An investigation of effective educational process elements for preschoolers' numeracy learning

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Abstract

This study investigates the process elements used by preschool teachers when teaching numeracy. The goals are a) to examine student-centered and teacher-centered process elements in planning, teaching, assessing, managing classroom behavior, and professionalism, and b) to identify those process elements that are more effective in terms of the preschoolers´ numeracy learning. We used a sample of 23 preschool teachers and their 369 students between 3 and 5 years of age. The teachers answered a series of questionnaires to describe their educational methods. The students were assessed on numeracy using several tasks from the TEMA3 (Ginsburg & Baroody, 2003). The numeracy tests and the teachers' questionnaires were administered simultaneously. The results show positive relationships between child-centered process elements and students' numeracy learning and negative relationships between teacher-centered educational methods and students' numeracy learning.

Keywords: Children, Education Numeracy, Mathematics, Preschool, Teaching,

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Research studies show that learning mathematical concepts and skills in preschool is one of the strongest predictors of children's academic success (Jordan, Kaplan, Ramineni, & Locuniak, 2009; Duncan et al., 2007; Claessens, Duncan, & Engel, 2009, Claessens, & Engel, 2013). Research also shows that children's early experiences with numbers constitute the foundation for the mathematical knowledge and skills that they will acquire in school (Sarama & Clements, 2015). Geary, Hoard, Nugent, and Bailey (2013) showed that when children develop a strong understanding of numeracy, they can better succeed in the primary grades' mathematics. Furthermore, Nguyen et al. (2016) showed that counting and numeracy skills are the mathematical skills that more strongly predict later mathematical achievement in fifth grade. Therefore, it seems crucial to teach numeracy to children to ensure their future academic success.

How to teach numeracy

When thinking about how to teach preschoolers, typically, two areas are discussed: "environmental elements" (Chukwuemeka, 2013) and "process elements" (Klein & Knitzer, 2006, Mugendawala & Muijs, 2020). The first ones refer to aspects of the environment such as room arrangement, materials used, space available, adult-child ratio; group size; and teacher training. The "process elements" refer to teacher and child interactions, teaching methods and strategies, management of time, and the social context of activities. Process elements are strongly related to preschoolers' learning (Howes et al., 2008). In fact, research has shown that the relationship between process elements and children's academic achievement is stronger than the one that this later variable enjoys with the environmental aspects (Mashburn et al., 2008).

In terms of the process elements, one of the most profoundly debated issues in education is whether a child-centered or a teacher-centered approach to teaching is more effective in producing children's learning (The SHARE Team, 2020). A child-centered approach to teaching would include a focus on meaning-making, inquiry, and authentic activity. "The instructional goal in student-centered classrooms, based on constructivist principles of learning, is to create a learning environment where knowledge is co-constructed by the teacher and students rather than transmitted directly by the teacher" (Garrett, 2008, p 34). On the other hand, a teacher-centered approach to teaching is one where the teacher is in control of the learning objectives, class content, evaluation methods, and classroom environment. (Zygmont & Schaefer, 2005). According to Huba and Freed (2000), in the teacher-centered type of education, the teacher provides information to the students who receive it passively. The main goal is to acquire knowledge by paying attention and memorizing the information that the teacher provides. The teacher then evaluates the students to make sure that they received that knowledge.

This dispute also affects the teaching of numeracy in preschool. Some research supports the idea that children acquire numeracy concepts and skills when they engage in child-centered explorations characterized by play, working in small groups, following children's interests, or using hands-on activities. For instance, Hunting and colleagues (2012) found that learning through play was an effective teaching strategy for young

children to learn math. Ramani and Siegler (2008) engaged children in a linear board game and found that the children's numeral identification and understanding of magnitudes improved significantly. Moreover, Wang and Hung (2010) also found that a strategically designed board game improved the numeracy skills of four kindergarten students compared to a control group. Play is so positive that even digital play improves children's ability to recognize numbers, write them, and quantify them (Spencer, 2013). Recently, Cohrssen and Niklas (2019), in a quasi-experimental study, showed that the experimental group that used a play-based math curriculum obtained significantly greater gains in their mathematical competencies than the control group that used a business-as-usual math curriculum.

Additionally, other research has shown that children learn best when instruction is based on the children's interest and curiosity, encouragement of their decision making, acknowledgment of their efforts, and use of different activities that motivate them (Law, 2008). It is also important that students are actively engaged in the learning process and that the new concepts are connected to the students' previous knowledge (Di Muro, 2006). Other elements that increase learning are opportunities for social collaboration among students, a warm and nurturing classroom climate, and positive interactions between teachers and children (as well as among peers) (Morrow, & Gambrell, 2011; Klein & Knitzer, 2006). Other typical aspects of a child-centered approach, such as working in small-group activities with concrete materials or using manipulatives, have also been effective when learning math in preschool (Klein & Starkey, 2004; Manches & O'Malley, 2012).

However, other findings support the idea that a teacher-centered approach may be more effective. For instance, children of East Asian descent often learn within an educational system characterized by direct instruction, coherent curriculum, close alignment to standards, high expectations, and textbooks. Their learning is disconnected from real-life situations, and teachers emphasize testing and memorization (Zhao, 2005). Nevertheless, they consistently outperform non-East Asian children according to PISA results, and that is even the case when those students reside in a Western country (Feniger & Lefstein, 2014; Jerrim, 2015).

Other typical aspects of a teacher-centered approach have also been found to be effective. For instance, Hinton, Flores, Schweck, and Burton (2016) found that explicit instruction (one of the main characteristics of the teacher-centered approach) improved the counting skills of four young children who were below their peers in their mathematical abilities. Passolunghi & Costa (2016) showed that paper-and-pencil specific training of children's early numeracy abilities enhances those abilities. Xu & LeFevre (2016), in a study with eighty-four children between 3 and 6 years of age, showed the effectiveness of direct training for the learning of sequence number knowledge. Moreover, researchers found direct instruction effective in teaching students in a full range of student populations (Adams & Engelmann, 1996). In addition, some research findings seem to indicate that the use of manipulatives can even harm learning instead of enhancing it (Kaminski, Sloutsky, & Heckler, 2009).

However, most, if not all, of the cited works are based on the investigation of specific experimental interventions. This type of research has the danger of obtaining results that are not due to the methods or strategies used but just to those applying the methodologies' personal or motivational characteristics. For instance, studies of counseling and psychotherapy have found that the biggest part of the variance in outcomes between different therapeutic interventions is due to the individual personality characteristics of the counselor and features of the counseling relationship (Cooper, 2008). The same phenomenon is likely to apply to studies of teaching. Therefore, we believed that to investigate which process elements are more effective when teaching math to preschoolers, it was important to examine the actual methods that current teachers use in their daily work, without any specific motivation to demonstrate anything. We believe that by investigating what those teachers typically do and comparing their results with the numeracy learning of their pupils, we can have a more realistic estimation of which process elements are more effective in real life.

Another way of looking at teacher's effectiveness beyond the child-teacher-centeredness dispute is the Danielson Framework for Teaching (Danielson, 2013). This model identifies those aspects of a teacher's responsibilities that promote improved student learning. It distinguishes four domains of teaching: planning, instruction, classroom management, and professionalism. Divided among those four domains, the model uses different indicators of good teaching. In this study, we added a fifth domain, assessing students' learning, using indicators that Danielson distributed between the first and third domains. This framework is of particular interest because it is based on years of empirical studies and theoretical research. In addition, many teachers, administrators, policymakers, and academics have embraced it because it provides a complete description of what good teaching is and a very effective tool to measure teacher effectiveness (Sartain, Stoelinga, & Brown, 2011).

We believe that the Danielson framework's domains are fundamental, but except for the Professionalism domain, they do not exclude the possibility that there may be differences in each of those domains between a child-centered approach and a teacher-centered approach. For instance, one of the indicators of good planning according to the Danielson model is "Lesson and unit plans that reflect important concepts in the discipline." This is a significant indicator, but it does not preclude that some teachers may work on important concepts using a child-centered approach, while others may use a more teacher-centered method, and the results may be different.

Therefore, we decided to investigate teachers in their daily work without altering anything they were doing. We used the Danielson framework as a base point, but we enriched it by exploring methods and strategies typical of a teacher-centered or a child-centered approach. Consequently, this study aims to find out which process elements in each of the five domains we identified based on the Danielson model are more effective when teaching numeracy to preschool children. Notably, we want to determine whether child-centered or teacher-centered approaches to planning, instructing, assessing, or managing classroom behavior produce better outcomes in terms of the preschoolers' ability to learn numeracy skills. For this reason, we investigated a group of preschool teachers to find out about their use of process elements. We also assessed the students of those teachers'

numeracy skills and found which process elements were more effective in learning those abilities.

Numeracy

Jordan, Kaplan, Olah, and Locuniak (2006) propose that numeracy comprises two great domains: number skills and verbal arithmetic. The number skills include counting, recognizing numbers, knowing the numbers, making nonverbal calculations, estimating, and recognizing and using number patterns. Young children's most common numerical activity, both at home and in the preschool classroom, is counting (Ramani & Siegler, 2011). Verbal arithmetic has abilities such as solving story problems and combining numbers, and among the second, the most common activity for preschool children is mentally adding small quantities (Purpura & Lonigan, 2013).

Concerning counting skills, preschoolers are expected to have reached two important milestones; one is the ability to rote count, and the second is the ability to count with one-to-one correspondence with the objects that children are trying to count (Clements & Sarama, 2009). Therefore, our study of numeracy will focus on the preschoolers' abilities to count by rote, count using one-to-one correspondence, and add small quantities mentally.

Methods

Sample

The sample consisted of 23 preschool teachers working with 369 preschoolers between 3 and 5 years of age (mean = 4.22) belonging to five schools in a city in Spain. All the teachers were females. The students were almost evenly divided between males (48.1%) and females (51.9%). The schools in the sample were selected by convenience. Two of the schools are public, while the other three are private. We combined schools in low, medium, and high-income neighborhoods. Therefore, the socioeconomic of the families varied from low to high. The participating teachers are those who teach preschool classrooms in those schools.

Procedures

This study is part of a more extensive study on math teaching factors in preschool settings. At the end of the 2018 Spring semester, we assessed the students on their math knowledge. All parents of the participant children provided their consent. Each child was evaluated individually. The numeracy part of the assessment lasted approximately 5 minutes per child. The students were assessed in the school during the school day in an office that each school facilitated for this study. The teachers answered a series of questionnaires asking about their planning of lessons, teaching, assessment, classroom behavior management, and professionalism.

Measures

Numeracy. To measure the children's numeracy skills, we selected three tasks from The Test of Early Mathematics Ability, Third Edition (TEMA-3; Ginsburg & Baroody, 2003): verbal counting, one-to-one counting, and concrete addition strategy use and accuracy. The Tema-3 is designed to assess children's informal and formal mathematics ability from ages 3 to 8. All tasks were presented and performed in a play context in which the children were helping a teddy bear called Peter to carry out the different tasks to celebrate his birthday. For the verbal counting, the maximum number that the children could count verbally was 50. When they reached that number, we stopped them. We recorded the higher number counted by the child before making a mistake. We created a verbal counting coefficient dividing the raw score by the maximum score possible (50). The maximum number that the children could count with one-to-one correspondence with the objects was 40. After that, we stopped counting. Equally, we recorded the higher number the child was able to count without error. We computed a one-on-one correspondence coefficient by dividing the raw score by the maximum score possible (40). For concrete addition, the students would place a specific number of cookies in an opaque plastic bag and then a second specific number of cookies. Then, they would be asked how many cookies were inside the bag. Four different sums were presented to the children. Each one more difficult than the previous one (1 + 1, 2 + 3, 4 + 5, and 7 + 6). For scoring purposes, each correct answer was given one point. Again, an addition coefficient was created by dividing the number of correct answers of each participant by the maximum possible (4). Finally, we submitted the three coefficients to a principal components analysis. The analysis of the Eigenvalues and the scree plot showed one unrotated factor. The factor loadings of the three coefficients in the factor were .94, .94, .85, respectively, showing that they formed a numeracy coefficient created by adding the three coefficients. The Cronbach's reliability of the scale was $\alpha = .90$.

Demographic information:

For the students, we gathered data on their gender and age. We used a third indicator to measure the SES of the students' families. We obtained that data from the schools' principals. They did not report the SES of each family. Instead, they provided the average SES of all the families in their schools. We then applied that average SES to all the children in that school. All teachers were females. We did not ask for their age, but we gathered information about their number of years of teaching experience.

Teachers' process elements.

For the teachers' process elements, we created four separate questionnaires that measured the child-centered ways of planning curriculum, teaching, assessing, and managing classroom behavior. We also create four additional questionnaires to measure the same four dimensions of a teacher-centered approach. For all those questionnaires, we selected items and used the general structure of the Danielson Framework for Teaching (Danielson, 2013). Nevertheless, because we wanted to identify at least two types of teaching factors and practices - one teacher-centered and another child-centered - we added items in each of the questionnaires that could provide detailed information about the strategies, techniques, and methods that teachers used in class with their

students. In addition, we created a short questionnaire to measure the teachers' professionalism. For all nine questionnaires, we used a 5-point Likert-style response.

Child-centered planning. We created a five-item questionnaire to measure a child-centered way of planning curriculum. Items were either taken from the above mentioned Danielson Framework or generated to reflect a form of planning curriculum based on the children's interests, an emergent curriculum, hands-on, active learning, and integration with other subject matters (e.g., "Work on math skills is developed as opportunities arise" or "I follow an emergent curriculum"). The reliability of the questionnaire measured by Cronbach's alpha was .88.

Teacher-centered planning questionnaire. We created a five-item questionnaire to measure a teacher-centered way of planning curriculum. Again, items were taken from the Danielson Framework or developed to reflect a type of planning based on a pre-established curriculum, pre-specified math goals, and systematic planning of the math concepts considered essential to the subject matter. Examples of items in this factor are the following: "I use a pre-established curriculum" or "In my planning, I use the sequence: demonstration, guided practice, independent practice.". The reliability of the questionnaire measured by Cronbach's alpha was .65.

Child-Centered Teaching. To measure the child-centered techniques and strategies that teachers used with their students when teaching math, we used ten items either taken from the third domain of the Danielson Framework for Teaching, which refers to instruction or developed to reflect a way of teaching based on children's independent inquiry, hands-on activity, meaningful activities, and choice (e.g. "I create opportunities for student choice.") The reliability of the questionnaire measured by Cronbach's alpha was .76.

Teacher-Centered Teaching. To measure the teacher-centered type of teaching, we again used ten items either taken from the third domain of the Danielson framework for teaching, which refers to instruction, or developed to reflect a way of teaching based on direct delivery of information, use of repetition, use of worksheets, and work in whole group instruction (e.g., "I use worksheets"). The Cronbach's reliability coefficient was .82.

Child-centered Assessment. To measure how teachers assess their students using a child-centered approach, we used five items from the first and third dimensions of the Danielson Framework for Teaching (Danielson, 2013) or developed to reflect the provision of effective feedback to pupils, the use of formative assessments, and the ability of pupils to assess themselves and understand how to improve (e.g. "Students assess their own work against established criteria"), The Cronbach's reliability coefficient was .73.

Teacher-centered Assessment. In contrast, in a teacher-centered type of assessment, teachers focus on quantity over quality of work, pay more attention to presentation than to understanding, and place a strong emphasis on summative assessments, so they can use the grades to rank and compare students (Squire, 2009). Following this description, we used five items for this questionnaire (e.g., "I use summative assessments"). The Cronbach's reliability coefficient was .72.

Child-Centered classroom behavior management. According to Willower, Eidell, and Hoy, (1967), the teachers that use a child-centered classroom behavior management style actively interact and communicate with their students, and establish personal relationships with them characterized by closeness and mutual respect. They also show a positive attitude when dealing with stressors and are flexible when applying and enforcing rules. Student's self-discipline is also fostered. Therefore, we used six items taken either from the second dimension of the Danielson Framework for Teaching (Danielson, 2013) that refers to the classroom environment or developed to reflect a child-centered approach (e.g., "I use a positive discipline when dealing with children's behavior"). The reliability of the scale was α =.84.

Teacher-Centered classroom behavior management. According to Garrett´s (2008), the characteristics of the teacher-centered approach are "high control, use of punitive sanctions, moralistic perceptions, highly impersonal relationships with students, attitudes of general mistrust, and a major focus on the maintenance of order." (Garrett, 2008, p. 35). Therefore, we used six items to represent a teacher-centered type of behavior management (e.g., "I use a firm type of discipline"). The reliability of the scale was α =.73.

Professionalism. To measure the teachers' professionalism, we used five items from the fourth section of the Danielson Framework. The items show the teachers' ability to reflect on their experience, keep accurate records, continue learning, and team up with colleagues to improve teaching (e.g., "I accurately reflect on each lesson.") Cronbach's alpha for this questionnaire was .75.

Analysis

We first submitted the four Child-centered scales to a factor analysis to investigate if they represented different dimensions of the same underlying construct of a Child-centered approach to teaching. We did the same for the Teacher-centered scales. We then analyzed the correlations between the students' numeracy scores and the demographic data: teachers' years of experience and children's socioeconomic status. We also used a t-test to compare the students' math learning by gender. Then, we looked at the correlations between the process elements the teachers used to plan curriculum, teach the math content and skills, assess students' learning, manage students' behavior, and be professional, and the scores obtained by the students in their numeracy test. Finally, we used regression analysis to investigate the teaching factors that best predicted the preschoolers' numeracy learning.

Results

Factor analysis

Analysis of the scree-plot of the unrotated factor analysis of the child-centered scales, using maximum likelihood, showed one factor. The factor loadings for the planning, teaching, assessing, and behavior management scales were .90, .78, .82, and .81, respectively. Analysis of the scree-plot of the unrotated factor analysis of the teacher-

centered scales, using maximum likelihood, also showed one factor. The factor loadings for the planning, teaching, assessing, and behavior management scales were .71, .90, .58, and .93, respectively.

Descriptives and Correlations

We show the descriptive data in Table 1.

Table 1. Descriptives
Estadísticos descriptivos

Process Elements	Min	Max	Mean	St. Dev.
Teachers' year of experence	1,0	30,0	15,50	8,67
Students' age	3,00	5,00	4,1184	,76117
Child-Centered planning	9,00	25,00	19,18	4,14
Teacher-Centered planning	11,00	23,00	19,75	2,62
Child-Centered teaching	18,50	42,00	31,84	6,58
Teacher-Centered teaching	18,00	45,00	32,57	6,97
Child-Centered assessing	9,00	23,00	15,06	3,60
Teacher-Centered assessing	5,00	23,00	14,44	3,66
Child-Centered behavior management	19,00	30,00	24,35	3,11
Teacher-Centered behavior management	20,00	28,00	23,77	2,59
Professionalism	11,00	25,00	17,21	3,48

N = 23

Demographic data. Only the SES of the students positively and significantly correlated with their scores in the numeracy test. The teacher's number of years of experience positively correlated with all the four numeracy coefficients (verbal counting, counting with one-on-one correspondence, adding, and the global coefficient), but the correlation was not significant. (See Table 2). The independent samples t-test showed no significant differences between boys and girls in numeracy scores t(362) =-1.73, p = .09.

Correlations between numeracy coefficients and the teaching process elements. The abilities to count verbally, count with one-on-one correspondence, and the general numeracy ability correlated positively with the variables child-centered planning, child-centered teaching, and child-centered behavior management. These abilities correlated negatively with the four teacher-centered dimensions, but only the correlation with teacher-centered teaching was significant. Preschoolers' ability to add correlated with all child-centered coefficients positively and significantly. It correlated negatively

with all teacher-oriented measurements, although none of those negative correlations were significant (See Table 2).

Table 2. Correlations between all variables and students' numeracy scores

	Verbal Counting	Counting Objects	Adding	Total Numeracy
SES	,230**	,215**	,104*	,203**
Teachers' years of experience	,026	,020	,067	,041
Child-centered planning	,151**	,131**	,195**	,175**
Teacher-centered planning	-,102	-,090	-,023	-,080
Child-centered teaching	,255**	,241**	,279**	,284**
Teacher-centered teaching	-,168**	-,159**	-,068*	-,146**
Child-centered assessment	.023	.025	.124*	.062
Teacher-centered assessment	-,057	-,060	,016	-,050
Child-centered behavior management	,097	,092	,190**	,139**
Teacher-centered behavior management	,100	-,080	-,008*	-,070
Professionalism	,073	,052	,056	,067

N = 369. **. Correlation significant at 0,01 level (two-tail).
*. Correlation significant at 0,05 level (two-tail).

Regression analysis

We used hierarchical regression analysis, in which we introduced the demographic variable (SES, years of experience) in the first step and all the process element variables in the second step. The results showed that none of the demographic variables had any predictive power. The analysis of collinearity showed problems of high correlations among all the child-centered variables. It also showed high correlations among several teacher-centered variables. Therefore, we added all the child-centered variables (planning, teaching, classroom management, and assessment) in one variable. We did the same for all the teacher-centered variables. The regression analysis with the new variables showed a child-centered educational approach to planning, teaching, assessing, and controlling behavior modestly but positively and significantly predicted numeracy test results. The teacher-centered dimensions also modestly, negatively, and significantly predicted the numeracy scores. Professionalism did not have any significant effect.

Table 3. Regression of preschoolers' numeracy scores on teaching process elements

Model		Nonestandarized coefficients		Standardized coefficients			Multicollienarity Statistics	
		B	Error típ.	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	1,274	,133		9,55	,000		
	Teaching years of experience	-,005	,005	-,064	-1,08	,281	,976	1,02
	SES	,020	,046	,026	,44	,657	,976	1,02
2	(Constant)	1,041	,336		3,10	,002		
	Teaching years of experience	-,007	,005	-,085	-1,47	,143	,873	1,15
	SES	-,005	,043	-,006	-,106	,916	,941	1,06
	Child-centered education	,029	,004	,522	6,67	,000	,478	2,09
	Teacher-centered education	-,020	,004	-,349	-5,18	,000	,645	1,55
	Professionalism	-,027	,017	-,117	-1,55	,122	,518	1,93

N= 369. a. Dependent variable: Total Numeracy score

Discussion

This study aimed to investigate the process elements in preschool numeracy teaching that are more effective for students' learning. Following the Danielson model and considering two different approaches to education, a teacher-centered approach, and a student-centered approach, we wanted to identify what constitutes effective planning, teaching, assessment, and classroom management. We also wanted to determine which elements of professionalism may be more critical for effective teaching. There were no "a priori" hypotheses. We did not attempt to prove that one method is better than the other. Instead, we wanted to investigate what process elements preschool teachers actually use daily and which ones are more effective.

The study shows that children's learning is related to socioeconomic status. The higher the socioeconomic status of the families, the stronger their numeracy skills. This is hardly a surprise. The literature is full of studies showing the effect of SES on learning (Morgan, Farkas, Hillemeier, & Maczuga, 2009; Aikens & Barbarin, 2008; Reardon, Valentino, Kalogrides, Shores, & Greenberg, 2013). Nevertheless, when we introduced SES in the regression equation, it had no predictive power. This makes sense considering that previous studies have also shown that children of low socioeconomic status tend to attend

under-resourced, low-quality schools (Aikens & Barbarin, 2008), which means that the effect of SES is already present in the methods and strategies that the teachers use.

In addition, the results showed clear correlations between the preschoolers' learning of numeracy and the process elements that teachers use when planning, teaching, assessing, and maintaining a classroom climate. In general terms, the pattern of the results (including the significant and the non-significant results) points to a tendency of the child-centered methods (either planning, teaching, assessing, or disciplining) to correlate positively with preschoolers' numeracy learning. It also shows a pattern of the teaching-oriented methods to correlate negatively with the preschoolers' numeracy learning. Teachers' professionalism showed no significant correlations with numeracy learning.

Child-centered planning and teaching methods may be positive because they tend to include several aspects that have been shown to relate to children's learning, foster a positive attitude towards mathematics, and increase children's thinking abilities. They include play (Hellmich, 2007; Cohrssen, Tayler, & Cloney, 2014), collaborative learning (Gerlach, 1994), student-generated questions (NICHD, 2000), attractive materials, and exciting activities such as picture books and stories (Van den Heuvel-Panhuizen, 2012), and active engagement rather than passive listening (Ambrose., Bridges, DiPietro, Lovett, & Norman, 2010).

In relation to the regression analysis, the results show that child-oriented planning, teaching, assessing, and classroom management positively predict the preschoolers' numeracy scores, while the teacher-centered educational approach negatively predicts numeracy learning. However, the child-centered variable contributes to only 18% of the numeracy learning, which can be considered a relatively weak predictive power.

This study has some limitations. First, this study is nonexperimental, and therefore we cannot draw any cause-and-effect relations of its results. Second, from all the numeracy skills that preschoolers are expected to acquire, we focused only on three. However, the abilities to count verbally, with one-to-one correspondence, and adding small quantities are among the essential curriculum focal points at this age as defined by the NCTM (2006), and therefore they seem an appropriate way to measure this construct. The teachers reported on their own process elements. They may have given professionally desirable answers to the items in the questionnaires. Nevertheless, teacher-centered and child-centered variables showed relatively strong reliability coefficients for all the dimensions considering the brevity of all the scales, which indicates that the teachers were not shy to report on their fundamental ways of teaching, planning, assessing, and disciplining their students.

In conclusion, the results of this study indicate that there are positive relationships between child-centered educational methods and numeracy learning and negative correlations between teacher-centered educational methods and numeracy learning. The direction of these relationships reveal the need to use a child-centered approach when teaching mathematics to preschool children.

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