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Analysis of the Relationship between Estimation Skills Based on Calculation and Number Sense of Prospective Classroom Teachers*

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Abstract
The aim of this study are to examine the relationship between prospective classroom teachers' estimation skills based on calculation and their number sense and to investigate whether their number sense and estimation skills change according to their class level and gender. The participants of the study are 125 prospective classroom teachers studying at faculty of education, department of classroom teaching, in a state university in Turkey. The findings of the study revealed that prospective teachers have a low level of scores in terms of number sense and estimation skills, the scores do not change according to gender but there is a statistically significant difference in terms of their grade levels in number sense test. Additionally, it wasn't indicated that there is a statistically significant difference between prospective teachers' number sense and estimation skills scores.

Keywords: number sense, estimation skills, classroom teachers

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Introduction

The studies on the educational system in Turkey aim to teach the means to access information that changes and shows progress over time rather than directly teaching the information to the students. In order to achieve these aims, the focus has been on building relationships across disciplines, making analogies from the daily life (Çilingir & Türnüklü, 2009). In this respect, there have been changes in the ways to teach and make sense of mathematics. As a result of this change, for instance, the importance of making calculation by means of paper-pencil has been decreasing while the abilities such as making estimation and problem solving have been becoming more important (Çilingir & Türnüklü, 2009). Furthermore, a clear indication of this situation is the aim which is to improve estimation about the results of the calculations in introducing the basic skills through reasoning that is included in the mathematics curriculum (MEB, 2013).

Analyzing the concept of estimation, it can be observed that there have been various definitions in the literature. NCTM (1989) defines the verb to estimate as reaching an approximate conclusion about and calculating approximately the quantities such as a value, an amount, a width, and a weight etc. It was indicated that the word of estimation is used both to refer to the process of estimation and to represent the result of the estimation. On the other hand, there are also certain definitions such as "process of being able to provide an adequate answer to a problem (Reys, 1986)", "quickly having an idea about the quantity or size of something without actually counting or measuring it (Micklo, 1999)." Segovia, Castro, Rico and Castro (1989) define estimation as the decision reached by the results obtained from numerical operations and the evaluation of a quantity or an amount. The general characteristics of the concept of estimation put forward by Reys (1984) and developed by Segovia et al (1989) are as follows: a) determining the value of an arithmetic operation and of a quantity; b) a subject used in identifying certain information, references or experiences; c) being able to evaluate mentally in general; d) being able to do quickly by using numbers as simple as possible; e) the obtained conclusion is not the precise result of the operation, but it is as close as possible to the desired result; f) the obtained value might vary depending on the evaluation criteria of the person.

The simplest concept of mathematics is related to its accuracy. Thus, estimation seems to be quite wrong for mathematics and it is outside the mathematics. However, analyzing the reasons in using estimation, a reversed result has been also revealed. The use of estimation is suitable for the purpose of mathematics, that is, it makes thinking and the course understandable and facilitates the process to cope with the problems and conducts consistent implementations (Usiskin, 1986, p.2). Most of the educators indicate that students have limited information and content related to estimation skills, thus, they should get help from teachers to develop these skills (Leutzinger, Rathmell &Urbatsch, 1986, as cited in Tekinkır, 2008). Analyzing the types of estimation, mathematics educators have investigated estimation by taking measurement estimation and operational estimation to the foreground. Tekinkır (2008) indicates that estimating the weight of a vehicle and the duration for walking a kilometer away by an adult could be given as an example for measurement estimation. Segovia and Castro (2009) indicate that there are two types of magnitude in measurement estimation and they derive from continuous and intermittent measurement. While estimating the height of a person could be given as an example for continuous magnitude measurement estimation, estimating the number of people in a meeting could be given as an example for intermittent measurement as well. In terms of measurement estimation Dowker (1992) indicates that it means to be able to make a reasonable estimation without calculation to find an answer to a problem. Segovia and Castro (2009) refer to measurement estimation as finding arithmetic operations and the results of them. For example, estimating approximately that 52 times 2345 is 120.000 could be given as an example for it.

The estimation based on calculation refers to reasoning to predict in order to obtain approximate answers about arithmetic problems (Liu & Neber, 2012). Sowder and Wheeler (1989) reflect that the estimation based on calculation includes conceptual components, skills components, related concepts and skills, and affective components. Furthermore, estimation skills have developmental characteristics. Some researchers express that the estimation skills enhance with advancing age and older people have tried more ways of estimation compared to other people (LeFevre, Greenham, & Waheed, 1993, Sowder & Wheeler, 1989).

In the studies on estimation skills, it was investigated whether gender factor is also an important variable. Mottram (1995) and Boz (2004) have concluded that estimation skills do not change according to gender. In the study on estimation skills, Munakata (2002) concluded that boys answered more questions than girls, thus, their scores in estimation skills test are higher.

Another concept in mathematics education is the concept of number sense. Number sense refers to the ability of people to have a good knowledge and understanding of numbers and operations as well as their relations, and to deal with daily life situations involving numbers; and this ability is used in developing flexible and convenient strategies in dealing with numerical problems (Howden, 1989; McIntosh, Reys & Reys, 1992; Yang, 2003). Howden (1989) defines the concept of number sense as a true sense regarding numbers and the relations between each other. Number sense includes a flexible way and useful strategies dealing with numbers and operations and capabilities and tendencies (Reys & Yang, 1998).

In recent years, the concept of number sense has been a topic of focus among mathematics educators, educational psychologists and researchers. Analyzing the studies, it was seen that there were principle components and frameworks on number sense (McIntosh, B. Reys, & R. Reys, 1992; Markovits & Sowder, 1994). Yang (2007) identified four components and this study was conducted based on these four components. The first of these components is Understanding the Meaning of Numbers, Operations and Their Relationships and it includes the understanding of integers, fractions, decimal system based on decimal numbers, four operations and multiple ways of representing (McIntosh, et al., 1992, as cited in Yang, 2010). The representation of the numbers more than one (% 25 = ¼ = .25) could be given as an example for this. The second component is Recognizing Relative Number Size. The expectancy in this component is to be able to realize relatively the magnitude of the numbers. This component does not adhere to written procedures, for example, different ways are used to be able to find the smallest common denominator (Cramer, Post, & delMas, 2002). The third component is Developing and Using Benchmarks Appropriately. As an example, when students were asked the operation such as 19/31x7/15, the student knows that the multiplier is less than 1 and the second multiplier is less than ½, thus, he/she determines the result is less than ½ and ½ is a reference point for him. The last component is Judging the Reasonableness of a Computational Result by Using the Strategies of Estimation. In this component, the students are asked a question like 0.525 x 987.6 =51849 and they are asked to guess where to use comma and doing so, he/she is not prompted to take advantage of any written algorithm. The importance of addressing the issue of number sense in school mathematics is emphasized in many national reports (National Research Council, 1989; Japanese Ministry of Education, 1989; Australian Education Council,1991). However, it was revealed that many pupils in primary education are inadequate in skills of number sense (Reys &Yang, 1998; Markovits & Sowder, 1994) and the reason for this is indicated that rules are emphasized seriously rather than number sense in the calculations included in the books (Yang, Reys & Reys, 2009).

The curriculum and assessment standards for school mathematics emphasize that teaching number sense is one of the fundamental objectives of school mathematics curriculum. Teachers have a critical role in teaching number sense and enable students to learn number sense and to appreciate its importance (Yang, 2007). One of the reasons that students fail in developing and using number sense is the lack of knowledge of teachers about how to help students in developing number sense as well as the insufficient knowledge of teachers with regard to the concept of number sense (Yang, Reys & Reys, 2009). Given the importance of the role of teachers in the improvement of number sense, it is an issue of concern what the competence level of teachers in regard to number sense is. Since the level of teachers in regard to this issue would affect the education number sense that they provide to students (Yang, 2007). Furthermore, there have been few studies on number sense of prospective classroom teachers in the literature.

The aim of this study is to explore the performances of prospective classroom teachers in estimation skills and number sense tests and to identify whether there is a relationship between the scores that they obtain from these tests. Within this purpose, answers to the following sub-problems have been sought.

1) What are prospective classroom teachers' performances in estimation skills and number sense tests?
2) Is there a significant difference between prospective classroom teachers' scores obtained from estimation skills and numbers sense tests and the scores obtained from sub-dimensions of these tests according to grade levels?
3) Is there a significant difference between prospective classroom teachers' scores in estimation skills and number sense tests according to gender?
4) Is there a significant difference between prospective classroom teachers' total scores in estimation skills and number sense tests?
5) Is there a significant difference between prospective classroom teachers' scores in the components of estimation skills and number sense tests?

Method

Relational survey model was used in this study that aimed to describe prospective teachers' performances in estimation skills and number sense tests. Survey models are approaches that aim to describe an existing situation in the past or present in a way that they are (Karasar, 2000).

Participants

A total of 125 prospective teachers (Table 1) studying in the department of classroom teaching for elementary schools in a public university (33 first, 31 second, 29 third and 31 fourth grade prospective classroom teachers) have participated in this study, which was carried out at the end of the fall semester of 2014-2015. The participants have been selected by means of purposive sampling method which is one of non-random sampling methods. The reason that the sample of the study is selected from the department of classroom teaching is that the basics of mathematics course are taught in elementary school.

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Table 1.
The distribution of participants by variables of gender and grade levels

		Grade Level				Total
		1st Grade	2nd Grade	3rd Grade	4th Grade	
Gender	Female	29	25	19	21	94
	Male	4	6	10	11	31
Total		33	31	29	32	125

Data Collection Tools

As data collection tools, "Number Sense Test" and "Estimation Skill Test Based on Calculation" have been utilized in this study to demonstrate the levels of number sense and estimation skills of prospective classroom teachers. The Number Sense Test consisted of 12 questions by taking advantage of the test developed by Yang (2007).

Several necessary changes have been conducted by having experts' views and Kr20 internal consistency coefficient of this test has been found to be .79. The prospective teachers solving a question in the number sense correctly have been given 1 point whereas those answering wrongly or not answering at all have been given 0 point. The maximum score that can be obtained from the number sense test is 12 while the minimum score is 0.
4 components are included in this test. These are Understanding the Meaning of Numbers (UMN), Operations and Their Relationships (OTR), Recognizing Relative Number Size (RRNS), and Developing and Using Benchmarks Appropriately and Judging the Reasonableness of a Computational Result By Using the Strategies of Estimation (DUBA).

Estimation skills test was developed by Tekinkır (2008) and consisted of 32 questions. The reliability finding of this test shows that Kr20 internal consistency coefficient is .84. The prospective teachers providing a correct answer in estimation skills test have been given 1 point whereas those answering wrongly or not answering at all have been given 0 point. The maximum score that can be obtained from the estimation skills test is 32 while the minimum score is 0. With respect to the kinds of issues and estimates of the items in the test, there are 20 items in operational estimation skills (OE) and 12 items in measurement estimation (ME).

Data Analysis

In data analysis, the performances of the participants in number sense and estimation skills tests in terms of grade levels have been initially determined and the average scores and standard deviation of these performances have been calculated. Parametric tests have been conducted in the statistics to be performed since a normal distribution of the data has been found in data analysis. In order to determine whether there is a difference between the performances of the participants in the number sense and estimation skills tests in terms of grade level, "One Way Anova" has been carried out. After determining the existence of a difference, one of the post-hoc tests depending on the homogeneity state of variances has been utilized in order to determine the grade levels in which there is a difference. Additionally, t-tests were conducted in order to analyze whether there is a significant difference between participants' scores in number sense test and estimation skills tests.

Findings

In this part, the findings obtained by means of the analysis of data through estimation skills test and number sense test of prospective classroom teachers have been demonstrated in details.

Table 2:
Findings regarding descriptive statistics of components of number sense test according to grade levels

		Grade Levels									
		Grade 1		Grade 2		Grade 3		Grade 4		Toplam	
		X	ss	X	ss	X	ss	X	ss	X	ss
Components	UMN	,848	,712	1,387	,803	,724	,701	1,062	,837	1,0080	,83758
	OTR	,666	,645	,806	,601	,758	,689	,406	,636	,6560	,63632
	RRNS	1,030	,683	1,163	,860	,758	,689	1,093	,772	1,0160	,77234
	DUBA	,454	,616	,516	,625	,379	,621	,625	,655	,4960	,65530
	Total	3,00	1,479	3,87	1,586	2,62	1,498	3,19	1,656	3,18	1,656

Analyzing the Table 2, with regard to number sense test, it was revealed that while the component in which 1st and 4th grade prospective classroom teachers are the most successful is RRNS (Recognizing Relative Number Size), for 3rd grade students it is Operations and Their Relationships (OTR) and RNNS, and for 2nd grade students it is UMN, in other words, Understanding the Meaning of Numbers. In general, while the component in number sense test in which prospective teachers are the most successful is RNNS ($\bar{x}$= 1,016), the one in which they are the least successful is DUBA ($\bar{x}$=0,4960). In all questions, the mean score of 1st grade prospective classroom teachers is 3.00, the mean score of 2nd grade level is 3.87, the mean score of 3rd grade level is 2.62 and lastly, the mean score of 4th grade level is 3.19. It was revealed that the highest mean score belongs to 2nd grade prospective classroom teachers ($\bar{x}$= 3,87), and the lowest mean score belongs to 3rd grade classroom teachers ($\bar{x}$=2,62). The participants' scores in number sense test is 3.18 and the value indicates that prospective teachers have a quite low level of number sense skills. One-way ANOVA was used in this study in order to analyze whether there is a significant difference between participants' scores in number sense test and their grade levels. The results are indicated in the Table 3 as in the following:

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Table 3:
One way Anova results demonstrating the variance in the scores of number sense test in terms of grade level

Group	Source	Sum of Squares	sd	Mean Square	F	p
UMN	Between Groups	7,727	3	2,576	3,932	,010
	Within Groups	79,265	121	,655		
	Total	86,992	124			
OTR	Between Groups	3,007	3	1,002	2,569	,057
	Within Groups	47,201	121	,390		
	Total	50,208	124			
RRNS	Between Groups	2,776	3	,925	1,573	,200
	Within Groups	71,192	121	,588		
	Total	73,968	124			
DUBA	Between Groups	,997	3	,332	,769	,513
	Within Groups	52,251	121	,432		
	Total	53,248	124			
Total	Between Groups	24,942	3	8,314	3,192	,026
	Within Groups	315,186	121	2,605		
	Total	340,128	124			

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In the Table 3, the differences between components of number sense test and the scores obtained from the whole and grade levels were analyzed. Analyzing the results, it was revealed that there was a significant difference between grade levels ($F_{(3-121)}$= 3,932, p< ,05) and the total score in the test ($F_{(3-121)}$= 3,192, p< ,05). In the other components of number sense, it was indicated that there was a significant difference in terms of grade levels (p> ,05). Tukey test was conducted in order to analyze in what grades there is a significant difference (the variances are homogenous).

Table 4:
Tukey test results regarding the difference in grade levels in number sense test

	Grade Levels(I)	Grade Levels (J)	Mean (I-J)	Standard Deviation	p
Total	2	3	1,25028	,41695	,015
UMN	1	2	-,53861	,20244	,043

According to the results indicated in Table 4, there has been a significant difference in terms of the scores of number sense test in favor of 2nd grade between 2nd and 3rd grades whereas in UMN component there has been a significant difference in terms of the scores in favor of 2^{nd} grade between 2^{nd} and 3^{rd} grades.
With regard to the scores in number sense test in terms of gender, the analysis results regarding whether there is a significant difference was indicated in Table 5.

Table 5:
T-test results regarding the difference between scores in number sense test and gender

Gender	N	Mean	sd	Sd	t	p
male	31	3,6452	1,51764	123	1,836	,069
female	94	3,0213	1,67832			

Analyzing Table 5, it was revealed that there is not a statistically significant difference between the scores in number sense test and gender ($t_{(123)}$= 1,836, p>,05).

Table 6:
Descriptive Statistics regarding estimation skills test

		Grade Levels									
		Grade 1		Grade 2		Grade 3		Grade 4		Total	
		X	Ss	X	Ss	X	Ss	X	Ss	X	Ss
Components	OE	11,78	2,88	12,90	2,56	13,89	2,58	12,28	3,62	12,68	3,02
	ME	7,24	1,601	6,258	1,731	6,724	2,51	6,90	2,51	6,79	2,13
	Total	19,03	3,74	19,16	3,56	20,62	4,58	19,18	5,64	19,47	4,45

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Descriptive statistics regarding grade levels and types of estimations in estimation skills test were indicated in Table 6. The most successful ones in operational estimations are 3rd grade prospective classroom teachers ($\bar{x}$= 13,89), and the most unsuccessful ones are 1st grade prospective classroom teachers ($\bar{x}$ =11,78). It is seen that there is an increase in terms of operational estimation scores from 1st grade levels to 3rd grade whereas there is a decrease in 4rd grade levels. It was indicated that in measurement estimation questions the most successful ones are 1st prospective classroom teachers ($\bar{x}$=7,24), whereas the most unsuccessful ones are 2nd grade prospective classroom teachers ($\bar{x}$=6,25). It was found that the mean scores of all prospective teachers in operational estimation questions is 12,68 and the mean scores in measurement estimation questions is 6,79. In all estimation questions, the lowest mean scores of estimation skills test belong to 1st grade prospective classroom teachers by 19,03, whereas the highest mean scores belong to 3rd grade prospective classroom teachers by 20,62. In all questions, prospective teachers got 19,47 out of 32. Although it was revealed that there were differences between the mean scores of prospective teachers in terms of estimation skills test and grade levels, One-way Anova was conducted in order to investigate whether the differences were significant. Analysis results on this test were indicated in Table 7.

Table 7:
Anova results regarding the variance in scores of estimation skills test according to grade level

Group	Source	Sum of Squares	sd	Mean Square	F	p
OE	Between Groups	75,817	3	25,272	2,892	,038
	Within Groups	1057,383	121	8,739		
	Total	1133,200	124			
ME	Between Groups	16,084	3	5,361	1,187	,318
	Within Groups	546,508	121	4,517		
	Total	562,592	124			
Total	Between Groups	50,286	3	16,762	,843	,473
	Within Groups	2406,866	121	19,891		
	Total	2457,152	124			

The differences between the scores in estimation skills test and the sub-dimensions of it in terms of measurement and operational estimations were analyzed in Table 7. It was indicated that there was no statistically significant difference in scores obtained from the whole test ($F_{(3-121)}$= ,843, p> ,05) and in measurement estimation ($F_{(3-121)}$= 1,187, p> ,05) in terms of grade levels. With regard to operational estimation skill, there was a significant difference ($F_{(3-121)}$= 2,892, p< ,05) and to be able to examine in which groups there were significant differences, Tukey test was administered.

Table 8:
Tukey test results regarding the difference between groups in estimation skill test

	Grade Levels(I)	Grade Levels (J)	Mean (I-J)	Standard Deviation	p
OE	1	3	-2,10867	,75243	,030

According to the results on Tukey test, there was a significant difference between 1st and 3rd grade levels in favor of 3rd grade levels. Independent samples t-test was conducted in order to analyze whether there was a significant difference between scores of prospective teachers in estimation skill test and gender. The results were indicated in Table 9.

Table 9:
T-test results regarding the variance between the scores in estimation skill test and gender

Gender	N	Mean	sd	Sd	t	p
male	31	20,0968	5,56989	123	40,860	,448
female	94	19,2660	4,02993			

In Table 9, it was indicated that there was no statistically significant difference in terms of scores in estimation skill test and gender ($t_{(123)}$= 40,86, p>,05). Simple Linear Correlation Analysis was conducted in order to analyze whether there was a significant difference between the scores of prospective teachers in estimation skill test and number sense test. Additionally, simple linear correlation analysis was also conducted in order to investigate whether there was a relationship between the components of tests.

Table 10:
The Correlational Relationship between the Scores in Estimation Skills and Number Sense Test

Test Types	Number Sense Total Score	Estimation Skill Total Score
Number Sense Total Score	1	
Estimation Skill Total Score	,102	1

p>0,05

In Table 10, it was indicated that there was no significant relationship between the scores of prospective teachers in estimation skills test and number sense test (r=,102, p>,05).

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Table 11:
The correlational relationship between the scores in sub-dimensions of estimation skills test and components of number sense test

Test Components	ÖT	İT	UMN	OTR	RRNS	DUBA
ME	1					
OE	,477**	1				
UMN	-,126	-,190*	1			
OTR	,155	,110	-,070	1		
RRNS	,188*	,151	,062	,307**	1	
DUBA	,080	,178*	0,96	,026	,175	1

** Significant at p<0,01.
*Significant at p<0,05.

In Table 11, simple linear correlation analysis was conducted in order to investigate whether there was a relationship between the components of estimation skills and numbers sense test. It was indicated that there was a positive medium correlation (r=,477, p<,01) between measurement estimation and operational estimation, a positive low correlation (r=,188, p<,05) between measurement estimation and UMN, a negative low correlation (r= -,190, p<,05) between operational estimation and UMN, a positive low correlation (r=,178, p<,05) between operational estimation scores and DUBA and lastly, a positive medium (r= ,307, p<,01) relationship between the components of number sense test as OTR and RRNS.

Conclusion and Discussion

The concept of number sense that has been included in the field of mathematics education in the last thirty years also has an important place today, and it is a part of many mathematics education programs (Şengül & Gülbağcı Dede, 2014). Teachers remain at the forefront of introducing this concept to students; therefore, the determination of the level of pedagogical content knowledge of teachers in regard to number sense has importance (Şengül & Gülbağcı Dede, 2014).

In the mathematics program issued by MEB (2013), it can be observed that the improvement of estimation skill was attached great importance, and educational resources also have been emphasizing the activities of this skill recently. The pedagogical content knowledge of teachers in regard to this issue plays a significant role in the improvement of estimation skills of students.

Given the importance of number sense and estimation skills, this study has determined to what extend the prospective teachers have the knowledge of the subject area that they are required to have in order to enable students to adopt these skills. The scores of the number sense test of prospective classroom teachers have been found to be quite low. This result is not thought to be desired. Since one of the reasons that the number sense of students is low results from the incompetence of teachers in this issue (Yang, Reys & Reys, 2009). The findings obtained also support this statement. The results of some

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studies are consistent with the result that the number sense of prospective teachers is low (Yang, 2007, Yang, Reys & Reys, 2009, Kayhan Altay & Umay, 2011; Şengül, 2013).

Analyzing the mean scores in terms of the components of number sense test, it was indicated that prospective classroom teachers had most difficulty in the component as Judging the Reasonableness of a Computational Result by Using the Strategies of Estimation whereas had the most success in the questions included in the component as Developing and Using Benchmarks Appropriately. Additionally, there was a significant difference between understanding the meaning of numbers, operations and their relationships and grade levels through which it was indicated that the scores of 2nd grade levels were higher than 1st grade levels. In the study, Yang (1995) found out that 8th grade level students had a higher level of number sense than 6th grade level students, Aunio et. al (2006) concluded that the number sense increased systematically depending on age. Through the study that was applied to secondary school students, Şengül and Gülbağcı (2012) revealed that the more grade levels increased, the more their number sense increased as well. Thus, it could be indicated that the results of these studies are also in line with the findings obtained in this study. Additionally, there has been a significant difference between the scores of number sense test and grade levels. The score of second grade has been found to be significantly higher than that of third grade. The reason behind the finding that indicates the scores of 2nd grade level prospective classroom teachers are higher could result from the idea that prospective teachers have Basic Mathematic 1 and Basic Mathematic 2 courses in 2nd grade and it could positively affect the development of their number sense.

With regard to gender, it was indicated that there was no significant difference in terms of number sense scores. However, the mean scores of male prospective teachers were higher than those of female prospective teachers.

In the analysis of the findings of estimation skill test, it has been observed that the prospective teachers have a lower average score. Similarly, in his study, Munakata (2002) concluded that the estimation skills of 5th, 7th, 9th, 11th grade students are low in general. Analyzing the scores of estimation skills test in terms of operational estimation which is the sub component of estimation skills test and grade levels, it was indicated that there was an increase up to 3rd grade level, however, there was a decrease in scores of 4rd grade prospective teachers. The reason for the decrease in the scores of 4th grade prospective teachers could be addressed to idea that they study for Kamu Personeli Secme Sınavı (The Selection Examination for Professional Posts in Public Organizations), thus, they have a low level of motivation while solving the test. Additionally, in the component of operational estimation there was a significant difference in terms of grade levels which was in favor of 3rd grade levels. Similarly, Lefevre (1993) and Sowder (1984) found that the estimation skills of elementary school students improve depending on age. In results with regard to measurement estimation skills, it was revealed that there was no significant difference in terms of grade levels. However, 1st grade level prospective teachers had higher mean scores than the others. In this study, it was concluded that there was no statistically significant difference between scores of prospective teachers in estimation skills test and grade levels. However, analyzing the mean scores, like operational estimation, there was an increase in the mean scores up to 3rd grade but there was a decrease in 4th grade level.

Through the results, it was revealed that there was no significant difference between prospective classroom teachers' estimation skills and their gender types, however, male participants had higher level of mean scores when compared to female participants. There have been various results in the literature. In their studies, Forrester and Beatrice (1995), Reys and Yang (1998), Mottram (1995) and Boz (2004) concluded that gender did not have significant impact on estimation skills; however, Dowker, Flood, Griffiths, Harris and Hook (1996), Munakata (2002) and Reys, Reys, and Penafiel (1991) have revealed that there were statistically significant differences between female and male participants in terms of estimation skills.

It was found that there was a positive relationship between the scores of prospective teachers in measurement estimation questions and operational estimation questions. Through this result, it was concluded that the more prospective teachers' scores of operational estimation increased, the more their scores of measurement estimation or the more prospective teachers' scores of measurement estimation increased, the more their scores of operational estimation increased as well. In her master thesis that aimed to analyze secondary school students' estimation skills, Tekinkır (2008) found that there was a positive significant relationship between students' measurement and operational estimation scores, thus, it is in line with our findings.

Lastly, it has been concluded that there has not been a significant relationship between the scores of the estimation skill test and the scores of the number sense test of prospective classroom teachers. However, there was a significant relationship between measurement estimation and Developing and Using Benchmarks Appropriately which is one of the components of number sense and there was a significant positive relationship between operational estimation and Judging the Reasonableness of a Computational Result By Using the Strategies of Estimation which is one of the components of number sense test as well. Greeno (1991) expressed that numbers sense has qualifications in that it provides flexibility in mental calculations, is effective in numerical predictions, and provides quantitative judgments and Howden (1989) defines number sense as having a good sense in terms of numbers and relationships between numbers. Through it, we can infer that the concepts as number sense and estimation are actually found in each other, and require each other reciprocally. Thus, the statements by Greeno (1991) and Howden (1989) are in line with our findings.

Prospective classroom teachers have been found to have quite low scores both in number sense test and in estimation skills test; therefore, their area knowledge on these subjects have been concluded to be insufficient. Many of the prospective teachers were in tendency of doing written calculations and finding the exact result and this showed that they had a lack of using estimation while solving the problems. Prospective classroom teachers' being aware of the importance of number sense and estimation skills for mathematical development is of importance for the basis of mathematics education. In this sense, prospective teachers could be provided to be more competent in these matters by reorganizing learning and teaching of number sense and estimation in teacher education programs. Since if prospective teachers learn these matters well, they will know how to teach them to their students and help their students improve their number sense and estimation skills. Additionally, taking the use of technology in mathematics education into consideration, it is thought that both in number sense and estimation skills, technology has an important role in order to obtain reasonable and consistent answers.

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