on teacher judgments about their students' achievement. Initially, the authors contextualized teacher judgments through two perspectives: the cognition of teachers and their assessment. The first one addresses the decision-making of educators (in relation to planning, for example), noting that this process is influenced by their judgment on their students. The second involves thinking about the importance of the accuracy of teacher judgments in the context of assessment: educational decisions are made on the basis of

the educators' assessment and their judgment is an important source of information about the students (Hoge & Coladarci, 1989).

In 2012, 23 years after the review mentioned, Südkamp, Kaiser & Möller also studied the precision of teachers' judgment about the performance of their students, conducting a meta-analysis on this subject. The authors pointed out that teacher judgment is one of the primary sources of information about students' academic performance, as Hoge and Coladarci (1989) highlighted. An accurate assessment of students' performance is a prerequisite for educators to be able to adapt their pedagogical practices, make decisions and support the students' development of an appropriate academic self-concept (Südkamp, Kaiser, & Möller, 2012).

The literature showed studies involving teachers' judgment/perception with different objectives: to verify predictors of performance (Teisl, Mazzocco & Myers, 2001), to identify students with difficulties in mathematics (Nelson, Norman, & Lackner, 2016), and to observe the relationship between teacher perceptions and students' performance in mathematics, specific math skills, student feeling, motivational factors, and activities choices (Eds & Potter, 2013; Martinez, Stecher, & Borko, 2009, Schappe, 2012).

Although these works show divergences in some aspects, they generally point to a positive relation between the teachers' perceptions on students' performance and the students' actual learning outcomes. The authors note the need for research on this relationship, highlighting the importance of teacher judgment for students' evaluation, pedagogical planning and decision making. The present study seeks to contribute to this discussion. The purpose of this study is to investigate the relationship between teachers' perceptions about the learning profile of their 1st year students and the students' actual performance in a counting principles task.

Method

Participants

The study included 136 Brazilian students (63 girls and 73 boys), aged between 6 and 7 years old, from 10 groups of 1st year of Elementary Schools. It involved 3 public schools. This group of children was participating in an intervention research, entitled "Intervention in counting principles for elementary school students", submitted as a paper to TWG2, this year. Students were assessed in a counting principles task and their teacher filled out a questionnaire focusing on their perceptions about the students' academic achievement. Therefore, besides the students, their teachers (n=10) also took part in this study. All of them were graduated in Pedagogy and 9 had post-graduation in the Education area. Regarding the teaching experience with first year of Elementary School: 1 teacher had 6 months, 1 teacher had 2 years, 2 teachers had 3 years, 1 teacher had 5 years, 1 teacher had 9 years, 1 teacher had 18 years, 1 teacher had 28 years, 1 teacher had 31 years and 1 teacher had 36 years. The parents of all participating students gave their authorization through the signing of the Free and Informed Consent Form and the Dissent Form. Approval for this study was obtained from the Research Ethics Committee of Universidade Federal do Rio Grande do Sul.

Procedures

The researcher administered the counting principles task, between September and December 2017, individually to each child in a room provided by the schools. The teachers received the questionnaire at the beginning of the data collection and returned it according to their availability.

Instruments

1) Counting principles task: The task is conducted in an interview format. There are specific questions to assess each principle. The questions were asked in the following order: stable order (“Until how much can you count?” “Count out loud up to the number you said, please”); one to one correspondence (The experimenter shows 10 chips in a row and asks “how many chips are there?” After, the researcher shows 10 chips misaligned and asks “how many chips are there?”. The same procedure is repeated with 15 chips. This activity will be called “A”); cardinality (by the end of counting 15 items, the experimenter asks “how many are there in total? Can you give me 10?” This activity will be called “B”); abstraction (the experimenter asks “if you were counting 15 candies, would you count the same way (in the same order) you counted the chips?” This activity will be called “C”); order irrelevance (the experimenter asks the child to count the 15 chips, arranged in a row, in a different order, that is, starting from another chip. Then, the child is asked to say how many chips would remain if the row was undone. After, the experimenter asks the child to count 8 chips of the set, separating them aside, and then, to count the remaining 7 chips of the row. By the end, the child has to say how many chips there are in total. This activity will be called “D”). For each principle, the subjects were classified into three groups: principle consolidated (Y – yes); in construction (IC); not consolidated (N). Some criteria were established to classify the children in each group. Some of the questions (2, 3 and 5) are formed by more than one query. In this case, the child’s answer was classified as “Y” if he/she answered all the solicitations in each question correctly; “IC” if only one part of the question was correctly answered; “N” if the student did not answer any part of the question correctly.

2) Teachers’ questionnaire: The teachers received a questionnaire, adapted by the author, based on the scale of "Strengths and Weaknesses of Attention-Deficit / Hyperactivity-symptoms and Normal-behaviors - SWAN" (Swanson et al., 2005), containing questions about attention, behavior, knowledge by area (mathematics, writing and reading) and social interaction. The objective of the questionnaire, presented in the table below, was to investigate the teachers' perceptions about the general learning profile of their students. For each statement, teachers could select one of four frequency options: often, sometimes, rarely, or never.

1 - Shows interest for the proposals	14 – Shows difficulties in writing
2 - Pays attention to the explanations	15 - Shows difficulties in reading
3 - Keeps the materials organized	16 - Shows difficulties in mathematics
4 - Complies with the teacher's requests	17 - Avoid tasks involving numbers
5 - Interactes well to colleagues	18 –Shows counting knowledge

6 - Manages well the time attributed to accomplish a task	19 – Shows difficulties in socializing
7 - Engages in activities	20 – Shows difficulty in understanding instructions
8 - Knows to take turns: when to speak and when to listen	21 - Plays together with colleagues at playtime
9 - Questions when in doubt	22 - Complaints about the class proposals.
10 -Requires a lot of attention from the teacher	23 - Demonstrates slowness to finish the tasks
11 - Moves a lot during class	24 – Is easily distracted
12 - Forgets about making the homework	25 - Expresses him/herself well
13 – Does not comply with the rules	

Table 1: Teachers' questionnaire

Results

The relationship between the questionnaires of the teachers and the performance of the children in the counting principles task was investigated. In order to do the analyses, it was necessary to make an adjustment in the questions of the questionnaire. Although all of them counted with the same frequency for answers, there were distinct kinds of affirmation, which meant that the same frequency attributed to two different questions resulted in opposite answers. For example: the “often” frequency is a positive answer to question number 1 (“shows interest for the proposals”), but negative for the question number 20 (“shows difficulty in understanding instructions”). Considering this fact, before running the analyses, it was necessary to transform the answers so they kept the same direction of association. They were classified as positives (1 to 9, 18, 21, 21 and 25), which had maintained the frequency (often, sometimes, rarely, never), and negatives (10, 12 to 17, 19, 20, 22 and 24), which suffered the transformation (never, rarely, sometimes, often). In this way, the frequency “often” for the positive question number 7 (“engages in activities”) had the same effect of the frequency “never” for the negative question number 23 (“demonstrate slowness to finish the task”). The box-plots, shown below, were constructed to highlight the frequency of distribution of the teachers' answers in relation to the students' constructs. It can be seen that most of the graphs below shows increasing frequency throughout the answers, with few occurrence in "never" and a gradual increase in the following answers. The only graph that does not follow this pattern is related to the construct "IC" (in construction principle) in activity C: this may be due to the fact that only 6 children presented this construct, making the analysis difficult due to the scarcity of data for this variable.

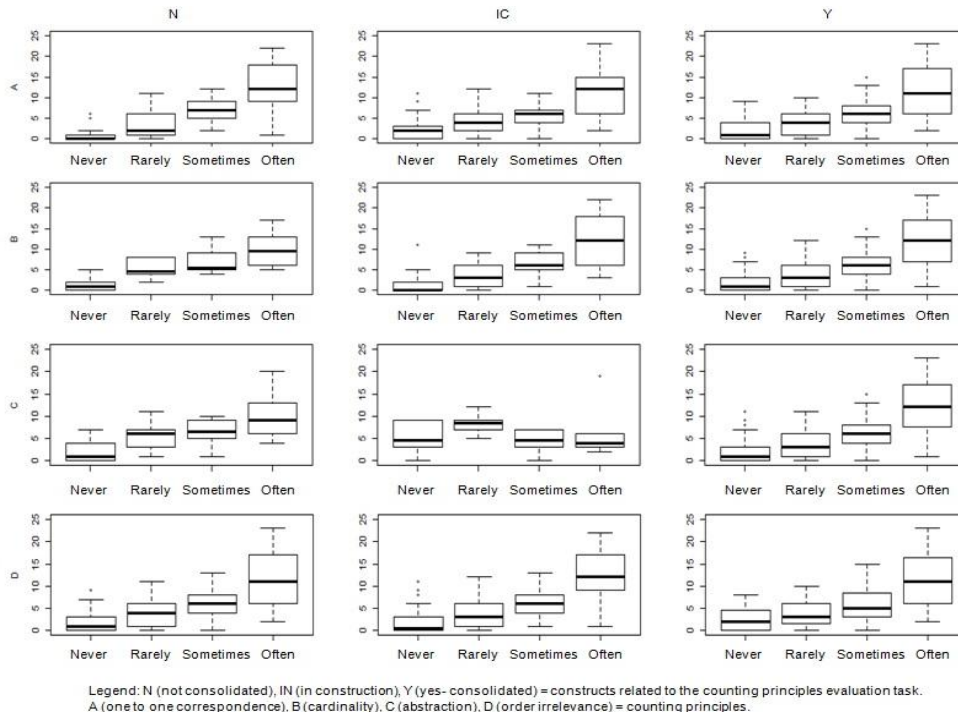


Figure 1: Box-plot graphs

Considering the information presented in the graphs, the Kruskal-Wallis test was applied to verify if the median of performance of the children in the counting principles task, between the four groups of frequencies (never, rarely, sometimes and often), was different, that is, if the oscillations in the graphs were statistically significant ($p < 0.05$). The samples were independent, so if one group has a high median, it does not interfere in the median of another group (high or low).

One to one correspondence							Cardinality						
Construct of the principle	Number of students	Answers of the teachers	Median	p-value	sig		Construct of the principle	Number of students	Answers of the teachers	Median	p-value	sig	
N	29	Never	0	0,0843	a		N	6	Never	1	0,6615	a	
		Rarely	2						Rarely	4,5			
		Sometimes	7						Sometimes	5,5			
		Often	12						Often	9,5			
IC	50	Never	2	0,0188	a	b	IC	17	Never	0	0,089	b	
		Rarely	4						Rarely	3			
		Sometimes	6						Sometimes	6			
		Often	12						Often	12			
Y	57	Never	1	0,0446	a	b	Y	113	Never	1	0,0003	c	d
		Rarely	4						Rarely	3			
		Sometimes	6						Sometimes	6			
		Often	11						Often	12			
Abstraction							Order Irrelevance						
Construct of the principle	Number of students	Answers of the teachers	Median	p-value	sig		Construct of the principle	Number of students	Answers of the teachers	Median	p-value	sig	
N	14	Never	1	0,3114	a	b	N	63	Never	1	0,0061	c	d
		Rarely	6						Rarely	4			
		Sometimes	6,5						Sometimes	6			
		Often	9						Often	11			
IC	6	Never	4,5	0,2873	a	b	IC	46	Never	0,5	0,2982	c	
		Rarely	8,5						Rarely	3			
		Sometimes	4,5						Sometimes	6			
		Often	4						Often	12			
Y	116	Never	1	0,0001	a	b	Y	27	Never	2	0,0096	c	
		Rarely	3						Rarely	3			
		Sometimes	6						Sometimes	5			
		Often	12						Often	11			

Figure 2: Kruskal-Wallis test results

As observed above in figure 2, in the one to one correspondence principle the medians of the "N"(not consolidated) construct were the same, since their p-value was greater than 0.05. In the "IC" (in construction) and "Y" (consolidated) constructs there was a difference between the medians, indicated by p-value less than 0.05, the medians of each response being different from each other. Although a numerical difference was observed between the medians of "N" construct responses, a statistical significance was not found (at 5% level) due to the low sample size. The number of students with the "IC" and "Y" constructs, which presented a significant difference, was 50 and 57 respectively, while the "N" construct had 29 students.

In the cardinality principle, it was possible to observe difference between the four medians only for the "Y" construct ($p < 0.05$), with the "N" and "IC" constructs not showing statistically significant differences. Again, this can be attributed to the size of the sample of each construct, since 113 children showed mastery of the cardinality principle, while only 17 were constructing it and 6 did not demonstrate its consolidation. In the abstraction principle, the "N" and "IC" constructs, with 14 and 6 subjects, respectively, did not present differences between the medians of the responses. The "Y" construct, with 116 students, showed to be statistically significant ($p < 0.05$) with the four medians differing from each other. In the irrelevance of the order principle, the construct "N", with 63 subjects, was shown to be statistically significant ($p < 0.05$), with the four medians being different. The "Y" construct, although with a small number of students, 27, was also evidenced as statistically significant ($p < 0.05$). The answers "Never" and "Rarely" presented median equality, as indicated by the letters in the table. The construct "IC", in turn, even with a larger sample than the previous one, with 63 subjects, was not statistically significant, showing equal medians.

Discussion

It was expected that the results of the data analysis, relating the teachers' perceptions about their students' general learning profiles and the constructs presented by the students in the assessment of the counting principles, would show that children who did not consolidate a certain principle would present a very frequent occurrence of "Never" or "Rarely" answers in the questionnaires; students who were constructing the principles would have "Sometimes" answers more frequently; children who demonstrated a "yes" construct for the counting principles, supposedly, would present a large occurrence of "Often" answers in the teaching questionnaires. In general, it is possible to consider that there was little differentiation in the occurrence of responses for almost all constructs: both those who did not consolidate the principles and those who were constructing them, or who already mastered them, obtained the same types of answers in the questionnaires, varying in the number of times they received them.

The results raise some possibilities of analysis. First, the relationship between teachers' perceptions about the students' learning profiles was in agreement with the performance of the students only in the cases of those who showed consolidation of the counting principles. Such a result converges with other studies demonstrating that teachers' judgements, through rating scales, are good predictors of students' academic performance, more specifically, in relation to students who did not develop learning difficulties in mathematics (Teisl, Mazzocco & Myers, 2001). Another possibility concerns how teachers answered the questionnaires: once they received the documents and were

able to fill them out without the presence of the researcher, it is not known exactly how they did it, what criteria they used to choose a response in to the detriment of another, whether they filled out quickly or dedicated time to think about the issues raised there. A third point refers to the number of students per class. The classes involved in this study had a maximum of 25 students. Although it seems a small number, it is complex for a teacher, alone, to have complete knowledge of all his/her students. Even though the questionnaire was delivered in the second half of the year, a period of time when teachers would have had time to get to know their students, it is difficult to know, precisely, how much and what each teacher knew about their pupils.

Limitations

The research results described in this paper should be considered in the context of some limitations. First, the counting principles task used was selected because it is a short and practical instrument, however, we believe that a broader task could elucidate more aspects to be analyzed and discussed. The same must be said in relation to the Swan questionnaire. Another limitation concerns the choice of statistical analysis that was conducted. It is possible that different findings would have emerged if the study included the association of different statistical tests, which could have made it possible to reinforce or question some of the results found or even to elucidate other possible outcomes.

Conclusion

This study showed that the teachers have correct perceptions of their students when it comes to students with good performance, that is, those with "Y" construct in the counting principles. Students who do not present consolidation or who are constructing the principles were perceived by the teachers in a way that did not correspond to the students' performance in the counting task used in this study.

This work points to the need and importance of deepening and expanding the development of teacher studies and their perceptions. More importantly, it is extremely relevant to investigate how teachers form their perceptions, what criteria they consider when evaluating students and how they see their students.

This study shows that there are still many aspects that need to be discussed between researchers and teachers, seeking to establish a significant link between theory and practice. It is imperative that teachers, especially those responsible for the early years of Elementary School, acquire knowledge about the factors involved in learning the initial mathematics: knowing how the learner learns will help them to identify aspects related to not learning and, therefore, perhaps their perceptions are clearer and they can recognize children who are facing problems. It is imperative that the link between researchers and teachers be built and used in favor of student learning, allowing the two sides to dialogue and understand how academic conceptions can contribute to pedagogical practices and vice versa.

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