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Exploration of the Factors Influential on the Scientific Literacy Achievement of Turkish Students in PISA*

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Abstract - The purpose of this study is to make a systematic examination of the results of those studies that have explored the variables associated with the scientific literacy achievement of Turkish students in PISA 2003, 2006 and 2009 (Programme for International Student Assessment) and to determine whether such studies have obtained any generalizable and consistent results in regard to the relationships between these variables and achievement. Document analysis, which is a qualitative research method, was used in this study. The research sample consisted of 23 national studies in this field. It was observed that these studies determined a positive relationship between parental educational level and student achievement in scientific literacy. Likewise, it was reported that there was a positive relationship between attitude towards science and student achievement and that female students are more successful in scientific literacy. Moreover, the examined studies showed that there was a positive relationship between devoted time for learning and scientific literacy.success.

Key words: PISA, scientific literacy, student success, science education.

Introduction

Tests such as Trends in International Mathematics and Science Study (TIMSS) and Programme for International Student Assessment (PISA) that are conducted at certain intervals allow countries taking part in them to compare the performance levels of their students in the field of science or mathematics with those of students from other countries, and to assess the effectiveness of their curricula. Education is a multidimensional process. Thus, the studies dealing with student achievement in education must take various variables (e.g. psychological factors, sociocultural difference, family structure, economic condition) into consideration.

PISA is a multidimensional survey study that explores student achievement by use of student, school, and computer use questionnaires besides test items. PISA projects are a beneficial instrument that can be used for enhancing equation, quality, and productivity in

education in that they explain certain common features of schools, students, and education systems (Schleicher, 2007).

PISA is an educational project that involves surveys for an international assessment of the knowledge and skills acquired by students in the age group of 15 attending formal education (Basusta, 2013). The primary objective of PISA assessments is to determine the degree to which students can use the knowledge they have in solving the problems they are likely to come across in their daily lives. PISA project is held through the agency of OECD (Organization for Economic Co-operation and Development) and with the cooperation of the governments of member countries. Within the scope of this project, data are collected about subject areas such as mathematical literacy, scientific literacy, and reading skills as well as student motivation, learning styles, school environments, student views about themselves, and students' families. PISA is held at three-year intervals and focuses on a particular subject area in each period. The first implementation in 2000 focused on reading skills, the second implementation in 2003 on mathematical literacy, the third implementation in 2006 on scientific literacy, the fourth implementation in 2009 on reading skills, and the most recent implementation in 2012 on mathematical literacy (OECD, 2013). Turkey has been participating in this test since 2003.

In the current age, we are experiencing a fast development and progress in science and technology. In the globalized world, educating individuals who have scientific literacy to keep pace with the fast developments and progress in science and technology has become one of the most important objectives of science curricula. Literacy is defined as students' capacity to use their knowledge in their daily lives, make logical deductions, and make inferences from what they have learned to interpret and solve problems related to certain situations (Ministry of National Education [MONE Turkey], 2010; OECD, 2013). Scientific literacy, on the other hand, refers to the scientific knowledge an individual has; the use of such knowledge to define questions, to acquire new knowledge, to explain scientific phenomena, and to draw conclusions based on evidence on subjects related to science; the understanding of the characteristic features of science for acquiring knowledge and searching; noticing the way science and technology shapes our material, intellectual, and cultural environments; and paying attention to scientific issues and scientific ideas as a conscious citizen (MONE, 2010; OECD, 2013). Our scientific literacy achievement field of the PISA projects is important in that it indicates to what extent our country has achieved its vision of scientific literacy in comparison to other countries in the world (Boztunc, 2010). The scientific literacy average of Turkey has been below the average

of OECD countries (500 points) in all the PISA assessments made every 3 years since 2003 (Table 1).

Table 1 The scientific literacy means of Turkey in PISA 2003, 2006, 2009, & 2012

	PISA 2003	PISA 2006	PISA 2009	PISA 2012
Scientific literacy averages	434.64	424.03	455.45	463

The studies exploring the variables associated with the success of students in PISA literacy (e.g. socio-economic status [SES], sociocultural status, family characteristics, attitude towards lessons, interest, self-efficacy, self-confidence) are quite important for the determination of those factors that are influential on the scientific literacy achievement of students in Turkey. In addition, research to be conducted by use of data related to PISA assessments in different years may contribute to the generalizability of the results concerning the factors associated with success. In this regard, a considerable number of studies have been conducted in Turkey based on PISA data. However, the results of these studies may vary. Thus, to understand and generalize the results better, the results of the studies carried out should be examined systematically. The purpose of the current study is to make a systematic examination of the results of those studies that have explored the variables associated with the scientific literacy success of Turkish students in PISA and to determine whether such studies have obtained any generalizable and consistent results in regard to the relationships between these variables and success.

Methodology

Document analysis, which is a qualitative research method, was employed in this study. The research sample consisted of 23 national studies (studies conducted in Turkey) in which the achievement levels of students in scientific literacy were assessed based on PISA 2003, 2006 and 2009 data, and the variables influential on the scientific literacy achievement of students were investigated. The study is limited to the studies accessed over the Internet. The studies analyzed within the scope of the present study were accessed by entering the keywords about PISA in various databases such as Google Scholar, Taylor and Francis Online Library, Willey Online Library, Springer, Turkish Academic Network and Information Center, Academia Social Science Index, Index of Turkish Education, and The Council of Higher Education of the Republic of Turkey. The accessed articles and theses were evaluated through

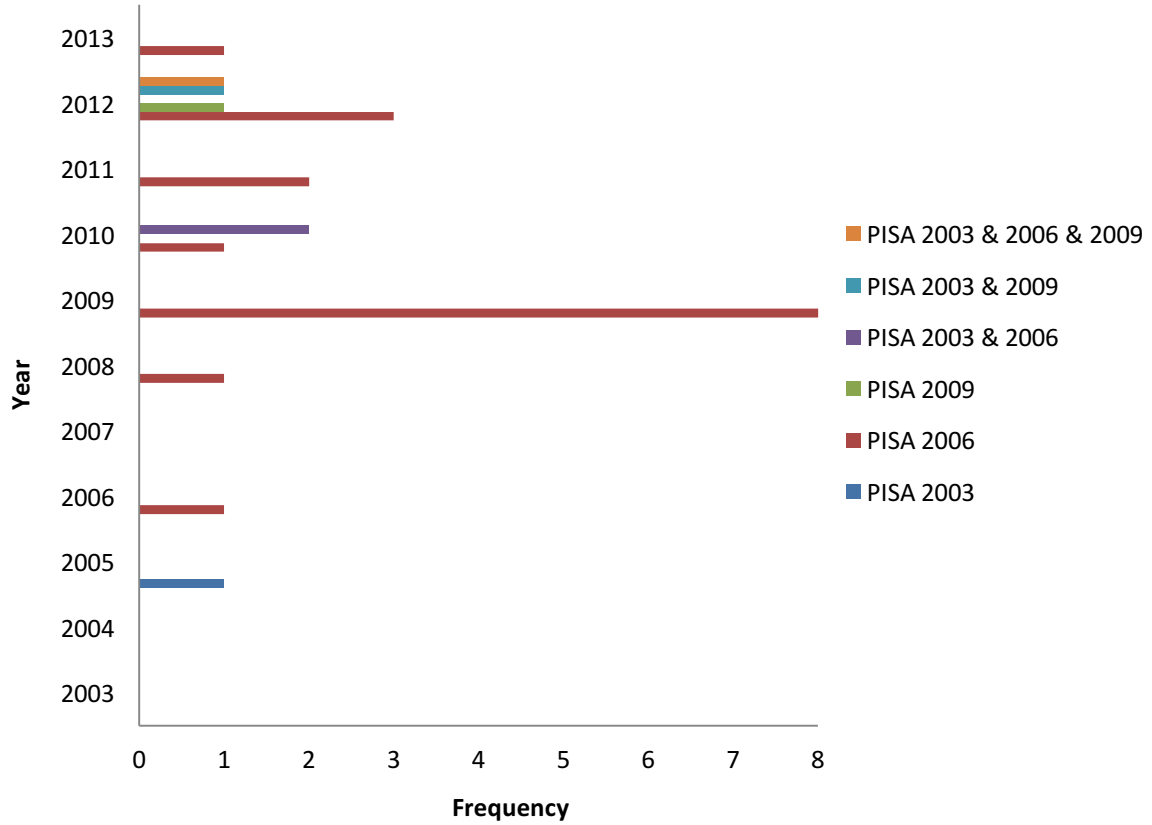
document analysis. SPSS 16 and Excel were used in the analyses. The distribution of the analyzed documents by type is given in the table below (Table 2).

Table 2 Types of The Examined Documents in This Research

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	PhD thesis	2	8.7	8.7	8.7
	Master thesis	7	30.4	30.4	39.1
	Article	14	60.9	60.9	100,0
	Total	23	100,0	100,0	

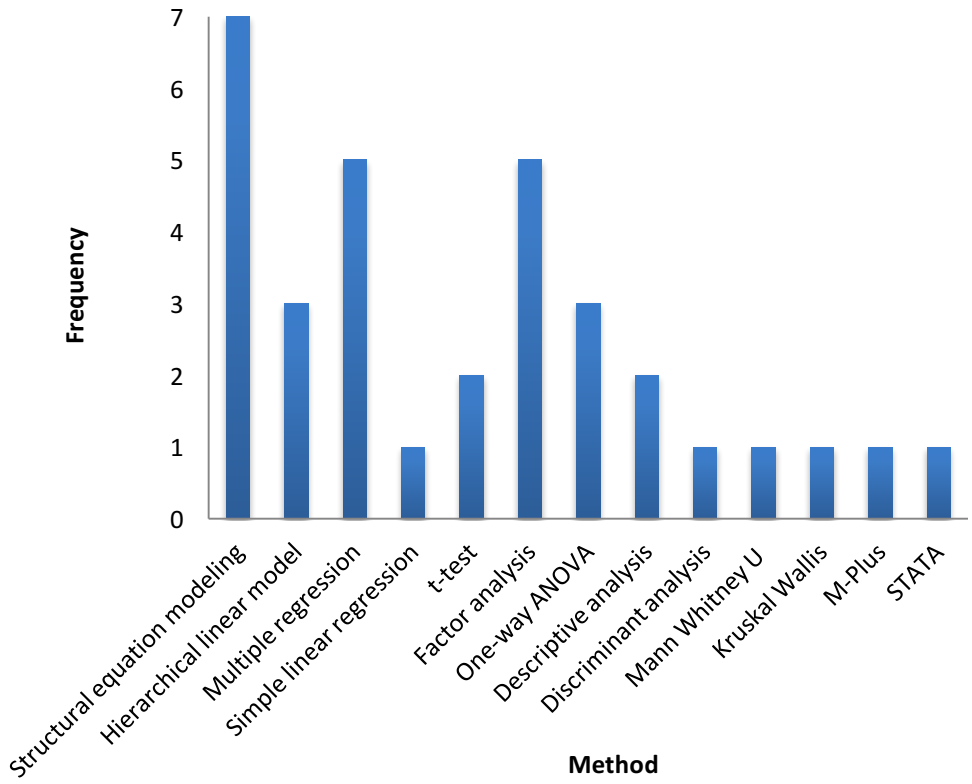
Results

The findings show that 2009 was the year when the most attention was focused on research of the factors associated with the scientific literacy achievement of students in Turkey. The number of publications decreased in the following years, and then increased again in 2012 (Graph 1).



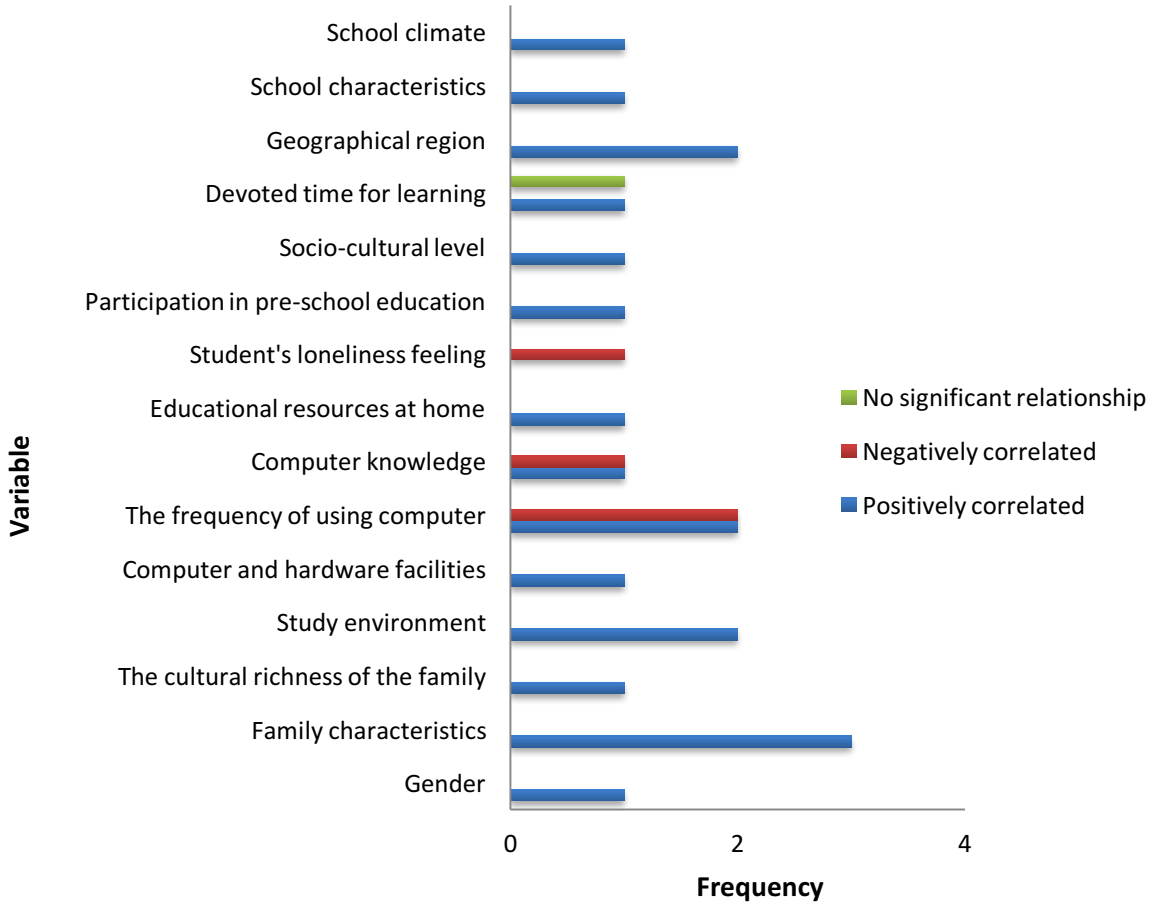
Graph 1 The Distribution of Researches Conducted in Turkey About Factors Releated Students' Scientific Literacy Achievement Success in PISA

Structural equation modeling was seen to be the data analysis method used most in the studies carried out (Graph 2).



Graph 2 The Distribution of Data Analysis Methods Used in Researches Conducted in Turkey About Factors Releated Students' Scientific Literacy Achievement in PISA

In the studies based on PISA 2003 data, researchers reached consensus on the fact that there was a positive relationship between family characteristics (e.g. parental educational level, the number of books in the house) and the scientific literacy achievement of students (Graph 3). Among family characteristics, parental educational level was the variable most influential on the students' scientific literacy achievement. Research findings indicate that as parental educational level (Boztunc, 2010; Karabay, 2012; Sasmazel, 2006) and the number of books in the house (Erbas, 2005; Sasmazel, 2006) increased, the students' scientific literacy achievement rose. Similarly, researchers reported that there was a positive relationship between student achievement and the geographical region where the student lived, and the study environment s/he had in his/her house (e.g. having his/her own room, having his/her own table, and having a quiet environment to study).

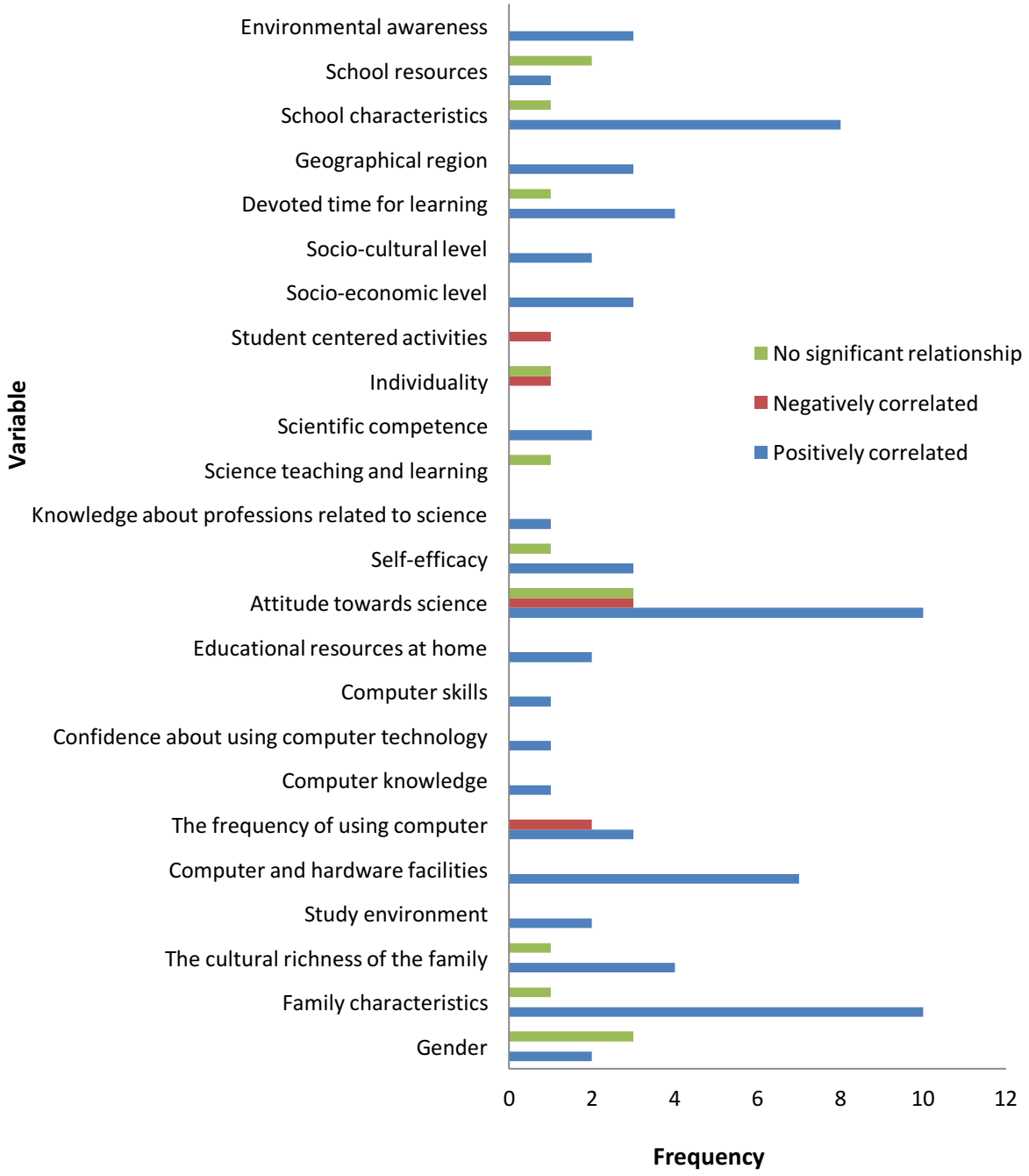


Graph 3 Results of Studies on Students' Scientific Literacy Achievement Conducted by Using PISA 2003 Data from Turkey

Data show that the students living in the Eastern Anatolian Region and the Southeastern Anatolian Region achieved lower science literacy scores in comparison to those living in other regions (Gumus & Atalmis, 2012; Sarier, 2010). In addition, it was stated that the students who have their own room or table and a quiet environment to study weret more successful than others (Boztunc 2010; Karabay, 2012).

The examined studies also identified variables having both positive and negative relationships with the scientific literacy achievement of students, for example frequency of using a computer.. The studies indicated that there was a positive relationship between the educational use of computer and scientific literacy achievement. As a student's frequency of computer use for this purpose increased, an increase occurs in his/her scientific literacy achievement. (Boztunc, 2010; Erbas, 2005). On the other hand, researchers stated that there was a negative relationship between the use of computer programs for entertainment and student achievement (Boztunc, 2010; Erbas, 2005).

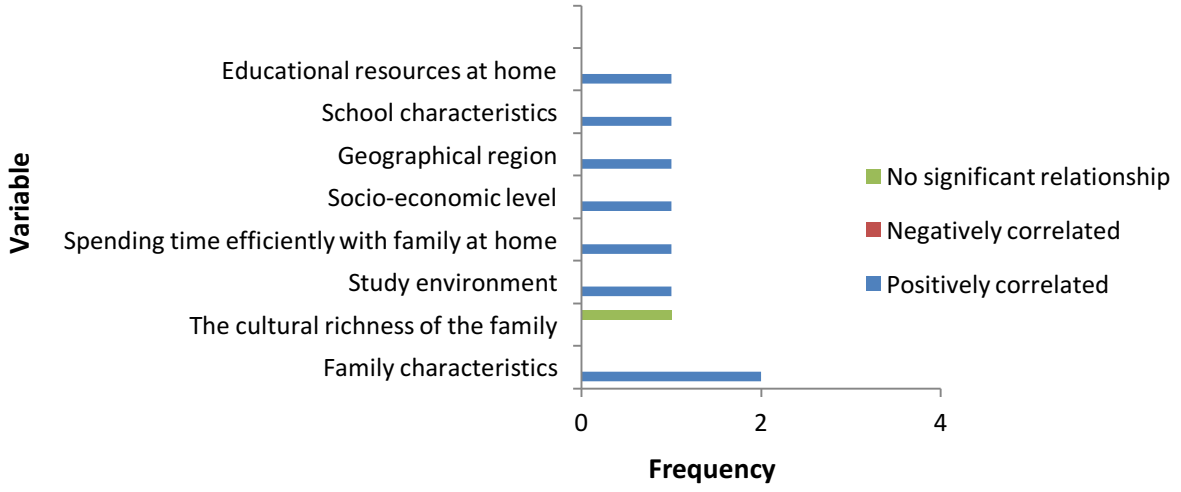
Regarding the studies based on PISA 2006 data, researchers generally agreed that there was a positive relationship between parental educational level, which was one of family characteristics, and students' scientific literacy achievement (Anil, 2009; Boztunc, 2010; Dincer & Kolasin, 2009; Karabay, 2012; Ozer & Anil, 2011; Ozer, 2009; Tomul & Celik, 2009; Yildirim, 2012) (Graph 4). Likewise, researchers mostly reported a positive relationship between student achievement and student attitude towards science, computers and hardware facilities in the house, devoted time for learning, and gender.



Graph 4 Results of Studies on Students' Scientific Literacy Achievement Conducted by Using PISA 2006 Data from Turkey

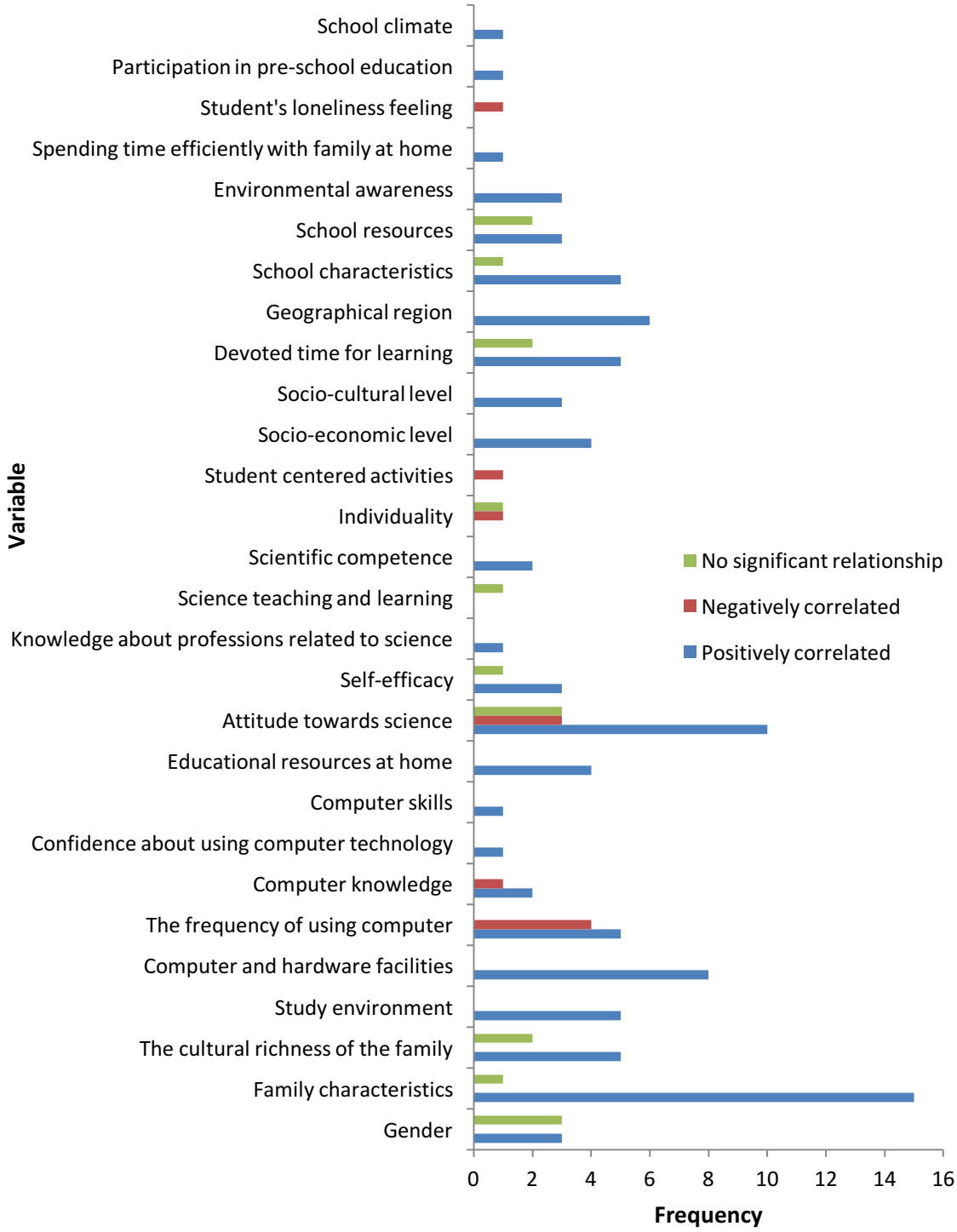
The separate examination of the components of student attitude towards science indicates that, among these variables, attitude towards science, taking pleasure in science, and the importance attached to scientific inquiry had a positive relationship with scientific literacy achievement (Anil, 2009; Celebi, 2010); whereas the variable of believing in the usefulness of science had a negative relationship with scientific literacy achievement (Ozel, Caglak, & Erdogan, 2013). While some studies suggested that there was a positive relationship between scientific literacy achievement and the value attached to science and motivation for science (Ozel et al., 2013), some other studies reported that there was no significant relationship between them (Caliskan, 2008; Usta, 2009). Research findings show that as student attitude towards science (Anil, 2009; Ceylan, 2009) and devoted time for learning (Anagun, 2011; Ozer, 2009; Ozer & Anil, 2011) increased, a rise occurred in scientific literacy achievement. In addition, it was reported that the availability of computer and hardware facilities (computers, computer programs, and internet access) for students had a positive influence on scientific literacy achievement (Anil, 2009; Anil & Ozer, 2012; Boztunc, 2010; Ozer & Anil, 2011). Research findings indicated that female students were generally more successful than male students (Albayrak, 2009; Ozer, 2009; Sarier, 2010).

In the studies based on PISA 2009 data, researchers mostly agreed that there wasw a positive relationship between family characteristics and scientific literacy success of students (Karabay, 2012; Yalcin, Aslan, & Usta, 2012). On the other hand, it was reported that there was no significant relationship between the cultural richness of the family (having literary works, poetry books, and art objects) and the success of their child (Karabay, 2012) (Graph 5).



Graph 5 Results of Studies on Students' Scientific Literacy Achievement Conducted by Using PISA 2009 Data from Turkey

When all the studies based on PISA 2003, PISA 2006, and PISA 2009 data related to Turkey are taken together, it is seen that the point on which researchers reached the highest level of agreement was the existence of a positive relationship between family characteristics (e.g. parental educational level, the number of books in the house) and student achievement (Graph 6).



Graph 6 Results of All Studies on Factors Related to Turkish Students' Scientific Literacy Achievement.

In a similar vein, researchers generally stated that there was a positive relationship between student achievement and computer and hardware facilities in the house, geographical region, and attitude towards science. Additionally, researchers agreed that there was a negative relationship between student success and frequency of using computer programs (Anil & Ozer, 2012; Boztunc, 2010; Erbas, 2005).

Conclusion and Discussion

The purpose of this study was to make a systematic examination of the results of those studies that have explored the variables influential on the achievement of Turkish students in PISA scientific literacy, to present the information that has been suggested by such studies so far, and to light the way for future studies on this subject. The examined studies were seen to provide consistent results in regard to certain variables. For example, researchers mostly reported a positive relationship between family characteristics and student achievement (Graph 6). The studies revealed that the mother's educational level and professional status were more influential on student achievement when compared to the father's educational level and professional status (Sasmazel, 2006). Both the studies based on PISA 2003 data and the studies based on PISA 2006 data indicated that those students who have a mother graduated from a high school, a vocational school of higher education, an undergraduate program, or a graduate program had a scientific literacy achievement level greater than the average of Turkey; while those students who had a mother who had completed apprenticeship training, middle school education, or primary school education or had not finished primary school had a scientific literacy achievement level below the average of Turkey. According to the report of the research conducted by the Republic of Turkey Ministry of Family Research Institution in 1995, as the mother's educational level and economic level increased, the rate of helping the child (the student) also increased; and as the mother's educational level increased the rate of buying a newspaper or magazine for the house and rate of dealing with the child (the student) one-to-one also increased (Boztunc, 2010). In Turkey, children spend most of their time with their mothers. Thus, it is not surprising that mother's educational level was found to be more influential on student success in comparison to that of the father. The reason for the relationship between parental educational level and student success may be that parents with a higher educational level deal with their children more consciously, and parents with a higher socio-economic level provide their children with better opportunities. These results are consistent with the results of

the research carried out in countries other than Turkey (Fush & Wössmann, 2006; Woessman, 2004).

In a similar way, research findings indicated that researchers generally thought that there was a positive relationship between the computer and educational opportunities in the house and student achievement (Graph 6). The related literature shows that there was a positive relationship between the use of computer for education and communication in the house and student achievement. Moreover, when socio-economic influences are disregarded, students having internet connection in their houses were reported to be more successful than those who did not have any internet connection in their houses (Fuchs & Woessman, 2004). Based on PISA 2006 data, when the frequency of the availability of the variables making up “”computer environment was taken into consideration, it was found that a majority of the students in the age group of 15 in Turkey did not have any computer which they could use for their lessons and homework (60%), did not have any computer programs for education (73.3%), and did not have any internet connection (74%) (Anil, 2009). Accordingly, it is thought that the scientific literacy achievement of Turkish students could be affected by this situation to a considerable extent (Anil, 2009; Boztunc, 2010; Ozer & Anil, 2011).

Research based on the results of PISA assessments for Turkey showed that female students were more successful in scientific literacy in comparison to male students (Albayrak 2009; Acar & Ogretmen, 2012; Ozer, 2009). It has been suggested that the low rate of schooling of female students, relative to the schooling of male students, especially in the Eastern Anatolian Region and the Southeastern Anatolian Region of Turkey could affect Turkey's success in PISA assessments (Sarier, 2010). Furthermore, research findings generally suggested that there was a positive relationship between students' levels of scientific literacy achievement and their attitudes towards science (Anil, 2009; Ceylan, 2009). The studies in the literature support this finding (Kahle, Meece, & Scantlebury, 2000). Likewise, research findings revealed that as a student's perception of self-efficacy in science increased, s/he becomes more successful in scientific literacy (Acar & Ogretmen, 2012; Albayrak, 2009; Calişkan, 2008; Celebi, 2010). The examined studies demonstrate that there weredifferent factors influential on students' attitudes towards science (e.g. motivation to learn science, belief in the usefulness of science, the value attached to science). However, there have been few studies dealing with these factors, and there may be a negative relationship between these factors and success. Therefore, examination of the dimensions related to attitude that are included in science questionnaires in

the framework of learning theories may allow more detailed information to be obtained about students' attitudes.

The findings of some studies conducted in Turkey suggested that as the number of books in the house, which is one of the indicators of cultural richness of the family, increased, an increase occurred also in scientific literacy achievement (Erbas, 2005; Ozer, 2009; Ozer & Anil, 2011; Sasmazel, 2006). What is more, the study environment (e.g. having one's own room, having one's own table, and having a quiet environment to study) was reported to be associated with scientific literacy achievement of students. It has been stated that those students who had their own rooms or tables in their houses and had a quiet environment to study were more successful than others (Boztunc 2010; Karabay, 2012). Also, a positive relationship was found between the socio-economic level and student achievement (Graph 6). It is thought that the study environment a student has in the house is associated with socio-economic level. The studies in the literature show that students with higher socio-economic levels had better conditions and thus better study environments (Fush & Wössmann, 2006; Geske, Grinfelds, Dedze, & Zhang, 2006). Though the results of the examined studies demonstrated that there was a positive relationship between devoted time for learning and scientific literacy success, they also implied that there may be a negative relationship between devoted time for learning and scientific literacy achievement of students if much time is spent using computer programs. However, the results of the studies dealing with this matter provide consistent results in that they show that there is a positive relationship between computer and hardware facilities and scientific literacy achievement. Regarding the relationship between the variables related to learning environments and success, research taking into account the interrelationships of these variables may contribute to a clearer understanding of the variables influential on scientific literacy achievement.

Finally, it must be remembered that the results obtained in regard to the variables examined in the studies which form the study group of the current study may have been influenced by the research designs, variables, and analyses employed in those studies. In terms of sampling, research on PISA assessments requires multilevel analyses such as hierarchical linear modeling and sampling weights (OECD, 2005; OECD, 2009; Rutkowski, Gonzalez, Joncas, & Von Davier, 2010). Because there is a big difference between the schools in Turkey in terms of achievement level, the analyses taking into account such differences may provide more accurate results. However, it is indicated in the literature that this issue has not been taken into consideration adequately (Drent, Meelissen, & Van Der Kleij, 2010). This may be the

reason for the diversity of the results obtained in regard to the examined variables. For this reason, employing appropriate analyses while exploring the relationship between success and the variables associated with PISA may allow more reliable results to be obtained.

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Türkiye'nin Pisa'daki Fen Başarısıyla İlişkili Faktörlerin İncelenmesi*

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Özet - Bu çalışmanın amacı, Türkiye'deki öğrencilerin PISA 2003, 2006 ve 2009 (Uluslararası Öğrenci Değerlendirme Programı) fen okuryazarlığı başarısı ile ilişkili olan değişkenleri araştırıldığı çalışma sonuçlarının sistematik bir şekilde incelenerek, bu değişkenler ve başarı arasındaki ilişkiler hakkında, eğer varsa, genelleme yapılmasına uygun, tutarlı sonuçların belirlenmesidir. Araştırmada nitel olarak yürütülmüş ve doküman analizi kullanılmıştır. Araştırmanın örneklemi bu alanda yapılan 23 ulusal çalışma oluşturmuştur. Araştırmacıların, anne-baba eğitim düzeyi değişkeni ile öğrencilerin fen okuryazarlığı başarısı arasında pozitif bir ilişki olduğunu tespit ettikleri gözlemlenmiştir. Benzer şekilde araştırmalarda, öğrenci karakteristiklerinden olan fene yönelik tutum ile öğrencilerin başarısı arasında pozitif ilişki olduğu ve kız öğrencilerin fen okuryazarlığı alanında erkeklerden daha başarılı oldukları rapor edilmiştir. İncelenen çalışma sonuçları öğrenmeye ayrılan zaman ile fen okuryazarlığı başarısı arasında pozitif bir ilişki olduğunu göstermiştir.

Anahtar Kelimeler: PISA, fen okuryazarlığı, öğrenci başarısı, fen eğitimi

Genişletilmiş Türkçe Özet

Giriş

İçinde bulunduğumuz çağda bilim ve teknoloji çok hızlı bir şekilde gelişmekte ve ilerlemektedir. Küreselleşen dünyada, bilim ve teknolojideki hızlı gelişim ve ilerlemeye ayak uydurabilecek fen okuryazarı bireylerin yetiştirilmesi, fen öğretim programlarının en önemli amaçlarından biri haline gelmiştir.

PISA, örgün eğitime devam eden 15 yaş grubu öğrencilerin kazandıkları bilgi ve becerilerin uluslararası düzeyde değerlendirilmesine yönelik taramaların yapıldığı bir eğitim projesidir (Başusta, 2013).

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OECD (Ekonomik İşbirliği ve Kalkınma Örgütü) aracılığı ve üye ülkelerin hükümetleri arasındaki işbirliği ile düzenlenen PISA projesinde; matematik okuryazarlığı, fen bilimleri okuryazarlığı, okuma becerileri konu alanları ile öğrencilerin motivasyonları, öğrenme biçimleri, okul ortamları, kendileri hakkındaki görüşleri ve aileleri ile ilgili veriler toplanmaktadır. Dolayısıyla uygulanan PISA projelerinin fen okuryazarlığı alanındaki başarımız; ülkemizin diğer dünya ülkelerine kıyasla bilim okuryazarlığı vizyonuna ne kadar ulaştığını göstermesi açısından önemlidir (Boztunç, 2010).

Ülkemiz bu sınava 2003 yılından itibaren katılmaya başlamıştır. Ancak ne yazık ki ülkemizin bilim okuryazarlığı ortalaması 2003 yılından itibaren her 3 yılda bir yapılan PISA uygulamalarının tamamında OECD ülkelerinin ortalamasının (500 puan) altında kalmıştır.

Öğrencilerin PISA sınavındaki fen okuryazarlığı alanındaki başarıları ile ilişkili değişkenlerin (sosyo-ekonomik statü (SES), sosyokültürel durum, aile karakteristikleri, derse karşı tutum, ilgi, öz-yeterlik ve özgüven vb.) araştırıldığı çalışmalar, ülkemizdeki öğrencilerin fen okuryazarlığı başarısı ile ilişkili faktörlerin tespit edilmesi açısından oldukça önemlidir.

Bu çalışmanın amacı, PISA fen okuryazarlığı ile ilişkili olan değişkenleri araştıran çalışmaların sonuçlarını sistematik bir şekilde incelemek ve bu değişkenler ve başarı arasındaki ilişkiler hakkında, eğer varsa, genellenebilir, tutarlı sonuçlar elde edilip edilmediğinin belirlenmesidir.

Yöntem

Araştırmada nitel araştırma kapsamında doküman analizi yöntemi kullanılmıştır. Araştırmanın örneklemini, PISA 2003, 2006 ve 2009 verilerine göre öğrencilerin fen okuryazarlığı başarılarının değerlendirildiği, öğrencilerin fen okuryazarlığı başarılarına etki eden değişkenlerin sorgulandığı toplam 23 (2 doktora tezi, y yüksek lisans tezi, 14 makale) ulusal çalışma oluşturmaktadır. Araştırma internetten online olarak ulaşılabilen çalışmalarla sınırlıdır. Araştırma kapsamında analiz edilen çalışmalara, Google Akademik, Taylor and Francis Online Library, Willey Online Library, Springer, ULAKBİM, ASOS, Türk Eğitim İndeksi, YÖK gibi çeşitli veri tabanlarından PISA ile ilgili anahtar kelimeler taranarak ulaşılmıştır. Ulaşılan makalelerin ve tezlerin değerlendirilmesinde doküman analizi tekniği kullanılmıştır. Analizlerde SPSS 16 ve Excel programlarından yararlanılmıştır.

Bulgular

PISA 2003 verilerinin kullanıldığı çalışmalarda, araştırmacılar en fazla aile karakteristikleri (anne baba eğitim düzeyi, evdeki kitap sayısı vb.) ile öğrencilerin fen

okuryazarlığı alanındaki başarıları arasında pozitif bir ilişki olduğu konusunda hemfikirdir. Anne baba eğitim düzeyi, aile karakteristikleri içinde öğrencilerin fen okuryazarlığı başarısı ile en fazla ilişkili olan değişkendir. Araştırma bulguları, anne baba eğitim düzeyi (Boztunç, 2010; Karabay, 2012; Şaşmazel, 2006) ve evlerindeki kitap sayısı artıkça (Erbaş, 2005; Şaşmazel, 2006), öğrencilerin fen okuryazarlığı başarılarının arttığını göstermektedir. Benzer şekilde araştırmacılar, çocuğun yaşadığı coğrafi bölgenin ve evde sahip olduğu çalışma ortamının (kendine ait odası olma, kendine ait masası olma ve çalışılacak sessiz bir ortamın olması) öğrencinin başarısı ile pozitif anlamda ilişkili olduğunu ifade etmektedir. Veriler Doğu ve Güneydoğu Anadolu bölgesinde yaşayan öğrencilerin fen okuryazarlığı puanlarının diğer bölgelerdeki öğrencilere göre daha düşük olduğunu göstermektedir (Gümüş ve Atalmış, 2012; Sarıer, 2010). Araştırmalar evinde kendisine ait bir odası veya masası olan ve çalışabileceği sessiz bir ortama sahip olan öğrencilerin diğerlerine oranla daha başarılı oldukları ortaya koymaktadır (Boztunç 2010; Karabay, 2012).

PISA 2006 verilerinin kullanıldığı çalışmalarda da, araştırmacılar genel olarak, aile karakteristiklerinden birisi olan anne baba eğitim düzeyinin öğrencilerin fen okuryazarlığı alanındaki başarılarıyla pozitif anlamda ilişkili olduğu konusunda hemfikirdir (Anıl, 2009; Boztunç, 2010; Karabay, 2012; Yıldırım, 2012). Benzer şekilde araştırmacılar çoğunlukla; çocuğun fene karşı tutumunun, evindeki bilgisayar ve donanım olanaklarının, öğrenmeye ayrılan zamanın ve cinsiyetin öğrencinin başarısı ile pozitif anlamda ilişkili olduğunu ifade etmektedir. Araştırmalar öğrencilerin bilgisayar ve donanım olanaklarının (bilgisayarlarının, bilgisayar programı ve internet erişimlerinin) olmasının fen okuryazarlığı başarılarını olumlu etkilediğini ortaya koymaktadır (Anıl, 2009; Anıl ve Özer, 2012; Özer ve Anıl, 2011). Diğer taraftan bulgular, kız öğrencilerin genel olarak erkek öğrencilerden daha başarılı olduğunu göstermektedir (Albayrak, 2009; Özer, 2009; Sarıer, 2010).

PISA 2009 verilerinin kullanıldığı çalışmalarda ise; araştırmacılar en fazla aile karakteristikleri ile öğrencilerin fen okuryazarlığı alanındaki başarıları arasında pozitif bir ilişki olduğu konusunda hemfikirdir (Karabay, 2012; Yalçın, Aslan ve Usta, 2012).

PISA 2003, PISA 2006 ve PISA 2009 Türkiye verileri yapılan tüm çalışmalar birlikte incelendiğinde ise araştırmacılar en çok aile karakteristikleri (anne baba eğitim düzeyi, evdeki kitap sayısı vb.) ile öğrencilerin başarısı arasında pozitif bir ilişki olduğu konusunda hemfikirdir. Benzer şekilde araştırmacılar genel olarak evdeki bilgisayar ve donanım olanakları, coğrafi bölge ve fene yönelik tutum ile öğrencinin başarısı arasında pozitif bir ilişkinin olduğunu ifade etmektedirler.

Sonuç ve Tartışma

İncelenen çalışmalarda elde edilen sonuçların bazı değişkenler açısından tutarlı olduğu tespit edilmiştir. Örneğin, araştırmacıların genel olarak aile karakteristikleri ile öğrenci başarısı arasında pozitif anlamda ilişki tespit etikleri görülmüştür. Anne eğitim düzeyinin ve mesleki konumunun öğrencinin başarısı ile baba ile karşılaştırıldığında daha fazla ilişkili olduğu ortaya koyulmuştur (Şaşmazel, 2006). Türkiye'de çocuklar zamanlarının çoğunu anneleri ile birlikte geçirmektedirler. Buradan yola çıkarak anne eğitim düzeyinin öğrencinin başarısı ile baba eğitim düzeyinden daha fazla ilişkili olması olağandır. Anne ve babanın eğitim düzeyinin öğrenci başarısı ile ilişkili olmasının sebebi, bu duruma paralel olarak ailelerin daha bilinçli olarak çocuklarıyla ilgilenmeleri ve sosyoekonomik düzeylerinin artmasıyla birlikte çocuğa daha iyi imkanlar sağlamaları olabilir. Sonuçlar yurtdışında yapılan çalışmalarla da paralellik göstermektedir (Fush ve WöBmann, 2006; Woessman, 2004).

Benzer şekilde araştırma bulguları; araştırmacıların genel olarak evdeki bilgisayar ve donanım olanakları ile öğrencinin başarısı arasında pozitif bir ilişkinin olduğunu düşündüklerini ortaya koymaktadır. PISA 2006 uygulamasının verilerine göre bilgisayar ortamını belirleyen değişkenlerin evde bulunma sıklığına bakıldığında, Türkiye'deki 15 yaş grubu öğrencilerin büyük bir çoğunluğunun ders ve ödevleri için kullanabileceği bir bilgisayarının bulunmadığı (%60), eğitimle ilgili bir bilgisayar programı (%73,3) ve internet erişiminin (%74) olmadığı belirlenmiştir (Anıl, 2009). Dolayısıyla Türk öğrencilerin fen okuryazarlığı başarılarının bu durumdan önemli bir şekilde etkilendiği düşünülmektedir (Anıl, 2009; Özer ve Anıl, 2011).

PISA uygulamalarının Türkiye sonuçlarına göre araştırmalar, kız öğrencilerin fen okuryazarlığı başarısının erkek öğrencilerden daha fazla olduğunu göstermektedir (Albayrak 2009; Acar ve Öğretmen, 2012; Özer, 2009). Türkiye'deki kız öğrencilerin okullaşma oranlarının özellikle Doğu ve Güneydoğu Anadolu gibi bölgelerde erkeklerden çok daha az olmasının PISA uygulamalarındaki fen okuryazarlığı başarımızı olumsuz etkilediği düşünülmektedir (Sarıer, 2010).

Ayrıca, araştırma bulguları genel olarak öğrencilerin fen okuryazarlığı başarıları ile öğrencilerin fene karşı tutumları arasında pozitif bir ilişkinin olduğunu göstermektedir (Anıl, 2009; Ceylan, 2009). Alan yazındaki çalışmalar bu çalışmanın bulgularını destekler niteliktedir (Kahle, Meece ve Scantlebury, 2000).

Türkiye'de yapılan çalışmaların bulguları, öğrencilerin evlerindeki kitap sayısı artıkça buna bağlı olarak fen okuryazarlığı başarılarının da arttığını göstermektedir (Erbaş, 2005; Özer, 2009). Ayrıca araştırmalar, çalışma ortamının (evinde kendisine ait odası olma, çalışma

masasına sahip olma, evde çalışabileceği sessiz bir ortama sahip olma vb.) öğrencilerin fen okuryazarlığı başarıları ile ilişkili olduğu ortaya koymaktadır. Yapılan çalışmalarda evinde kendisine ait bir odası veya masası olan ve çalışabileceği sessiz bir ortama sahip olan öğrencilerin diğerlerine oranla daha başarılı oldukları ortaya koyulmuştur (Boztunç, 2010; Karabay, 2012). Benzer şekilde sosyoekonomik düzey ile öğrenci başarısı arasında da pozitif bir ilişki tespit edilmiştir. Öğrencinin evde sahip olduğu uygun çalışma ortamının sosyoekonomik düzeyle ilişkili olduğu düşünülmektedir. Alan yazındaki çalışmalar, sosyoekonomik düzeyi yüksek olan öğrencilerin daha iyi imkanlara ve dolayısıyla daha iyi çalışma ortamına sahip olduklarını göstermektedir (Fush ve WöBmann, 2006; Geske, Grinfelds, Dedze ve Zhang, 2006).

İncelenen çalışma sonuçları öğrenmeye ayrılan zaman ile fen okuryazarlığı başarısı arasında pozitif bir ilişki olduğunu gösterse de, öğrenmeye ayrılan bu zamanda bilgisayar programları kullanımı ile öğrencilerin fen başarısı arasında negatif ilişki olabileceğini de göstermektedir. Ancak bu konuda yapılan çalışmaların sonuçları bilgisayar ve donanım olanakları ile fen okuryazarlığı başarısı arasında pozitif bir ilişki olduğu konusunda tutarlıdır. Öğrenme ortamlarıyla ilgili değişkenlerin başarı ile ilişkisi araştırılırken, bu değişkenlerin birbiri ile olan ilişkisini de dikkate alan çalışmaların, fen okuryazarlığı başarısı ile ilişkili olan değişkenlerin daha net ortaya konulmasına katkı sağlayabileceği düşünülmektedir.

Son olarak, bu çalışmada incelenen değişkenlerle ilgili elde edilen sonuçların araştırmalardaki araştırma desenlerinden, seçilen değişkenlerden ve kullanılan analizlerden de etkilenebileceği dikkate alınmalıdır. PISA uygulamalarında örnekleme yöntemi, hiyerarşik lineer modeller gibi çok düzeyli analizler ve örnekleme ağırlıklarını kullanmayı gerektirmektedir (OECD, 2005; OECD, 2009; Rutkowski, Gonzalez, Joncas ve von Davier, 2010). Türkiye de okullar arasındaki başarı farklılığının fazla olmasından dolayı, bu farklılığı dikkate alan analizlerle daha doğru sonuçlar elde edilebilmektedir. Ancak alan yazında bunun yeterince dikkate alınmadığı belirtilmektedir (Drent, Meelissen ve vander Kleij, 2010). Bu durum yapılan çalışmalarda incelen değişkenlerle ilgili elde edilen farklı sonuçları açıklayabilir. Bu nedenle PISA ile ilgili değişkenlerin başarı ile ilişkisini araştırırken uygun analiz yöntemlerinin kullanılması daha güvenilir sonuçlara ulaşılmasını sağlayacağı düşünülmektedir.