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EXAMINING NUMBER SENSE SKILLS OF KINDERGARTEN CHILDREN

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Abstract

The aim of this study is to determine the number sense skills of preschool (Kindergarten) children. In the study, survey design, one of the quantitative research methods, was used. The study group consists of a total of 114 children attending all the kindergartens (5 kindergartens) in the city center of Tunceli in the 2020-2021 school year. The data collection tool used in the study is the "Preschool Number Sense Test" developed by the researchers. In the analysis of the data, the correct answers obtained by using number sense skills, the correct answers obtained by using rule and operation-based methods, the false answers obtained by using number sense skills, the false answers obtained by using rule-operation-based methods and the questions left unanswered were considered. As a result of the analysis made, it was determined that preschool students used rule- and operation-based methods more in problem-solving when dealing with questions, and it was seen that they used number-sense-based methods less frequently.

Keywords: Number sense, number sense test, kindergarten children.

INTRODUCTION

The concept of number sense is a topic that has recently started to be studied in our country. There are many different definitions of this concept in the related literature, and it is addressed in different dimensions. While Berch (2005) defines number sense as "the sense of the meanings of numbers", McIntosh, Reys, and Reys (1992) and Reys, Reys, McIntosh, Emanuelsson, Johansson, and Yang (1999) describe number sense as number and operations, comprehension, reasoning when using numbers, using numbers flexibly and developing strategies. According to Howden (1989), it is the process of constructing logical estimates by identifying the many applications for numbers, their significance in activities, the best method for computation, patterns among numbers, and the development of an intuitive framework around numbers.. Therefore, rather than merely knowing a number, the sense of a number may be defined as the capacity to understand all the interactions associated with it, such as few-many, part-whole, the link between the number and the real quantity, and the outcomes of the measurement (Olkun & Toluk Uçar, 2018). Although many definitions are made, the short definition of the concept of number sense in Siegler's study (1991) is also developmentally appropriate for kindergarten mathematics: Number sense includes identifying numbers, performing counting activities, arranging numbers in order, and making decisions about sizes (As cited in McGuire, Kinzie, & Berch, 2012). A person with a sense of number can use numbers flexibly to make numerical expressions more meaningful and understandable, can switch between different representations of given numbers and can also relate numbers, operations and symbols to each other (Markovits & Sowder, 1994).

The importance of this idea in mathematics instruction is demonstrated by the fact that students who possess a sense of number are better able to handle mathematical issues with ease and flexibility

(NCTM, 2000). With the concept of number sense gaining importance in mathematics education, skills such as how to perform mental operations, how to examine mathematical patterns, how to predict the outcome of a problem and how to talk about emerging relationships are tried to be taught to students. (Anghileri, 2006). Therefore, by providing students with flexible thinking skills, students are enabled to produce different solutions without depending on mathematical rules and paper and pencil.

In children, mathematical concept development is experienced in early childhood. However, basic mathematical skills are also acquired in early childhood. Therefore, this period is of great importance for children. Mathematics learning begins with the acquisition of some of the basic concepts by children. In the standards of the National Council of Teachers of Mathematics (NCTM) (2000), it is emphasized that preschool children should become more skilled in recognizing the patterns in their environment and, through their experiences at school, in recognizing patterns in the arrangement of objects, shapes and numbers, and in using patterns to predict the next step in an arrangement (As cited in Smith, 2001). Again, among the basic concepts stated by NCTM (2006) (As cited in the National Association for the Education of Young Children (NAEYC), 2008) as associated with the sense of number, numbers and operations (ordering, combining, comparing, separating), algebraic thinking, patterning, and ordering objects with their measurable properties are considered important. Even though many mathematicians and scientists still disagree about the optimal age to start teaching these concepts (Mix, Huttenlocher & Levine, 2002), it is generally accepted that children learn a great deal about mathematics up until the ages of three and four, at which point they develop a great deal of mathematical knowledge (Baroody, Lai and Mix, 2006; Ginsburg, Cannon, Eisenband and Pappas, 2006; Saracho and Spodek, 2008).

Development of Number Concept and Number Sense in Preschool Children

According to Spelke and Kinzler (2007), infants grasp the notion of "more" eight months after birth, and Charlesworth and Lind (2010) states that children grasp the concept of "one-to-one matching" by the end of the first 24 months. The development of the number concept in children takes place much later than the concept of 'more'. Children start using numbers by the end of the first 24 months. However, at this stage, children are not aware of the meaning of the numbers, and they only imitate what is being said.

By the age of 3, children begin to acquire mathematical skills that can be considered important through games and other activities. Children at this age can classify objects, group them according to color and shape, and solve the problems they face in daily life (NAEYC, 2008). During this period, children can count small numbers sequentially. However, the numerical meaning of numbers is not understood by children in this period. Children's counting at this age is analogous to speaking the letters. According to Charlesworth and Lind (2010), number perception does not develop as a result.

Four-year-olds can say the next number while counting numbers. In this period, it is seen that children still make counting errors. Nonetheless, around this time, children are able to respond to the query "How many?" using their fingers (NAEYC, 2008). Although children can write and say numbers in this period, they are not aware of the quantitative meaning of the numbers (Seo & Ginsburg, 2004). Youngsters between the ages of four and five are aware that counting entails adding one number to the previous one. Children do, however, comprehend that the number they pronounce includes the numbers that come before that number while they are counting (Clements & Sarama, 2006).Five-year-olds can understand the concept of sequentiality. During this period, children can categorize triangles, circles, squares by size. Basic geometric shapes such as triangle, circle and square can be distinguished by children in this period. In addition, the variational and symmetrical differences and similarities regarding these geometric shapes can also be understood by children (Clements & Sarama, 2006). Towards the end of the age of 5, children begin to measure length and area using non-standard units. For example, a child at this age can tell how many steps (up to 5-10 steps) he/she needs to take to reach his/her teacher's desk (Spelke & Kinzler, 2007).

Most 6-year-olds develop the concept of one-to-one matching. However, the concept of quantity is also beginning to be understood in this period. Most children at this age understand how to count and that numbers increase one by one while counting. Although many 6-year-old children develop counting skills starting from their first year, along with combining and separating skills, the ability to count by adding does not reach the same level in 6-year-olds (Smith, 2009).

The intuitive behaviors of children in the preschool period form the basis of mathematical thinking. It is possible to view children's interactions with different things as their initial encounters with perception (Erdoğan & Baran, 2003).. Children with a developed sense of number can compare groups to discover the difference between groups of objects. They can increase or decrease the number of objects in the group, merge or separate groups. In addition, they realize that numbers can represent concrete elements (McIntosh, Reys, & Reys, 1992).

Number sense first develops in infancy through verbal notifications (Dehaene, 2011). Along with the information taught in schools about numbers and quantities, the development of the sense of number is also supported by the informal knowledge that children learn through their experiences in daily life (Tsao, 2004). Children's first experiences with numbers are usually formed by the acquisitions they have achieved through their interactions with objects (Guven, 2009). Piaget states that the concept of number is a matter of logic, and that children cannot learn to count logically without gaining the concept of number and developing logical thinking skills (Sarıca, 2007).

Children have a rudimentary and hidden intuition as early as age one or two, such as identifying and favoring the more. Children are taught to count by their families using their fingers, toys, other little items, and individuals seated at the table. Children ask questions like "Which is more?" and "Is there enough?" on a regular basis (Van de Walle, Karp, Bay Williams, & Wray, 2013). Although by age 3 they cannot count reliably and cannot use number words to express the number of objects in a group, they can consciously arrange objects, understand the interaction between them, and distinguish groups of two or three objects. A 3- or 4-year-old child can compare two small numbers and specify the larger or smaller number when required (Gersten & Chard, 1999). A 4-year-old child can count in the first six months in an orderly sequence, pointing out objects even though the numbers are not consistent. In the second six months, he/she can recite the numbers by heart and correctly indicate the counted objects. Children at this age use collections of objects when comparing numbers (Anghileri, 2006). At the age of 5, the child can compare numbers mentally, express the mental representation of numbers and visuals, count correctly starting from 1, and know that the last number he/she says while counting a group of objects indicates the total number of objects in the group (Gersten & Chard, 1999).

The Concept of Number and Sense of Number in Preschool Education

The early childhood years, between the ages of 0 and 8, are perhaps the most important developmental years in a person's life. In recent years, the importance of this development has been recognized and adopted by teachers, parents and researchers, especially in the field of mathematics. There is a lot of interest and time devoted to teaching numbers in mathematics teaching in early childhood as well as in the first years of primary school. Relevant objectives in the programs also seem to support the conceptual development of children's sense of number. The reason for this is the recognition of number sense as a concept to be developed in early childhood. The most important reasons for targeting the development of number sense in mathematics in early childhood are that it is a prerequisite for teaching other subjects of mathematics, and it has an important place in teaching the concept of digits and operations (combining, separating, piecemeal whole, comparison, peer groups). Insufficient number sense development in early childhood can harm a person's long-term math skills. Interventions in early childhood will prevent the difficulties that will be encountered in later years (McGuire, Kinzie & Berch, 2012). Acquisitions for the concept of number developed in the preschool years are related to the number sense skills as well as the concept of number.

In the current study, the objectives related to mathematics in the Preschool Education Program were examined and the number sense components introduced to the literature by McIntosh, Reys, & Reys,

(1992) and Reys, Reys, McIntosh, Emanuelsson, Johansson, & Yang, (1999) were examined. In this connection, the following components were addressed:

(1) Knowledge and Skills about Numbers; sense of regular existence of numbers, multiple representations of numbers, sense of relative and absolute magnitudes of numbers, one-to-one correspondence principle, regular counting or literal order, one-to-one matching, understanding cardinal value.

(2) Flexible Calculation and Counting Strategies; the ability to count and perform mathematical operations practically. To be able to use fast and practical counting methods by grouping instead of counting one by one or to use fast and practical ways while performing mathematical operations (addition, subtraction, multiplication and division).

3) Understanding the Meaning and Magnitude of Numbers; distinguishing quantities, comparing numerical magnitudes, ordering numbers, distinguishing relationships, developing conceptual understanding of numbers, and reasoning over numbers.

In counting activities, one-to-one matching should be used when comparing two multiplicities. One-to-one matching is the matching of sets of different objects (pens, children, etc.) according to their quantity (Mastropieri & Scruggs, 2016). In minority-to-many comparisons, attention is drawn to the difference between one-to-one matching, "How many more?", "How many missing?". Questions such as "Is it the same?" should be asked and questioned. This situation completes the preparation of the concepts of addition and subtraction, while developing minority-many relations and large-small relations (Tertemiz, 2017).

It is important to create rich learning environments to develop the mathematical competence that occurs through the naturally developing experiences in children so that advanced mathematical skills can be acquired later. In addition, identifying children who are inadequate in terms of mathematics skills and taking necessary precautions will help to eliminate their mathematics deficiencies (Güleç & İvrendi, 2017). Thus, it can be said that the application of various support educations for the development of mathematics skills for children in the preschool period will positively affect not only the school success of the child, but also his/her whole life.

Purpose of the Study

The importance of number sense is frequently emphasized in the literature, and there are studies showing that students' success in mathematics is significantly related to their number sense skills (Çekirdekçi, 2015; Harç, 2010; Mohamed & Johnny, 2010; Yang, Li, & Lin, 2008). However, studies show that students' level of use of number sense is low, and students adhere to rule-based strategies and written processing algorithms rather than using strategies based on number sense (Reys, Reys, McIntosh, Emanuelsson, Johansson, & Yang, 1999; Yang, Li, & Lin, 2008).

Number sense is one of the newly studied subjects in our country, and it is seen that the number of related studies is limited and in addition, most of the studies conducted both in Turkey and abroad have been conducted with students at secondary school level. In the studies mentioned, students' number sense levels and performances (Cheung & Yang, 2018; Cheung & Yang, 2020; Lemonidis & Kaiafa, 2014; Li & Yang, 2010; Öztürk, Durmaz & Can, 2019; Ulusoy, 2020; Yang, 2019; Yang & Li, 2016; Yang, Li & Li, 2008; Yang & Lin, 2015; Yang & Sianturi, 2020), the relationship between number sense and math achievement (Alsawaie, 2012; Bayram & Duatepe Paksu, 2014; Tümer, 2018; Günkaya, 2018; Kyaw & Thein, 2018; Marga, Kusmayadi & Fitriana, 2020), the effects of number sense-based teaching on students' self-efficacy and performance in mathematics (Sevgi & Alpaslan, 2020; Yarar, Es & Gürefe, 2018) and number sense components and their relationship with gender and grade level (Akkaya, 2015; Günkaya, 2018; Singh, Rahman, Ramly, & Hoon, 2019; Yapıcı, 2013; Yenilmez & Yıldız, 2018) have been investigated.

The fact that there is a very limited number of studies on number sense in Turkey and abroad, especially at the preschool level (Aunio, Niemivirta, Hautamaki, Luit, Shi, & Zhang, 2006; Kilimlioğlu, 2018; Pittalis, Pitta-Pantazi, & Christou, 2018) can be seen as a gap in the literature. Seen from this perspective, there is a need for research on the determination of number sense skills of preschool students.

In this regard, the purpose of the current study is to examine the number sense skills of children attending kindergarten. To this end, answers to the following problems and sub-problems are sought.

Problem: "How are the number sense skills of kindergarten children?
Sub Problems
1. What are children's knowledge and skills about numbers?
2. What are their knowledge and skills about flexible calculation and counting strategies?
3. What are their knowledge and skills of understanding the meaning and magnitude of numbers?

METHOD

Research Model

In the current study, it was aimed to determine the number sense skills of preschool students. Thus, survey design, one of the quantitative research methods, was used in the studyThe survey design not only offers the information, abilities, and attitudes of the participants regarding a subject or event being examined, but it also necessitates working with bigger groups than other designs (Fraenkel & Wallen, 2006). In other words, the survey design refers to the collection of data from a large group to reveal the characteristics of the group (Büyüköztürk, Kılıç Çakmak, Akgün, Karadeniz, & Demirel, 2014).

Study Group

This study was carried out in all the kindergartens (5 kindergartens) in the city center of Tunceli. It was planned to include all the students in these kindergartens, but at the time of the study, some of the students could not attend their schools due to the Covid-19 Pandemic, and all the continuing students were tried to be reached. The study was carried out in the 2020-2021 school year and a total of 114 preschool students were included in the study. The participating students were 5-6 years old.

Data Collection Tool

Preschool Number Sense Test: In this study, the "Preschool Number Sense Test" developed by the researchers was used. While developing the number sense test, the test development stages were considered and while the questions were being prepared, the number sense components that were introduced to the literature by McIntosh, Reys & Reys (1992) and Reys, Reys, McIntosh, Emanuelsson, Johansson & Yang (1999) were used. As a result of the analysis made, it was decided to remove 6 questions from the preschool number sense test, the final version of the test consisted of 15 questions. The KR-20 reliability coefficient of the test was found to be 0.858, the mean of the item difficulty index was found to be 0.68, and the mean of the item discrimination index was found to be 0.63.

Data Collection

The number sense test, which was prepared for preschool children, was started to be applied in the designated schools after the necessary permissions were obtained from the Tunceli Provincial Directorate of National Education and the Tunceli Governorship. Before starting the applications in schools, the necessary permissions were given to the school administrators and brief information was given about the purpose of the study and the applications to be made. The number sense test was administered to the students by the researcher under the supervision of the teachers. During the administration, approximately 5 minutes were given for each question, and the administration was completed in 2 class hours. During the study with pre-school students, the questions were read to the students by the teachers, since the students could not read and write, and the answers were written to the number sense test simultaneously by the teachers.

Analysis of Data

While examining the answers given by the students to the number sense test, it was checked whether the questions were answered correctly or not, and then, the explanations made by the students in the explanation sections below the questions were examined. In line with the answers given to the questions and the explanations made, the solution strategies of the students were tried to be determined and coding was made in this direction. The coding table given below was used while coding.

Table 1. Number sense test coding table.

Answer Type	Strategy Type	Coding No.
True	Solution with Number Sense	4
	Rule-Based Solution	3
False	Solution with Number Sense	2
	Rule-Based Solution	1
Questions Left Unanswered		0

According to Table 1, in the solutions of the items in the number sense tests, the correct answer obtained by using number sense skills was coded as 4, and the correct answer obtained by using rule- and operation-based methods was coded as 3. If the answer obtained by using number sense skills was false, it was coded as 2 and if the answer obtained by using rule- and operation-based solutions was false, it was coded as 1. And if the question was left unanswered, it was coded as 0.

RESULTS

In the study, it was attempted to answer the question "How are the number sense skills of the children attending the kindergarten?" The numbers and percentages of the students using number sense-based solutions and rule-based solutions are presented in tables. In addition, the findings are presented in line with the components covered in the study (knowledge and skills about numbers, flexible calculation and counting strategies, understanding the meaning and magnitude of numbers).

Findings Regarding the Component of Knowledge and Skills about Numbers

The findings regarding the component of knowledge and skills about numbers of the children attending the kindergarten are given in two different tables, Table 2 and Table 3, as the number of items in this component is high.

Table 2. Preschool students' knowledge and skills about numbers.

	Questions							
	Q 1		Q 2		Q 3		Q 4	
Strategy Types	N	%	N	%	N	%	N	%
Number Sense Based Solution - Correct Answer	11	9.6	15	13.2	14	12.3	14	12.3
Number Sense Based Solution - False Answer	0	.0	0	.0	0	.0	0	.0
Rule-Based Solution - Correct Answer	52	45.6	53	46.5	51	44.7	59	51.8
Rule-Based Solution - False Answer	51	44.7	42	36.8	44	38.6	29	25.4
Unanswered	0	.0	4	3.5	5	4.4	12	10.5
Total	114	100	114	100	114	100	114	100

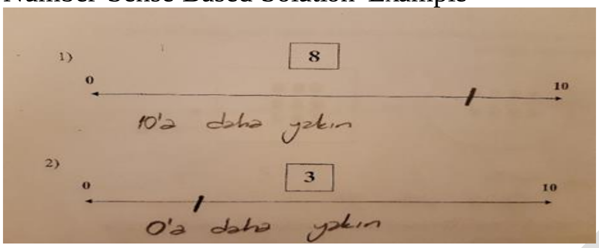
As seen in Table 2, the preschool students' knowledge and skills about numbers can be explained as follows:

While 11 (9.6%) of the students who answered the first question correctly gave answers based on number sense, 52 (45.6%) gave a rule-based answer. While 51 students (44.7%) who gave false answers used a rule-based solution, no students who left the question unanswered were identified. Fifteen

(13.2%) of the students who answered the second question correctly gave answers based on number sense, while 53 (46.5%) gave a rule-based answer. Forty-two students (36.8%) who gave false answers used a rule-based solution, while 4 students (3.5%) left the question unanswered. While 14 (12.3%) of the students who answered the third question correctly gave answers based on number sense, 51 (44.7%) gave a rule-based answer. While 44 students (38.6%) who gave false answers used a rule-based solution, 5 students (4.4%) left the question unanswered. While 14 (12.3%) of the students who answered the fourth question correctly gave answers based on number sense, 59 (51.8%) gave a rule-based answer. While 29 students (25.4%) who gave false answers used a rule-based solution and gave false answers, 12 students (10.5%) left the question unanswered.

Two different student answers to questions 1 and 2 in this component are given below as examples.

Number Sense Based Solution Example



Rule Based Solution Example

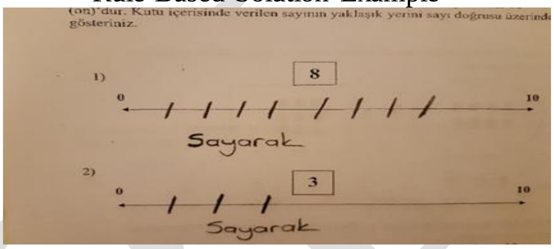


Figure 1. Sample student answers-preschool number sense test question 1 and 2.

Table 3. Preschool students' knowledge and skills about numbers.

	Questions							
	Q12		Q13		Q14		Q15	
Strategy Types	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Number Sense Based Solution - Correct Answer	8	7.1	14	12.3	11	9.6	14	12.3
Number Sense Based Solution - False Answer	0	.0	0	.0	0	.0	0	.0
Rule-Based Solution - Correct Answer	58	50.8	53	46.5	54	47.4	59	51.8
Rule-Based Solution - False Answer	42	36.8	37	32.5	41	35.9	35	30.7
Unanswered	6	5.3	10	8.8	8	7.1	6	5.3
Total	114	100	114	100	114	100	114	100

While 8 (7.1%) of the students who answered the twelfth question correctly gave answers based on number sense, 58 (50.8%) gave a rule-based answer. While 42 students (36.8%) who gave false answers used a rule-based solution, 6 students (5.3%) left the question unanswered. Of the students who answered the thirteenth question correctly, 14 (12.3%) answered based on number sense, while 53 (46.5%) gave a rule-based answer. While 37 students (32.5%) who gave false answers used a rule-based solution, 10 students (8.8%) left the question unanswered. While 11 (9.6%) of the students who answered the fourteenth question correctly gave answers based on number sense, 54 (47.4%) gave a rule-based answer. While 41 students (35.9%) who gave false answers used a rule-based solution, 8 students (7.1%) left the question unanswered. While 14 (12.3%) of the students who answered the fifteenth question correctly gave answers based on number sense, 59 (51.8%) gave a rule-based answer. While 35 students (30.7%) who gave false answers used a rule-based solution, 6 students (5.3%) left the question unanswered. In line with the obtained data, it was determined that preschool students use more rule- and operation-based solutions in solving the questions in this number sense component.

Findings Regarding the Component of Flexible Calculation and Counting Strategies

Findings for the component of flexible calculation and counting strategies are presented in Table 4.

Table 4. Preschool students' skills for the component of flexible calculation and counting strategies.

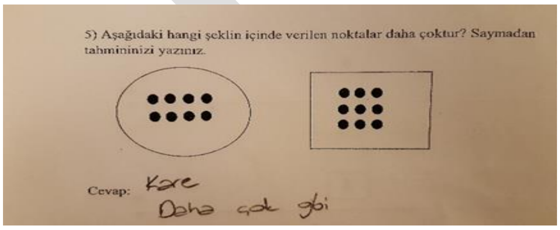
	Questions					
	Q 5		Q 6		Q 7	
Strategy Types	**N**	**%**	**N**	**%**	**N**	**%**
Number Sense Based Solution - Correct Answer	14	12.3	15	13.2	10	8.8
Number Sense Based Solution - False Answer	0	.0	0	.0	0	.0
Rule-Based Solution - Correct Answer	86	75.4	83	72.8	82	71.9
Rule-Based Solution - False Answer	11	9.6	9	7.9	14	12.3
Unanswered	3	2.6	7	6.1	8	7.1
Total	114	100	114	100	148	100

According to the data in Table 4, the preschool students' performance regarding the questions in the component of flexible calculation and counting strategies can be explained as follows:

While 14 (12.3%) of the students who answered the fifth question correctly answered based on number sense, 86 (75.4%) gave a rule-based answer. While 11 students (9.6%) who gave false answers used a rule-based solution, 3 students (2.6%) left the question unanswered. Fifteen (13.2%) of the students who answered the sixth question correctly gave answers based on number sense, while 83 (72.8%) gave a rule-based answer. While 9 students (7.9%) who gave false answers used a rule-based solution, 7 students (6.1%) left the question unanswered. While 10 (8.8%) of the students who answered the seventh question correctly gave answers based on number sense, 82 (71.9%) gave a rule-based answer. While 14 students (12.3%) who gave false answers used a rule-based solution, 8 students (7.1%) left the question unanswered. In line with the obtained data, it was determined that preschool students use more rules and operation-based solutions in solving the questions in this number sense component.

Two different student answers to questions 5 and 6 in this component are given below as examples

Number Sense Based Solution Example



Rule Based Solution Example

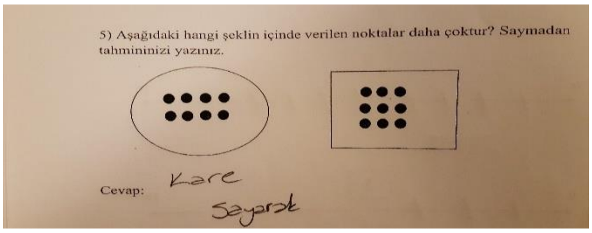


Figure 2. Sample student answers-preschool number sense test question-5.

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Number Sense Based Solution Example | Rule Based Solution Example

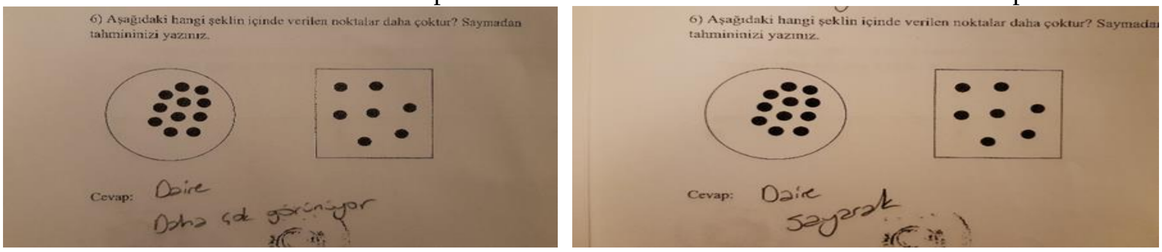

Figure 3. Sample student answers-preschool number sense test question-6.

Findings Regarding the Component of Understanding the Meaning and Magnitute of Numbers

The findings for the component of "Understanding the Meaning and Magnitute of Numbers" are given in Table 5.

Table 5. Preschool Students' Performance for the Component of Understanding the Meaning and Magnitute of Numbers

	Questions							
	Q 8		Q 9		Q 10		Q 11	
Strategy Types	N	%	N	%	N	%	N	%
Number Sense Based Solution - Correct Answer	0	.0	0	.0	0	.0	0	.0
Number Sense Based Solution - False Answer	0	.0	0	.0	0	.0	0	.0
Rule-Based Solution - Correct Answer	75	65.8	73	64.1	78	68.4	83	72.8
Rule-Based Solution - False Answer	36	31.6	38	33.4	32	28.1	28	24.6
Unanswered	3	2.6	3	2.6	4	3.5	3	2.6
Total	114	100	114	100	114	100	114	100

According to the data in Table 5, preschool students' performance regarding the component of understanding the meaning and magnitute of numbers can be explained as follows:

While 75 students (65.8%) who answered the eighth question correctly gave a rule-based answer, 36 students (31.6%) who gave the false answer used a rule-based solution and gave the false answer. Three students (2.6%) left the question unanswered. No solution based on number sense was identified for this question. While 73 students (64.1%) who answered the ninth question correctly gave a rule-based answer, 38 students (33.4%) who gave the false answer used a rule-based solution and gave the false answer. Three students (2.6%) left the question unanswered. No solution based on number sense was identified for this question. While 78 students (68.4%) who answered the tenth question correctly gave a rule-based answer, 32 students (28.1%) who gave the false answer used a rule-based solution. Four students (3.5%) left the question unanswered. No solution based on number sense was identified for this question. While 83 students (72.8%) who answered the eleventh question correctly gave a rule-based answer, 28 students (24.6%) who gave the false answer used a rule-based solution. Three students (2.6%) left the question unanswered. No solution based on number sense was identified for this question.

Two different student answers to questions 8 and 10 in this component are given below as examples:

Rule Based Solution Example (Correct Answer)

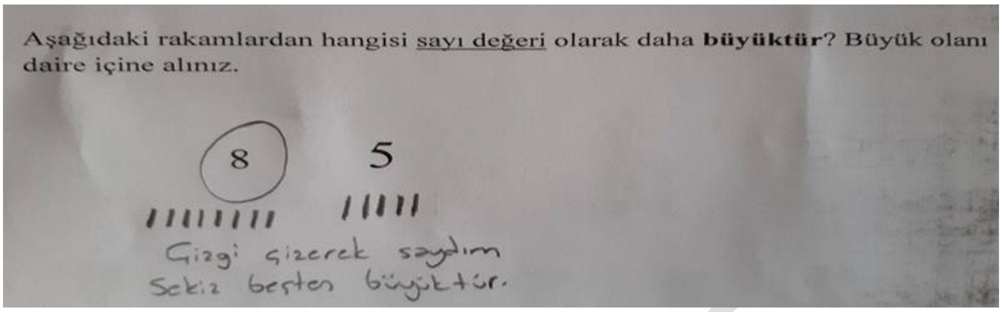

Figure 4. Sample student answer-preschool number sense test question-8.

Rule-Based Solution Example (False Answer)

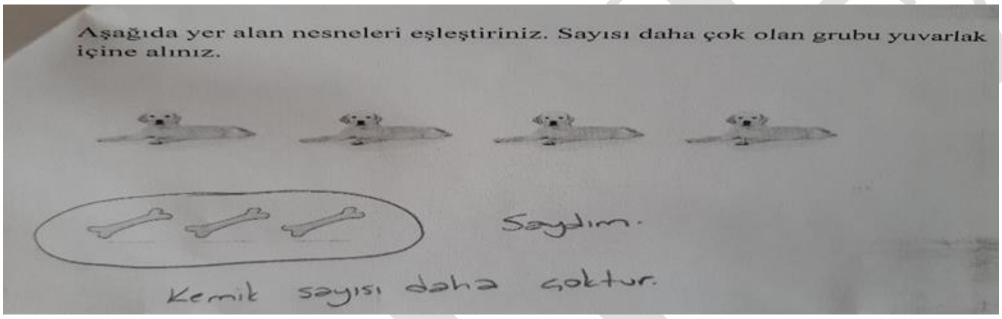

Figure 5. Sample student answer-preschool number sense test question-10.

As seen in figures 4 and 5 above, the student compared the given multiplicities by counting. He preferred to compare by counting instead of using estimation skill. Therefore, we can say that this student preferred rule-based solution instead of number sense.

DISCUSSION, CONCLUSION and SUGGESTIONS

The purpose of this study was to ascertain the preschoolers' level of number sense proficiency. The researcher created the preschool number sense exam with this goal in mind, and it was attempted to ascertain the pupils' current standing in this area. According to the results, preschoolers employ more rules and operation-based answers when completing the number sense component problems. It was observed that they used the number sense-based solution less frequently. The components in which the solution was made by using the number sense strategies most (about one fifth of the children) were determined to be the components of "Flexible calculation and counting strategies" and "Knowledge and skills about numbers". The component in which the solution was obtained by using the rule-based solutions the most (almost all) was determined to be the component "Understanding the meaning and magnitude of numbers", and no solution based on number sense could be determined in the questions in this component. In other words, it was determined that preschool students use rule- and operation-based solutions more in problem-solving questions, and they use number-sense-based solutions less frequently.

Examining research on number sense reveals that pupils do poorly in number sense and rely more on rule- and operation-based strategies; these findings are consistent with the current study's findings at the primary school level (Çekirdekçi, 2015; Cheung & Yang, 2018; Lemonidis & Kaiafa, 2014; Yang, 2019; Yang, Li and Li, 2008) and secondary school level (Akkaya, 2015; Alsawaie, 2012; Bayram & Duatepe Paksu, 2014; Tümer, 2018; Can, 2019; Can, 2017; Facun & Nool, 2012; Harç, 2010; İymen, 2012; İymen & Duatepe Paksu, 2015; Kayhan Altay, 2010; Lin, Yang, & Li, 2016; Markovist & Sowder, 1994; Mohamed & Johnny, 2010; Singh, Rahman, Ramly & Hoon, 2019; Şengül & Gülbağcı, 2012;

Takır, 2016; Yang, 2005; Yang, 2018; Yang & Li, 2008; Yang & Sianturi, 2019; Yang & Sianturi, 2020; Yapıcı, 2013; Yapıcı & Altay, 2017; Yenilmez & Yıldız, 2018). According to the findings of the study by Aunio, Niemivirta, Hautamaki, Luit, Shi & Zhang (2006), there were notable variations found between the kids of different ages (55-99 months) when we looked at the preschool level studies. As the age of students increased, it was observed that there was an increase in number sense, calculation and relational skills. In his study, Kilimlioğlu (2018) determined that there is a positive relationship between interactive and competent play and verbal language achievement and number sense of children aged between 5 and 6, and a negative significant relationship between low-level play alone and verbal language achievements and number sense.

The low number sense performance of the students and the tendency of students to use rule-operation-based methods may be a result of the activities in the Preschool Education Program (MEB, 2018), Mathematics Curriculum and textbooks. The lack of number sense as a program concept, the objectives' tangential relationship to number sense, and the paucity of number sense activities in mathematics activity books could all have an impact on students' number sense performance (Çekirdekçi, 2015). In light of this, it is imperative to investigate whether or not students perform poorly in number sense, whether or not preschool curricula in our nation include objectives pertaining to the concept of number sense, whether or not lessons adequately incorporate activities and objectives related to this subject, and how much the teachers are knowledgeable about number sense.In conclusion, given the low performance of students in number sense, students should be supported to think flexibly, make logical guesses, and develop different solutions and strategies in problem-solving questions. In addition, more detailed data can be obtained with qualitative analyses by conducting interviews over the answers given to the questions to better determine the status of students in number sense. Experimental studies can be conducted to improve children's number sense performance.

Suggestions

Flexible calculation and counting strategies as well as knowledge and skills about numbers are among the skills that need to be developed in kindergarten students. For this reason, suggestions for preschool teachers and those who write books on this subject are that children should have an intuition about how big numbers are. For example, it would be useful to include activities such as How many marbles can a jar hold? The development of estimation skills should not be neglected here. The use of number lines or number strips will be materials that contribute to the understanding of the location of the number (For example, where is 7 closer between 0-10? etc.) Likewise, studies based on visual skills, such as number pairs that make up a number, should be emphasized towards abstract thinking. From another point of view, the conservation of objects/quantities is also of great importance in the development of number sense. Emphasis can be placed on the idea that the result does not change even if the location of the objects changes. For example, how many ways can five cars be parked on a certain line in a part-whole relationship (3+2, 4+1, etc.) will improve children's ability to use numbers flexibly.

As for suggestions for the researchers, considering that number sense develops from infancy, this study was conducted with a limited number of students. It is also important to investigate why students tried rule-based solutions more often.

Ethics and Conflicts of Interest Approval

This study is produced from the first author's doctoral thesis completed under the supervision of the second author. The study has undergone appropriate ethics protocol. The author(s) acted in accordance with the ethical rules in all the parts of the study such as data collection and there is no conflict of interest between the authors. This study was ethically approved by the Gazi University Ethics Commission's decision dated 07 April 2020 and numbered 91610558-302.08.01. Informed consent was obtained from the participants. No funding was received for the conduct of this study.

The ethical approval for this research was obtained from the Ethics Committee of the Gazi University Rectorate on 07.04.2020 with the decision number 91610558-302.08.01. The authors of the study acted in accordance with ethical rules in all processes of the research. There are no individuals or financial relationships that could be perceived as potential conflicts of interest related to this study

Contribution Rate of Authors

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