CEREN ÖZBAY

INVESTIGATION OF TURKISH STUDENTS' PERFORMANCE IN MATHEMATICS, READING AND SCIENCE LITERACY IN THE PISA 2012 DATA

A MASTER'S THESIS

BY

CEREN ÖZBAY

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Ceren Özbay

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Ceren Özbay

May 2015

I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Arts in Curriculum and Instruction.

Asst. Prof. Dr. İlker Kalender

I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Arts in Curriculum and Instruction.

Prof. Dr. Alipaşa Ayas

I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Arts in Curriculum and Instruction.

Asst. Prof. Dr. Semirhan Gökçe

Approval of the Graduate School of Education

Director: Prof. Dr. Margaret K. Sands

ABSTRACT

INVESTIGATION OF TURKISH STUDENTS' PERFORMANCE IN MATHEMATICS, READING AND SCIENCE LITERACY IN THE PISA 2012 DATA

Ceren Özbay

M.A., Program of Curriculum and Instruction

Supervisor: Asst. Prof. Dr. İlker Kalender

May 2015

Every student needs to be provided a certain minimum level of acquisition in the education system. Hence, this study investigated differences in students' performance in mathematics, reading and science literacy among the school types and geographical regions in Turkey by using PISA 2012 data. In this research, MANOVA was employed using Multivariate Linear Model procedure of SPSS. The aims of the research were to examine if there are any differences among Turkish students' performance that live in different geographical regions in Turkey in terms of mathematics, reading and science literacy and also to examine whether there are any differences among Turkish students' performance in mathematics, reading and science with respect to the school types or not. Analyses of the current study based on PISA 2012 data showed that Turkish students' performance in mathematics, reading and science differed significantly across the geographical regions and school types. The major difference was observed among school types.

Key Words: PISA 2012, mathematics literacy, science literacy, reading literacy, geographical regions in Turkey, school types in Turkey

ÖZET

TÜRKİYE'DEKİ ÖĞRENCİLERİN MATEMATİK, FEN BİLİMLERİ OKURYAZARLIĞI VE OKUMA BECERİLERİNDEKİ PERFORMANSLARININ PISA 2012 VERİSİNE GÖRE İNCELENMESİ

Ceren Özbay

Yüksek Lisans, Eğitim Programları ve Öğretim

Tez Yöneticisi: Yrd. Doç. Dr. İlker Kalender

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Eğitim sisteminde, her öğrencinin derslerinde belirlenmiş minimum düzeye ulaşmasının sağlanması gerekir. Bu çalışma PISA 2012 verileri kullanılarak, Türkiye'deki öğrencilerin matematik okuryazarlığı, okuma becerileri ve fen bilimleri okuryazarlığı performansları arasındaki farklılıkları hem okul türü bazında hem de coğrafi bölge bazında araştırmaktadır. Bu araştırmada, MANOVA tekniği kullanılarak analizler gerçekleştirilmiştir. Araştırmanın amaçlarından ilki; yaşadıkları farklı coğrafi bölgeler dikkate alındığında Türk öğrencilerin matematik, okuma ve fen okuryazarlığı perfomanslarında anlamlı bir fark olup olmadığını incelemektir. Diğer amaç ise Türk öğrencilerin matematik, okuma ve fen bilimlerindeki performansları arasında gittikleri okul türleri açısından anlamlı bir fark olup olmadığını araştırmaktır. Bu çalışmanın sonuçları, PISA 2012 sonuçları göz önüne alınarak Türk öğrencilerin matematik, okuma ve fen bilimleri performanslarında hem coğrafi bölgeler hem de okul türleri arasında anlamlı bir farklılık olduğunu göstermiştir. Başlıca fark ise okul türü değişkeninde gözlenmiştir.

Anahtar kelimeler: PISA 2012, matematik okuryazarlığı, fen bilimleri okuryazarlığı, okuma becerileri, Türkiye'deki coğrafi bölgeler, Türkiye'deki okul türleri.

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CHAPTER 1: INTRODUCTION

There can be many factors that affect achievement of students such as family background, motivation, or school type. To give an example, Demir, Ünal and Kılıç (2010) investigated the effect of technological and non-technological educational resources on students' achievement. Their research concluded that there were positive relationships between technological and non-technological educational resources and students' achievement. There is also some research showing that there is a positive correlation between socio-economic status and students' achievement (Kalende & Berberoğlu, 2009; Shah, Atta, Qureshi, & Shah, 2012).

In order to observe those types of differences, each student should be provided a certain minimum level of acquisition in the education system (OECD, 2014). For example, National Council of Teachers of Mathematics (NCTM) (2000) defined some principles and standards for mathematics education in which it focused on every student deserving to access the concepts of mathematics equally. So, at the end of their education, they can have an equal chance to learn mathematics according to their own learning levels. Similarly, the National Council of Teachers of English (NCTE) (2013) stated the standards that all the students should have the same opportunities in order to improve their skills. Moreover National Research Council Report (2011) emphasized that if equal learning opportunities are provided, all the students will be capable of practicing in science even if they have diverse backgrounds.

The school type can be also considered as one of the factors that affects students' achievement. As of March 2015, there are 13 different school types in Turkey which

is categorized into two institutions as general secondary education and vocational and technical secondary education. General secondary education covers general, Anatolian, Anatolian teacher training, science, social science, fine arts and sports and also private high schools. Vocational and technical secondary education includes Imam Hatip, Anatolian Imam Hatip, vocational and technical, private education vocational and also special vocational high schools (MEB, 2015). Therefore, it is expected that as the number of school type increase, the achievement levels of the students are spread out over a wider range.

Geographical regions where students live and the type of school which students attend are the two variables focused upon in this research. This study aims to investigate whether the differences in students' achievement are originated either from geographical region (which is also an indicator of the socio-economic level) or from school type. In this framework, Program for International Student Assessment (PISA) 2012 data set is used in order to examine students' mathematics, reading and science literacy levels in Turkey.

Background

Turkish students demonstrate low achievement in many circumstances. One of them is nation-wide exams. In the Turkish education system, there are mainly two important exams. One of them is administered at the end of secondary school which is called TEOG (transition system from primary to secondary education). The other one is taken at the end of high school as a two-stage exam system: YGS (Transition to Higher Education Examination) and LYS (Undergraduate Placement Examination) (ÖSYM, 2014a). There may be differences in students' achievement in those exams. To give an example, Bahar (2013) stated that there was a statistically

significant difference in students' performance in university entrance exam dependent on the school types in Turkey.

In addition to national exams, Turkish students also perform poorly in international benchmarking studies, such as the PISA tests. It is a survey that was launched by the Organization for Economic Co-operation and Development (OECD) since 2000 and it is administrated once every three years. It assesses the key competencies such as mathematics, reading and science literacy that contribute to the successes of 15 years old students, within an internationally accepted common framework. In addition to that, PISA survey tests cover science, reading and mathematics literacy. PISA also assessed financial literacy in 2012. There are plenty of questionnaires in PISA which are mainly grouped as student- related questionnaires, family-related questionnaires and school-related questionnaires (OECD, 2014). All of those questionnaires include many factors affecting students' mathematics literacy in PISA (Akyüz & Pala, 2010). In addition, the Ministry of National education report (2013) indicated that although Turkey has shown a progression in mathematics, science and reading literacy in PISA since participating in the test, Turkey has performed below the OECD average for each PISA test.

The mathematics literacy result in PISA is important because it refers to making connections between mathematics and real life and making mathematical judgments rather than assessing content knowledge of students (OECD, 2006). Reading literacy is also crucial for individuals to be able to develop their mental capacity to understand and interpret what they read (OECD, 2007). Finally, scientific literacy can be defined as the awareness of characteristics features of science and if one can have scientific literacy skills then it is expected from him/her to define science-related questions, to explain reasons behind it and to be interested in science-related

issues such as environmental issues refers to scientific literacy (OECD, 2009). So, as a result of scientific literacy, students'-show an interest in science and the environment.

Result showed that most of the Turkish students had even the basic literacy skills across all subject areas. The performance of Turkish students is not different as the results are compared with other international studies such as Trends in International Mathematics and Science Study (TIMSS) and Progress in International Reading Literacy Study (PIRLS). The studies in the literature showed that the lack of achievement is mostly explained by socio-economic status (Aikens & Barbarin, 2008). However, one of the problems in Turkish education system can be the differentiation of school types. As of 2015, there are 23 different school types. Thus, type of school can be also considered as a factor by Berberoğlu and Kalender (2005) and the researchers examined the effects of school types and geographical regions on mathematics literacy of Turkish students by using PISA 2003 results. This study will also include geographical regions and school type as factors that affect students' performance in literacies. Although the authors focused only on mathematics literacy of Turkish students, this study will include not only students' mathematics literacy but also science and reading literacy of students in Turkey. This study will utilize recent information about these factors and Turkish students' performance in mathematics, reading and science based on PISA 2012 results.

Problem

Every student deserves to have equal access to all the concepts of mathematics, reading and science and also teachers must provide the right circumstance for this situation to be feasible (NCTM, 2000; National Research Council, 2011; NCTE

2013).This condition is valid not only for mathematics but also for all the subject areas (OECD, 2013). In this framework, students should encounter equity in education (OECD, 2014). It means that the schools in Turkey ought to provide equal accessibility to mathematics, reading and science literacy to improve students' performance.

Students' performances are generally both in national exams and international studies in Turkey (MEB, 2013a; ÖSYM, 2015b). There can be some reasons behind this issue. For example, geographical regions in Turkey may have different social, economic and environmental characteristics and the difference in those characteristics can bring about many disadvantages, especially for eastern part of Turkey (Bülbül & Köse, 2010). Since the eastern part of Turkey is worse than the other parts of Turkey in YGS and PISA 2012, it is important to find out such differences in students' performance across geographical regions.

Many school types also can bring about many different curricula among the schools. This means there can be some differences in curricula in terms of weekly courses hours, content of courses and level of courses among the school types in Turkey. Those differences can be one of the reasons behind such low achievement because Alacaci and Erbas (2010) stated that school type is important for the academic performance of students in Turkey.

Purpose

There are two purposes of this study, the first of which is to investigate how much students' academic performance in mathematics, reading and science literacy vary statistically according to their location i.e. the geographical region based on PISA 2012 results. The second one is to examine how much the performance of Turkish

students in mathematics, reading and science literacy differs statistically according to the school types based on PISA 2012 results or not.

Research questions

- Are there any significant differences among Turkish students' academic performance according to their location i.e. different geographical regions of Turkey in terms of mathematics, reading and science literacy?
- Are there any significant differences among Turkish students' academic performance in mathematics, reading and science with respect to their school types?

Significance

The present study is expected to reveal statistically significant information as to the sources of achievement differences in Turkey across three subjects: mathematics, science and reading. Although socio-economic status is mostly stated as one of the main factors explaining the achievement differences, having a large number of school types in education system may also create a problem in setting a minimum standard for all students. Thus, the current study compares the literacy level differences across regions and school types.

CHAPTER 2: REVIEW OF LITERATURE

Introduction

Turkey has participated in some international studies to measure Turkish students' achievement like PISA. According to OECD (2014) report, Turkish students performed below average in PISA 2012 for mathematics, science and reading literacy. This is not the first time that the averages of Turkish PISA scores were low. As Kilic, Cene and Demir (2012) stated, Turkish students had also the lower performance in mathematics literacy in PISA 2009.

In the light of these issues, this chapter focused on the literature reviewing information about national and international studies, international benchmarking studies, Turkish students' performance both in national and international studies and in general.

Turkish students' performance in national exams

In the Turkish education system, students have to take exams in order to enter high schools and universities (ÖSYM, 2009a). In the recent years, there have been some major changes in these exams in terms of both content and sessions ("University entrance exam", 2009).

There are some examples to highlight the changes. For example, while student selection examination was just a one-stage multiple choice test system and then it was turned into two-stage multiple choice exam system in 2010 (ÖSYM, 2009b). The first exam is YGS. It is administered in April and aimed to measure high school

learning outcomes of Turkish students (ÖSYM, 2014b). The score of YGS ranges from zero to 500. The students who get threshold score (greater than or equal to 180) from YGS, they can take LYS in June (ÖSYM, 2015a). There are also five sessions within the LYS which are science, social sciences, mathematics, Turkish and foreign language. Afterwards students are allocated to departments of universities according to their scores and preferences (MEB, 2013a).

Interesting results were also obtained in the last YGS, in 2015. For instance, there were 1.986.995 students who participated in exam but only 68.89% of the students got the score ranging from 180 to 500 (ÖSYM, 2015b). As students who wish to partake in higher education are supposed to take the exam YGS, the number of students who get threshold score from YGS should be higher. In addition to that, YGS covers major subjects which are Turkish, foreign language, social studies, basic mathematics and science (ÖSYM, 2013). So it was expected that all the students attending YGS should get at least the score 180 without taking into consideration which school they go or which geographical region they live in (Kartal, 2009).

In addition, some previous national exam results demonstrated that there were big differences among means of different school types. To give an example, 2014 LYS results can show clearly such differences (ÖSYM, 2015a). After categorizing students' score according to their area like mathematics-science, Turkish-mathematics and Turkish-social studies, differences in schools' mean score appeared. When the mean scores of science high schools were 373.306, general high school had only 199.983 mean score for the area mathematics-science. Moreover, although social science high schools give importance to social science courses, they could not exceed the mean score of science high schools (360.272) with their score 337.246 in LYS 2014 according to the area Turkish-mathematics. There was the

same case in the area Turkish-social studies. Science high school had the greatest mean score (365.216) among the different types of schools (ÖSYM, 2014a).

In general, it can be expressed by taking into consideration the YGS 2015 and LYS 2014 results that there can be large differences in students' achievement level across school types in Turkey. Some students do not get even the minimum threshold score (180) to continue their education at the universities.

Turkish students had low scores not only in university entrance examinations and in national studies but also in the international benchmarking studies as well.

International benchmarking studies

There are many international studies across the world. Turkey participates in some of them such as TIMSS, PIRLS and PISA projects periodically in order to examine whether the desired quality of education is applied in a contemporary manner or not (EARGED, 2005).

The Ministry of National Education also stated that participating in these enables Turkey to establish to what extent they are making progress in education at both national and international levels. In addition to standardized tests, there are some student, teacher and school related questionnaires which are applied to students in those international tests. According to this feedback and information, what students know or what to extend students reach the learning-outcomes can be determined (MEB, 2013a). Moreover, there is a chance to contrast and compare Turkish education system with other education systems in terms of educational policies, teaching strategies, qualification of teachers and materials used in classes (MEB, 2013b).

There are many differences among the international studies TIMSS, PILRS and PISA in terms of subjects that they measure, years that they are applied to and the age range of students that they address (Rindermann, 2007). Basic characteristics of the tests are given in the following paragraphs as well as the Turkish students' academic performance in these tests.

TIMSS

TIMSS is an international assessment that has measured mathematics and science skills of both fourth and eighth grade students around the world. TIMSS has been administered every four years since 1995. It was applied by the International Association for the evaluation of Educational Achievement (IEA) in order to compare the achievement of students (IEA, 2015a).

Turkey joined TIMSS in 1999 the first time (EARGED, 2003a) and participated in the last administration in 2011 most recently (IEA, 2015b). The results are remarkable and showed that Turkey got higher scores gradually for eight graders (Büyüköztürk, Çakan, Tan, & Atar, 2014). Despite of the fact that Turkey had 452 points from mathematics, it was below the TIMSS average score (500) (IEA, 2012a). TIMSS 2011 results also emphasized that mathematics scores varied across the geographical regions of-Turkey but Turkish students could not reach the TIMSS mean score in any of the regions. Whilst the Marmara region had the greatest mean score (465), the southern Anatolian region had the lowest mean score (416) in TIMSS 2011 (MEB, 2014b).

In addition, science score in Turkey (483) was also below the TIMSS mean score (500) (IEA, 2012b). However, this time Black sea region reached the TIMSS mean

score with the greatest mean score (500) across the geographical regions. Southern Anatolian region also had the lowest mean score (447) again (MEB, 2014b).

In conclusion, there is a gap among geographical regions in Turkey in terms of mathematics and science scores in TIMSS 2011 results. Such differences provide evidence for the existence of inequality in education among students from different locations of Turkey.

PIRLS

PIRLS has measured only the reading knowledge of only fourth graders since 2001.The study has been developed within years by IEA. In contrast to TIMSS, PIRLS has been conducted every five years (Mullis, Martin, Gonzalez, & Kennedy, 2003). The aim of the study is to gather information about students' academic knowledge in reading and emphasize the factors increasing students' achievement in reading (Elley, 1994).

In addition to that, prePIRLS has started to be conducted in 2001. The aim of the study is to give chance to developing countries for assessing reading performance of their students. It has the same characteristics with PIRLS except the difficulty level of questions IEA (2013). PrePIRLS is less difficult than PIRLS.

Lastly, Turkey participated in PIRLS just when it was first conducted, in 2001. PIRLS 2001 results resembled TIMSS results such that Turkey had a lower score (449) than the PIRLS mean score (500) (EARGED, 2003b).

PISA

PISA is one of the international studies that has been organized by the OECD. It was developed in 1997 but it has been conducted since 2000. In contrast to TIMSS and

PIRLS, PISA has been administered once every three years. Since countries have different curricula and education systems, the test is given to 15 years-old students in PISA (OECD, 2003).

In addition to that, the PISA study is more comprehensive than TIMSS or PIRLS. It has measured not only students' performance in mathematics and science literacy but also their performance in reading literacy among the OECD countries. Although it puts emphasis on one of those three subjects in PISA in the year when it is applied, students have items to solve from all of three subjects: mathematics, reading and science. During the last PISA administration conducted in 2012, financial literacy of young people and problem solving assessment were included for the first time and that was optional for countries (OECD, 2014).

Furthermore, the achievement of students is defined by the OECD in a different way. According to OECD achievement in mathematics, science or reading is to find out how much students can apply their knowledge of these areas in real life situations rather than determine students' academic knowledge (OECD, 2012). That is why PISA uses the term "literacy" instead of the term "achievement" or "success".

PISA has also assessed some of the key competencies that contribute to the successes of students, within an internationally accepted common framework (Pons, 2011). This means PISA aims to search in order to provide a basis for collaboration of teachers in defining and implementing educational goals in terms of mathematics, reading and science literacy.

PISA defines mathematics literacy as the capacity of students to make connections between mathematics and real life, to make mathematical judgments. According to PISA, mathematics literacy is the ability of students to express mathematics

problems in their own words (OECD, 2006). It refers to that students are expected to go beyond the mathematics taught in schools, find their own way to solve problems and connect mathematics to real life (Ilbagi & Akgun, 2013).

In addition to that, PISA focused on mathematics literacy in 2003 for the first time. Then, mathematics literacy was the focus in PISA 2012 again (OECD, n.d.). So, countries had chances to observe the differences in students' mathematics performance through the years (Thomson, Cresswell, & De Bortoli, 2004).

In addition, in PISA 2012 it was the first time that mathematics covered an optional computer-based test (OECD, 2014). This means, students could use computers to respond the PISA items in addition to paper-based test which depended on the question types such as multiple-choice or open-ended.

The content of mathematics is determined according to their relevancy and connectivity in real situations and context. It is also related to the performance of students and countries. In general, mathematics content has consisted of quantity, space and shape, change and relationships and uncertainty in PISA since 2000 (Neidorf, Binkley, Gattis, & Nohara, 2006). Additionally in PISA 2012 one more topic called "data" was included (OECD, 2014).

According to PISA, reading literacy is an individual's mental ability to understand and interpret what they read in order to reach their own aims. Moreover, reading literacy is described as the capability of young people to use and engage with what is written in text in to be a part of society (OECD, 2006). This means PISA measures to what extent students connect their reading knowledge to real life.

Reading literacy was the first major subject of PISA both in 2000. Then it became a major subject in 2009 again. PISA also takes into consideration the attitudes of

students towards reading and their learning strategies to reading through student questionnaires which were quite useful for the assessment of students' performance in reading (OECD, 2010b). For example, there is a strong relation between the students' performance in reading and their wide range of reading activities (Guthrie, 2008). Skinner, Kindermann and Furrer (2009) stated that lower achievement in reading at school work may stem from less practicing in reading or ineffective learning strategies. Thus, PISA results showed that students' achievement in reading does not only depend on their academic knowledge.

Reading content has covered both continuous texts and non-continuous texts in PISA since 2000. PISA 2012 also covered mixed and multiple texts. Continuous texts include mainly different types of prose like narrative prose and argumentative prose. In contrast to continuous text, non-continuous texts consist of graphs, forms and lists. In addition to that, the combination of continuous and non-continuous texts comprises mixed text and finally the aim of multiple texts is also to compare independent texts with each other (OECD, 2010c). Because PISA has different types of questions which is a kind of multiple intelligence activity, students can engage with the PISA questions rather than school work and improve their reading skills (Burman & Evans, 2003).

PISA describes scientific literacy in many ways. Initially, scientific literacy is to be aware of the characteristics features to make up science. Scientific literacy and science cannot be thought of as a separate entity. In addition to that, scientific literacy means that students should be able to define science-related questions, explain reasons behind it and be interested in science-related issues such as environmental issues (OECD, 2007).

The major subject was science for PISA 2006 assessment. Science literacy will be the major area in the 2015 administration. In addition, PISA 2006 showed some results that pointed out the differences among school type in Turkey. For example, Alacaci and Erbas (2010) indicated how different that the students' performances in science among the schools are.

The content of science test includes mainly the following subjects: physics, chemistry, biological sciences, and earth and space sciences (Fensham, 2009). However, the content may change for the following PISA according to the new trends in education and economies. For example, in PISA 2009 science content was composed two parts as knowledge of science and knowledge about science but there was no such a categorization in PISA 2012. In addition to that, items do not ask for being recalled the whole topic of those subjects; they are integrated with the content of the items (OECD, 2014). In a nutshell, this content was organized in order to engage science with real life situations.

PISA results of Turkey

Rankings of Turkey can range according to international studies. To begin with, there were 42 participating countries for eight graders in TIMSS 2011 with Turkey ranking in 24th in mathematics (452 mean score), 21st in science (483 mean score). It means that although Turkey's means score for mathematics and reading was below the TIMSS means score (500). Turkey showed improvement in science and mathematics from TIMSS 1999 to TIMSS 2011. To give an example, Turkey had 429 mean score in mathematics in 1999 and 23 points increase was observed in TIMSS 2011 in mathematics means score of Turkish students (Oral & McGivney, 2013).

In addition to that, Turkey participated in the PISA in 2003 for the first time and in that assessment nearly 28% of the students in Turkey could not even reach the minimum proficiency level in mathematics as defined by the PISA scale (National Education Publications, 2005). Moreover, Turkey had 424 mean score in mathematics literacy in PISA 2006 when the OECD average was 500 (Baldi, Jin, Green, & Herget, 2007) which means that Turkey still performed below the OECD average. In the following exam, Turkey increased its mathematics mean score to 445 (OECD, 2010a)

In addition to that, according to Aksit (2007), PISA 2003 results indicated that both private and public schools in Turkey performed below the OECD average with 441 mean score in reading literacy. In PISA 2006, Turkey had 447 mean score which means that Turkey could not reach OECD average. Although Turkey increased its reading result in PISA 2009, it could not pass through the average of OECD countries again with 464 mean score (EARGED, 2010a).

Although the OECD international mean score was 500 with 100 standard deviation, Turkey had just the score 434 in science literacy in PISA 2003. The results differed from geographic regions and school types (EARGED, 2005). In PISA 2006, the main focus was the scientific literacy. Turkey still performed under the average of OECD countries with 425 mean score in PISA 2009 (EARGED, 2010a). In addition, Turkey increased the science mean score to 455 in PISA 2009 (EARGED, 2010b).

Finally, according to PISA 2012 results, Turkey generally performed better in mathematics, reading and science literacy compared with previous PISA administrations. To give an example, Turkey was ranked in 44th in mathematics literacy with 448 mean score in PISA 2012 (OECD, 2014). It means that Turkey

showed a progress in mathematics performance but ranking could not be improved when it was compared to previous PISA results. Reading mean score of Turkey also increased (475) with ranking in 42th (Yıldırım, Yıldırım, Yetişir, & Ceylan, 2013). Moreover, Turkey had 463 mean score with ranking in 43th in science literacy in PISA 2012 (MEB, 2013). This shows that Turkey indicates progress in science literacy.

Factors affecting mathematics, science and reading literacy of students

Questionnaires administered during PISA study can mainly be grouped as student-related questionnaires, family-related questionnaires and school-related questionnaires. All of those questionnaires include many factors affecting students' mathematics, reading and science literacy in PISA (Akyüz & Pala, 2010; Anagün, 2011; Yıldırım, 2012). This study will focus on geographical regions and school types in Turkey as factors that affect students' performance in mathematics, reading and science literacy based on PISA 2012 data.

Geographical regions in Turkey

Turkey is divided into geographical regions: Aegean Region, Black Sea Region, Central Anatolia Region, Eastern Anatolia Region, Marmara Region, Mediterranean Region and Southeastern Anatolia Region in 1941 based on some factors like socio-economic issues, habitat, transportation and climate (Darkot, 1955). These kinds of factors may bring with it some drawbacks and it may impact students' achievement in many ways.

To begin with, it was found that education levels of parents had a positive effect on students' performance in mathematics literacy based on PISA 2003 results (Akyüz &

Pala, 2010). Gürsakal (2012) also focused on the same issue based on PISA 2009 results and stated that parents' educational level was one of the important factors for students' achievement level. There is a link between education level of parents and the regions where they live and generally parents who lived in eastern part of Turkey are less-educated compared with the western part (Tunç, 2009).

In addition, Kasapoglu (2014) indicated that, there is a positive correlation between education levels of parent and students' performance in reading literacy by using PISA 2006. The study showed especially the importance of mothers' level of education on students' achievement. The author also focused on the effect of economic background of the families on students' achievement by taking into consideration school quality factor. Aikens and Barbarin (2008) also claimed that there was an impact of socioeconomic status on children's early reading. The authors demonstrated that if the socio economic status of the family is better, then students can take the advantage in reading in terms of school conditions or home environment. So it is important for students' performance in reading where they live, what kind of facilities they can reach.

Some research results demonstrated that low-income is one of the factors that have an effect on students' performance in science literacy (Baratelli, West-Olatunji, Pringle, Adams, & Shure, 2007). PISA 2006 also resulted that families' economic background can also impact students' science literacy performance because there is a link between socio-economic status and having a computer at home (Özer & Anıl, 2011). Western parts of Turkey have higher socio economic status (Bülbül & Köse, 2010) so it is more probable that people living there can supply these types of technological equipment in for their children to improve their achievement.

In general, there can be differences in students' achievement with respect to geographical regions in Turkey. However, Berberoğlu and Kalender (2005) stated that geographical regions do not affect Turkish students' achievement as much as school type based on PISA 2013 results.

School types in Turkey

In PISA 2012, there were 12 different school types in Turkey that participated in. They were basically general high school, Anatolian high school, science high school, and Anatolian teacher training high school, social science high school, vocational high school, Anatolian vocational school, technical high schools, Anatolian technical high school, multi program high school, and police training high school (OECD, 2012). Although it is not the only reason that affects students' performance, there is research that reported the effect of school type on students' achievement (Berberoglu & Kalender, 2005; Fındık & Kavak, 2013).

First of all, Alacacı and Erbaş (2010) indicated that because schools' qualities differed in Turkey, school types had great effects on students' mathematics performance based on PISA 2006 results. In addition to that some research showed school climate was also an important factor to improve mathematics literacy (Demir, Kılıç, & Depren, 2009). Since school climate and school type are related to each other, students can get disadvantage to improve their own achievement just because of school-related factors. For example, students who enter private school instead of a public school can get better opportunity to access higher education because most of the private schools give importance to school climate mostly (Nata, Pereira, & Neves, 2014).

In addition to that, differentiated instruction can act an important role in students' reading performance. According to related research, implementation of differentiated instruction affects students' achievement in terms of their reading skills in a better way (Little, McCoach, & Reis, 2014). However, differentiated instruction is mostly applied in private schools. So, students who go to private school or can reach school materials quickly can get more advantage to increase their performance in reading (Thapa, 2015).

There are also some school-based factors like teacher quality and adequacy of physical and instructional materials in the literature. All those factors can influence students' performance (UNICEF, 2000). To give an example, Ercan (2014) focused on the importance of accessibility and use of technology in science classrooms. The author also indicated that there is positive effect using multimedia learning material on students' science achievement of students. However, some teachers in some schools in Turkey may not use technology in their classes although they have the technological devices in classrooms (Seferoğlu, 2009). It can be easier for the private schools to use technology in classes (Demirci, Taş, & Özel, 2007). So, there can be differences among students' science performance and students may not reach all the concepts of science (National Research Council, 2011).

In conclusion, reviewing the literature makes it easier to draw a picture of the factors related to Turkish students' performance in mathematics, science and reading all with respect to different school types. In addition, there are also differences in students' performance in both national and international exams among the geographical regions. There are many researches showing that socio-economic status of families and education level of parents are important factors of students' achievement in Turkey.

CHAPTER 3: METHOD

In this chapter, methodological issues are presented. First of all, context and sample are described and then methods of data collection are given. Finally, methods of data analyses are stated.

Context

PISA 2012 data will be used in this study. The study includes 4848 Turkish students aged 15 from all the geographical regions who participated in PISA 2012 (OECD, 2013).

In modern societies, application of knowledge learned in classes both in and outside of school is crucial as much as acquisition of knowledge. For this reason PISA focuses not only on what students know but also what students can do by using their prior knowledge across countries. Based on PISA results, educators and policy makers can realize how important and acceptable it is increasing students' performance. This assessment gives also opportunity to find out similarities and differences among countries' education system (OECD, 2014).

Moreover, PISA has some exclusive features. To give an example, PISA can be a guide for countries to follow their progression. One of the characteristics of PISA is the breadth of its coverage. It means that PISA is administered in many countries. In PISA 2012, there were around 510 000 students from 34 OECD member countries and 31 partner countries and economies (OECD, 2014).

Research design

This study is a quantitative research in which causal-comparative research method is used. Causal-comparative research method determines cause (or effect) that has occurred and looks for effect (or cause) from it (Fraenkel, Wallen, & Hyun, 1993).It means that, the effect is the main focus on causal comparative research.

Participants

In this study, Turkish students participating in PISA 2012 were used as sample. In Turkey, the PISA sample is determined according to the number of 15-year-old students and schools that they attend. All the information is taken from the Ministry of Education, Department of Strategy Development and sent to an international statistics firm (Westat) in order to determine the sample. The firm uses lamination techniques to determine the schools that participate in PISA by taking into consideration some criteria such as 12 statistical regions or school type in Turkey. Then, 35 students are selected randomly by using a computer program called KeyQuest because 35 students from each school were expected to participate in PISA (MEB, 2011). In light of this issue, 4848 Turkish students of 170 schools were selected from 56 provinces in 12 statistical regions in PISA 2012 (MEB, 2013b).

Because of differences among countries and their education system, it is hard to compare students' performance on key subject areas internationally based on their grade levels across countries. So, PISA determined a particular age range. Ages of participating students were between 15 years three months and 16 years two months. Participating students must be studying for at least six years officially and can be any private schools, public school, vocational and academic programmes (OECD, 2014).

Instrumentation

The PISA 2012 data set will be used in this study which includes student questionnaire and cognitive booklets as instruments (Grønmo & Olsen, 2006).

Tests in the PISA study consist of multiple-choice and open-ended items from mathematics, reading and science literacy. They are all related to real life situations because literacy is not about students' academic achievement within school. It is not just about exam grades. It refers to students' capacity to make a connection between real life and those main subjects (mathematics, reading and science) (OECD, 2006). To sum up, literacy measures how much of knowledge is used in daily life.
In addition, students have two-hours to complete the paper-based test. Test items have different combinations for different students. To give an example,there are at least 13 different booklets for each country in PISA 2012 (OECD, 2014).

Finally, students are supposed to take a background questionnaire that covers some information about themselves, their families, homes, schools and their learning activities. It takes 30 minutes. In addition to that, school principals answered a questionnaire which is related to the school system and learning environment. There also some optional questionnaires for parents. It covers some questions about their child's career expectations, their support for learning and involvement in their child's education. In addition to that, there are two more questionnaires for students that are mainly related to their use of information technology and thoughts about future careers (OECD, 2014). In addition to that, Turkish students answered only the main student questionnaire and the school principal answered their own questionnaire (Yıldırım, Yıldırım, Yetişir, & Ceylan, 2013). Sample PISA paper-based test items can be found in Appendix 1.

Method of data collection

PISA data on students' performances in mathematics is used in the study. Anyone with access to this PISA 2012 data set can do analysis accordingly.

School coordinators are in charge of communication between students and the PISA National Centre in case of participation. They create a list that comprises the name of all the 15-years of students from their schools and send it PISA National Center in the country. The PISA National Centre chooses 35 students randomly and informs school coordinators. Then, school coordinators contact selected students and their parents to get permission (OECD, 2014).

Generally, the PISA National Centre appoints test administrators in order to conduct the test session of PISA. The test administrator and school coordinator determine together the date and time of the test. Then, the test administrator distributes different booklets to different students. The test administrator is also responsible for sending the booklets to the PISA National Centre (OECD, 2014). In Turkey, all processes of PISA are carried out by the Ministry of National Education (Yıldırım, Yıldırım, Yetişir, & Ceylan, 2013).

Data in PISA 2012 was gathered from all 12 statistical regions in Turkey which is called Nomenclature of Territorial Units for Statistics (NUTS). However, in this study NUTS of Turkey was converted to seven geographical regions which are Marmara, Aegean, Mediterranean, Central Anatolia, Black sea, Eastern Anatolia and Southeastern Anatolia. Figure 1 shows the sample size of each geographical region.

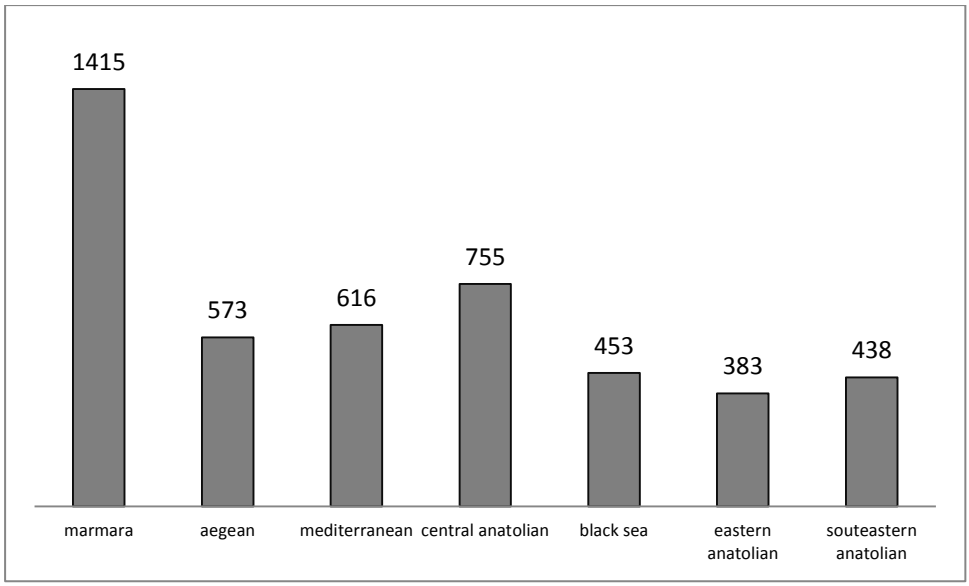

Figure 1. Sample size of geographical regions.

As a second independent variable, school type in Turkey was used. There are many types of school in Turkey. In PISA, data was collected from 12 different school types in Turkey. In the following, there is some information about schools in which PISA 2012 was conducted. In this study, primary school and technical high school were excluded because their sample size was small. Table 1 gives a brief explanation for each school type included in the present study. In addition to that, Figure 2 showed the numbers of students attending to the test from different schools.

Table 1
Brief information about included school types

General high school	Any students who complete eight years of education can enter without taking any entrance exam. The school supports development of students' general knowledge and citizenship consciousness.
Anatolian high school	Students have to take entrance exam in order to enter these schools. It is four-years long including one year English education.

Table 1 (cont'd)
Brief information about included school types

Science high school	These schools admit high ability students with entrance exams. Generally, students are trained for higher education in science, technical or medical fields.
Social Sciences high school	Those schools put emphasis on social science courses.
Anatolian Teacher Training high school	Those schools give importance to teacher training education. Students take history of education, education theory and methodology in general.
Vocational high school	Graduates can go on higher vocational education at the end of this school without taking any university entrance exam.
Anatolian Vocational high school	Students are prepared for employment in those schools. They attach importance to foreign language learning of students.
Anatolian Technical high school	Those schools are a sub-type of Anatolian schools that offer technical courses such as electronics and communications.
Multi Programme high school	Those schools contain general, vocational and technical schools' curriculum.
Police high school	Selective students are trained to be police officers in those schools.

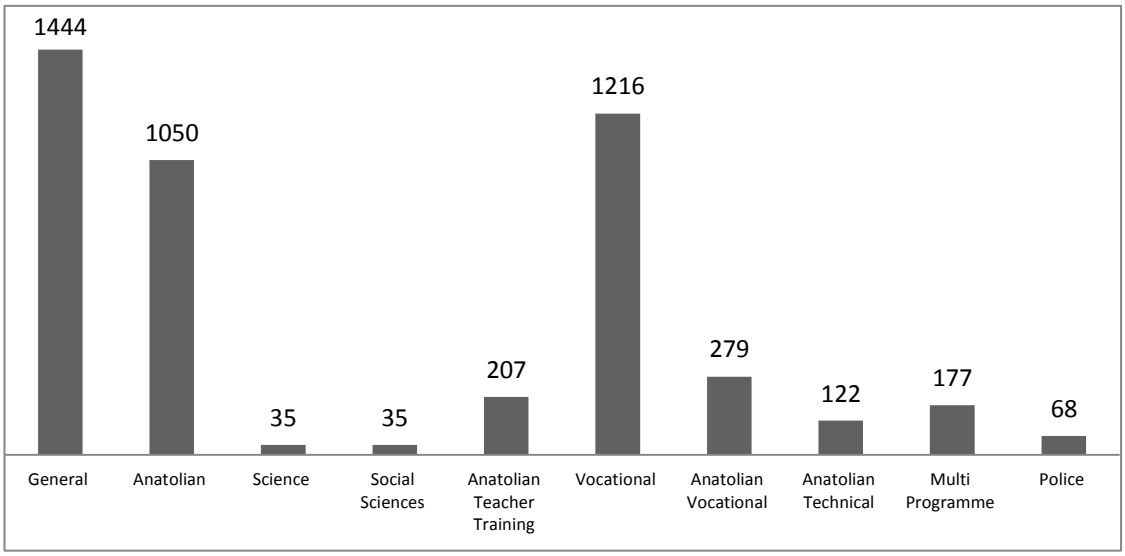

Figure 2. Sample size of school types.

Methods of data analysis

In this study, Statistical Package for the Social Sciences (SPSS) was used for data analysis. Multivariate Analysis of Variance (MANOVA) was employed by Multivariate Linear Model procedure of SPSS. Independent variables were geographical regions and school types, while three dependent variables were Turkish students' mathematics, science and reading literacy scores. Due to the fact that there are three dependent variables, two-way MANOVA was preferred in order to minimize type1 error.

Before conducting MANOVA, means of mathematics, reading and science literacy for both each geographical region and school type in Turkey were calculated. Then, one sample t-tests were conducted in order to compare means of mathematics, reading and science scores with respect to geographical regions and school types with OECD mean score (500 points) (OECD, 2014). After that, means of Turkish students' mathematics, science and reading literacy scores were examined according to school types and geographical regions in Turkey through MANOVA.

Effect size was assessed using partial eta squared (η^2). In addition to that the size of effect is categorized as small, medium or large. When the value of η^2 is around .02, there may be a small affect. If effect size is around .13, it may be a medium effect and finally .26 or more than that means large effect (Cohen, 1988). All analyses were conducted at 0.05 significance level.

Prior to MANOVA, statistical assumptions were checked (Huck, 2011). The first assumption is that the measurement of two or more dependent variables needs to be at interval or ratio scale. This assumption was considered to be satisfied because mathematics, science and reading literacy are continuous variables. Secondly, the assumption that independent variable should be divided into two or more categories. This study includes two independent variables, school types and geographical regions in Turkey. School types consist of 12 categorical independent groups and geographical regions include seven categorical independent groups in this study. Another assumption is the independence of observations. Because PISA is applied under the responsibility of the Ministry of National Education, required measures were taken to ensure that there was no interaction among students. Since the total sample size in this study was 4848, it was assumed that the number of observations was sufficient to conduct a MANOVA. Since it was not feasible to check all dependent and independent variables for normality, only dependent variables were investigated against normality and the results indicated that normality was held. And last, the assumption that there should not be a relationship among independent variables. It refers to the lack of multicollinearity. Inter-item correlations were checked. There was no correlation coefficient above 0.80.

CHAPTER 4

In this chapter, results of the analyses conducted were presented.

Findings

In PISA 2012, mathematics, reading and science scores were set as 500 points with a standard deviation of 100. The scale was also divided into levels which were determined by the range of difficulty of the tasks based on the outcomes of PISA 2003. The lowest level is level 1 and the highest level is level 6. Those levels are called as proficiency levels. Table 2 shows the summary descriptions proficiency levels of mathematics, reading and science literacy. Detailed descriptions of the proficiency levels are given in OECD (2014).

Table 2
Summary of six proficiency levels with minimum scores for mathematics, reading and science literacy

P. L.	Mathematics	Reading		Science
1 (the lowest level)	Students can typically answer questions that are clearly defined. They also can recognize the information and apply what they learn through familiar procedures (358).	B (the lowest level within reading)	Students can make simple connections between the given information and figures in text. Texts generally include repetition of information with figures or familiar symbols (262).	Students can describe obvious scientific explanations. Students can define limited scientific information (335).
		A	Students can find out the main idea or purpose of author in text. Students can also link between information in the text and daily knowledge (335).	
2	Students can interpret results literally. Students can use basic algorithms and formulas to solve problems (420).	Students can compare information in the text and everyday knowledge. Students can make inference to gather pieces in the text (407).		Student can give adequate scientific information in order to draw solution by facilitating simple investigation (409).
3	Students can use calculation techniques in an appropriate way. (482).	Students can combine some piece of information which refers to multi-cases in order to find main idea and understand the concept of idioms and phrased used in the text (480).		Students can provide a clear scientific knowledge within the context. (484).

Table 2(cont'd)
Summary of six proficiency levels with minimum scores for mathematics, reading and science literacy

P. L.	Mathematics	Reading	Science
4	Students can link between two dimension objects and three dimension objects. Students also can compare and these type of questions by using geometric rules (545).	Students can think the text as a whole. Students can also evaluate the long and more complex text in a critical way by using categorization (553).	Students can link between scientific issues and daily life based on taking into consideration of the role of science or technology. Students can reflect their experiences within the scientific context (559).
5	Students can use theorems in order to solve problems. Students can analyze questions through appropriate assumptions (607).	Students can evaluate the text critically. Students can understand unfamiliar and detailed content of the text fully (626).	Students can use scientific contents in complex life situations. Students can evaluate those situations with appropriate scientific evidence (633).
6 (the highest level)	Students can solve mixed multiple representations based questions. Students can also justify their finding and generalize them (669).	Students can go beyond the text in order to apply their sophisticated and deeply understanding. Students can also handle unfamiliar ideas within multiple inferences (698).	Students can justify their conclusion with scientific evidence. Students can also reflect their scientific and critical thinking on more complex personal, social and global situations (708).

Differences in mathematics, reading, and science scores across geographical regions

According to PISA 2012 results, mathematics proficiency levels in Turkey show many variations within geographical regions. Table 3 represented the range from level 1 to level 2. It refers to that although students can answer well-defined questions, they can have difficulties in using basic formulas including geometric properties to solve questions or justifying answers. In addition to that, Table 2 shows students' proficiency levels in reading vary from level 2 to level 3 within the geographical regions. Students can make connections along a text, but it can be challenge for students to evaluate the text critically or to go beyond content of the

text to find the main idea. Finally, according to Table 3, proficiency levels in science do not differ so much. It is at level 2 for all geographical regions. It means that students have adequate scientific knowledge within the context. However, they can have problems to integrate scientific context on more complex life situations or global issues.

Table 3
Proficiency levels, means and standard deviations for mathematics, reading and science literacy with respect to geographical region

	Mathematics			Reading			Science		
Geographical regions	M	SD	P.L.	M	SD	P.L.	M	SD	P.L.
Marmara	469.460	94.412	2	493.750	83.720	3	482.304	80.220	2
Aegean	463.582	87.889	2	490.244	76.262	3	475.549	76.262	2
Mediterranean	445.104	96.616	2	474.553	91.248	2	463.973	79.535	2
Central Anatolian	473.320	94.873	2	498.468	84.034	3	481.856	80.450	2
Black sea	431.009	82.664	2	465.276	78.359	2	456.737	70.935	2
Eastern Anatolian	417.221	79.083	1	454.316	77.959	2	440.201	70.745	2
Southeastern Anatolian	398.151	77.069	1	429.765	75.721	2	416.717	67.986	2

Note: P.L.: Proficiency level

In addition to that, mathematics, reading and science mean scores were compared with the OECD mean score (500 points) all across the geographical regions. Figure 3 showed that mathematics mean scores in almost all the geographical regions did not reach the OECD mean score. Science mean scores of Turkish students were also below the OECD mean score in Figure 4 for all geographical regions. Figure 5 also indicated that reading mean scores had the same result with mathematics and reading mean scores. Any of literacy means' scores were not relative to the OECD mean score all across the geographical regions.

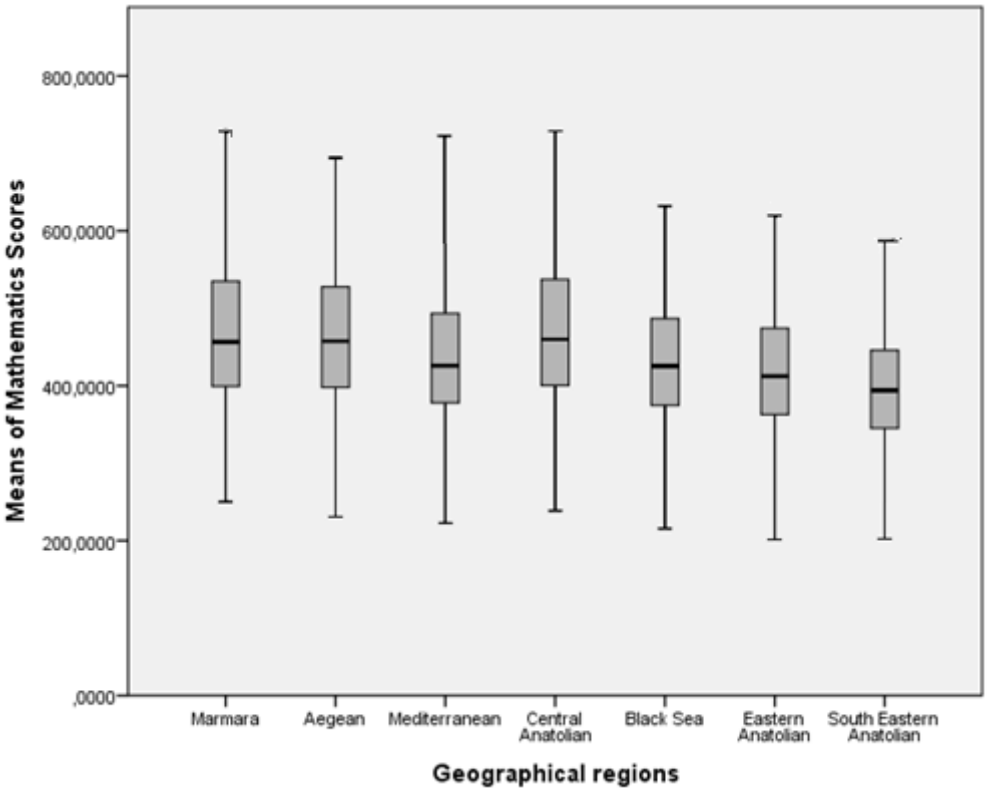

Figure 3. Mean scores of mathematics among geographical regions.

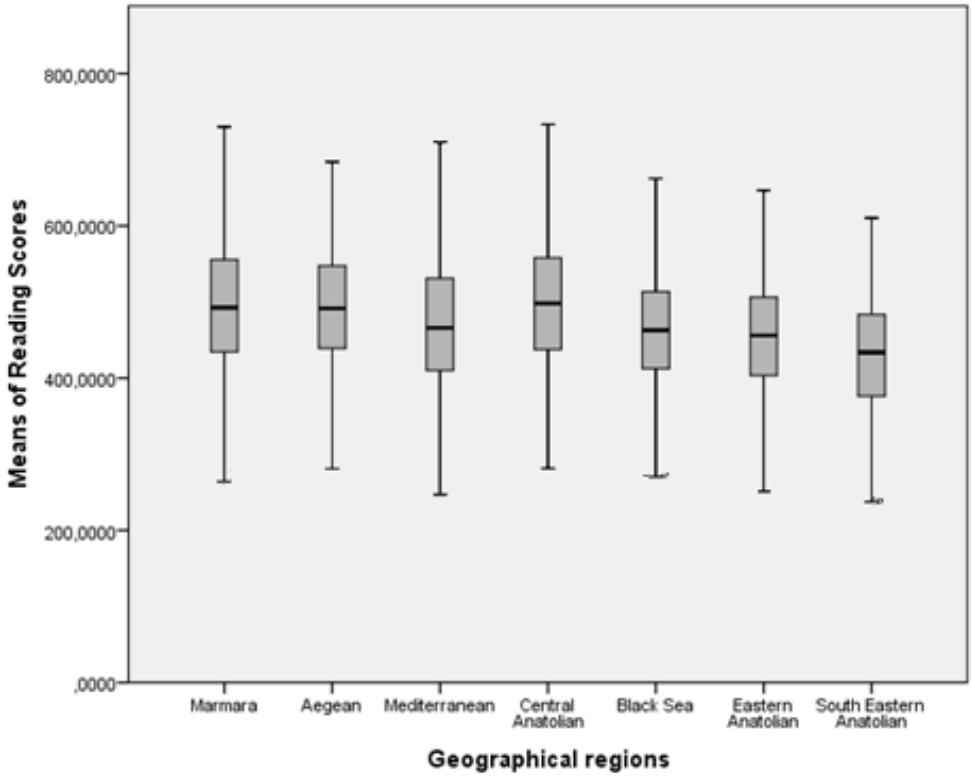

Figure 4. Mean scores of reading among geographical regions.

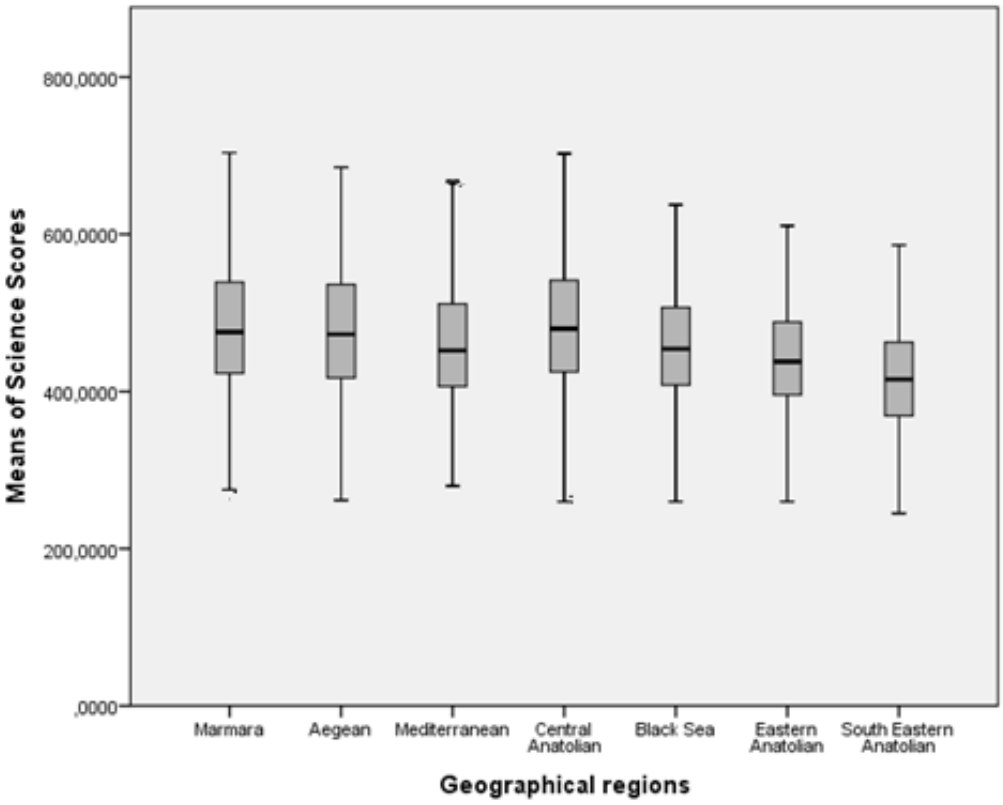

Figure 5. Mean scores of science among geographical regions.

One-sample t-test indicated statistically significant difference in mathematics, reading and science score among the geographical regions except reading score in Central Anatolian. It means that the reading score in Central Anatolia was relative to OECD mean score. However, Table 4 showed that mathematics, reading and science mean scores were below the OECD mean score.

The analysis of the data indicated that differences between the OECD means and means for all three subject areas are becoming larger from west to east.

Table 4
Mean differences between OECD mean score and both mathematics, science and reading mean score across the geographical regions

Geographical Regions in Turkey	Literacies	Test Value = 500			
		T	df	Sig. (2-tailed)	Mean Difference
Marmara	Mathematics	-12.168	1414	.000	-30.540
	Reading	-2.808	1414	.005	-6.250
	Science	-8.298	1414	.000	-17.696
Aegean	Mathematics	-9.919	572	.000	-36.418
	Reading	-3.062	572	.002	-9.756
	Science	-7.350	572	.000	-24.451
Mediterranean	Mathematics	-14.102	615	.000	-54.896
	Reading	-6.922	615	.000	-25.447
	Science	-11.242	615	.000	-36.027
Central Anatolian	Mathematics	-7.727	754	.000	-26.680
	Reading	-.0501	754	.617	-1.532
	Science	-6.197	754	.000	-18.144
Black Sea	Mathematics	-17.763	452	.000	-68.991
	Reading	-9.432	452	.000	-34.724
	Science	-12.981	452	.000	-43.263
Eastern Anatolian	Mathematics	-20.485	382	.000	-82.779
	Reading	-11.468	382	.000	-45.684
	Science	-16.542	382	.000	-59.799
South Eastern Anatolian	Mathematics	-27.658	437	.000	-101.849
	Reading	-19.412	437	.000	-70.235
	Science	-25.637	437	.000	-83.283

According to MANOVA results, geographical region was found to be a significant factor (Wilks'Λ= .978, F (6, 4633) = 5.780, $p < .05$). Effect size for the geographical region was small (η^2=.008).

Explained variances were found to be .587 (Adjusted R Squared = .583), .473 (Adjusted R Squared = .468), and .508 (Adjusted R Squared = .504) for mathematics, reading, and science literacy, respectively. These values refers to the variation in geographical regions explaining a significant amount of variability of students' literacy scores.

In addition to that, MANOVA results showed there are statistically significant differences of students' performance in mathematics ($F (6, 4633) = 12,832$, $p <0.05$), reading ($F (6, 4633) = 7.726$, $p < 0.05$) and science ($F (6, 4633) = 9.807$, $p < 0.05$) literacy all across the geographical regions in Turkey. Moreover geographical region had an effect on students' performance in mathematics literacy ($\eta^2 = .17$). For reading literacy, effect size was estimated as large ($\eta^2 = .10$) and for science literacy, it was also estimated as large ($\eta^2 = .13$) respectively. MANOVA results also indicated that there is a statistically significant difference of students' performance in mathematics literacy among all geographical regions except Marmara and central Anatolian region ($p > .05$), Aegean and Black sea region ($p > .05$), Eastern Anatolian and Southeastern Anatolian region ($p > .05$). Table 5 shows mean differences between regions. MANOVA results pointed out that there is also a statistically significant difference of students' performance in reading literacy among all geographical regions except Marmara and central Anatolian region ($p > .05$), Aegean and Black sea region ($p > .05$), Eastern Anatolian and Southeastern Anatolian region ($p > .05$) and also Mediterranean region and Central Anatolian ($p > .05$). Table 5 showed mean difference of reading scores among the schools. In addition, based on mean differences between regions on Table 5 , it can be seen that there is a statistically significant difference of students' performance in science literacy among all geographical regions except Aegean and Black sea region ($p > .05$), Eastern Anatolian and Southeastern Anatolian region ($p > .05$) and also Mediterranean region and Central Anatolian ($p > .05$).

Table 5
Turkish students' performance in mathematics, reading and science literacy with respect to geographical regions

Geographical regions		Mathematics		Reading		Science	
I	J	M.D. (I-J)	Sig.	M.D. (I-J)	Sig.	M.D. (I-J)	Sig.
Marmara	Aegean	34.863	.000	25.631	.000	30.179	.000
	Mediterranean	15.747	.000	9.474	.040	13.157	.002
	Central Anatolian	1.312	.741	2.325	.568	8.568	.021
	Black sea	39.730	.000	24.880	.000	29.851	.000
	Eastern Anatolian	75.740	.000	47.033	.000	60.311	.000
	South Eastern Anatolian	80.346	.000	62.722	.000	59.372	.000
Aegean	Mediterranean	-19.116	.000	-25.631	.000	-17.022	.000
	Central Anatolian	-33.551	.000	-23.306	.000	-21.611	.000
	Black sea	4.867	.494	-.750	.918	-.328	.961
	Eastern Anatolian	40.878	.000	21.403	.000	30.132	.000
	Southeastern Anatolian	45.484	.000	37.091	.000	29.193	.000
Mediterranean	Central Anatolian	-14.435	.003	-7.148	.155	-4.589	.317
	Black sea	23.983	.001	15.407	.044	16.694	.017
	Eastern Anatolian	59.993	.000	37.560	.000	47.154	.000
	Southeastern Anatolian	64.599	.000	53.248	.000	46.215	.000
Central Anatolian	Black sea	38.418	.000	22.555	.002	21.283	.001
	Eastern Anatolian	74.428	.000	44.708	.000	51.743	.000
	Southeastern Anatolian	79.034	.000	60.396	.000	50.804	.000
Black sea	Eastern Anatolian	36.011	.000	22.153	.006	30.460	.000
	Southeastern Anatolian	40.617	.000	37.841	.000	29.521	.001
Eastern Anatolian	Southeastern Anatolian	4.606	.602	15.688	.084	-.939	.910

Differences in mathematics, reading, and science scores across school types

To begin with, Table 6 showed that proficiency levels vary within the school types more than it happens in the geographical regions. To give an example, there is a wide range of mathematics proficiency levels across the school type in Turkey in PISA 2012. It ranges from level 1 to level 6. Table 6 stated that nevertheless some students in vocational high school may not solve questions that they are not familiar with, some students in science high school can go beyond the scope of the questions by justifying their answers. Moreover, Table 6 indicated proficiency levels in reading differ from level 2 to level 4. Science literacy has also the same situation with

reading literacy. So, it is hard for students to generalize their findings and reflect their thinking in a critical way both on reading and science items.

Table 6
Proficiency levels, means and standard deviations for mathematics, reading and science literacy with respect to school type

	Mathematics			Reading			Science		
School type	M	SD	P.L.	M	SD	P.L.	M	SD	P.L.
General	413.438	64.900	1	449.031	67.178	2	436.974	62.421	2
Anatolian	531.750	73.892	3	550.042	68.280	2	533.970	63.428	3
Science	672.335	34.764	6	624.975	47.598	4	608.275	39.411	4
Social Sciences	543.099	47.754	3	573.078	51.228	4	547.584	43.443	3
Anatolian Teacher Tra.	576.597	45.555	4	571.891	46.935	4	563.483	42.987	4
Vocational	389.524	58.327	1	427.452	65.908	2	415.856	57.132	2
Anatolian Vocational	449.959	58.559	2	494.781	60.955	3	475.196	56.473	4
Anatolian Technical	474.904	55.401	2	488.291	45.629	3	479.766	50.541	2
Multi Programme	410.465	66.999	1	436.866	62.970	2	433.028	60.897	2
Police	645.057	48.414	5	592.107	43.657	4	593.921	46.004	4

Note: P.L.: Proficiency level

When Table 3 and 6 were considered together, it seemed the large differences in proficiency levels are from school types rather than geographical regions. Regions differed in 3 levels, where schools did 6 proficiency levels.

Moreover, mathematics, reading and science mean scores were compared with the OECD mean score with respect to the school types. According to Figure 6, the mathematics mean score exceeded the OECD mean score in some of schools such as science, Anatolian and police high school but the rest of the schools did not reach the OECD mean score. Figure 7 and Figure 8 contained reading and science mean scores which were above the OECD mean score for all of the schools except general, vocational, Anatolian vocational, Anatolian technical and multi-programme high school.

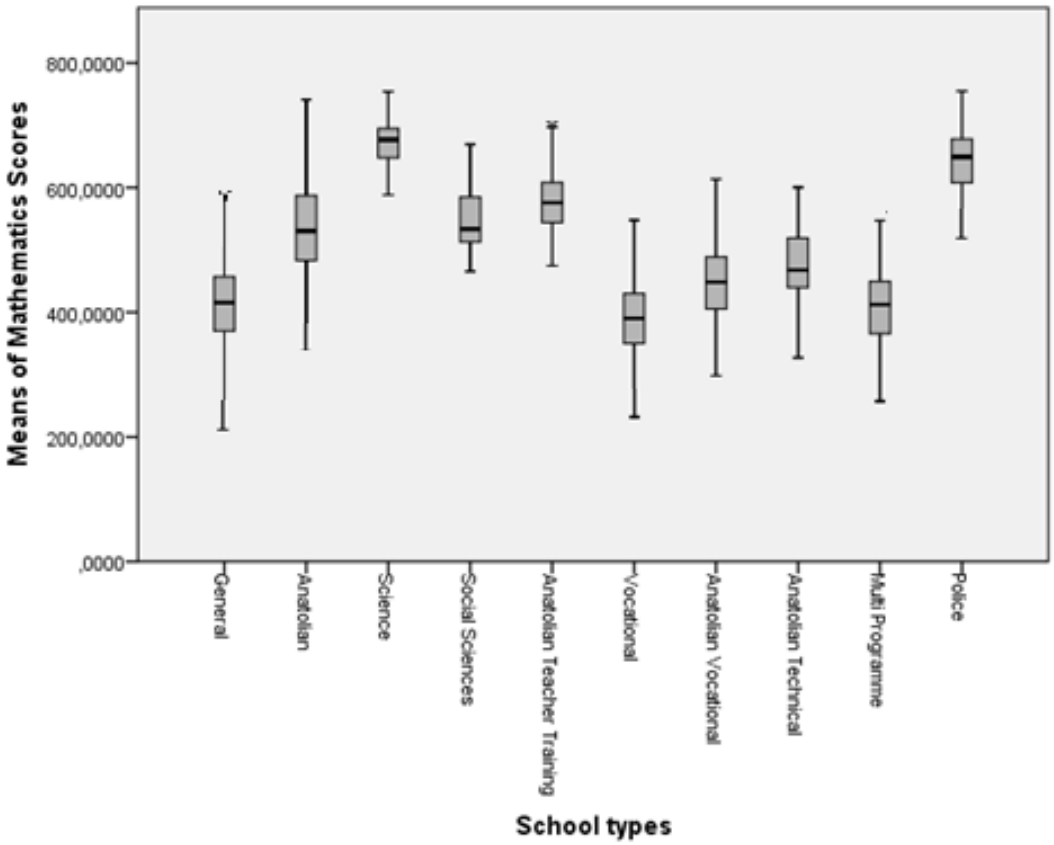

Figure 6. Mean scores of mathematics among school type.

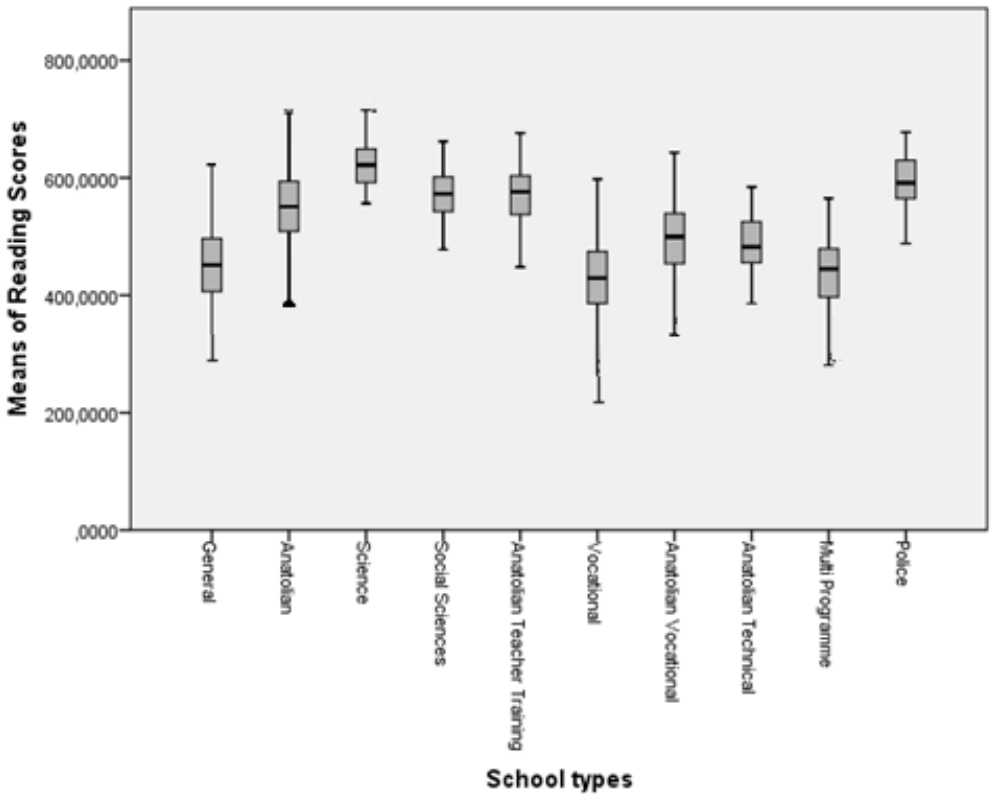

Figure 7. Mean scores of reading among school type.

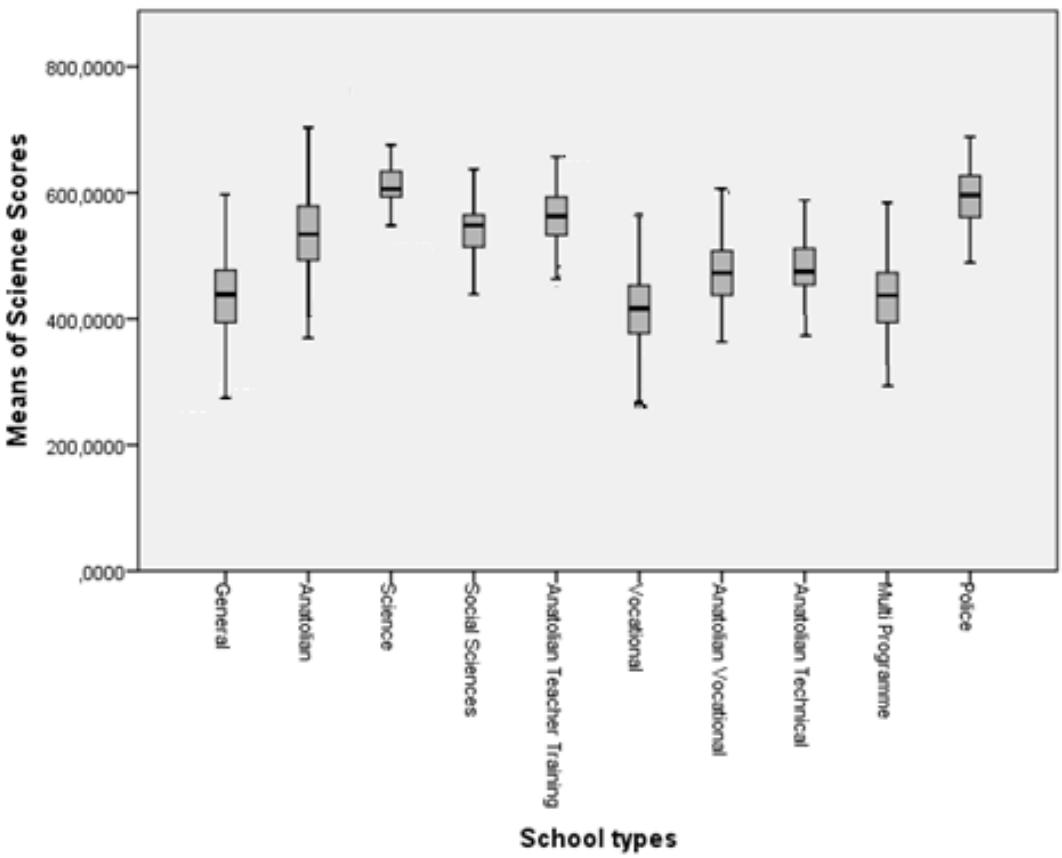

Figure 8. Mean scores of science among school type.

In addition to that, one-sample t-tests at 95% confidence level showed statistically significant difference in mathematics, reading and science scores among the school types except reading mean score in Anatolian Vocational high school.

Table 7 also indicated that although mathematics, reading and science mean scores were below the OECD mean for general, vocational, Anatolian vocational, Anatolian technical and multi-programme high schools, the mean scores were above the OECD mean for the rest of them.

After the analysis of the data, it was concluded in Table 7 mathematics, reading and science mean score for science and police high school had the highest mean

difference with the positive sign. Vocational and general high school had the highest mean with negative sign.

Table 7
Mean differences between OEDC mean score and both mathematics, science and reading mean score across the school type

		Test Value = 500			
School types	Literacies	T	df	Sig. (2-tailed)	Mean Difference
General	Mathematics	-50.684	1443	.000	-86.562
	Reading	-28.831	1443	.000	-50.969
	Science	-38.369	1443	.000	-63.026
Anatolian	Mathematics	13.923	1049	.000	31.750
	Reading	23.749	1049	.000	50.042
	Science	17.354	1049	.000	33.970
Science	Mathematics	29.328	34	.000	172.335
	Reading	15.534	34	.000	124.975
	Science	16.253	34	.000	108.275
Social Sciences	Mathematics	5.339	34	.000	43.099
	Reading	8.439	34	.000	73.078
	Science	6.480	34	.000	47.584
Anatolian Teacher Training	Mathematics	24.191	206	.000	76.597
	Reading	22.037	206	.000	71.891
	Science	21.248	206	.000	63.483
Vocational	Mathematics	-66.048	1215	.000	-110.476
	Reading	-38.384	1215	.000	-72.548
	Science	-51.358	1215	.000	-84.144
Anatolian Vocational	Mathematics	-14.274	278	.000	-50.041
	Reading	-1.430	278	.154	-5.219
	Science	-7.337	278	.000	-24.804
Anatolian Technical	Mathematics	-5.003	121	.000	-25.096
	Reading	-2.834	121	.005	-11.709
	Science	-4.422	121	.000	-20.234
Multi Programme	Mathematics	-17.779	176	.000	-89.535
	Reading	-13.339	176	.000	-63.134
	Science	-14.631	176	.000	-66.972
Police	Mathematics	24.707	67	.000	145.057
	Reading	17.398	67	.000	92.107
	Science	16.835	67	.000	93.921

School type was also found to constitute a significant effect (Wilks'Λ= .481, F (6, 4633) = 5.780, p<.05). Effect size for the school type variable is large (η^2=.216).

There are statistically significant differences of students' performance in mathematics ((F (6, 4633) = 498.584, p <0.05), reading (F (6, 4633) = 301.021, p <0.05) and science ((F (6, 4633) = 353.212, p <0.05) literacy among school types in Turkey. School type had the strong relationship on students' performance in mathematics literacy (η^2= .494) in contrast to reading (η^2=.371) and science literacy (η2=.409).

Explained variances were found to be .587 (Adjusted R Squared = .583), .473 (Adjusted R Squared = .468), and .508 (Adjusted R Squared = .504) for mathematics, reading, and science, respectively. These values indicated that variation in school type explained a significant amount of variability of students' literacy scores.

According to Table 8, there are differences of performance of students' mathematics literacy among most of the school types. To give an example, there are statistically significant differences among general high school and all the other schools (p<.05) except multi programme high schools (p>.05).

Table 8 also showed the performance of Turkish students' reading literacy all across the school types. According to MANOVA results, it was seen that there are statistically significant differences between the schools except social sciences high school and Anatolian teacher training high school (p>.05), social sciences high school and police high school (p>.05) and also Anatolian vocational and Anatolian technical high schools (p>.05).

In addition to that, for the science scores of Turkish students, there are statistically significant differences between the school types except general high school and multi programme high school (p>.05), science high school and police high school (p>.05), social sciences high school and Anatolian teacher training high school (p>.05) and also Anatolian vocational and Anatolian technical high schools (p>.05).

To sum up, most of the schools in Turkey have statistically significant differences in terms of mathematics, reading and science performance.

Table 8
Turkish students' performance in mathematics, reading and science literacy with respect to school type

School type		Mathematics		Reading		Science	
I	J	(I-J)	Sig.	(I-J)	Sig.	(I-J)	Sig.
General	Anatolian	-111.493	.000	-96.242	.000	-94.287	.000
	Science	-261.575	.000	-179.838	.000	-176.665	.000
	Social Sciences	-132.338	.000	-127.942	.000	-115.974	.000
	Anatolian Teacher Training	-163.259	.000	-125.972	.000	-132.883	.000
	Vocational	28.957	.000	22.434	.000	20.237	.000
	Anatolian Vocational	-34.671	.000	-45.467	.000	-36.713	.000
	Anatolian Technical	-55.525	.000	-44.279	.000	-47.064	.000
	Multi Programme	-2.917	.560	10.272	.046	-4.033	.389
	Police	-233.774	.000	-146.469	.000	-162.444	.000
Anatolian	Science	-150.082	.000	-83.597	.000	-82.379	.000
	Social Sciences	-20.845	.045	-31.700	.003	-21.687	.026
	Anatolian Teacher Training	-51.766	.000	-29.731	.000	-38.596	.000
	Vocational	140.450	.000	118.675	.000	114.524	.000
	Anatolian Vocational	76.822	.000	50.774	.000	57.574	.000
	Anatolian Technical	55.969	.000	51.963	.000	47.223	.000
	Multi Programme	108.576	.000	106.514	.000	90.254	.000
	Police	-122.280	.000	-50.228	.000	-68.157	.000
Science	Social Sciences	129.237	.000	51.897	.000	60.692	.000
	Anatolian Teacher Training	98.316	.000	53.866	.000	43.783	.000
	Vocational	290.532	.000	202.272	.000	196.903	.000
	Anatolian Vocational	226.904	.000	134.371	.000	139.952	.000
	Anatolian Technical	206.051	.000	135.559	.000	129.601	.000
	Multi Programme	258.658	.000	190.111	.000	172.633	.000
	Police	27.801	.027	33.369	.010	14.222	.225

Table 8 (cont'd)
Turkish students' performance in mathematics, reading and science literacy with respect to school type

School type		Mathematics		Reading		Science	
I	J	(I-J)	Sig.	(I-J)	Sig.	(I-J)	Sig.
Social Sciences	Anatolian Teacher Training	-30.921	.006	1.969	.864	-16.909	.106
	Vocational	161.295	.000	150.375	.000	136.211	.000
	Anatolian Vocational	97.667	.000	82.474	.000	79.260	.000
	Anatolian Technical	76.814	.000	83.663	.000	68.910	.000
	Multi Programme	129.421	.000	138.214	.000	111.941	.000
	Police	-101.435	.000	-18.528	.150	-46.470	.000
Anatolian Teacher	Vocational	192.216	.000	148.406	.000	153.120	.000
Training	Anatolian Vocational	128.588	.000	80.505	.000	96.169	.000
	Anatolian Technical	107.735	.000	81.693	.000	85.818	.000
	Multi Programme	160.342	.000	136.245	.000	128.850	.000
	Police	-70.515	.000	-20.497	.021	-29.561	.000
Vocational	Anatolian Vocational	-63.628	.000	-67.901	.000	-56.951	.000
	Anatolian Technical	-84.481	.000	-66.713	.000	-67.301	.000
	Multi Programme	-31.874	.000	-12.161	.019	-24.270	.000
	Police	-262.730	.000	-168.903	.000	-182.681	.000
Anatolian	Anatolian Technical	-20.853	.040	1.188	.909	-10.351	.276
Vocational	Multi Programme	31.754	.000	55.740	.000	32.681	.000
	Police	-199.103	.000	-101.002	.000	-125.730	.000
Anatolian Technical	Multi Programme	52.607	.000	54.551	.000	43.032	.000
	Police	-178.249	.000	-102.191	.000	-115.380	.000
Multi Programme	Police	-230.857	.000	-156.742	.000	-158.411	.000

CHAPTER 5: DISCUSSION

Introduction

This chapter contains an overview of the study including aims of the research and analysis used in this study. In addition to that, major findings are discussed. Recommendations for further research are also given in this section. Then limitations of the study are stated.

Overview of study

As it is stated before, there were two purposes of this study, one of which is to investigate if there are differences among the performance of Turkish students who live different geographical regions in Turkey in terms of mathematics, science and reading literacy. The second one is to examine whether Turkish students' performance in mathematics, science and reading literacy differs according to the school types based on the PISA 2012 results. In this study, MANOVA was used to compare the mean differences of students' performance in mathematics, science and reading across the geographical region and school type in Turkey.

Discussion of major findings

This research showed that Turkish students' performance in mathematics, reading and science differs all across the geographical regions and school type in the PISA 2012. However, the major difference was observed across school types in Turkey. In addition, LYS 2014 and YGS 2015 results pointed out the difference in students' academic achievement not only among geographical regions but also among

different school types in Turkey. This shows that Turkish students have problems both in the area literacy and application of content knowledge.

Geographical regions

This study indicated relatively small variations of the mean scores in mathematics, reading and science all across the geographical regions in Turkey. Students' performance was also benchmarked in terms of proficiency levels that are defined by the OECD. To begin with, students were at level 1 or level 2 in terms of mathematics performance all across the geographical regions in PISA 2012. This means that students in Turkey may solve well-defined questions mostly rather than going beyond the scope of questions in mathematics because students' proficiency level was low. Students performed in reading better than mathematics. However, their performance altered from level 2 to level 3 in general. So, students can gather information from a text and connect them but they may have difficulties to make inferences about unfamiliar of more complex content of the text. Similar situations applied to the students' science performance as these students were at level 2 in science. Although students may have adequate scientific knowledge, connection of this knowledge with real life situation can be hard for students. The overall conclusion is that since Marmara, Aegean and central Anatolian region were at the lowest level (level 2 or 3) among geographical regions, it could be said that the western part of Turkey performed better than the eastern part of it. This situation can be due to the family's socio-economic status, educational level of the family and the circulation of teachers.

Initially, the socio-economic status of a family can be one of important factors that influence student's achievement positively, especially in mathematics and science (Koutsoulis & Campbell, 2001). Since the argument of Bülbül and Köse (2010)

stated that the western part of Turkey has a higher socio economic status than the eastern part of it, one may expect to observe such differences in students' achievement across the geographical regions. This means living eastern part of Turkey may be a disadvantage for students' achievement in mathematics, reading or science.

Moreover, some research demonstrated that the educational level of parents plays an important role on students' achievement (Gürsakal, 2012). The author supports the view that there is a positive correlation between the performance of students and whether parents are educated well or not. Tunç (2009) also showed that parents are less educated parents because of tradition in the eastern part of Turkey and it affects students' performance in a negative way.

In addition to socio-economic status and parents' educational background issues, there are some teacher-related factors that can cause such differences in students' performance among geographical regions in Turkey. Due to the eastern regions' unique conditions, cities which are located in the eastern parts of Turkey have experienced an intense circulation of teachers (Gedikoğlu, 2005). This means teachers may not work in the same schools in eastern part of Turkey for many years and a class may experience teachers who change constantly. To give an example, one report stated generally that, newly graduated teachers in the profession are appointed in Southeastern Anatolian region in Turkey. The report also illustrated that many teachers want to leave this region as soon as possible. As a result, a classroom may change more than one teacher in a year and frequent teacher replacements can bring with some negative effects on students' achievement in these geographical regions in Turkey (Demir & Çobanoğlu, 2012).

School type

This research also indicated the large differences in students' mathematics, reading and science performances all across the different types of school in Turkey. In contrast to geographical regions, there were larger mean differences among the school types in terms of students' achievement. Proficiency in mathematics, reading and science literacy varied considerable with respect to school types. According to the PISA 2012 results, proficiency levels of school types were altered from level 1 to level 6.

First of all, the largest proficiency level variety was observed in mathematics literacy. When some students were at level 6, some of them were at the lowest level (level 1). This means that while students of science high school can justify their findings or generalize what they find in mathematics, students of Anatolian teacher training high school may have difficulties using theorems or providing adequate assumptions to solve questions or students of vocational high school can just answer only the well-defined questions.

In addition to that, proficiency levels in reading literacy differed from level 2 to level 4. Proficiency levels in science literacy had the same situation with reading literacy. So that although some students can make connections between scientific issues and real life situations, the rest of them may not be capable of thinking critically or they may not show deep understanding within the text. This means that the difference in students' mathematics, reading and science all across the school type is larger.

When being considered the characteristics of the schools that got higher proficiency levels in mathematics, science and reading, it could be said that they have some common characteristics. To give an example, those schools (science and police high

school) take selective students who take higher scores from the exam TEOG. Moreover, for example students of science schools have more mathematics and science classes in their curriculum (MEB 2014a). Hence, students of science high school or police high school receive advantages to increase their achievement.

Schools at lower proficiency levels (level 1 or level 2) in mathematics, reading and science have some common characteristics. In addition to mathematics or science courses, they have vocational training courses like electronics, communication or foreign languages courses. However, this is not the reason to get lower scores from national (YGS or LYS) or international studies (PISA or TIMSS). Although Anatolian teacher training school has vocational training courses, students of it were at a higher proficiency level not only in mathematics but also in reading and science (level 4 for all). The problem behind such differences in the performance of students can mean different curricula across the school in terms of weekly courses hours, content of courses and level of courses among the school types in Turkey.

When tenth graders in Anatolian and science high schools have six hours mathematics lessons in a week, it is just four hours in a week for students of fine arts high schools. In addition, after grade nine, students of Anatolian, and sport high schools have mathematics courses as basic mathematics and advanced mathematics. However, students of science high schools have more real-life related mathematics courses which are astronomy and space science and applied mathematics (MEB, 2014a).

Although all students have basic mathematics class at 9^{th} grade, students who could not get higher scores in national exams can have difficulties to understand the logic behind topic or formulas. They do not have opportunities to make mathematics

concepts clear or reach every area of mathematics. It is the same case for reading and science. Thus, their performance would be lower in both national and international exams.

In addition, in Turkey general high school comprises approximately 42% of all high school students (MEB, 2013c). The PISA 2012 results indicated that students of this school type were at the lower levels in mathematics, reading or science (level 1 or level 2). This means nearly half of the students in Turkey were at a lower level. Ten years earlier a similar situation existed. As Berberoglu and Kalender (2005) stated students' performance in mathematics was low according to the PISA 2003 results. In addition, the differences in students' performance across school type were larger compared to geographical regions. This means Turkish students do not show that much progress over time in terms of mathematics, reading and science literacy.

There are also some factors that influence students' achievement among the school types in Turkey. Those factors can stem from teachers, parents and/or schools. To give an example, research results showed that school facilities and family attitude can take into account the reasons of such differences (UNICEF, 2000; Thapa, 2015).

School facilities can affect students' performance in mathematics, reading or science. Some research findings indicated that improving school facilities has a positive effect on students' learning (O'Neill & Oates, 2001) and students who can access instructional materials more can get advantage to increase their achievement. For example, the use of technology and its accessibility in science classes is crucial for students' achievement (Ercan, 2014). However, many of school types do not have such facilities in their classes in Turkey. This means students who do not have a

chance to use instructional materials may be disadvantageous in terms of getting a better learning environment.

In addition to that, attitudes of family can play an active role on students' achievement (Woessmann, 2004) and also ends up with large differences among school types. In general, families who have better educational backgrounds or who are able to send their children to send their children to private school in the case when students do not a high enough score to enter science school or other qualified school can affect students' performance positively. Since those families can also contribute to raise their children achievement by giving support (Özkan, 2010), they can impact such differences across the different types of school.

Finally, the Ministry of National Education claimed that Turkey became aware of its low performance in PISA and started showing improvement year by year. Turkish students' PISA scores in mathematics, reading and science have been increasing. In addition to that, the MEB focused on decreasing the number of students who are below the minimum proficiency level defined by the OECD (MEB, 2013c). Because this increment was slight, Turkey could not reach the OECD means scores so far. In addition to that Turkey has failed to increase its low proficiency levels. The PISA 2012 results showed that despite the progress of Turkey in the recent decades, its ranking has not changed that much among the OECD countries. Both Berberoğlu and Kalender (2005) and this study supported that not much has changed over the years in terms of Turkish students' performance in PISA.

Implications of practice

- Considering the conditions of the eastern regions, housing needs of teachers may be met to make them stay for long years at the same region.
- Salaries or teachers who will work eastern part of Turkey can be increased so that qualified, experienced teachers want to go and work there.
- Adequate funding for all the state schools should be provided in order to prevent inequality in education across the school types.
- There can be some in-service training like seminars or conferences or extra meetings in schools to raise awareness the importance of family education.
- In addition to modifying physical conditions of schools, there should be some arrangements in number of school types. The number of school types can be reduced.
- The curriculum of each school should be organized again in order to make students reach the minimum educational level for mathematics, science and reading.

Implication for further research

- Further studies may focus on the interaction models between geographical regions and school types using a larger data set.
- Adding several covariates in the MANOVA model such as socio-economic status may provide a more comprehensive picture about Turkish students' performance differences.

Limitations

PISA has some limitations in general. Initially, the sample covers just 15-year old students in PISA (de Carvalho, Gamboa, & Waltenberg, 2012). It means that PISA actually has a limited sample. In addition to that, PISA eliminates the contribution and the role of teachers. PISA 2012 has just four subjects to assess which are mathematics, science, reading and financial literacy (Mortimore, 2009).

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APPENDICES

APPENDIX 1: PISA 2012 items

Mathematics items:

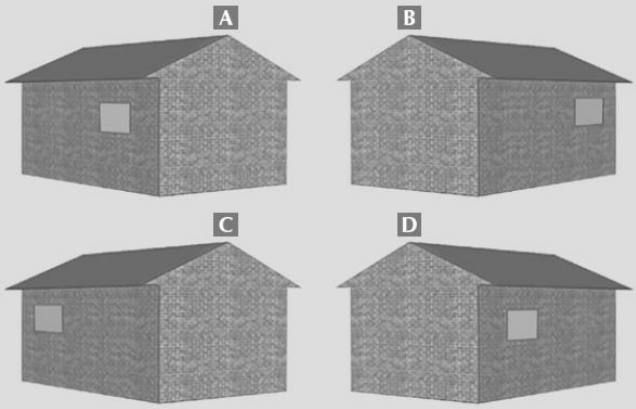
Level 1/ Question 1

A garage manufacturer's "basic" range includes models with just one window and one door.
George chooses the following model from the "basic" range. The position of the window and the door are shown here.

GARAGE – *QUESTION 1*

The illustrations below show different "basic" models as viewed from the back. Only one of these illustrations matches the model above chosen by George.

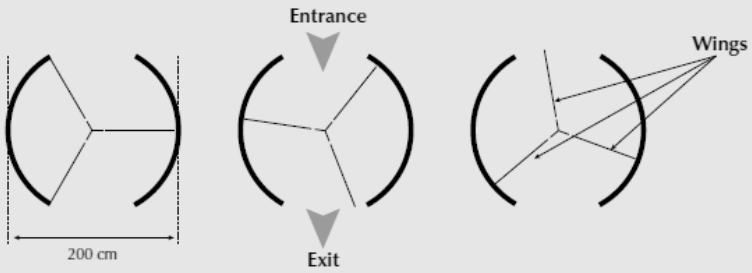
Which model did George choose? Circle A, B, C or D.



Level 3/ Question 1

REVOLVING DOOR

A revolving door includes three wings which rotate within a circular-shaped space. The inside diameter of this space is 2 metres (200 centimetres). The three door wings divide the space into three equal sectors. The plan below shows the door wings in three different positions viewed from the top.



The stimulus for these three questions concerns a revolving door, which is common in cold and hot countries to prevent heat moving into or out of buildings.

REVOLVING DOOR – *QUESTION 1*

What is the size in degrees of the angle formed by two door wings?

Size of the angle: .....°

Level 5 / Question 2

CLIMBING MOUNT FUJI

Mount Fuji is a famous dormant volcano in Japan.

CLIMBING MOUNT FUJI – *QUESTION 2*

The Gotemba walking trail up Mount Fuji is about 9 kilometres (km) long.

Walkers need to return from the 18 km walk by 8 p.m.

Toshi estimates that he can walk up the mountain at 1.5 kilometres per hour on average, and down at twice that speed. These speeds take into account meal breaks and rest times.

Using Toshi's estimated speeds, what is the latest time he can begin his walk so that he can return by 8 p.m.?

Reading items

Level 1b /Question 7

THE MISER AND HIS GOLD
A fable by Aesop

A miser sold all that he had and bought a lump of gold, which he buried in a hole in the ground by the side of an old wall. He went to look at it daily. One of his workmen observed the miser's frequent visits to the spot and decided to watch his movements. The workman soon discovered the secret of the hidden treasure, and digging down, came to the lump of gold, and stole it. The miser, on his next visit, found the hole empty and began to tear his hair and to make loud lamentations. A neighbour, seeing him overcome with grief and learning the cause, said, "Pray do not grieve so; but go and take a stone, and place it in the hole, and fancy that the gold is still lying there. It will do you quite the same service; for when the gold was there, you had it not, as you did not make the slightest use of it."

Use the fable "The Miser and his Gold" on the previous page to answer the questions that follow.

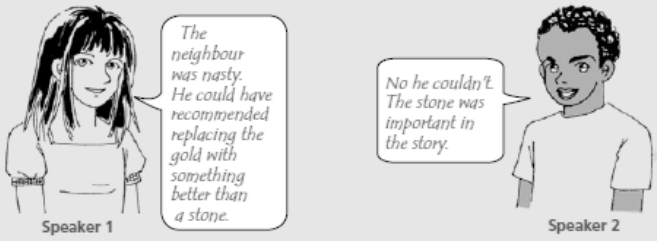
MISER – *QUESTION 7*

How did the miser get a lump of gold?

Level 3/ Question 5

MISER – *QUESTION 5*

Here is part of a conversation between two people who read "The Miser and his Gold".

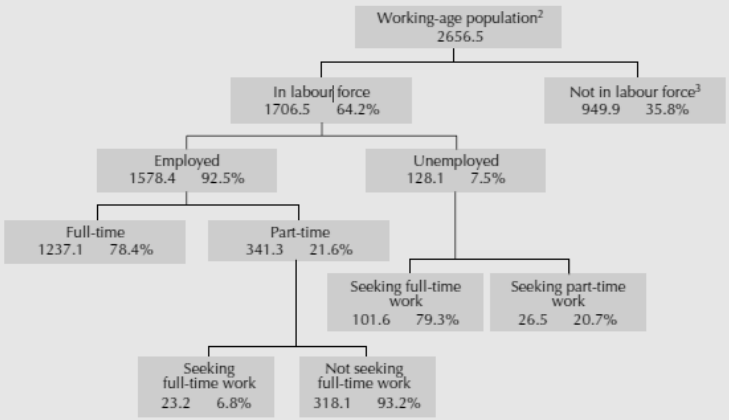


What could Speaker 2 say to support his point of view?

Level 5/ Question 16

The tree diagram below shows the structure of a country's labour force or "working-age population". The total population of the country in 1995 was about 3.4 million.

The labour force structure, year ended 31 March 1995 (000s)[1]



1. Numbers of people are given in thousands (000s).
2. The working-age population is defined as people between the ages of 15 and 65.
3. People "Not in labour force" are those not actively seeking work and/or not available for work.

Source: D. Miller, *Form 6 Economics*, ESA Publications, Box 9453, Newmarker, Auckland, NZ, p. 64.

LABOUR – *QUESTION 16*

How many people of working age were not in the labour force? (Write the **number** of people, not the percentage.)

Science items

Level 1 /Question 3

Regular but moderate physical exercise is good for our health.

PHYSICAL EXERCISE – *QUESTION 3*

What happens when muscles are exercised? Circle "Yes" or "No" for each statement.

Level 3 /Question 4

Read the following newspaper article and answer the questions that follow.

THE HISTORY OF VACCINATION

Mary Montagu was a beautiful woman. She survived an attack of smallpox in 1715 but she was left covered with scars. While living in Turkey in 1717, she observed a method called inoculation that was commonly used there. This treatment involved scratching a weak type of smallpox virus into the skin of healthy young people who then became sick, but in most cases only with a mild form of the disease.

Mary Montagu was so convinced of the safety of these inoculations that she allowed her son and daughter to be inoculated.

In 1796, Edward Jenner used inoculations of a related disease, cowpox, to produce antibodies against smallpox. Compared with the inoculation of smallpox, this treatment had less side effects and the treated person could not infect others. The treatment became known as vaccination.

MARY MONTAGU – *QUESTION 4*

Give one reason why it is recommended that young children and old people, in particular, should be vaccinated against influenza (flu).

Level 5 / Question 4

Read the texts and answer the questions that follow.

THE GREENHOUSE EFFECT: FACT OR FICTION?

Living things need energy to survive. The energy that sustains life on the Earth comes from the Sun, which radiates energy into space because it is so hot. A tiny proportion of this energy reaches the Earth.

The Earth's atmosphere acts like a protective blanket over the surface of our planet, preventing the variations in temperature that would exist in an airless world.

Most of the radiated energy coming from the Sun passes through the Earth's atmosphere. The Earth absorbs some of this energy, and some is reflected back from the Earth's surface. Part of this reflected energy is absorbed by the atmosphere.

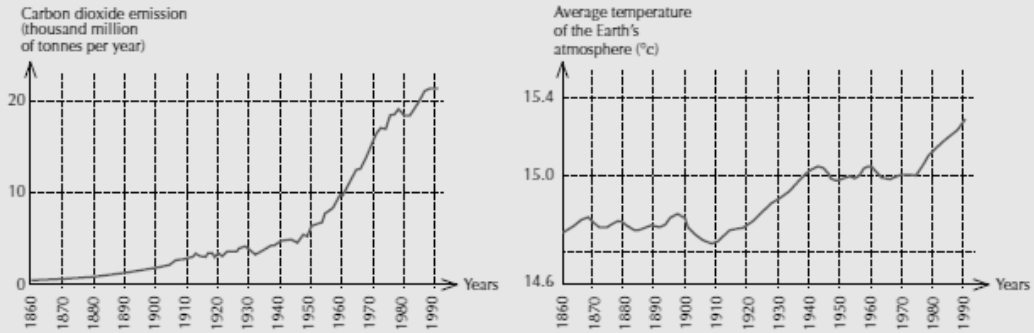
As a result of this the average temperature above the Earth's surface is higher than it would be if there were no atmosphere. The Earth's atmosphere has the same effect as a greenhouse, hence the term greenhouse effect.

The greenhouse effect is said to have become more pronounced during the twentieth century.

It is a fact that the average temperature of the Earth's atmosphere has increased. In newspapers and periodicals the increased carbon dioxide emission is often stated as the main source of the temperature rise in the twentieth century.

A student named André becomes interested in the possible relationship between the average temperature of the Earth's atmosphere and the carbon dioxide emission on the Earth.

In a library he comes across the following two graphs.



André concludes from these two graphs that it is certain that the increase in the average temperature of the Earth's atmosphere is due to the increase in the carbon dioxide emission.

GREENHOUSE – *QUESTION 4*

Another student, Jeanne, disagrees with André's conclusion. She compares the two graphs and says that some parts of the graphs do not support his conclusion.

Give an example of a part of the graphs that does not support André's conclusion. Explain your answer.