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Research Article

UNDERSTANDING THE CONCEPT OF NUMBER IN PRESCHOOL CHILDREN: A STUDY OF THE NUMERICAL ABILITIES OF FIVE-YEAR-OLD CHILDREN

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Abstract

This paper explores preschool children's understanding of the concept of number, with a focus on five-year-olds. The research aims to investigate the numerical abilities of preschool children. The sample consisted of 100 five-year-olds from private and public preschool institutions in the Zenica-Doboj Canton in Bosnia and Herzegovina, 50 children from public institutions and 50 from private institutions. The children answered 10 questions related to counting up to 10, reading and writing numbers from 1 to 10, and counting backwards from 10 to 1. The aim was to determine their understanding of the concept of number, numerical sequences, counting elements of a given set, recognising numerical notations and writing numbers, while also identifying possible differences based on gender and the type of preschool institution they attended. The results of the research may provide insight into the development of numerical abilities in preschool children and may be useful for future educational strategies.

Keywords: Preschool children, Numbers, Understanding, Counting, numeracy, Writing numbers, Preschool institutions.

INTRODUCTION

The development of mathematical concepts in early school age is a crucial means of understanding the world and the environment. Through mathematics, a child develops logical thinking, enriches their vocabulary, and enhances communication with their surroundings. Recognizing quantitative relationships, through experience and logical operations, forms the basis for the development of mathematical concepts.Within the realm of early mathematical skills, a central place is occupied by the concept of numbers, defined as the ability to manipulate numbers, understand their meanings, solve mathematical problems, and connect them to the real environment. A child's understanding of cardinal numbers before starting school provides the foundation for formal mathematics education (Mou *et al.,* 2021). Mathematical content in preschool age is designed to maximally engage a child in their own development, especially in the development of logical thinking. Therefore, in early education, the development of mathematical concepts should involve a child's interaction with various materials and direct contact with objects in their environment. Individual differences in how children come to mathematical understandings highlight the need for diverse experiences with concrete materials to develop more general concepts about the nature of mathematics. A child is born with a sense of mathematics, and through everyday activities and thinking, they construct mathematical concepts. Active thinking and encouraging children to think in their daily lives contribute to the development of mathematical abilities, which are achieved through everyday activities and play. In the context of the importance of numerical abilities, the goal of this research is to investigate the understanding of the concept of numbers in five-year-old preschool children through various tasks.

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This research will focus on five-year-old children in the preschool age, which is a critical period for the development of mathematical concepts. Through this research, we aim to better understand the development of mathematical concepts in five-year-old children and emphasize the significance of numerical abilities for their future success in mathematics.

Theoretical overview

The acquisition of the concept of number begins at a very young age. Von Aster and Holger Lorenz (2013) describe various forms of numbers: as words ("three"), as numerals (3), as Roman numerals (III), as non-symbolic notations (●●● or ▲▲▲), as finger representation, as words with numerical meanings (trio, group of three), or in a temporal sequence (the beat of a waltz). According to Sharma (2001), understanding numbers means "knowing how to apply them." Numbers are sometimes used to specify the size of a set of objects (as cardinal numbers), sometimes to specify the position of an object in a sequence (as ordinal numbers), sometimes to determine the size of objects (as a ratio), and so on. Understanding all aspects of numbers is equally important. According to Dejić (2015), the concept of number is developed through the establishment of various preconcepts: sets, classification, seriation, conservation, additivity (one and one make two, two and one make three, etc.), inclusion (1 is included in 1+1, i.e., 2, 1+1 is included in (1+1)+1, i.e., 3, etc.), counting, measurement, and more. Subitizing plays a significant role in early childhood and the development of mathematical skills in children. Subitizing is the ability to "instantly see how many." The ability to see numbers in patterns is fundamental to several senses. There is perceptual and conceptual subitizing, with the latter being built upon the former as an advanced skill. More information on this can be found in Conklin (2010) and Parrish (2010). Subitizing can serve as a foundation for understanding cardinality, which is an important aspect of mathematics as children develop the ability to connect recognized quantities with appropriate numbers. Research by Paliwal, Baroody, and Das (2018) suggests that an understanding of cardinality principles facilitates the ability to adjust collections of 4 or more items, especially when used with a modeling approach to counting and labeling. This highlights the need for early childhood educators and parents to enhance subitizing ability to teach the concept of cardinality. In early childhood, children become acquainted with numbers through stories, fairy tales, rhymes, apps, and similar resources. According to Egerić (2006, p. 85-86), in the younger age group, a child can grasp the numbers one, two, and three at a perceptual level, meaning they can perceive sets of one, two, and three elements. A systemic approach to forming the concept of numbers occurs when the child is emotionally and mentally more mature. On the other hand, according to Likierman and Muter (2007), children begin to recognize numerals when they flip through picture books with numbers. By this time, they have accumulated enough experience, and most children, when they see the number three, can say "three." Children initially develop a sense of a sequence and use numbers in a sequence, for example, counting fingers. Later, they develop a sense of a set and realize that adding numbers at the end of the counting process results in a larger set. A number answers the question: "How many of something are there?" Therefore, Egerić (2006) emphasizes that "by constructing a number scale, children realize that each number consists of units, and each subsequent number is one more than the previous one, and each previous one is one less than the next one."Introducing children to the world of numbers goes through three fundamental phases, which according to Dobrić (1981) conditionally occur: working on acquainting the child with the real world, working with sets, and working with numbers. Egerić (2006) emphasizes that building each number up to ten requires special attention to recognizing the quantity represented by various sets, the position of the number in a sequence, conscious counting, and the structure (components) of a given number. While counting, children notice that the more fingers they count, the larger the number, meaning the cardinal number of the set being counted increases. We can conclude that counting is an important mathematical skill that children often acquire through informal education in early childhood, through activities such as counting steps, toys, fingers, and counting-related games. Learning to count begins around the age of three, and most four-year-olds still have difficulty counting a set of up to 10 items (Gallistel and Gelman, 1992, as cited in Vlahović-Štetić *et al.,* 2006). When they start school, most children can count at least up to 20. Understanding the sequence of numbers is crucial for grasping the basics of calculation, and therefore, it requires special attention (Kaufmann and Wessolowski, 2006). Dobrić (1981) emphasizes that counting is essentially the naming of a set, and children need to recognize the quantity that the set represents and understand that the number relates to the whole set. Egerić (2006) points out that counting is a mental action that develops through material, verbal, and mental procedures. During the counting process, physical activity gradually gives way to mental activity. Dobrić (1981) describes the following stages in the development of counting: children count by moving objects, children touch objects without moving them, children point to objects without touching them, and finally, children count objects only by looking at them, without physical involvement. Building on the idea of Ho and Fuson (1998), who differentiated between the concepts of cardinal counting and cardinal number and argued that the more advanced concept of cardinality is the basis of the counting process, Baroody and Lai (2022) also examined their hypothesis. They investigated whether these two cardinality concepts are different and whether the concept of cardinal counting serves as a developmental prerequisite for the concept of cardinal number. They demonstrated that an understanding of the concept of cardinal counting is a necessary condition for understanding the concept of the cardinal number. According to Mou et al. (2021), tasks related to sets and numbers share some common characteristics but also differ significantly, so they should not be used indiscriminately in assessing the numerical abilities of preschool-age children.

METHODOLOGY

The research presented in this paper is part of a larger study conducted in preschool institutions. It explored the understanding of the concept of number, relationships, and mathematical operations in the case of five-year-old children attending public or private preschools. Research instruments tailored to the research needs were constructed and validated on a smaller sample. IBM SPSS 20 software was used for data analysis in this research. The research was carried out in public and private preschool institutions under the authority of the Public Institution "Preschool Education and Upbringing" in the Zenica-Doboj Canton. The study involved 100 participants (45 girls and 55 boys), with 50 of them coming from public kindergartens ("SeadŠkrgo," "Dunja," "Poletarac," "Radost," "Pinokio") and 50 from private kindergartens ("Hud-Hud," "Abakus," "Kidtropolis," "Sindibad," "Mala tratinčica") during the period from May to July 2021. Ten children of 5 years old participated from each of the listed kindergartens, chosen using a convenient sample method. The research aimed to investigate the understanding of the concept of number and identify potential differences among children based on gender and the type of preschool institution they attend. Based on the research subject, problem, and objective, we formulated the main hypothesis of the study and two sub-hypotheses:

Main Hypothesis:

- Gender and the type of preschool institution are not statistically significant factors in the understanding of the concept of numbers in preschool children.

Sub-Hypotheses:

1. There are no statistically significant differences in the results of tasks related to number sequences, recognizing number notations, counting elements of a given set, and writing numbers among children attending private and public preschool institutions.
2. There are no statistically significant differences in the results of tasks related to number sequences, recognizing number notations, counting elements of a given set, and writing numbers among children of different genders.

The research was conducted individually for each child, supervised by preschool teachers, using a workbook and a control sheet. The workbook consisted of ten questions/tasks, which were scored as zero for incorrect answers, one point for partially correct answers, and three points for fully correct answers. Children marked their answers, completed them, or displayed them. On the control sheet, teachers recorded data for each child, indicating whether the answers were correct, incorrect, or partially correct. They also monitored the use of different strategies and made additional notes as needed. The tasks in the workbook were related to counting (in both directions) starting from 1 or from a given number, counting elements of one or more sets, recognizing notations corresponding to the number of that/those set(s) or writing that number, writing number words using digits, or representing a set whose cardinality corresponds to a given number word. We grouped the tasks as follows: tasks related to number sequences (T1, T2), tasks related to recognizing number notations (using digits) (T3, T4, T7, T8, T9), tasks related to counting elements of a given set (T3, T5, T6, T9, T10), and tasks related to writing numbers (T5, T10). These task groups are not mutually exclusive. In this way, we classified the tasks into four categories, as shown in Table 1. When classifying the tasks, we were guided by the primary criteria of the task itself, rather than all its parts.

Table 1. Tasks categorization

Tasks category	Label	Tasks
Tasks related to numerical sequences	C1	T1, T2
Tasks related to recognizing number symbols	C2	T3, T4, T7, T8, T9
Tasks related to counting elements in a given set	C3	T3, T5, T6, T9, T10
Tasks related to writing numbers	C4	T5, T10

RESULTS AND DISCUSSION

The children from private and public preschool institutions were tasked with completing ten different assignments related to the understanding of the concept of numbers. By analyzing their responses, we concluded that when considering each task individually, there are no statistically significant differences in their responses, regardless of the type of preschool institution they attended or their gender. Using Levene's test for equality of variances and t-tests for equality of means, we obtained the following results: F(1, 98) = .16, p = .70, indicating no statistically significant difference in variability between groups when considering the type of institution the children attended, and t(98) = -1.86, p = .07, showing no difference in means.

The results also confirm that there are no statistically significant differences when considering the gender variable (F(1, 98) = 1.23, p = .27), which suggests that the assumption of equality of variances between these groups can be accepted. The t-test value for equality of means is t(98) = .55, p = .59. These results confirm the main hypothesis that there is no statistically significant difference in the understanding of the concept of numbers among the studied children, regardless of the type of preschool institution they attend, their gender, or individual aspects of each task. These results pertain to the total score of all 10 tasks. For the purpose of testing the sub-hypotheses of this study, tasks were grouped into categories that encompass number sequences, recognizing number notations, counting elements in a given set, and writing numbers, as shown in Table 1.

Table 2 presents the results of t-tests conducted for different categories of tasks according to the type of institution attended by the participants. This analysis relates to the equality of variances between groups, t-values indicating differences between groups, and the significance of t-tests (two-tailed p-values). For all four categories, two t-tests were conducted. The first test, assuming equal variances, shows t-values with degrees of freedom and p-values, and the second test, assuming unequal variances, with the same parameters, is presented in Table 2 for each category. However, the situation significantly differs when it comes to tasks in category C3 and C4, which involve counting elements in a given set and writing numbers. In the first case, both t-tests (assuming equal and unequal variances) show very low t-values of -3.63, with high significance (p-value of .00). These results indicate statistically significant differences between groups in this category of tasks, with children from different types of institutions showing significantly different performances in favor of the participants attending private preschool institutions. The t-test results confirm sub-hypothesis 1 regarding counting elements in a given set and writing numbers, while the results showed that there are no statistically significant differences for counting and recognizing number notations.

Table 2. Results of Levene's test by task categories according to the type of institution

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval	
									Lower	Upper
C1	Equal variances assumed	.11	.75	.09	98	.93	.02	.22	-.42	.46
	Equal variances not assumed			.09	97.03	.93	.02	.22	-.42	.46
C2	Equal variances assumed	1.02	.32	.35	98	.73	.16	.46	-.74	1.06
	Equal variances not assumed			.35	94.22	.73	.16	.46	-.74	1.06
C3	Equal variances assumed	.18	.68	-3.63	98	.00	-1.68	.46	-2.60	-.76
	Equal variances not assumed			-3.63	94.57	.00	-1.68	.46	-2.60	-.76
C4	Equal variances assumed	4.56	.04	-5.30	98	.00	-1.54	.29	-2.12	-.96
	Equal variances not assumed			-5.30	92.03	.00	-1.54	.29	-2.12	-.96

For the first two task categories (C1 and C2), the tests indicate the absence of statistically significant differences between groups (t = 0.09; p = 0.93 and t = 0.35; p = 0.73).

Table 3. Results of Levene's t-test by task categories according to gender

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval	
									Lower	Upper
C1	Equal variances assumed	.03	.87	.05	98	.96	.01	.22	-.43	.45
	Equal variances not assumed			.05	95.82	.96	.01	.22	-.43	.45
C2	Equal variances assumed	4.29	.04	.71	98	.48	.32	.46	-.58	1.23
	Equal variances not assumed			.75	88.82	.46	.32	.43	-.54	1.19
C3	Equal variances assumed	.83	.37	.72	98	.47	.36	.49	-.62	1.34
	Equal variances not assumed			.74	97.80	.46	.36	.48	-.60	1.31
C4	Equal variances assumed	4.12	.05	.41	98	.68	.14	.33	-.52	.79
	Equal variances not assumed			.417	97.99	.68	.14	.32	-.51	.78

The results presented in Table 3 confirm that there are no statistically significant differences in the means between different task categories when it comes to gender, regardless of equal variances. In other words, the mean values between groups for the observed variable did not significantly differ in this study, confirming sub-hypothesis 2.

Conclusion

Based on the conducted research, it can be inferred that preschool children are capable of developing their mathematical competencies similarly, regardless of their gender or the type of preschool they attend. The key hypothesis concerning the non-existence of statistically significant variations in children's comprehension of numbers was validated. However, Sub-hypothesis 1 regarding variations in counting elements of a set and writing numbers was not entirely confirmed as significant statistical differences were discovered in young children attending diverse preschool institutions. Therefore, these findings imply that preschool educators should concentrate on cultivating early subitising skills and comprehending cardinality concepts to establish a firm mathematical literacy foundation amongst children. Educators and teachers can utilise these findings as a framework to enhance methodologies and approaches to early years mathematics education. This investigation can also form a foundation for future studies to be conducted within diverse educational cohorts and on a wider scope, to generate further insights into the progression of children's numeracy proficiencies. In brief, the investigation into the comprehension of numbers among preschool children is significant for enhancing educational methodologies and facilitating their numerical abilities, crucial for their accomplishment in mathematical education in the future.

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