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Examining Elementary School Students' Scientific Process Skills[1]

İlkokul Öğrencilerinin Bilimsel Süreç Becerilerinin İncelenmesi

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Abstract
With the preparation of the science curricula in our country in accordance with constructivism, scientific process skills have also gained importance. The examination of science curricula revealed that scientific process skills are either considered as a separate learning area or classified as field-specific skills. In this context, scientific process skills are defined as skills that enable students to learn science while actively involving in the learning process and conducting research appropriate for their age. Individuals with these skills are aware of how scientific research is conducted and solve problems they encounter during a daily life by using these skills. In this respect, it is critical to teach scientific process skills to students starting from an early age. To this end, this study aims to determine third and fourth grade students' scientific process skills. The participants consisted of 147 third and fourth grade students. For data collection, the basic skills scale with 31 items was administered to the participants. Third- and fourth-year students participated in the study. Frequencies and percentages were calculated and One-way analysis of multiple variances (MANOVA) were conducted to identify gender and grade level differences. For analysis, the SPSS 21.0 (Statistical Package for the Social Sciences) program was used. The results revealed that while there was no significant difference based on grade level, a significant difference was observed in favor of female students in terms of scientific process skills.

Keywords: Elementary school, science circula, scientific process skill.

Öz
Ülkemizdeki fen bilimleri dersi programlarının yapılandırmacılığa uygun biçimde hazırlanmasıyla birlikte bilimsel süreç becerileri de ayrı bir önem kazanmıştır. Günümüze kadar yapılan Fen Bilimleri dersi programları incelendiği zaman bilimsel süreç becerilerinin ya ayrı bir öğrenme alanı olarak değerlendirildiği ya da alana özgü beceriler şeklinde sınıflandırıldığı görülmektedir. Bu bağlamda bilimsel süreç becerileri, öğrenme sürecinde öğrencilerin aktif olarak yer aldıkları, kendi yaş seviyelerine uygun biçimde araştırma yapmalarına olanak sağlayan ve dolayısıyla bilimi öğrenmeye ilişkin beceriler olarak tanımlanabilir. Bu becerilere sahip bireyler, bilimsel olarak bir araştırmanın nasıl yapılması gerektiğinin farkına varır ve günlük yaşamda da edindikleri bu becerileri kullanarak karşılaştıkları problemleri çözerler. Bu açıdan bilimsel süreç becerilerinin öğrencilere erken yaşlardan itibaren öğretilmesi büyük önem arz etmektedir. Bu araştırmada bu noktadan hareketle, ilkokul 3. ve 4. sınıf öğrencilerinin bilimsel süreç becerilerinin belirlenmesi amaçlanmıştır. Öğrencilerin bilimsel süreç becerilerini belirlemek amacıyla 31 maddelik "Temel Bilimsel Süreç Becerileri Ölçeği" kullanılmıştır. Araştırmaya üçüncü ve dördüncü sınıf öğrencileri katılmıştır. Araştırmadan elde edilen verilerin analizi için frekans (f) ve yüzde (%) testlerinin yanı sıra sınıf seviyeleri ve cinsiyet değişkeni açısından karşılaştırma yapmak amacıyla da tek yönlü çoklu varyans analizi (MANOVA) kullanılmıştır. Verilerin istatistiksel analizleri için SPSS 21.0 (Statistical Package for the Social Sciences 21.0) programı kullanılmıştır. Araştırmanın sonuçları incelendiğinde sınıf seviyesi değişkeni bakımından anlamlı farklılığa ulaşılmazken cinsiyet değişkeni açısından kız öğrenciler lehine anlamlı farklılığa ulaşılmıştır.

Anahtar kelimeler: Bilimsel süreç becerileri, cinsiyet, ilkokul.

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INTRODUCTION

Due to the increase in scientific knowledge and technological innovations, the importance of science has emerged while resulting in people to experience those knowledge and innovations in their lives more effectively. While societies follow up the scientific developments, they also attempt to provide their students with scientific skills in their schools under the science courses (Aydoğdu & Kesercioğlu, 2005). In this context, with the changes made in the education programs of our country, it is aimed to provide students with scientific process skills MEB, 2005, 2013). Scientific process skills are the skills that should be acquired from an early age that help students think rationally, ask meaningful questions and seek answers to these questions, and cope with problems they encounter in daily life (German, 1994). It is expected from individuals with these skills to realize the phases of scientific research and to use these skills to solve problems they encounter (Çepni & Çil, 2009).

Although there exist various classifications in scientific process skills in the literature, they are generally grouped as basic and high level skills (Saat, 2004; Germann, 1994). Basic skills include observing, classifying, communicating, measuring, using numbers, making inferences and predicting, high-level skills can be classified as hypothesizing, controlling variables, interpreting data, creating models, and experimenting (Kaya, 2017). In order for students to gain high-level skills, it is critical to enhance their basic skills at early ages from pre-K to 4 (Çelik, 2013). With the effective use of such skills in learning environments, students can directly participate in the scientific process and improve themselves in many ways, which was proved in the literature. According to the findings of the studies, scientific process skills have positive association with scientific creativity (Aktamış & Ergin, 2007), reading comprehension levels (Özdemir, Özdemir & Parmaksız, 2016), students' reflection skills and level of conceptual changes (Yıldırım, 2012), and academic achievement and attitudes towards science (Öztürk, 2008).

Gaining scientific process skills from an early age contribute to the development of various skills and the advancement in these skills, students are expected to follow scientists' paths while increasing their positive attitude towards science from an early age (Kaya, 2017). In order to achieve this goal, it is necessary to determine students' scientific process skills level from an early age and to develop these skills by using them effectively in educational environments. To this end, this study aims to determine third and fourth grade students' scientific process skills (SPS) and addresses the following research questions:

1. What are the third and fourth grade students' scientific process skills?
2. Is there any difference in third and fourth grade students' scientific process skills in terms of gender?
3. Is there any difference in third and fourth grade students' scientific process skills in terms of grade level?

METHOD

Research Model

This study was designed based on non-experimental quantitative design-survey method (Johnson & Onwuegbuzie, 2004). Survey method is a research approach that aims to describe past or present situations as they are, to compare the relationship between variables, and to collect data in a specific time period (Karasar, 2000). The event, individual or object subject to the research is tried to be defined in its own conditions in the survey method (Karasar, 2009). And also, this method is the work carried out by collecting data to determine certain characteristics of a group (Büyüköztürk, Kılıç Çakmak, Erkan Akgün, Karadeniz ve Demirel, 2012).

Participants

In order to retrieve participants, simple random sampling method was employed. A total of 147 participants were recruited from three different schools located in Elazığ, Turkey. Demographic information about the participants is given in Table 1.

Table 1. Demographic Information About the Participants

Variable		*f*	*%*
Gender	Female	*70*	*47,6*
	Male	*77*	*55,4*
Grade level	3rd grade	*68*	*46,3*
	4th grade	*79*	*53,7*

Data Collection Tool

For data collection, the basic process skills questionnaire (BSQ) was administered to the participants. The questionnaire was developed by Padilla, Cronin and Twiest (1985) and translated into Turkish by Aydoğdu and Karakuş (2015). It consists of 31 items with six factors: observation (five items), classification (five items), inference (five items), measurement (five items), estimation (six items), and communication (five items). The percentage of agreement between the original and translated version of the scale was 0.92. The scale for language validity was translated into Turkish by 3 experts and was administered to 3th, 4th, and 5th grade primary school students (n=447) in 6 different elementary schools by Aydogdu&Karakuş (2015). The reliability coefficient of the questionnaire (KR –20) was found to be 0.83 and the average difficulty of the scale as 0.55.

Data Analysis

In the analysis of demographic information, percentages and frequencies were calculated. One-way analysis of multiple variances (MANOVA) was used to compare the grade levels and gender variable. The assumptions (sample size, normality, extreme values, linearity, multiple linearity and singularity, and homogeneity of variance and covariance matrices) required for one-way multiple variance analysis were checked and it was observed that there were no violations. In addition to looking at assumptions about normality such as Kolomogorov-Smirnov test, skewness and kurtosis values (-2.0- + 2.0), the sample number of each cell is accepted as a sign of robustness of the analysis results and parametric tests can be performed (George & Malley, 2003; Tabackhick & Fidell, 2007). Also, the p values obtained for Box's M (17.5 for grade levels and 31.74 for gender) are calculated >.05 (.728 for grade levels and .085 for gender). In addition, Mahalanobis distance value was found below the critical value. SPSS 21.0 statistics program was used for data analysis.

FINDINGS

In this section, the results of the analyses are provided.

Table 2**.** Descriptive Results of Third And Fourth Grade Students' BSQ

Sub-dimensions	N	$\overline{X}$	**s**d
Measurement	147	2,60	,99
Observation	147	3,51	1,32
Estimation	147	4,38	1,27
Classification	147	2,86	1,03
Inference	147	2,22	1,07
Communication	147	3,15	1,49

According to the results, the lowest mean scores for sub-dimensions of the BSQ belong to the inference sub-dimension ($\overline{X}$=2.22) and the highest mean scores were obtained for the estimation sub-dimension ($\overline{X}$=4.38).

Table 3. Descriptive Results Based On Gender

Sub-dimensions	Gender	N	$\overline{X}$	**s**d
Measurement	Female	70	2,72	,96
	Male	77	2,49	1,00
Observation	Female	70	3,85	1,13
	Male	77	3,20	1,41
Estimation	Female	70	4,77	,99
	Male	77	4,03	1,39
Classification	Female	70	3,05	,88
	Male	77	2,68	1,12
Inference	Female	70	2,58	,97
	Male	77	1,89	1,05
Communication	Female	70	3,44	1,47
	Male	77	2,89	1,48

The results revealed that female participants had higher scores comparing with male students. Among the sub-dimensions, the participants had the highest mean score for the estimation sub-dimension ($\overline{X}$ = 4.55) and the lowest mean score for the inference ($\overline{X}$ = 2.235).

Table 4. Results Of The MANOVA Test Based On Gender

Effect	Wilk's Lambda	F	Hypothesis df	Error df	p	Partial eta square	Observed power
Intercept	,049	449,950	6,000	140,000	,000	,951	1,000
Group	,848	4,194	6,000	140,000	,001	,152	,975

* The mean difference is significant at the.05 level.

** Design. Intercept + Group

Table 5. Results For The Test Of Between-Subjects Effects Based On Gender Variable

Source	Dependent variable	df	F	p	Partial eta square	Observed power *
Intercept	Measurement	1	1027,617	,000	,876	1,000
	Observation	1	1100,004	,000	,884	1,000
	Estimation	1	1899,844	,000	,929	1,000
	Classification	1	1167,765	,000	,890	1,000
	Inference	1	711,229	,000	,831	1,000
	Communication	1	675,124	,000	,823	1,000
Group	Measurement	1	2,082	,151	,014	,300
	Observation	1	9,293	,003*	,060	,857
	Estimation	1	13,131	,000*	,083	,949
	Classification	1	4,182	,030*	,032	,587
	Inference	1	16,839	,000*	,104	,983
	Communication	1	5,023	,027*	,033	,605

*p<.05

When the results were examined in terms of the gender variable, except for the measurement sub-dimension, a statistically significant difference was observed in favor of female students in all sub-dimensions of BSQ with large effect (F (6,140) = 4.194; p = , 001; Wilk's Λ= .848; η^2 = .152). In terms of the measurement sub-dimension, despite the non-significant difference between female and male students' average scores, a small effect size difference was found in favor of female students (F (1, 145) = 2,082; p =, 151; η^2 = .014). For the other sub-dimensions, there was a medium level effect size for the observation (η^2:,060); a medium-large effect size for the estimation (η^2: ,083) and the inference (η^2: ,104); and small-medium effect size for the classification (η^2: ,032) and the communication (η^2: ,033) sub-dimensions.

Table 6. Descriptive Results Based On Grade Level

Sub-dimensions	Grade level	N	$\overline{X}$	sd
Measurement	Grade 3	68	2,73	,98
	Grade 4	79	2,49	,98
Observation	Grade 3	68	3,72	1,23
	Grade 4	79	3,34	1,38
Estimation	Grade 3	68	4,54	1,11
	Grade 4	79	4,25	1,39
Classification	Grade 3	68	2,82	,96
	Grade 4	79	2,89	1,09
Inference	Grade 3	68	2,30	,99
	Grade 4	79	2,15	1,13
Communication	Grade 3	68	3,14	1,52
	Grade 4	79	3,16	1,48

According to the results, the lowest mean scores for sub-dimensions of the BSQ belong to the inference sub-dimension ($\overline{X}$=2.30 for third grade and $\overline{X}$= 2.15 for fourth grade) and the highest mean scores were obtained for the estimation sub-dimension ($\overline{X}$=4.54 for third grade and $\overline{X}$= 4.25 for fourth grade).

Table 7. Results of The MANOVA Test Based on Grade Level

Effect	Wilk's Lambda	F	Hypothesis df	Error df	P	Partial eta square	Observed power
Intercept	,054	411,142	6,000	140,000	,000	,946	1,000
Group	,951	1,191	6,000	140,000	,315	,049	,458

* The mean difference is significant at the.05 level.

** Design. Intercept + Group

Table 8. Results for The Test of Between-Subjects Effects Based on Grade Level Variable

Source	Dependent variable	df	F	p	Partial eta square	Observed power *
Intercept	Measurement	1	1027,671	,000	,876	1,000
	Observation	1	1051,022	,000	,879	1,000
	Estimation	1	1754,006	,000	,924	1,000
	Classification	1	1118,893	,000	,885	1,000
	Inference	1	632,532	,000	,814	1,000
	Communication	1	644,766	,000	,816	1,000
Group	Measurement	1	2,194	,141	,015	,313
	Observation	1	3,024	0,84	,020	,408
	Estimation	1	1,919	,168	,013	,280
	Classification	1	,193	661	,001	,072
	Inference	1	,783	,378	,005	,142
	Communication	1	,005	,944	,000	,051

According to the results, no significant difference was observed between the third and fourth grade students' overall BSQ mean scores (F (6,140)= 1.191; p= .315; Wilk's Λ = .951; η^2 = .049). In terms of sub-dimensions, a small effect size difference was found in favor of third grade students in the measurement (F (1, 145)= 2,194; p= ,141; η^2= ,015); observation (F (1,145)= 3,024; p=,084; η^2= ,020), and estimation (F (1,145)= 1,919; p=,168; η^2= ,013). On the other hand, there was no significant difference observed in the other sub-dimensions of BSQ between the third and fourth grade students.

CONCLUSION, DISCUSSION AND SUGGESTIONS

Present results showed that inference sub-dimension ($\overline{X}$=2.22) was the lowest mean scores while estimation sub-dimension ($\overline{X}$=4.38) was highest mean scores in the third and fourth grade students' BSQ. It is important for science education to provide students with scientific process skills, which are expressed as skills used in creating knowledge, thinking on problems, and formulating results (Tan & Temiz, 2003). It has been demonstrated that specific science process skills programs significantly increased the level of using scientific process skills (Kurnaz & Kutlu, 2016). Also, based on the results, a statistically significant difference with large effect size was observed in favor of female students in all sub-dimensions of BSQ except for the measurement sub-dimension (p<.05). For the measurement sub-dimension, a small effect size was found in favor of female student's despite of the non-significant difference between female and male students' average scores. These results revealed that the scientific process skills levels of female students in third and fourth grades are at a higher level than boys. Similar results were found in the other studies conducted by Can and Uluçınar Sağır (2019), Özdemir, Özdemir, and Parmaksız (2016), and Zeidan and Jayosi (2015). Aydınlı (2007) compared female and male students in sixth, seventh and eighth grades in terms of their scientific process skills levels and found a significant difference in favor of female students. Zeidan and Jayosi (2015) stated that the results in favor of female students are because of that female students were more disciplined than male students. Can and Uluçınar Sağır (2019) stated that female students are more prone to science and scientists and have higher level of problem solving and scientific thinking skills. In addition, various biological and genetic differences of male and female students are considered as the cause of differences in school performance or learning abilities (Bassey & Amanso, 2017). Another critical finding is that medium-high effect size for the estimation and inference, medium effect size for the observation, and small size effect for the classification and communication sub-dimensions were observed. In a similar study, Also, Sabır (2016) found significant differences in favor of fifth grade female students for the observation, estimation, and classification sub-dimensions. These findings reveal that the perception of scientist in our society is not limited to males only and females can be effective in the field of science by using their scientific process skills efficiently. Therefore, it is suggested that girls should be supported through various activities that enables them to use their scientific skills from an early age (Sabır, 2016).

In this study, students' scientific skills were also examined in terms of grade level. The results revealed that there was no significant difference between the third and fourth grade students. In addition, small effect size was observed for the measurement, observation, and estimation sub-dimensions for the third-grade students. In other sub-dimensions, statistically and practically no difference was found between the third and fourth grade students. As seen in Table 6, although the arithmetic averages were relatively high in the observation and estimation sub-dimensions, the average scores for the other sub-dimensions were low. In a study conducted with third, fourth, and fifth graders by Aydoğdu in 2017, it was found that the basic scientific process skills of primary school students differ significantly according to their grade level. On the other hand, Hazır and Türkmen (2008) reported that fifth grade students' scientific process skill acquisition levels were below 50%. Specifically, Hazır and Türkmen (2008) stated that the reason for such low level may be due to elementary teachers perceiving themselves as inadequate in teaching scientific process skills, lack of sufficient time for activities, lack of equipment, and the curricula itself. However, Kalemkuş, Bayraktar & Kalemkuş (2008) found that 5th grade students have relatively high level for the skills of observation, prediction, classification and they demonstrated a moderate ability in inference. Kaya (2017) suggests that teachers should take into account students' development level while teaching scientific process skills and teaching observation, estimation, inference, classification, and communication skills should be taught at early ages. Kaya (2016) also examined the quality of the elementary school 3rd grade science textbook to determine whether it supports students' scientific process skills and found that although the textbook includes some activities to advance these skills, it is still insufficient to teach them. For this reason, it may be concluded that students may enhance some of those skills but there are deficiencies in materials, activities, and methods that will provide students with scientific process skills at an early age. In the literature, there exist studies that discuss various methods and activities that have a positive effect on the acquisition of scientific process skills. STEM (Atik, 2019), science teaching program (Yalçın & Şişman, 2018), science notebook (Arık, 2019) are some of the examples for the mentioned methods and activities. Accordingly, it is suggested that teachers must use various materials, activities, and methods to teach students scientific process skills from an early age.

REFERENCES

Aktamış, H., ve Ergin, Ö. (2007). Bilimsel süreç becerileri ile bilimsel yaratıcılık arasındaki ilişkinin belirlenmesi. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, 33(33), 11-23.

Arık, N. (2019). *İlkokul dördüncü sınıf fen bilimleri dersinde bilim defteri kullanılmasının etkilerinin çeşitli değişkenler açısından incelenmesi*. Yüksek Lisans Tezi, Marmara Üniversitesi, İstanbul.

Atik, A. (2019). *STEM etkinliklerinin bilimsel süreç becerileri üzerine etkisi: 5 yaş örneği*. Yüksek Lisans Tezi, Trabzon Üniversitesi, Trabzon

Aydınlı, E. (2007). *İlköğretim 6, 7 ve 8. sınıf öğrencilerinin bilimsel süreç becerilerine ilişkin performanslarının değerlendirilmesi*. Yüksek Lisans Tezi, Gazi Üniversitesi, Ankara.

Aydoğdu, 2017. A study on basic process skills of Turkish primary school students. *Eurasian Journal of Educational Research*, 67, 51-6.

Aydoğdu, B. ve Karakuş, F. (2015). İlkokul öğrencilerine yönelik temel beceri ölçeğinin Türkçe'ye uyarlama çalışması. *Mehmet Akif Ersoy Üniversitesi Eğitim Fakültesi Dergisi,* 1 (34), 105-131.

Aydoğdu, M. ve Kesercioğlu, T. (2005). *İlköğretimde fen ve teknoloji öğretimi. Ankara*: Anı Yayıncılık.

Bassey, A.B. and Amanso, E. O. I. (2017). Assessing students' gender, school type and science process skills acquisition of senior secondary schools students in Calabar education Zone, Cross River State, Nigeria. *International Journal of Education and Evaluation*, 3(4), 19-25.

Büyüköztürk, Ş., Çakmak, E. K., Akgün, Ö. E., Karadeniz, Ş. & Demirel, F. (2012). *Bilimsel araştırma yöntemleri* (10. Baskı). Ankara: Pegem A Yayıncılık.

Can, K., ve Uluçınar Sağır, Ş. (2019). İlkokul 4. sınıf öğrencilerinin bilimsel süreç becerilerinin incelenmesi. *Electronic Journal of Social Sciences*, *18* (71), 145-1556.

Çelik, P. (2013). *Probleme dayalı öğrenmenin öğretmen adaylarının fizik dersi başarısı, öğrenme yaklaşımları ve bilimsel süreç becerileri üzerindeki etkisi.* Yayınlanmamış Doktora Tezi, Dokuz Eylül Üniversitesi, İzmir.

Çepni, S., ve Çil, E. (2009). *Fen ve teknoloji programı ilköğretim 1. ve 2. kademe öğretmen el kitabı*. Ankara: Pegem A Yayınları.

Germann, P. J. (1994). Testing a model of science process skills acquisition: an interaction with parents' education, preferred language, gender, science attitude, cognitive development, academic ability, and biology knowledge. *Journal of Research in Science Teaching*, 31(7), 749-783.

George, D. & Mallery, S. (2003). *SPSS for Windows step by step a simple guide and reference 11.0 update* (4th Ed.). Boston, MA: Pearson Education

Hazır, A., Türkmen, L. (2008). İlkokul 5. Sınıf öğrencilerinin bilimsel süreç beceri düzeyleri. *Selçuk Üniversitesi Ahmet Keleş Eğitim Fakültesi Dergisi*, 26, 81-96.

Johnson, R. B. & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigma whose time has come. *Educational Researcher*, *33*(7), 14-26.

Kalemkuş, J., Bayraktar, Ş. & Kalemkuş, F. (2016). Determining and comparing the science process skill levels of 5th and 8th grade students. *The Eurasia Proceedings of Educational & Social Sciences (EPESS),* 4, 79-83.

Karasar, N. (2000). *Bilimsel araştırma yöntemi* (10. Baskı). Ankara: Nobel Yayınları.

Karasar, N. (2009). Bilimsel araştırma yöntemi (19. Baskı). Ankara: Nobel Yayın Dağıtım.

Kaya, E. (2016). İlkokul 3. *sınıf fen bilimleri ders kitabının yapılandırmacılık ve bilimsel süreç becerilerini geliştirmesi açısından incelenmesi.* Yüksek Lisans Tezi, Adıyaman Üniversitesi Sosyal Bilimler Enstitüsü. Adıyaman

Kaya, S. (2017). *Fen bilimleri içeriği ve bilimsel süreç becerileri. (*Çocuk Bilim ve Teknoloji, içinde 86-110), Eskişehir: Anadolu Üniversitesi.

Kurnaz, F. B. ve Kutlu, Ö. (2016). İlkokul 4. sınıf için hazırlanan bilimsel süreç becerileri programının etkililiğinin belirlenmesi. *İlköğretim Online*, 15(2), 529-547.

MEB (2005). *İlköğretim Fen ve Teknoloji dersi öğretim programı ve kılavuzu*. Ankara, Türkiye: Devlet Kitapları Müdürlüğü.

MEB, (2013). *İlköğretim kurumları fen bilimleri dersi öğretim programı*. Ankara: Milli Eğitim Bakanlığı.

Özdemir, M., Özdemir, O. ve Parmaksız, R. Ş. (2016). İlkokul öğrencilerinin bilimsel süreç becerilerinin ve okuduğunu anlama düzeylerinin incelenmesi. *Turkish Studies - International Periodical for the Languages, Literature and History of Turkish or Turkic*, 11(3), 1829-1848.

Öztürk, N. (2008). *İlköğretim 7. sınıf öğrencilerinin fen ve teknoloji dersinde bilimsel süreç becerileri kazanma düzeyleri.* Yüksek Lisans Tezi, Osmangazi Üniversitesi, Fen Bilimleri Enstitüsü, Eskişehir.

Padilla, M., Cronin, L., & Twiest, M. (1985). The development and validation of the test of basic process skills. *Paper presented at the Annual Meeting of the National Association for Research in Science Teaching, French Lick, IN*.

Saat, R. M. (2004). The acquisition of integrated science process skills in a web-based learning environment. *Research in Science ve Technological Education*, 22(1), 23- 40.

Sabır, A. (2016). *İlköğretim 4. ve 5. sınıf öğrencilerinin bilimsel süreç becerilerine etki eden faktörlerin incelenmesi*. Yüksek lisans Tezi., Mustafa Kemal Üniversitesi, Hatay.

Tabachnick, B. G. & Fidell, L. S. (2007). Using multivariate statistic. Boston, MA: Pearson Education, Inc.

Tan, M. ve Temiz, B. K. (2003). Fen öğretiminde bilimsel süreç becerilerinin yeri ve önemi. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi,* 13, 89-101.

Yalçın, H. ve Şişman, Z. B. (2018). Keşif ve sorgulama temelli bilim öğretimi programının 10-12 yaş çocukların bilimsel süreç becerilerine etkisi. *Uluslararası Eğitim Bilim ve Teknoloji Dergisi*, 4(2), 83-96.

Yıldırım, C. (2012). *Bilimsel süreç becerileri etkinliklerinin ilköğretim 7. sınıf öğrencilerinin yansıtıcı düşünmelerine etkisi*. Yüksek lisans tezi, Pamukkale Üniversitesi Fen Bilimleri Enstitüsü, Denizli.

Zeidan, A. H. & Jayosi, M.R. (2015). Science process skills and attitudes toward science among Palestinian secondary school students. *World Journal of Education*, 5(1), 13-24.