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The Relationship between Elementary Students' Problem Solving and Inquiry Learning Skills

Fen İlköğretim Öğrencilerinin Problem Çözme ve Sorgulayıcı Öğrenme Becerileri Arasındaki İlişki

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ABSTRACT: The individuals of the 21st century are expected to possess life and high end thinking skills such as entrepreneurship, creativity and problem solving skills. Problem solving skills and inquiry skills from this category are much important in terms of their place in education program and daily life. Determining the situation about these skills and relationship between these skills may be important by the content. Therefore, aim of this study is to determine relationship between students' problem solving and inquiry learning skill perceptions. Within this aim, "problem solving skill perceptions scale" and "inquiry learning skill perceptions scale" used as data collection tools. 553 students studying in lower secondary education participated in this study. Pearson correlation coefficient used in analysis of collected data and relationship between variables were determined. As a result of data analysis, a significant and positive relationship found between students' inquiry learning skills and problem solving skills. According to this result it was determined that these two variables affect each other in a positive way and it can be said that individuals with improved problem solving skills also have improved inquiry learning skills. Thus, in next studies it should be taken into account that using techniques and methods which encourages students to inquire would also contribute to their problem solving skill perceptions.

Keywords: problem solving skills, inquiry learning skills.

ÖZ: 21. yüzyıl bireylerinin girişimcilik, yaratıcılık ve problem çözme gibi üst düzey düşünme becerilerine sahip olmaları beklenmektedir. Bu becerilerden problem çözme ve sorgulayıcı öğrenme becerileri öğretim programındaki ve günlük hayattaki rolleri nedeniyle ön plana çıkmaktadır. Bu becerilerin durumunu ve beceriler arasındaki ilişkiyi belirlemenin önemli bir bulgu ortaya koyabileceği düşünülmektedir. Bu nedenle gerçekleştirilen bu araştırmada öğrencilerin problem çözme ve sorgulayıcı öğrenme becerileri algıları arasındaki ilişkinin belirlenmesi amaçlanmıştır. Bu amaçla araştırmada veri toplama aracı olarak "problem çözme becerileri algı ölçeği" ve "sorgulayıcı öğrenme becerileri algı ölçeği" kullanılmıştır. Araştırmaya ilköğretim ikinci kademede öğrenim görmekte olan 553 öğrenci katılmıştır. Araştırmadan elde edilen verilerin analizinde Pearson korelasyon katsayısı hesaplanarak değişkenler arasındaki ilişki belirlenmiştir. Verilerin analizi sonucunda öğrencilerin sorgulayıcı öğrenme becerileri ve problem çözme becerileri algıları arasında anlamlı düzeyde ve pozitif yönde bir ilişki olduğu tespit edilmiştir. Bu sonuca göre her iki değişkenin birbirlerini olumlu yönde etkilediği ve problem çözme becerileri algıları gelişmiş bireylerin aynı zamanda sorgulayabilen bireyler oldukları söylenebilir. Bu nedenle yapılacak olan yeni araştırmalarda öğrencileri sorgulamaya yönelten yöntemlerin ve tekniklerin kullanılmasının öğrencilerin problem çözme becerileri algılarının geliştirilmesine de katkı sağlayacağı göz önünde bulundurulmalıdır.

Anahtar kelimeler: problem çözme becerileri, sorgulayıcı öğrenme becerileri.

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Introduction

Today, individuals need to use high end thinking skills such as critical, logical and creative thinking skills to live their lives, adapt to the innovations of their times, solve the problems they have encountered and make inventions that will ease their lives. Problem solving and inquiry learning skills are two of these high end thinking skills. According to Lee, Hart, Cuevas and Enders (2004), scientific inquiry includes high end thinking skills or research of natural phenomena via experiments. Therefore inquiry based learning becomes a focus point of research on science education (Howes, Lim, & Campos, 2009). According to Chin and Chia (2006), inquiry based learning aims for students to comprehend scientific content conceptually, develop related process skills and comprehend the nature of science. Schools are important environments where these learning skills are gained and used. Especially in the science learning process, individuals examine problems they have encountered in daily life, inquire about the problem source and what they can do to solve these problems. In addition the inquiry process continues while using the information they have gained to solve the problem. Thus it is possible to say that inquiry learning skills have been used in the problem solving process.

Using inquiry learning and problem solving skills together in life increases the importance of learning these skills, because individuals encounter various issues in their lives and those with improved problem solving skills can overcome these issues. Similarly individuals, who can inquire into the knowledge instead of blindly accepting it and know how to do research, have the opportunity to learn during their whole lifetime. Problem solving skills are important for healthy relations with other individuals because individuals encounter various problems during their lifetimes (Guven, 2010). According to Yavuz, Arslan and Gulten (2010), problem solving is one of the skills required for the continuity of the human race. Societies formed by individuals with problem solving and inquiry learning skills contribute positively to the development of their countries. Therefore activities with methods for developing individuals' high end thinking skills, especially at an early age, and evaluation tools aimed at measuring these skills for determining students' situations, are being developed in scientific research. Also there is research about how and at which level these variables affect each other. In this research it is aimed to determine the relationship between problem solving skills and inquiry learning skill perceptions which are thought to give a positive contribution to each other.

Sub-problems of this research are classified as below:

- Is there any significant difference between elementary sixth grade students' problem solving skill perceptions and inquiry learning skill perceptions according to their gender?
- Is there a significant relationship between elementary sixth grade students' problem solving skill perceptions and inquiry learning skill perceptions?

Method

In this research, survey and relational survey techniques were chosen from quantitative research methods and applied. Survey methods are useful for defining a situation which occurred in the past or persist in present (Karasar, 2006). Specifically, relational survey method is being used in research models which determine the existence or level of mutual exchange between two or more variables (Cohen, Manion, & Morrison, 2000).

This study was conducted on five hundred and fifty-three sixth grade students studying in an elementary school in a city in Turkey. Participant students consist of sixth grade students studying in 27 classrooms in 9 schools. 4.6% of the participants (*n*=263) were female and 52.4% of the participants (*n*=290) were male. The ages of the participants varied between 11 and 13.

Data Collection Tools

The measures of inquiry learning skill perceptions and problem solving skill perceptions of students were taken with two scales and the sum of the points from these scales compared according to gender and the relation between the scores of these scales were examined.

Problem solving skill perceptions scale (PSSP). In this research, the problem solving skill perceptions scale developed by Inel, Evrekli and Turkmen (2011) was used. The pre-practice of this scale was implemented on eight hundred and fifty students. According to DFA results, the compliance value of the scale after confirmatory factor analysis was found to be: x2 = 483.09, df = 208, p = .000<.001; RMSEA = 0.039; X2/df = 2.32; NFI = .97; NNFI = .98; CFI = .98; GFI = .95; AGFI = .94. The correlations of items in the scale varied between .44 and .63. Cronbach's alpha reliability coefficient of the first factor was found to be .88, and the Cronbach's alpha reliability coefficient of the second factor was found to be .78. Cronbach's alpha reliability for the whole scale was determined as .88. The scale consists of twenty-two perception items and two factors. The factors of scale are "perception of problem solving" (15 items) and "perception of decisiveness and willingness towards problem solving skills" (7 items).

Inquiry learning skill perceptions scale (ILSP). This scale was developed by Balim and Taskoyan (2007) in order to determine students' inquiry learning skills. The scale consists of twenty-two perception items. Factors of scale were determined as "negative perception items", "positive perception items" and "inquiry accuracy perception items" by researchers. The reliability coefficients of these factors are 0.72, 0.67 and 0.71 respectively. Cronbach alpha reliability for the whole scale is determined as 0.84; Spearman-Brown test inconsistency coefficient is 0.82. The maximum score that can be taken from the scale is 110, while the minimum score is 0.

Data Analysis

In this study, data collection tools were applied to participants and applications were continued for approximately 20 minutes. Applications took place in classroom environment and students were encouraged to answer personally. Absent and inappropriately filled data were removed from collected data. Collected data were transferred to computer via SPSS and prepared for the analysis. Descriptive analyses were applied on data first and MANOVA applied in order to see the relation afterwards. MANOVA technique selected to analyze data because there was more than one dependent variable. MANOVA is being used for analyzing variance in studies with two or more dependent variables. The main difference of this technique from ANOVA is being used in researches with two or more dependent variables (Karasar, 2006)

Results

The data collected from participants were analyzed and evaluated. The descriptive statistics obtained from participants are given in Table 1. According to descriptive analysis results and in terms of scores from the scales, it can be seen that female students' score means are higher than male students' score means. Male students took 94.59 points from inquiry learning skill perception scale while female students took 90.44 points. In problem solving the skill perception scale, male students took 93.05 points while female students took 96.75.

Table 1

Descriptive Statistics about Participants Scores From Scale

Variables	Gender	N	Mean	SD
ILSP	Male	263	90.44	11.78
	Female	290	94.59	11.73
PSSP	Male	263	93.05	11.30
	Female	290	96.75	10.56

Effect of Gender on Problem Solving Skill Perceptions and Inquiry Learning Skill Perceptions

In the first sub-problem of this study, 6th grade primary students' problem solving skill perceptions and inquiry learning skill perceptions were examined according to their gender and checked to see if there was a difference based on 0,05 significance level . In order to arrive at the solution to the first sub-problem, inquiry learning skill perceptions scores and problem solving skill perceptions scores were compared based on a gender variable. According to the MANOVA results, both inquiry learning skill perception scores ($F(1,152)=17.19$, $p=.000$, $\eta 2(\text{partial})= .30$) and problem solving skill perception scores ($F(1,152)=15.82$, $p=.000$, $\eta 2(\text{partial})= .28$) of elementary sixth grade students differ significantly in favor of female students. In collected data F value represents variance analysis test statistics which result after dividing "in groups

square means" to "between groups square means". Moreover, partial eta square (η2) value represents a variance rate which explains every main effect, relation and error in used technique. Partial eta square value, which does not require linearity hypothesis, indicates effectiveness of independent variable on dependent variable. Effect size can be between 0.00 and 1.00 values. 0.1, 0.6 and 0.14 level eta square values are evaluated as small, moderate and broad in order (Bakeman, 2005). Therefore, the results of MANOVA indicate broad effect size for inquiry learning skill scores and problem solving skill scores.

Table 2

MANOVA Results of ILSP and PSSP

	F	p	η2
ILSP	17.19	0.000	0.30
PSSP	15.82	0.000	0.28

Relationship between on Problem Solving Skill Perceptions and Inquiry Learning Skill Perceptions

In the second sub-problem of this study, the relationship between 6th grade primary students' problem solving skill perceptions and inquiry learning skill perceptions were examined according to their gender and checked to see if there was a significant relationship. The solution of the second sub-problem, the relationship between students' scores obtained from the problem solving skill perceptions scale and the inquiry learning skill perceptions scale were examined by using the Pearson Moments Multiplier. The correlation coefficient which was indicated by Pearson Moments Multiplier represents the direction and level of linear relation between two variables and ranges between -1 and +1. The correlation coefficient was indicated as "r" and the values represent different relationships. The correlation coefficient values from 0 to 0.5 represent weak relationship while 0.5 to 0.9 represents moderate relationship and 0.9 to 1 represents strong relation. The negative values represent opposite relationship. Moreover, "p" value represents statistical power (Christensen, 2004). After analysis, it was found that there was a significantly moderate positive relationship between students' problem solving skill perceptions and inquiry learning skill perceptions (r=.74, p=.000). Both findings were given in Table 2.

Discussion and Conclusion

This study was focused on inquiry learning skills and problem solving skills included in high end thinking skills. One of the reasons to choose these skills was that students and, indeed, all individuals encounter some issues or problems in their daily life. They try to define and solve these problems. During the problem solving process individuals need to use their problem solving and inquiry learning skills effectively. Within this scope, while problem solving skills include individuals producing solutions using both their experience and knowledge, inquiry learning skills include individuals who think about all possible ways to build their hypothesis, form plans and execute

them. Obviously problem solving and inquiry learning skills play an important role in the definition and solution of problems.

In this study, we first examined if there was a significant difference between 6th grade primary students' problem solving skills and inquiry learning skills according to their gender. The analysis of the students' problem solving skills and inquiry learning skills perceptions based on the gender variable were shown to differ significantly in favour of female students. There are several studies in which the effects of variables such as gender on problem solving skills have been examined in the literature (Celikkaleli & Gunduz, 2010; Karabulut & Kuru, 2009; Keskin & Yildirim, 2008; Korkut, 2002; Polat & Tumkaya, 2010; Turkcapar, 2009; Yavuz, Arslan, & Gulten, 2010). In addition, Inel, Evrekli and Turkmen (2011) determined that even when there is not a significant difference between male and female prospective teachers' problem solving skills, female prospective teachers' scale score means are higher than male prospective teachers'. Also there are several studies in literature in which the effects of problem solving skills on attitudes were examined (Capa & Cil, 2000; Capri & Celikkaleli, 2008; Tanrıogen, 1997). Studies conducted on students with different learning levels indicate that female students take higher scores than male students in measurement tools. This may be because of female students' higher consciousness, more systematic and logical approach, higher reading abilities and comprehension skills. Female students' planning capabilities and their attention to details might have an effect on the increase in skill levels because individuals who have grown up with a detailed and systematic view could predict which direction they should follow and the possible results. Individuals' high end thinking skills develop along this line. When the literature was reviewed, Korkut (2002) examined high school students' problem solving skills and found a significant difference in favor of male students. Kuloglu and Ari (2014) found no significant difference on problem solving skills according to gender but indicated that male scores are higher than female scores. Some study results in literature contradict the results of the current study. Moreover, some studies (Dundar, 2009; Izgar, 2008; Kucukkaragoz, Denis, Ersoy, & Karatas, 2009; Ulusoy, Tosun, & Aydin, 2014; Yildirim & Yalcin, 2008) indicate no significant relationship between participants' gender and their problem solving skills. As can be seen, there is not an absolute result about problem solving or inquiry learning skill levels according to gender. In order to determine details of this variable, qualitative data should be included in future studies. In new research, it would be possible to examine more thoroughly the reasons for these results with qualitative measurement tools and determine the reasons for the differences in detail.

According to the analysis for the second sub-problem, a strong, significant and positive relationship has been found between students' problem solving skills and inquisitive learning skills. In literature no study about the relationship between problem solving skills and inquiry learning skills could be found. However, similar to these variables, studies which examine relationships between high end thinking skills could be found. Yilmaz Karabulutlu, Yilmaz and Yurttas (2011) found that students' problem solving skill levels increase as their emotional intelligence levels rise. Ozsoy (2005) indicated a significant relationship between mathematical academic achievement and problem solving skills.

To conclude, we can say there are high end thinking skills that could be related. The problem solving process consists of five main stages defined as: determining the problem, revealing prior knowledge, determining learning fields, making research about learning fields and relating gained knowledge with prior knowledge. Inquiry and research skills such as inquiring about the problem, doing research and validating the accuracy of the knowledge are being used intensively in the problem solving process. Therefore it may be possible to say that individuals with improved problem solving skills also have improved inquiry learning skills. Similarly it can be said that individuals with improved inquiry learning skills go through the problem solving process better. As a result, because these two skills affect each other in a positive way, if activities designed for improving each of these skills are used in the classroom, they may contribute to the development of both students' problem solving skills and inquiry learning skills together.

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