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Pre-school Teacher Candidates' Use of Mathematical Concepts in Daily Life

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Abstract

In this study, pre-school teacher candidates' use of mathematical concepts that are frequently used in daily conversations was examined. To achieve this, a sequential explanatory pattern, one of the mixed method designs, was used. The research was carried out with two study groups. The first study group consisted of 114 pre-school teacher candidates while the second study group consisted of eight teacher candidates who were selected by considering their success level among these teacher candidates. The purpose of determining the second study group was to focus on classroom activities within the scope of teaching practice. The teacher candidates were asked two questions related to comparison, classification, ordering and matching, which are among the mathematical concepts that are frequently used in daily conversations. Descriptive analysis techniques were used in the analysis of the research data. As a result of the research, the success of the teacher candidates in using the concepts indicating quality, quantity, position and contrast in mathematics was found very low. In addition, it was observed that teacher candidates mostly exhibited erroneous usage regarding the use of words "more" and "most".

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INTRODUCTION

Previous studies stated that mathematics learning activities begin in informal education and are shaped in the formal education process (Bailey et al., 2014; Fırat, 2016; Gürgah Oğul & Aktaş Arnas, 2020; Karakuş, 2015; Starkey et al., 2004; Taşkın, 2013). Supporting this statement, it is commonly acknowledged that students learn some of the mathematical concepts (e.g., counting, comparison, sequencing) through family experiences or environmental factors before they start schooling (Aslan & Aktaş Arnas, 2015; LeFevre et al., 2010). In addition, the preschool period is considered as an opportunity to establish the foundations of mathematics education, as it is the period in which students' mental development shows the fastest growth (Günindi, 2010). In this context, it is necessary for preschool teachers to approve the concepts that students use correctly, to fill in the missing concepts if there are deficiencies in the students, and to correct the misuse if there is a misuse in the students. For this reason, it is important to determine the use of these mathematical concepts by pre-school teacher candidates before carrying out the teaching profession.

THEORETICAL FRAMEWORK

MATHEMATICAL TALKS IN PRESCHOOL EDUCATION

It is an undeniable fact that the mathematical thinking skills that teachers can develop in students during the early childhood years can help students the later formal mathematics learning process (National Council of Teachers of Mathematics [NCTM], 2000; Peter-Koop & Scherer, 2012; Umay, 2003). It is also known that an important part of the behaviors that will be gained by students in pre-school education consists of the ability to express the positions of the objects and assets in the environment and to express the qualities and quantities according to their external appearance (Kazu, & Is, 2018; LeFevre et al., 2010). The basic skills to be acquired in the pre-school education period include matching, classification, comparison, and sequencing skills. For example, children should be able to distinguish the words "less", "more" and "same" before the schooling period starts. When children understand the concept of "same", they can make one-to-one matching. Because matching is seen as a prerequisite skill in the acquisition of number conservation (Sperry Smith, 2006). Classification is the separation of objects according to their attributes and then grouping them together according to their common characteristics. It is a basic method that children use to organize objects and events (Lind, 2005; Reys et al., 2014). In the social environment they live in, students hear the words to compare objects according to their specific characteristics (length-shortness, greatness-smallness, weight-lightness, near-far, high-low, first-last) more or less. When children's observation skills develop, they can naturally distinguish differences, contrasts and similarities from each other, and the process of children's comparison begins with their observation skills (Bağcı & İvrendi, 2016). Teachers should ensure that children use these words by using terms such as "few, less, much, more" both formally and informally in their classroom activities (Boonen et al., 2011). In addition, comparison activities can be conducted by using contrasting expressions (hot-cold, big-small, long-short, etc.) (Aktaş Arnas, 2013). Sorting can also be carried out when one object has a distinctive feature (large-small, long-short, more-less, light-heavy) compared to another. Therefore, the concepts used for sequencing must be intelligible and understandable by children. Furthermore, the differences regarding the listed features should be clearly revealed (Dinçer & Ergül, 2015). The word “more” (less, better, longer, shorter, heavier, lighter, etc.) is used in ordering/comparing objects (Aktaş Arnas, 2013; Charlesworth, 2015). While the word “most” is used in ordering four objects, ordinal numbers are used as “first, second …” in ordering more than four objects (Korkmaz, 2003). Using mathematical expressions in gaining these skills can be considered as the first step of starting mathematics education.

TEACHER TRAINING IN PRE-SCHOOL EDUCATION

Teachers who will carry out the teaching process of mathematics need sufficient information about content knowledge, pedagogical knowledge, that is, the way of teaching knowledge, and the

cognitive development of students during the planning and implementation stages of instruction (Ball et al., 2008; Coddington, 2014; Even, 1993; Shulman, 1987; Yazıcı & Albayrak, 2022). In studies conducted with preschool teachers, it has been observed that teachers have deficiencies about the basic competencies and concepts that preschool mathematics education should incorporate (Aydın, 2009; Chen et al., 2014; Çelik, 2017; Fırat & Dinçer, 2018; Giren & Erdoğan, 2015; Lee & Ginsburg, 2007; Umay, 2003). In the study conducted by Fırat and Dinçer (2018) with preschool teachers, it was determined that teachers did employ a small amount of mathematical conversations in the classroom teaching process. In addition, they also found that teachers generally made speeches in the categories of counting, number, and measurement. It is considered that the speaking performance of the teachers regarding the mathematical language during the teaching process is effective in the development of mathematical concepts in children (Boonen et al., 2011; Erdoğan & Baran, 2003). Therefore, it is obvious that teachers' lack of pedagogical content knowledge about teaching mathematical concepts, as well as deficiencies in the content of basic competencies and concepts, might potentially cause difficulties in the teaching process (Aydın, 2009; Lee & Ginsburg, 2007; Tarım & Bulut, 2006).

PURPOSE OF THE RESEARCH

It is thought that the speaking performance of the teachers regarding the mathematical language during the teaching process is effective in the development of mathematical concepts in children (Boonen, et al., 2011). For the child to understand the mathematics that he will use in his future life, basic mathematical knowledge and skills must be acquired in the preschool period (Akman, 2002; Balfanz et al., 2003; Charlesworth, 2005; Greenes et al., 2004; Hachey, 2013; Jackman, 2005). School is the second most important environment apart from the home environment affecting the development of children. It is thought that the use of the language of mathematics by teachers at school and their inclusion of mathematical activities throughout the day and within the framework of the program will help children's mathematical development. In this regard, pre-school teacher candidates should have acquired the competencies related to the skills that should be acquired in the pre-school period in the undergraduate education before starting the profession. Within this context, the purpose of this research is to evaluate the instructional explanations of pre-school teacher candidates about the mathematical skills that should be acquired in preschool. In line with the purpose of the research, the research problem and research questions were determined as follows:

Problem: How do pre-school teacher candidates use mathematical concepts in the teaching process?

Research questions:

1) How do pre-school teacher candidates use concepts of short-long, large-small?

2) How do pre-school teacher candidates use concepts of heavy-light, less-more?

3) How do pre-school teacher candidates use concepts of location (place)?

4) How do pre-school teacher candidates use ordinal numbers?

METHOD

RESEARCH MODEL

This research was conducted with a sequential explanatory design, one of the mixed method designs. In this design, qualitative data is collected after quantitative data is collected and analyzed. Qualitative data are obtained to refine and augment quantitative data (Creswell &Plano Clark, 2017). Data analysis is interrelated. Therefore, quantitative, and qualitative data are combined in the findings and discussion sections of the research (Creswell, 2013). In the study, firstly, pre-school teacher candidates' use of mathematical concepts in daily life was categorized as true-false-no answer on a

larger sample. Afterwards, in-depth observations and interviews were made, and the approaches of the pre-school teacher candidates were evaluated. Within the scope of the research, observations and interviews were conducted in order to observe the pre-school teacher candidates' use of mathematical concepts in their daily conversations and to determine their level of knowledge about the concepts they will teach in mathematics education activities.

STUDY GROUP

The research was carried out with two study groups. The first study group of the research consists of 114 pre-school teacher candidates studying in the last year of the undergraduate education program of a university in the Eastern Anatolia Region of Turkey in the 2020-2021 academic year. Table 1 shows the distribution of pre-school teacher candidates participating in the research by gender. When Table 1 is examined, 58% of the participants are female (f=66) and 42% are male (f=48). Therefore, it can be said that the distributions by gender are close to each other. In addition, pre-school teacher candidates participating in the research are studying in the third and fourth years of undergraduate education and have completed the "Early childhood mathematics education" course.

Table 1. Distribution of pre-school teacher candidates by gender

	f	*%*
Male	48	42
Female	66	58
Total	114	100

The second study group consists of eight teacher candidates determined according to their success level among 114 teacher candidates. In the determination of these eight teacher candidates, undergraduate grade point average was used as a criterion. The purpose of determining this second study group is to focus on classroom activities within the scope of teaching practice. Table 2 shows the undergraduate grade point average of all teacher candidates participating in the research.

Table 2. *The Undergraduate Grade Point Average of Pre-School Teacher Candidates*

	f	*%*
I have a very good average. (Between 4.50 and 5.00 average score)	8	7
I have a good average. (Between 3.50 and 4.50 average score)	24	21.10
I have a medium average. (Between 2.50 and 3.50 average score)	82	71.90
I have a low average. (2.50 and below average score)	0	0
Total	114	100

Table 2 contains data on undergraduate grade point average of preschool teacher candidates. These data were determined by taking the average of pre-school teacher candidates' report card scores related to academic record. In Table 1, it is seen that the grade point averages of the pre-school teacher candidates are 3.50 points and above. In the research, instead of using the names of the pre-school teacher candidates, codes such as TC1 (Teacher Candidate 1), TC2, …, TC114 were used to anonymize the participants. In addition, TCV1, ..., TCV8 coding was used for eight teacher candidates whose in-class activities were observed within the scope of teaching practice. For this, teacher candidates from all levels were selected according to their grade point average. Namely, TCV1, TCV2 and TCV3 have a very good average, TCV4 and TCV5 have a medium average, TCV6, TCV7 and TCV8 have a good average.

DATA COLLECTION TOOLS AND PROCEDURE

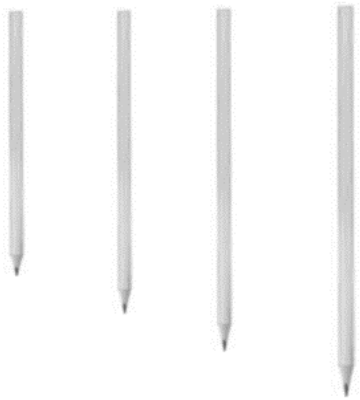
In order to collect research data, semi-structured interview form, observation form, voice recorder and structured interview form were used. A semi-structured interview form consisting of 11 open-ended questions and allowing partial exchange of views between the participants and the researchers was prepared. The first three questions in the interview form were for collecting

information about the candidate. The other eight questions were about the "position, quality, quantity, and ordering" of objects, in relation to the "comparison, classification, ordering, and matching" often used in everyday conversation. Two questions were asked for each situation. One of the questions in the semi-structured interview form is included as an example.

Figure 1. The Comparison Question in the Semi-structured Interview Form

1. The picture below shows four pencils of different lengths. Let's say you sort these pencils by length (from shortest to tallest). How do you do your ranking?

……



During the preparation of the semi-structured interview form, the basic principles and aims of pre-school education and speaking Turkish properly were determined as the basic criteria. At this stage, a total of two expert opinions from childhood development and Turkish Language and Literature areas, were applied. In line with the expert opinions, use of adjectives and a particular Turkish grammar rule were paid attention to in the formation of the questions in the interview form. In other words, based on expert opinions, the concept of "adjective" was thought to be important within the scope of this research. For this reason, the following features regarding the concept of "adjective", which is taken as a basis within the scope of the research, are included: The words that come before the nouns and describe them show their manner or indicate other aspects (quantity, place, etc.) are called adjectives (Turkish Language Society [TLS], 2020). The degree of superiority of the adjectives (indicating that the quality of one being is more, superior, less, or lower than another being or assets) is made by using the word "more". The degree of superiority (indicating the highest level of the attribute in terms of function) is also made with the word “most”. Ordinal number adjectives (adjectives that show the number of degrees in entities and objects) were used as “first, second, …” (Korkmaz, 2003).

The content of the lesson observation form was arranged to focus on daily conversations during the implementation of the activities. The course observation form included three levels as insufficient, partially sufficient, and sufficient. In determining the levels, it was taken as a criterion that the pre-school teacher candidates included daily mathematical conversations in language integrity during the activities. The activities to be used within the scope of teaching practice were identified by the researchers in a way that would serve the same purpose as the questions did in the interview form. In addition, the activities were selected from the Education Information Network [EIN] (2022) preschool activity pool in accordance with the purpose of the research. Each activity was implemented by two teacher candidates. By doing so, four activities in total were implemented by eight teacher candidates.

In the research, structured interviews were conducted with five teacher candidates selected on a voluntary basis among 114 teacher candidates. During the interview, the participants were asked, “Do you think the questions in the semi-structured interview form have anything to do with the mathematics course?” A single question was asked orally, and verbal responses were received from

the participants. There was no time limit for responses. The responses were recorded and transcribed by the researchers.

DATA ANALYSIS

Research data were analyzed in the context of sequential explanatory design. In other words, firstly, quantitative data was analyzed, and then qualitative data was analyzed. All the analyzed data were then interpreted together. In the research, firstly, the data obtained from the teacher candidates (n=114) were analyzed within the scope of the semi-structured interview form. Then, the data obtained from eight pre-school teacher candidates whose activities in the teaching practice process were followed with the lesson observation form (LOF) and voice recordings were analyzed. Regarding the recordings, the first audio recordings were transcribed. At this stage, the researchers particularly focused on the parts of daily conversations. While analyzing the audio recordings, it was checked by continuous comparison with the LOF. Descriptive analysis technique was used in the analysis of the data of the research. For this purpose, the questions in the semi-structured interview form were analyzed in three categories as true answer-wrong answer-no answer. The data obtained as a result of the analysis are presented using percentage-frequency tables. The questions asked to the participants in the interview form and the correct answers to the questions were added to each table in the presentation of the findings in a short and concise manner in order to inform the reader. Immediately after giving the quantitative data in tables, five of the wrong answers of the participants related to each research problem are included. Afterwards, some sections of the activities of the pre-school teacher candidates whose in-class activities were followed were included. In this way, it is aimed to support quantitative data with qualitative data. Table 3 shows a sample analysis table regarding the data analysis process. Although the third stage of data analysis was theoretically expressed in Table 3, it was not included in the table in detail in order to avoid repetition in the presentation of the findings.

Table 3. Stages of the Data Analysis Process

Theme of the research	*Codes (sub-problems of the research)*	*Analysis Categories*	*Data Analysis Process*
Use mathematical concepts in the teaching process	Qualitative concepts Quantitative concepts Concepts of location Ordinal numbers	True answer Wrong answer No answer	In the first stage, the explanations (codes) written by the pre-service teachers to the questions in the semi-structured interview form for each determined code were analyzed under the categories determined by percentage-frequency techniques. In the second stage, the data regarding the teaching processes of these pre-service teachers were transcribed in order to compare the data obtained from the pre-service teachers whose in-class teaching activities were followed with the semi-structured interview form data. In the third stage, quantitative and qualitative data were interpreted together by giving quotations.
A data analysis sample			
Question 1 - Qualitative concepts First stage: "…Let say you sort these pencils by length (from shortest to tallest). How do you do your ranking?" *Short-tall-taller-the tallest (True answer)* *The shortest - short - tall - very tall (Wrong answer)* *Very short - short - tall - very tall (Wrong answer)* *Second stage:* *…TCV4: Yes, when we put this sock next to the other socks, we sort from the shortest socks to the longer ones. Now let's say the length of the socks again: (showing the socks)* *Short socks - long socks - longest socks (Wrong answer)*			

In order to increase the reliability of the research data, triangulation was made. Triangulation is the comparison of the results of two or more data collection methods (for example, interviews and observations) or two or more data sources. In this way, the weaknesses of one of the methods can be compensated by the strengths of the other method (Creswell, 2013). In this study, triangulation was made using semi-structured interview, lesson observation form and direct quotations to ensure reliability. Therefore, various data were compared with each other. Thus, the reliability was tried to be increased.

ETHICS

Based on the Bayburt University Ethics Committee's letter numbered 79126184-050.099/23654, this research was decided to comply with the ethical principles. It was earlier stated that the research would be carried out on a voluntary basis and that personal information would not be shared by third parties or institutions in any way other than the purpose of the research. No visuals were included during the implementation of classroom activities. In addition, attention was paid to the rules of scientific writing and citing references in the research.

FINDINGS

In this section, the findings obtained in line with the research questions are written in order. First, the findings of the interview form and then the findings of the teaching practice and lesson observation form were included. In Table 4, the answers written by the candidates to the two questions on short-long, large-small concepts are demonstrated.

Table 4. *Use of Concepts (*short-long, large-small)

To be able to sort the four pencils in order of height (short, tall, taller, the tallest or short-long-longer-the longest)		
	f	*%*
True	34	29.80
False	72	63.20
No answer	8	7
Total	114	100
To be able to rank the four animals "elephant, lamb, rabbit, bird" from largest to smallest (large, small, smaller, smallest)		
	f	*%*
True	37	32.50
False	69	60.50
No answer	8	7
Total	114	100

When Table 4 is examined, more than half of the candidates provided wrong answers for both questions. Some of the wrong answers of the teacher candidates are given below:

TC1: Short - tall - too tall - the tallest.

TC17: The shortest - short - tall - very tall.

TC 21: Very short - short - tall - very tall.

TC 35: Very large - slightly large - large - small.

TC 50: Very small - small - large - largest.

When the wrong answers of the teacher candidates were examined, it was seen that the teacher candidates did not know at what level the words "more" and "most" would be used while ranking. In addition, it has been observed that they use the word "many" instead of these words. However, teacher candidates experience deficiencies in grading levels while ranking. For example, while TC17

was ranking, she/he rated the word short twice and the word long twice consecutively. If the sorting was started from the shortest item, it was not sorted as short-long-longer-longest. The ranking continued as shortest-short-long-very long.

It was observed that TCV1 and TCV4, whose activities within the scope of teaching practice were recorded and followed up with LOF, included the use of qualifying concepts at a partially sufficient level. Below is a section of the activity carried out by TCV4, one of the teacher candidates, in the classroom:

Activity Name: I'm Learning with Socks (EIN, 2022)

The socks requested on the previous day are opened in the classroom and the socks are talked about. Then, the students are asked to divide into groups of two. At this stage, the game of putting on the socks and then removing the socks is played, accompanied by music. After the game, the socks are lined up side by side to talk about their length:

TCV4: Come on guys, what can we say about the lengths of these two socks that we put side by side?

Students: This is small … This is long … very big …

TCV4: Okay. Let's rank them together by length. Let's start with the short one first. This sock is the shortest. Let's put this first. Yes. Since that sock (pointing to the sock) is a little longer, we put it right next to it. Are there any socks that are longer than these socks? Let's look at him. Who tells?

…

TCV4: Yes, when we put this sock next to the other socks, we sort from the shortest socks to the longer ones. Now let's say the length of the socks again: (showing the socks)

Short socks - long socks - longest socks.

When TCV4's expressions in the activity were examined, he used the word "the most" incorrectly as a rating expression even though he had two socks in his hands during the first stage of the activity. In addition, it was observed that he used the word "the most" when he should have used the word "the more" while listing the three socks at the end of the activity. Similar errors were also encountered in TCV1.

In Table 5, the answers written by the teacher candidates to the two questions on heavy-light, less-more concepts are demonstrated.

Table 5. *Use of Concepts (*heavy-light, less-more)

To be able to sort the four objects (row, bag, notebook, pen) from heavy to light (heavy, light, lighter, lightest).		
	f	*%*
True	38	33,30
False	70	61,40
No answer	6	5,30
Total	114	100

To be able to sort four marble groups of different numbers from least to most (less, more, better, most).		
	f	*%*
True	34	29,80
False	77	67,60
No answer	3	2,60
Total	114	100

When Table 5 is examined, more than half of the teacher candidates gave wrong answers for both questions. When the wrong answers of the teacher candidates were examined, similar to the results in the previous Table 3, the teacher candidates made mistakes regarding the use of the words "more" and "most". Therefore, teacher candidates experienced deficiencies in using the level grading adjectives. Some of the wrong answers of the teacher candidates are given below:

TC31: Heavy – light – lighter – very light.

TC42: Lightest – very light – lighter – light.

TC57: Heaviest – heavy – light – lightest.

TC81: At least – less – much – most.

TC93: At least – much less – more less – less.

It was observed that TCV2 and TCV3, whose activities within the scope of teaching practice were recorded and followed up with LOF, included the use of quantitative concepts at a partially sufficient level. Below is a section of the activity carried out by TCV3, one of the teacher candidates, in the classroom:

Activity Name: My Colored Stones (EIN, 2022)

Four stones of different sizes, collected from the garden with the children, are brought together in the middle of the classroom. The children are asked to examine the collected stones. Ask the children to weigh the stones with their hands and estimate their weight. After giving the estimates, it is stated that which stones are heavy and which ones are light, and that they can be found with the help of a balance.

TCV3: Come on guys, let's look at these two stones (showing the stones) together. Ali, you tell me. First, put these two stones in your right and left hand. Now can you tell which of these stones is the heaviest?

Student (Ali): … (pointing to the stone) this is the heaviest stone.

TCV3: Yes, let's compare other stones now. So which of these two stones (pointing to the stones) could be heavier or lighter? Who wants to guess?

Students: … (pointing to the stone) this stone is lighter. this is the very heavy one.

At this stage, ÖV3 chooses the heavier ones from the two groups of stones they are comparing and again asks the students to find the heavier one among these stones. After comparing the remaining stones, a general comparison is made by ranking the stones from the heaviest to the lightest.

TCV3: You can see the stones in my hand right now. Who wants to determine which of these stones is the heaviest?

Students: He/she takes the stones. Then showing the stones: This stone is the heavy one.

TCV3: Yes, that's right. Now we have determined the heaviest stone. So who wants to find out which of the two remaining stones is heavier?

Student: …(pointing to the stone) this is the heavy one…

TCV3: Yes, now let's compare the stones in order from the heaviest to the lightest. … (pointing to the stone) this heavy stone, this light stone, this lighter stone, this very light stone…

When the activity of TCV3 was examined, he/she compared two stones at the beginning of the activity by using the word "the most". In other words, he/she was expected to make only a heavy-light comparison at this stage. However, at the end of the activity, when comparing the four stones with each other, he/she misused the word "many" instead of using the word "the most".

In Table 6, the answers written by the teacher candidates to the two questions on locative concepts are expressed.

Table 6. *Use Of Locative Concepts*

To be able to arrange the objects in the picture (row, teacher's desk, blackboard, flag) from high to low as "the flag is highest, the blackboard is low, the teacher's desk is lower, the desk is the lowest".

	f	*%*
True	32	28
False	74	65
No answer	8	7
Total	114	100

In the picture, the students to the right of the teacher (Erkul, Onur, Sema, Vildan, respectively) and to the left (Ayse, Ali, Ömer, Zehra, respectively) are "Erkul on the teacher's right, Ayşe on the teacher's left, Vildan on the teacher's far right, Zehra on the teacher's far left" sorting as.

	f	*%*
True	52	45,6
False	58	50,9
No answer	4	3,5
Total	114	100

When Table 6 is examined, the answers written by the teacher candidates to the two questions on locative concepts are expressed. As can be seen from the data, the success of the teacher candidates in these questions was very low. However, a significant increase was observed in the success of teacher candidates in positioning right-left ($f_{number\ of\ correct\ answers}$=52) compared to other tables. Some of the wrong answers of the teacher candidates are given below:

TC18: The flag is too high - under the blackboard - the teacher's desk is low - the desk is too low.

TC28: The flag is high - the blackboard is low - the teacher's desk is even lower - the desk is very, very low.

TC39: The flag is too high - the blackboard is low - the teacher's desk is too low - the desk is much lower.

TC78: There is Erkul to the right of the teacher, Onur and Sema to the far right, and Vildan to the right of the teacher. We can sort the left in the same way.

TC102: There is Erkul on the right side of the teacher and Ayşe on the left. There are other students to the right and left of the teacher.

When the wrong answers of the teacher candidates were examined, it was observed that they made more mistakes in the use of the concepts describing the position as low-high than the concepts describing the position as right-left.

It was observed that TCV5 and TCV8, whose activities within the scope of teaching practice were recorded and followed up with LOF, included the use of quantitative concepts at a partially sufficient level. Below is a section of the activity carried out by TCV5, one of the teacher candidates, in the classroom:

Activity Name: Hang out the laundry (EIN, 2022)

Clotheslines are tied in the classroom, one high and the other low. Children are told to hang the laundry in the basket on these ropes. With the instructions given, children try to hang the laundry by first attaching them to the low rope and then to the high rope with pegs. The children are asked on

which rope they hang the laundry more easily, on which rope they have difficulty hanging the laundry, and the reasons are discussed. Then, the dialogue continues in the classroom about which objects are high and which objects are low.

TCV5: Come on guys, let's find three items that are higher than the teacher's desk and tell them their names?

Students: Blackboard, projection, portrait…

TCV5: Well, which of these items is located very high?

Students: Projection.

TCV5: Then which one is the highest?

Students: Portrait…

TCV5: Then which one is the lowest compared to the others?

Students: The board…

TCV5: Now, let's list them from highest to lowest.

The projector is at the highest. The portrait is lower than the projection. The board is even lower. The table is the lowest.

When the effectiveness of TCV5 is examined, it is observed that there are deficiencies due to the misuse of the words "more" and "most" in the sentence. To put it more clearly, TV4 used the word "many" instead of "more" when ranking opposite concepts. In addition, it was observed that he/she could not use the grading adjectives correctly. That is, he/she made a wrong order as highest-low-even lower-lowest. Similar errors were also encountered with the responses of TCV8. In Table 7, the answers written by the teacher candidates to the two questions about ordinal numbers are shown.

Table 7. *Use of Ordinal Number*

The order of paying the cashier in a market is (Ahmet, Betül, Fatma, Ali, Osman). Sorting the status of customers according to the cash register as first, …, last.		
	f	*%*
True	32	28
False	79	69,3
No answer	3	2,7
Total	114	100
To be able to list the animals (Elephant, Cow, Lamb, Rooster, Bird) expressed with pictures, from light to heavy "1st Bird, 2nd Rooster, 3rd Lamb, 4th Cow, 5th Elephant".		
	f	*%*
True	14	12,3
False	77	67,6
No answer	23	20,1
Total	114	100

When Table 7 is examined, the success of the teacher candidates in these questions was lower than the data in the other tables. Some of the wrong answers of the teacher candidates are given below:

TC51: Ahmet is in the front, Betul is in the back, Fatma is behind her, Ali and Osman are at the very back.

TC72: Ahmet ranks first, Betul second, Fatma third, Ali fourth, Osman last.

TC98: The heaviest elephant, then the cow, then the lamb, then the rooster and the lightest bird.

TC102: The bird is the lightest. The rooster is heavier than the bird. The lamb is heavier than the rooster. A cow is heavier than a lamb. The elephant is the heaviest of them all.

TC114: If we were to sort, I would sort by bird, rooster... up to the elephant.

When the incorrect answers of the teacher candidates regarding the use of antonym concepts are generally interpreted, it is observed that the teacher candidates' mistakes regarding the ordering increase as the grade/level increases. That is, it was determined that the teacher candidates used the words "later, afterwards" and "after" instead of making the order as first, second...

It was observed that TCV6 and TCV7, whose activities within the scope of teaching practice were recorded and followed up with LOF, included the use of quantitative concepts at a partially sufficient level. Below is a section of the activity carried out by TCV6, one of the teacher candidates, in the classroom:

Activity Name: Mind and Intelligence Games (EIN, 2022)

*Five cards of red, blue, green, yellow and white are placed on a flat surface. How many cards of each color are found with the students? The table consisting of 25 (5*5) boxes is placed on the table. Boxes are counted with children. From left to right, from top to bottom, the first, second, third and fourth boxes are studied. Sudoku game is reminded with colors previously played with four colors. In this activity, it is aimed to use ordinal numbers such as first, second, third, while ordering objects.*

TCV7: Come on guys. Let's count together how many of each of the red, blue, green, yellow, and white cards I have in my hand?

Students: Count the cards and state the results. (There are five cards each.)

TCV7: Yes, we will now place these cards on the table. And together we will find the rank of the cards. Cards are placed on the table. And the students are asked in which rank the red card occupies on the table.

Students: Second from left to right. When we list it from top to bottom, it is in the last place…

TCV7: Yes, that's right guys. Likewise, can you tell me where the yellow card is?

Students: Ranks first when we list them from top to bottom. Fourth from left to right…

TCV7: Yes, that's right. Now let's look at the other cards. (Similarly, the places of the other cards are determined by the students.)

After this stage, the teacher reaches all sorting situations together with the students. Then, by placing the cards side by side on the table in different colors, he deals with the cards and the order together.

TCV7: Come on guys, now let's list the places of the cards together.

Red card in first place, yellow card in second place, green card in third place, blue card in fourth place and white card in last place...

When the in-class activity of TCV7 was examined, it was observed that instead of using the ordinal numbers as "first, second, third, fourth, fifth", he/she used "initial, second, third, fourth, last". While TCV7 was expected to sort by using ordinal numbers according to the number of objects, he/she displayed incorrect usage by using the words "first" and "last". Similar errors were also observed with the answers of TCV6.

In the research, the data obtained in the interview with five teacher candidates are presented as follows:

TC10: I don't know how the concepts are classified.

TC25: These are things that happen in our daily life. The conversations we have without paying attention. I don't know their relationship with mathematics.

TC40: If the lengths of the pencils are considered as length, a relationship can be established with the length measurements. The weight of the items (table, bag, notebook, pen) can also be related to the weight measure. The presence of more or less balls may also be related to counting. I have no idea about the other questions.

TC77: If we are interested in these in the mathematics education activities, it means that they have something to do with mathematics, but I do not know.

TC95: I understood that my mathematical knowledge was superficial, that is, what I learned was learning by rote. I started to think that I would have a lot of difficulty in teaching these concepts.

When the statements of the teacher candidates were analyzed from a general perspective, the teacher candidates stated that they actually used these concepts incorrectly in daily life and that they could not adequately understand the relevance of classification with mathematics.

DISCUSSION, CONCLUSION AND IMPLICATIONS

In this research, the data obtained from the teacher candidates who were interviewed and whose teaching practice and classroom activities were followed up showed parallelism with each other. When the research findings are examined in general, it was seen that the teacher candidates had enough mathematical knowledge to teach the subjects in the pre-school mathematics curriculum; however, they did have conceptual deficiencies in this knowledge. It can be thought that the reason why the teacher candidates cannot make instructional explanations and re-adapt a situation is that they do not know the relationship between concepts and mathematics. However, it was observed that teacher candidates could not make instructional explanations due to their inadequacy in using concepts and adapting them to different situations. Especially, the success of the teacher candidates in using the concepts indicating quality, quantity, position and contrast in mathematics was found very low. In addition, it was observed that teacher candidates mostly exhibited erroneous usage regarding the use of words "more" and "most". These results are equivalent to the results of previous research in this field (Chen et al., 2014; Çelik, 2017; Kim, 2013; Tarım & Bulut, 2006; Umay, 2003).

The research findings also showed evidence on that the teacher candidates have deficiencies in the use of the concepts of "most" and "more", which are frequently used in the use of concepts that indicate quantity, location and antonym situations. This finding is particularly striking in the use of concepts such as "longer, longest" or "smaller, smallest", and in cases related to the place of "more" and "most" in the ranking. In other words, it was observed that the teacher candidates were deficient in the ranking of the concepts of "more" and "most". In addition, it was determined that teacher candidates had uncertainty about how and where they should start ranking. This result is frequently encountered in the use of the concepts of position and antonym (opposite) situation. Aktaş Arnas (2013) mentioned the importance of teachers' correct use of the concepts of "sequencing" and "comparison" in classroom activities. This is due to the fact that the correct use of technical terms included in these activities is significant for learning the language correctly (Charlesworth, 2015; Dinçer & Ergül, 2015; Korkmaz, 2003). In teaching positional concepts, a fixed place must first be determined (e.g. door, teacher's desk). Next, it is necessary to sort by the distance between the objects (near, far, farther, farthest). In preschool children, the ability to position in place is expressed by distance from other objects and position or it can also be expressed with descriptive concepts. Knowing the location in the space enables children for movement, body orientation, distance perception, spatial and three-dimensional thinking (Giren & Erdoğan, 2015). It was observed that the pre-service teachers, who were followed up with the lesson observation form, were insufficient in terms of developing positioning skills in the teaching of the activities. As a matter of fact, pre-service teachers adopted a more rote

teaching style during the activities and applied to a spoken language that is far from mathematical language. In other words, during the activities, pre-service teachers did not perform adequately in the discourses about developing the skill of emphasizing a fixed object and positioning it on that object.

In the interview findings of the study, it was observed that the teacher candidates stated that they had deficiencies in the use of the concepts of quantity, location and antonym situation in mathematics. Moreover, teacher candidates stated that they did not know that these concepts were related to mathematics and that they used these concepts by heart in daily life. From this point of view, it is thought that teacher candidates may have difficulties in completing the deficiencies of students' concept use or correcting the misuse in the teaching process. This result is similar to many other studies (Charlesworth, 2015; Aktaş Arnas, 2013). Therefore, it can be said that the inadequacies of pre-school teacher candidates in the teaching process will negatively affect the process of using their field-specific pedagogical knowledge (Even, 1993; Yazıcı & Albayrak, 2022).

RECOMMENDATIONS

In order to prepare teacher candidates for teaching in line with the purposes of pre-school mathematics education, their prior mathematical knowledge can be transformed into conceptual level. For this reason, it is highly recommended to organize the content of mathematics education courses in the undergraduate program in this direction. It is also recommended that undergraduate programs should be shaped in order to determine the deficiencies in the teaching of concepts and the way they are used in daily life, what the concepts do, how they are related to the courses, and how they can be adapted to new situations. It is recommended that pre-service teachers focus on sequencing, comparison, classification and contrast activities in the teaching process. In addition, during these activities, it is recommended that students correct the incorrect usages correctly.

LIMITATIONS

The application step (in-class activities) of this research was carried out with a limited participant group due to its nature. Different findings that could not be obtained in this study can be reached with different participant groups. In addition, this study, which was carried out with pre-service teachers, can be conducted with teachers who continue their profession, and findings in different dimensions can be revealed.

AUTHOR CONTRIBUTIONS

Both authors contributed equally contributed to the creation of the literature, the collection of data, the analysis of the data, the revealing the findings and the writing of the results.

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