AN INVESTIGATION ON REGIONAL ACHIEVEMENT GAPS IN MATHEMATICS IN TURKEY: A MULTILEVEL ANALYSIS OF TURKEY 2015 PISA DATA

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Approval of the Graduate School of Social Sciences

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ABSTRACT

AN INVESTIGATION ON REGIONAL ACHIEVEMENT GAPS IN MATHEMATICS IN TURKEY: A MULTILEVEL ANALYSIS OF TURKEY 2015 PISA DATA

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This study aims to map the regional achievement gaps in mathematics in Turkey and to find the variables that are helpful to close the achievement gaps in mathematics for each Nomenclature of Territorial Units for Statistics (NUTS) Level-1 regions of Turkey by utilizing 2015 PISA Data. The sample consisted of 187 schools selected by cluster sampling method from 12 NUTS Level 1 regions and 5895 students which are selected by random sampling from the selected schools.

Hierarchical Linear Modelling (HLM) analysis was conducted using HLM7 software due to the nested nature of the data. HLM results revealed that there exists a statistically significant difference between math achievement of the students in Aegean and Central East Anatolia regions and, between Aegean and Southeast Anatolia regions. Furthermore, there is a marginally significant difference between Aegean and East Black Sea regions. When family-related factors are controlled, there

is a statistically significant difference only between Aegean and East Black Sea regions. When school-related factors are controlled, there is a statistically significant difference between Aegean and Central East Anatolia regions and between Aegean and Southeast Anatolia regions. Lastly, when family-related and school-related factors are controlled together, there is no statistically significant difference between Aegean region and any other region in math performance.

Overall, the results suggested that different regions respond uniquely to different sets of variables. However, when similar opportunities are offered in terms of both school and family factors, the achievement gaps in math among different regions of Turkey can be closed.

Keywords: PISA, regional achievement gaps, math achievement

ÖZ

TÜRKİYE'DE MATHEMATİK BAŞARISINDAKİ BÖLGELER ARASI FARKLILIKLAR ÜZERİNE BİR İNCELEME: TÜRKİYE 2015 PISA DATA'SININ ÇOK DÜZEYLİ BİR ANALİZİ

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Bu çalışmanın amacı, Türkiye'de İstatistiksel Bölge Birimleri Sınıflaması (İBBS) Düzey 1 bölgeleri arasındaki matematik başarısına dair farkları, PISA 2015 Türkiye verisini kullanarak incelemektir. Çalışmanın örneklemi, PISA 2015 Türkiye verisinde yer alan, 12 İBBS Düzey 1 bölgeden tabakalı seçkisiz örnekleme yöntemi ile seçilmiş 187 okul ve bu okullardan seçkisiz yöntemle belirlenmiş 5895 öğrenciden oluşmaktadır.

Verinin kümeli yapısı sebebiyle, analizler için HLM7 programı kullanılarak Hiyerarşik Lineer Modelleme (HLM) yapılmıştır. Analiz sonuçlarına göre, Ege Bölgesi'ndeki öğrencilerin matematik başarısı ile Orta Doğu Anadolu ve Güneydoğu Anadolu'daki öğrencilerin başarısı arasında anlamlı düzeyde fark bulunmuştur. Ayrıca, Doğu Karadeniz Bölgesi'ndeki öğrencilerin başarıları ile Ege Bölgesi'ndeki öğrencilerin başarıları arasında sınırda anlamlı farklılık bulunmuştur. Aile

değişkenleri kontrol edildiğinde; sadece Ege Bölgesi ve Doğu Karadeniz Bölgesi arasında anlamlı düzeyde farklılık olduğu, Ege Bölgesi ile Orta Doğu Anadolu ve Güneydoğu Anadolu Bölgeleri arasındaki anlamlı farkın ortadan kalktığı görülmüştür. Okul değişkenleri kontrol edildiğinde ise; Ege Bölgesi ile Orta Doğu Anadolu ve Güney Doğu Anadolu Bölgeleri arasında anlamlı farklılığın devam ettiği, diğer taraftan, Ege Bölgesi ile Doğu Karadeniz Bölgesi arasındaki sınırda anlamlı farklılığın ortadan kalktığı görülmektedir. Son olarak hem aile hem okul değişkenleri kontrol edildiğinde Ege Bölgesi ile diğer hiçbir bölge arasında öğrencilerin matematik başarısı arasında anlamlı bir farklılık bulunmadığı görülmüştür.

Çalışmanın sonuçları genel olarak değerlendirildiğinde, bölgelerin farklı değişken setlerine birbirinden farklı cevaplar verdiği görülmektedir. Fakat hem okul, hem de aile faktörleri açısından benzer olanaklar sağlandığında, Türkiye'de bölgeler arasındaki matematik başarı farklarının ortadan kalkabileceği görülmektedir.

Anahtar Kelimeler: PISA, bölgesel başarı farkları, matematik başarısı

To My Family

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I also dedicate this work to the children who are suffering from achievement gaps due to the factors which are not in control of them.

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LIST OF ABBREVIATIONS

PISA	Programme for International Student Assessment
TIMSS	Trends in International Mathematics and Science Study
OECD	Organisation for Economic Co-operation and Development
HLM	Hierarchical Linear Model
ICC	Intraclass Correlation Coefficient
NUTS	Nomenclature of Territorial Units for Statistics
ISCED	International Standard Classification of Education
ISEI	International Socio-Economic Index
MISCED	Mother's International Standard Classification of Education
FISCED	Father's International Standard Classification of Education
BMMJ1	Mother's Occupational Status
BFMJ2	Father's Occupational Status
IMMIG	Immigrant Background
LANGN	Language Spoken at Home
EMOSUPS	Parents Emotional Support
CULTPOSS	Cultural Possessions
HEDRES	Home Educational Resources
ESCS	Index of Economic, Social, and Cultural Status
LEAD	Educational Leadership
EDUSHORT	Shortage of Educational Material
STAFFSHORT	Shortage of Educational Staff
STUBEHA	Student-Related Factors Affecting School Climate
TEACHBEHA	Teacher-Related Factors Affecting School Climate
PVMATH	The Plausible Values of Math Performance
TR1	Istanbul Region
TR2	West Marmara Region

TR3	Aegean Region
TR4	East Marmara Region
TR5	West Anatolia Region
TR6	Mediterranean Region
TR7	Central Anatolia Region
TR8	West Black Sea Region
TR9	East Black Sea Region
TRA	Northeast Anatolia Region
TRB	Central East Anatolia Region
TRC	Southeast Anatolia Region

CHAPTER 1

INTRODUCTION

The main problem of the study is represented in this chapter. It starts with the background of the study. Then, it is continued with statement of the problem and the purpose of the study. Lastly, the significance of the study and definition of terms are explained.

1.1 Background of the Study

Over the two decades, discussion on the growth and success of nations and regions are progressively done in the central role of the analysis of human capital primarily since advanced societies increasingly evolved towards "knowledge-based economy" (Faggian, Modrego, & McCann, 2019; OECD, 2006). The central formula of development economics of the second half of the 20th century was to catch up to the richest economies by industrialization through a Fordist mass production but this formula has stopped working and the alternative formula which is knowledge economy appeared (Unger, 2019). Useful knowledge and skills acquired by people is a form of capital which is substantially a product of thoughtful investment so that the later distribution of income can be related with the distribution of individual abilities (Mincer, 1958; Schultz, 1959). Activities that affects future real income by embedding resources in people is called investing in human capital (Becker, 1962). Despite nowadays, there is no consensus on the definition of human capital, it can be simply referred as any knowledge, skills and competencies embodied in individuals or their social relations which increase an individual's productivity (Faggian et al., 2019).

Investment in human capital and growing in human capital faster than nonhuman capital is the most distinctive feature of the Western economic system and can be referred to explain economic gaps between Western and Eastern economies (Salle, 2010; Schultz, 1959). There are many ways to invest in human capital like medical care, on-the-job training, vitamin consumption, acquiring information about the economic system, and schooling (Becker, 1962). In order to bring economic growth and development investing in human capital through education is as crucial as investing in physical capital through plant and equipment, housing and infrastructure (Horioka, Morgan, & Niimi, 2018). However, Unger (2019, pp. 74–125) claims that in developing countries there are two forces which are often converged to cheat them of the opportunity to develop the knowledge economy in inclusive rather than insular form: weakness of democracy and mental colonialism which is the subordination of intellectual life in these countries to the currents of thought prevalent in the richest and most resigned parts of the world. He asserts that a knowledge economy in which many can take part not only increase productivity and diminish inequality but also it has the potential to lift us up together and offer us a shared bigness.

Despite the usage of the human capital as the justification ground of the knowledge-based economy, there are some criticism on the human capital theory as well. The human capital model is basis of neoclassical analysis of education, economic growth and labor markets (Quiggin, 1999). Tan (2014, pp. 413–437) summarizes criticism on human capital theory under the headings of: methodological criticisms, empirical criticisms, practical criticisms and moral criticisms. Methodological criticism of the human capital theory is due to its methodological individualism that takes the individual as a point of departure and the paradigm that human capital theory rests on which is rational choice theory which suggests that individuals seek to maximize their own interests by making optimal decisions in the entire domains of their lives. However, methodological collectivists argue that social phenomena cannot be reduced to the individual alone because the whole is different from the sum of the

individual constituents. Also, there are three limitations in rational choice theory which are bounded rationality, bounded willpower and bounded self-interest (Jolls, Sunstein, & Thaler, 1998). Bounded rationality is the fact that there is finite cognitive abilities of human beings (Simon, 1956). Bounded willpower is human beings can display behaviors which are inconsistent with their long term interest even they are aware of it like smoking while preferring not to smoke (Jolls et al., 1998). The bounded self-interest is that most people care or act is they care about others and their goal is not solely to promote their own interests (Jolls et al., 1998). Empirical criticism of human capital theory is that human capital theory suggests that education increases a human's productivity in workplace and consequently leads earning a higher wage and all sides, including the firm and the country, will benefit from the productivity stemming from education. On the other hand, signaling theory suggests that education may bring a higher income to the individual without bringing any higher productivity for the firm and the country so more investment in education neither means more economic growth nor mass education leads mass production (Spence, 1973). Only education is not enough for economic growth. Social infrastructure which is the institutions and government policies that determine economic environment plays a key role in the effective use of potential human capital (Hall & Jones, 1999). Thus, state establishments and bureaucratic regulations should create a habitat where human capital accumulation is rewarded and encouraged. The practical criticism of the human capital theory is related to the scope and boundaries of the discipline of economics due to its intrusion into the realms of sociology, education, law, etc. and its desire to influence and dominate other academic disciplines to the extent to reshape and redesign according to its own needs. Moral criticism of the human capital theory is related the meaning that it attributes to human beings and referential framework in the analysis of human action and goals. Homo economicus who always desires to maximize his or her own utility in a set of constraints. These constraints are not moral, ethical, political or social constraints rather these are time, money and information. Thus, homo economicus is a non-moral person, if not immoral. If s/he does not steal something, it is not due to being immoral, rather it is cost is too big and too risky

investment in the economic sense. By pointing this calculative mentality, Foucault (1979) argues that human beings in human capital theory are completely identified with homo economicus who is an entrepreneur of himself, by being his own capital, by being his own producer and by being a source of earning for himself. By summarizing all the four aspects of the criticism, Tan (2014) argues that despite these critiques gives the impression that they have a better alternative model to drive education policies but sometimes it is quite noticeable that these criticism are mostly driven by ideological zeal just to attack the dominant school of thought while there is no alternative present at hand. He suggests that despite every criticism valuable on its own, a more systematic and comprehensive approach is necessary to analyze and criticize it better. For example, in Australia, Quiggin (1999, pp. 130–140) asserted that the alternative models to the human capital model like the screening model and public choice theory which imply that cuts in educational spending will be socially beneficial are implemented primarily because their policy implications are convenient to governments and other groups seeking to cut public expenditure in education and other areas with justification that current levels of expenditure constitute a burden on future generations. However, he states that the reduction in education spending on the basis of screening and public choice models will have adverse effect on Australia's long-term economic growth and on the lifetime welfare of the students affected by the cuts.

Beyond the human-capital-centric strategies of the growth, new researches raise questions on whether they are as effective as they are believed. Currently, it is suggested that a stronger consideration of social capital strategies in driving both performance and innovation within complex organizations are needed (Arena & Uhl-Bien, 2016). Coleman (1988a) states that social capital especially important due to its effect on the creation of human capital in the next generation. Bronfenbrenner (1986) declared in his ecological systems theory that in order to understand the child, the environment which students inhabits in must be fully examined including home, school, community, culture, and so on. Heyneman and Loxley (1982) have found that

the effect of family on the achievement of the student differs according to developmental levels of the countries and effect of school is more influential on achievement in less developed countries compare to the effect of family (1982). Besides country level study of Heyneman and Loxey's (1982), Tomul and Çelik's (2009) study shows that some country-level patterns can be visible on regional level as well. They have found that the effect of family is the greatest in Aegean region and the smallest in the South East Anatolian region in PISA 2006. Furthermore, they have found that family variables have highest effect on math achievement and least effect on reading achievement.

In the light of the literature, which is partially cited above, it can be said that human capital is the backbone of the knowledge-based economy of today. Thus, success of a region or, in sum, success of a nation is related to its success of investing in human capital. By considering that education and schooling are among the primary ways to invest in human capital, effectiveness of them can give clue about the geography's growth and success. In that sense, it is important to figure out the factors that are related to the output of schooling in the form of knowledge and skills acquired by the students, i.e. student achievement, in order to both estimate current situation of the human capital in the related region and to take measure on those factors to rise the accumulation of the human capital in those regions. In that sense, in the context of Turkey, by considering the both socio-economic and academic achievement gaps among the regions of the Turkey, mapping the achievement gaps among the regions of Turkey and figuring the factors that are effective to close the gaps among the regions will help to raise the human capital on the regional base for underachieving regions and the total human capital of the country as a result of cumulative increase in the human capital of the regions. Thus, in this study, school and family handled as two important factors on the academic achievement of the students and some variables in these groups are determined as related to the achievement of the students based on the literature. They are controlled both separately and together in order to see whether the achievement gaps among the regions are eliminated by assuming that they are

coming from the similar background in terms of the specified variables. Both family-related and school-related variables' relation to the achievement and their relation to regional achievement gaps will be discussed in the following parts of this thesis.

1.2 Statement of the Problem

Until the end of 1990s, The Organization for Economic Cooperation and Development (OECD) was comparing educational outcomes mainly by years of schooling. However, by PISA this changed and they started to test the knowledge and skills of students directly with a metric which was internationally agreed upon (Schleicher, 2019). The OECD aimed to respond the governments' and general public's demand of solid and comparable evidence on educational outcomes by launching PISA in 2000 (OECD, 2000). PISA surveys are administered in OECD member countries and a group of partner countries every three-year cycle. The countries who take PISA make up close to 90% of the world economy (OECD, 2009). There are three core domains in PISA which are science, reading, and mathematics. In each cycle of the PISA, one of these core domains is tested in detail by taking up around two-thirds of the total testing time. In 2015 and 2006 the major domain was science, 2012 and 2003 major domain was mathematics and in 2009 and 2000 major domains was reading (OECD, 2016). Mathematical literacy in PISA assesses to what extent 15-year-old students can be regarded as informed, reflective citizens and intelligent consumers (OECD, 2006).

Despite all the legitimate and rightful criticism of the human capital theory, human capital concept which is coming from human capital theory has been used in this study mainly due to two factors. Firstly, there is not a better structured model to drive education policies (Tan, 2014). Secondly, backbone of the PISA is human capital since OECD launched PISA with the aim of monitoring human capital with economic concerns. Thus, throughout this study, I will barrow the concept of human capital to point the inequalities in terms of educational returns among the regions.

From a human capital point of view, the economic gaps between different parts of the world partially can be attributed to the gap between skills and knowledge in these geographies. The reciprocity between economic gap of the geographies and gap in skills and knowledge of the populations inhabited in these geographies cannot be limited only inter-country level, rather the same pattern can be witnessed intra-country level as well. In the case of Turkey, the relative achievement of the regions is consistent in both national examinations like university entrance exams and international assessments like PISA and TIMSS (Ataç, 2017; Erberber, 2009; Karahasan & Uyar, 2009). Also, the underachieving regions of the Turkey which are east regions are socio-economically disadvantaged regions. By considering that one standard deviation increase in mathematics performance at the end of high schools translates into 20% higher annual earnings, in this study math achievement of the students have been chosen as dependent variable of the study due to its high capacity of estimating economic condition of the individual and cumulatively economic condition of the region (Hanushek & Zhang, 2009).

Faggian et al (2019, pp. 8–16). states that increase in human capital due to education can easily leak out of an area even when produced there by migration of individuals with high embodied human capital. Thus, the more advanced higher wage regions would benefit from the in-migration of workers which in turn leads to greater localized knowledge-investments and knowledge activities and out-migration of workers will lead to a decline in knowledge-investments and knowledge-activities. In that way, more advanced regions benefit from a range of positive externalities while depressed regions will progressively suffer from outflow of skills. By considering the effect of human capital on both region and aggregate effect of regional human capital on the country level and, inequalities among the human capital levels of the regions which both manifest and translate themselves as achievement gaps, this study will explore the outcome of schooling in math on regional base in Turkey and try to map the factors that have influence on the gaps in terms of outcomes of the schooling in math.

1.3 Purpose of the Study

The main purpose of this study is to investigate the regional achievement gaps in math in Turkey and find the variables that can account for achievement gap in math for each region. The variables are selected in this study consists of two levels as variables associated with family and variables associated with school. Family variables predict the family background. By taking into consideration the analytical separation of the family background as financial capital, human capital and social capital clearly there is a need to examine each factor when addressing student achievement (Coleman, 1988b). However, since variables like human capital or social capital cannot be extracted precisely from the PISA 2015 Turkey data set, in this study the predictors of them which are parents' education, parents' occupational status, immigration status, language at home, parents' emotional support, cultural possession at home, home educational resources, and the PISA index of economic, social and cultural status will be used as indicators of these capital types which constitute family background all together. Also, the school variables consist of the variables from PISA 2015 Turkey data set that predicts the educational leadership, school resources, and school climate as school background factors. Math performance of the students in PISA 2015 being dependent variable, and school-level and family-level variables being independent variables, this study aims to explore the regional achievement gaps in Turkey. PISA 2015 data is used since it is the last released PISA data in the OECD PISA database. Therefore, this study seeks an answer for the following research questions:

1. Is there a significant difference between mathematics achievement of the students in Aegean Region which had the highest student achievement in mathematics in PISA 2015 in Turkey and the other Nomenclature of Territorial Units for Statistics (NUTS) Level-1 Regions of Turkey?

2. Is there a significant difference in mathematics performance of the students in Aegean Region and the other NUTS Level-1 Regions of Turkey when we control the family-related variables (i.e., mother's education, father's education, the international socio-economic index of occupational status of father, the international socio-economic index of occupational status of mother, immigration status, language at home, parents emotional support, cultural possessions at home, home educational resources, and the PISA index of economic, social and cultural status)?

3. Is there a significant difference in mathematics performance of the students in Aegean Region and the other NUTS Level-1 Regions of Turkey when we control the school-related variables (i.e., the overall scale for leadership, school resources which includes the index on staff shortage and the index on shortage of educational material, and school climate which includes student related factors and teacher related factors affecting school climate)?

4. Is there a significant difference in mathematics performance of the students in Aegean Region of Turkey and the other NUTS Level-1 Regions of Turkey when we control both specified family-related variables and school-related variables (i.e., mother's education, father's education, the international socio-economic index of occupational status of father, the international socio-economic index of occupational status of mother, immigration status, language at home, parents emotional support, cultural possessions at home, home educational resources, the PISA index of economic, social and cultural status (ESCS), the overall scale for leadership, school resources which includes the index on staff shortage and the index on shortage of educational material, and school climate which includes student related factors and teacher related factors affecting school climate) ?

1.4 Significance of the Study

Turkey's underachievement among OECD countries in the international assessments like PISA is an ongoing debate for years. Together with the achievement gap among the other OECD countries, there is another persistent achievement gap intra-country level which is among the different region of Turkey. If the achievement of the country is the summation of the achievements of the different regions of it, it can be said that endeavors to close the achievement gap among different regions is translated to closing achievement gap of the country with other OECD countries. Thus, this study aims to diagnose the factors that is accounted for the regional achievement gap for each region. So that region-based educational policies can be formulated in order to take measure on the variables that are accounted for achievement gap for each region. Consequently, this will both close the regional achievement gaps and will raise the achievement level of the country.

It is known that economically more developed regions are performing better than the economically less developed regions in Turkey. However, very limited research has been done one the factors that contributes the regional achievement gaps in Turkey. Especially, since 2012 in which the compulsory education included high school education, no research done on factors behind the regional achievement gaps in Turkey at the end of the compulsory education.

Since academic achievement is a cumulative function of current and prior family, school and community experiences, in order to comprehend the reasons and mechanism under the regional achievement gaps in math, some family and school factors associated with student achievement have been chosen based on the literature (Rivkin, Hanushek, & Kain, 2005). Then the association of family and school factors with the achievement and their collective association with the achievement explored for each region since their collective effect can be different than their isolated effect. In fact, scholastic underachievement can be modelled as a contagious disease (Usaini,

Mustapha, & Sabiu, 2018). Thus, it is important to diagnose and cure it without spreading it to the wider population. In that sense, this study tries to reveal the factors that controlling them can be precautions the spread of these disease on the country as much as on the regional base.

Furthermore, PISA 2015 data has been chosen due to two reasons. Firstly, it is the last released data. Secondly, as Babadogan and Olkun (2006, p. 1) stated, international indicators like TIMSS (1999) and PISA (2003) showed that the Turkish Educational System did not produce quality in math and science at the elementary level and such international indicators and other internal indicators like national exams, forced educational system for a major curricular change at both elementary and secondary level. Thus, a massive curricular reform has been initiated in 2004 by a grant from the European Union. After piloting them in 100 elementary schools in 6 provinces for an academic year, the new curriculum started to be implemented in 2005-2006 school year. PISA 2015 is the first cycle that students who are subjected to constructivist curriculum entered the PISA. Thus, the results of this study can reveal the impact of the curriculum reform which is triggered by underachievement in the PISA and TIMSS on the math performance. Especially, this study will monitor the regional achievement gaps after the curriculum reform.

Compare to the extensive literature on the factors that are associated with student achievement, there is limited researches that take into consideration the geography as an intervening variable in Turkey. Moreover, literature is also limited on the geographical and regional achievement gaps and the factors influencing these gaps in Turkey. Since there is no research in the literature on the factors behind achievement gaps in math performance of the students in Turkey on the regional base, this study will be the first study which diagnose the variables that controlling them will close math achievement gap for each region.

1.5 Definition of the Terms

The operational definitions of the variables of the study are provided below:

1. *Mother's Education and Father's Education:* These terms correspond to students' responses on questions regarding parental education which are classified by using ISCED 1997 (OECD, 1999). In this study, educational qualifications of mother and father represented into these categories: (0) None, (1) ISCED 1 (primary education), (2) ISCED 2 (lower secondary), (3) ISCED Level 3B or 3C (vocational/pre-vocational upper secondary), (4) ISCED 3A (general upper secondary) and/or ISCED 4 (non-tertiary post-secondary), (5) ISCED 5B (vocational tertiary) and (6) ISCED 5A and/or ISCED 6 (theoretically oriented tertiary and post-graduate) (OECD, 2017).

2. *Mother's Occupational Status and Father's Occupational Status:* These terms correspond to the international socio-economic index occupational status (ISEI) of mother and father which are derived by recoding the data on students' responses to open ended question about their mother and father occupations (OECD, 2017).

3. *Immigrant Background:* In PISA, both students' and their mother and father' country of birth are asked. According to the answers, students are divided into three categories as: native students whose at least one parents born in the country of assessment, second-generation students who born in the country, but their parents born in another country and first-generation students who born outside of the country and whose parents also born outside of the country (OECD, 2017). Immigrant background implies being native, second-generation or first-generation.

4. *Language Spoken at Home:* Based on the answers of the students on what language they usually speak at home, language spoken at home is either: (1) language at home is the same as the language of the assessment which is Turkish in this case, or (2) language at home is another language (OECD, 2017).

5. *Parents Emotional Support:* This term corresponds to students' perceived emotional support from their parents using their answers on whether parents are interested in school activities, support the students' educational efforts and achievements, support students when they are facing difficulties at school and encourage them to be confident with a four-point Likert scale (OECD, 2017).

6. *Cultural Possessions:* This term corresponds to an index which is derived from the students answers to the availability of five household items (which are classic literature, books of poetry, works of art, books on art, music or design and a musical instrument) at home (OECD, 2017).

7. *Home Educational Resources:* This term also corresponds to an index which is derived from the students answers to the availability of the sixteen household items stated above (OECD, 2017).

8. *Index of Economic, Social and Cultural Status (ESCS):* It is a composite score consists of the indicators parental education, highest parental occupation, and home possessions including books in the home via principal component analysis (PCA). Since socio-economic status has usually been considered as based on education, occupational status and income and there is not a direct income measure available from the PISA data, the existence of household items has been used as a proxy for family wealth (OECD, 2017).

9. *Educational Leadership (LEAD):* It is a scale which consists of answers of school principals' answers to the frequency of the 13 activities about school leadership and behaviors in their school during the previous academic year. These questions are about using students' performance results, professional development activities of teachers, work of teachers and appropriateness and utilization of these three item with school's educational goals, promoting teaching practice based on recent educational research, praising teachers whose students are actively participating in learning, taking initiative to discuss the problems that teachers encounters in the classroom, drawing attention of teachers to the pupil's development of critical and social capacities, paying attention to disruptive behaviors in classrooms, providing staff opportunities to participate in school decision making, engaging teachers to help build a school culture of continuous improvement, asking teachers to participate in reviewing management practices, together solving the problem which are brought up a classroom by a teacher, discussing the school's academic goals with teachers at faculty meetings (OECD, 2017).

10. *Shortage of Educational Material:* It is an index which indicates the degree that the school's capacity to provide instruction hindered by due to four issues as a lack of educational material, and inadequate or poor-quality educational material, a lack of physical infrastructure, inadequate or poor-quality physical infrastructure (OECD, 2017).

11. *Shortage of Educational Staff:* It is an index which indicates the degree that the school's capacity to provide instruction hindered by due to four issues as a lack of teaching staff, inadequate or poor qualified teaching staff, a lack of assisting staff, and inadequate or poorly qualified assisting staff (OECD, 2017).

12. *Student-related Factors Affecting School Climate:* It refers to school principals' perception of the student behavior that might influence the instruction's provision in the school. The answers of the school administers to the questions of to what extend learning of students hindered by the phenomenon of student truancy, students skipping classes, students lacking respect for teachers, students use of alcohol or illegal drugs, students intimidating or bullying other students are used to reflect the student related factors affecting school climate (OECD, 2017).

13. *Teacher-related Factors Affecting School Climate:* It is school principals' perception of the teacher behavior that might influence the instruction's provision in the school. The answers of the school administers to the questions of to what extend learning of students hindered by the phenomenon of teachers not meeting the individual students' needs, teacher absenteeism, staff resisting change, teachers being too strict with students, teachers not being well prepared for class are used to reflect the teacher related factors affecting school climate (OECD, 2017).

14. *Math Performance of the Students:* It refers to 10 math plausible values which will be used together. Since, in PISA, population's performance is on the focus rather than the individual student performance, plausible values are used. Using plausible values also confirms with the purpose of the study since regional performance is on the focus rather than the individual performance (Wu, 2005).

CHAPTER 2

LITERATURE REVIEW

In this chapter of the study, information about literature related to Programme for International Student Assessment (PISA) and student achievement are given. Literature is reviewed under the headings of PISA, student achievement, and summary of the literature review.

2.1 PISA

A detailed analysis of the literature on PISA is presented in this section. PISA is introduced within theoretical foundations in this section. Firstly, under the heading of "what is PISA?" PISA has been presented with its emergence and aim, implementation procedures and some technical properties. Secondly, critiques on PISA has been mentioned. Lastly, PISA in Turkey has been mentioned through academic studies made on PISA in Turkey.

2.1.1 What is PISA?

PISA is launched by OECD as a collective endeavor of OECD member countries with the aim of measuring how well 15-year-old students who are approaching the end of compulsory education are ready to face the challenges of today's knowledge society (OECD, 2017a). In this section, PISA has been introduced under the headings of emergence and aim of PISA, cycles of PISA, performance scales in PISA,

mathematical literacy in PISA, plausible values in PISA, and background questionnaires in PISA.

2.1.1.1 Emergence and Aim of PISA

The Organization for Economic Cooperation and Development (OECD) is a forum in which 36 member states' governments and 70 non-member states' governments compare policy experiences, coordinate domestic and international policies, identify good practice, and seek answers to common problems in order to promote economic growth, sustainable development and prosperity. The OECD provides a valuable source of policy analysis and internationally comparable statistical, economic and social data (U.S. Mission to the Organization for Economic Cooperation & Development, n.d.).

The OECD's Survey of Adult Skills revealed that highly skilled adults more likely to volunteer and report that they are in good to excellent health, to see themselves as actors rather than as objects of political processes, and to trust others as well as twice as likely to be employed and around three times more likely to earn an above-median salary compare to poorly skilled adults (PISA, 2016). Until end of 1990s, the OECD was comparing education outcomes mainly by years of schooling. However, by PISA this changed. The intention of the PISA is testing the knowledge and skills of students directly with the help of a metric which was internationally agreed upon, linking the student skill with data from students, teachers, schools and system to understand performance differences, then act upon the data with collaboration by creating shared points of reference and peer pressure (Schleicher, 2019).

The aim of OECD by launching PISA was to respond the governments' and general public's demand of solid and comparable evidence on educational outcomes (OECD, 2000). PISA seeks to answers the questions of whether students are well prepared to the challenges of the future, whether they are able analyze, reason and communicate

their ideas in an effective way, whether as a productive member of the economy and society, they have found the kinds of interests that they can deal with throughout their lives though its surveys of 15-year-old students' key competencies (OECD, 2009). PISA as an ongoing programme, will lead to development of a body of information in order to monitor trends in the knowledge and skills of students in different countries as well as in various demographic subgroups of each country (OECD, 2016).

2.1.1.2 Cycles of PISA

PISA surveys are administered in OECD member countries and a group of partner countries every three-year cycle. The countries who take PISA make up close to 90% of the world economy (OECD, 2009). There are three core domains in PISA which are science, reading, and mathematics. In each cycle of the PISA, one of these core domains is tested in detail by taking up around two-thirds of the total testing time. In 2015 and 2006 the major domain was science, in 2012 and 2003 major domain was mathematics, and in 2009 and 2000 major domains was reading (OECD, 2016).

2.1.1.3 Performance Scales in PISA

Students performance in PISA reported using scales. At the beginning, the OECD average score of all three subject areas was 500 with a standard deviation of 100. This means that scores which represent degrees of proficiency in a domain was between 400 and 600 for two-thirds of students across OECD. For the following PISA cycles, the OECD average score slightly fluctuated around this original score (OECD, 2016).

2.1.1.4 Mathematical Literacy in PISA

Mathematical literacy defined as an individual's capacity to formulate, employ, and interpret mathematic in variety of contexts. Reasoning mathematically, and using mathematical concepts, facts, procedures and tools in order to explain, describe and

predict phenomena are included in mathematical literacy (OECD, 2016). Mathematical literacy in PISA assesses to what extent 15-year-old students can be regarded as informed, reflective citizens and intelligent consumers (OECD, 2006). Students' math performance is assessed in PISA through questions related to processes, content and context (OECD, 2016).

2.1.1.5 Plausible Values in PISA

In large-scale assessments programs like PISA, TIMSS, and NAEP, students' achievement data sets provided for secondary analyses contains plausible values which are multiple imputations of the observable latent achievement for each student (Wu, 2005). Using plausible has several methodological advantages compare to classical Item Response Theory (IRT) estimates by returning unbiased estimates of population performance parameters, percentages of students per proficiency level as they are on a continuous scale and bivariate or multivariate indices of relations between performance and background variables (OECD, 2009). The plausible values incorporate responses to test items and information about the background of responses; therefore, they cannot be used to compare individuals. Rather, they will provide consistent estimates of population characteristics despite they are not generally unbiased estimates of the individual proficiency. In PISA 2015, for each student 10 plausible value is computed (OECD, 2017a).

2.1.1.6 Context Questionnaires in PISA

The context of questionnaires in PISA include various indicators for reporting over time which are trend indicators or were designed to be used in analyses as single items like gender. On the other hand, many questionnaire items were designed to be combined in some way in order to measure latent constructs that cannot be observed directly like a student's achievement motivation or economic, social, and cultural background. Transformations or scaling procedures were applied to construct

meaningful indices to these items which are referred as derived variables. Context Questionnaires in PISA 2015 included a broad scope of context factors assessed with different questionnaire instruments. Student and school context questionnaires were mandatory in all countries. Also, many countries also administered the optional parent questionnaire. In addition, countries could choose to administer the international options Information and Communication Technology (ICT) Familiarity Questionnaire and the Educational Career Questionnaire to students. Furthermore, several countries took Teacher Questionnaire (OECD, 2017b).

In 2015, the computer-based test lasted a total of two hours for each student. Around 390 minutes of test items which are a mixture of multiple-choice questions and open-ended questions are given different students by different combinations of the test items. Also, students answered a background questionnaire about students themselves, their homes, and the school and learning experiences which took 35 minutes to complete. Moreover, school principals answered a questionnaire about school system and the learning environment. Optionally, for the first time, teacher questionnaire is offered. Parent questionnaire which is distributed to the parents, information and communication technologies (ICT) familiarity questionnaire and education career questionnaire for students was optional questionnaires of PISA 2015 (OECD, 2016).

2.1.2 Critiques of PISA

Baker, Goesling, and Letendre (2002, pp. 291–292) states that social class reproduction, human capital production and national economic development are interconnected with each other and this interconnection is a major topic of cross-national comparative researches which is broken into two major streams of researches. The first stream centers the social reproductive capacity of modern schooling via the production of human capital i.e., academic achievement with an obvious implication for social stratification theory. This stream has established a strong link between social

reproductive processes and achievement production in schools. On the other hand, the second stream examines how the nation-state has become the main provider of schooling over the past 100 years with an increasingly political interest in human capital production among its citizens. This second stream has established a clear link between qualities of nation states and institutionalized public schooling.

In recent years, supranational organizations started to set the parameters of school development in Western countries in particular directions and PISA tests are one important example of this. PISA generated shockwaves in many countries and shockwaves lead to critical re-assessment of their education system due to the results worse than expected (Haugsbakk, 2013, p. 607). Waldow (2009, pp. 477–479) states that PISA Educational policy changes are represented or interpreted as being remedies of failures in PISA by the advocates of these policy measures. However, it cannot be said that each policy measure justified by PISA was really motivated by the PISA-shock. The legitimacy of a policy chance does not necessarily result of its empirical proves but rather it is result of political and public acceptance of the measure. The high degree of acceptance of centralized instruments of examination and assessment in the media and general public which was significantly reinforced by PISA. Thus, through its impact on national education systems, PISA plays an indirect but no less important role on the governance of education spaces of the countries that implemented it by being a tool of domestic policy legitimation for education reforms (Grek, 2009). Pons (2012) indicates that there are limitations of PISA shock discourse in the national public debates. He states that

> Without being totally false, this vision has three limitations when addressing the issue of the reception of this survey in national public debates. First, this vision is not politically neutral, since it is in conformity with the global strategy that has been implemented by the OECD since 1961 to influence national political leaders and to progressively impose the centrality of its expertise. This strategy consists in using international comparison to put 'soft' pressure on national policy makers (through peer pressure, the pressure of a public opinion informed by the OECD's publications, the pressure of influential countries, etc.) and invites them to take into account specific policy

> issues that the OECD strongly contributed to defining as relevant. Searching for PISA shocks means, at least indirectly and implicitly, admitting that it is legitimate to expect from PISA that it produces a PISA shock, so it is, at least partially, accepting some aspects of the OECD rhetoric. (p. 206)

Moreover, Carvalho and Costa (2015) states that PISA is a 'norm and standard' instrument which does not operate only through its power of position in a competitive space and numbers bring 'naming, blaming, and shaming' to national policy arenas but rather, its strength rests also in the hope it creates about possibility of reform and confidence in national policy actors as a crucial banner of 'need to change' in their hands.

Also, it should be noted that comparisons through international tests like PISA tended to produce convergence in terms of what is seen as valuable in terms of education rather than celebrating difference which leads to policy convergence (Baird et al., 2016). Policy making processes in national contexts ever more inspired from PISA and the reference systems it constructs which increases the global impact on national policy-making processes (Rautalin, Alasuutari, & Vento, 2019). Carvalho (2014, p. 69) states that the surveillance of performances through the measurement of the outcomes by PISA to meet the demands of an imagined global environment which is the 'knowledge society' and the competitive 'knowledge economy', leads to assessing education systems with categories which are not nationally generated. This leads to changing power relations between transnational and national policy fields and decreases the national policy fields' abilities to define their own education understanding and to prompt their choices on 'legitimate means of making sense' of their own activity.

2.1.3 PISA in Turkey

In order to interpret how PISA results are utilized in the educational processes, including educational politics and planning in Turkey, we can take a glance researches

and discussions on PISA in Turkey. PISA implemented in 2000 for the first time but Turkey started to attend the PISA in the next cycle, in 2003 (Aydin, Erdağ, & Taş, 2011). When Turkey's mathematical literacy performance is examined from PISA 2003 to PISA 2012, approximately a 25 points increase can be seen between two assessments but despite the increase, the math performance is still below the OECD average (Özberk, Atalay Kabasakal, & Boztunç Öztürk, 2017). In PISA 2009, a significant progress among Turkish students below the basic skill level has been seen but this did significantly changed Turkey's international rankings despite the improvement in its average scores by ranking 32nd among 34 OECD countries (Köseleci Blanchy & Şaşmaz, 2011). Nic (2019, pp. 397–418) states that among the OECD countries that attended PISA, Turkey has one of the lowest performance level and the highest improvement in PISA between 2003 and 2012. From 2003 to 2012 Turkey improved the PISA math scores for 25 points which means that almost a full year of learning and, also decreased the achievement gap between rich and poor students as an axis of equity. Still, he states that additional caution is needed when interpreting the changes in PISA results due to the proportion of the students who are eligible for PISA in Turkey. In PISA 2003, less than half of Turkish 15-year-olds were eligible for the PISA sampling frame primarily due to dropout or delay which means that PISA 2003 was representing less than half of the 15-year-old population in Turkey. However, in 2013 15-year-old students eligible for PISA become 80% of the population while it was %45 in 2003 which means that the percentage of the population that PISA is representative of doubled. However, when it comes to PISA 2015, it can be seen that math performance of the students decreased sharply (420 points) compare to the both PISA 2012 math performance (448 points) and PISA 2009 (445 points) (Arıcı, Ozarkan, Özgürlük, & Taş, 2016). Furthermore, the math performance of the students in Turkey in 2015 falls behind even the PISA 2003 in which the math score was 423(Eğitimi Araştırma ve Geliştirme Dairesi Başkanlığı, 2005).

In terms of the PISA's effect on the policy changes in the implemented countries, Gür, Çelik, and Özoğlu (2012, pp. 5–9) argues that PISA used to justify curriculum reform which is already decided to implement in Turkey. They state that in 2002, shortly after The Justice and Development Party being elected for the government, an Emergency Action Plan (EAP) prepared with the first signs of the curriculum reform. Soon after the EAP, in 2003, the MONE started working on the new school curriculum in 2003 with the aim of enhance educational quality. In 2004, the new curricular programmes in the subjects of math, science and technology, Turkish, life sciences, and social studies piloted in 120 schools in nine different cities. One year after, in 2005, the MONE implemented the new curriculum which covers all subjects, all around the country without a proper evaluation of the pilot programme. Despite PISA is not a school curriculum study, in Turkey the curriculum is reformed, and PISA tests are used to justify this reform. However, PISA does not intended to test mastery of school curriculum (Prais, 2003). Akınoğlu (2008) states that this reform was unique compare to the several curricular reforms in the Turkish education system history by distinguishing the policymakers' direct reference to the concepts, skills and values which are borrowed from educational discourse of globalization and the European Union to point the need for a curriculum change.

In terms of the relationship between family background and academic achievement, in PISA 2003, Turkey had one of the highest degree of differences among student performances both between and within schools among the countries that attended PISA 2003 which implies that socioeconomic background of the students plays an important role in the student performance (Eğitimi Araştırma ve Geliştirme Dairesi Başkanlığı, 2005) PISA 2006 results also pointed the relatively high level family SES background on student achievement in Turkey. At that time, Turkey had one of the largest school effects and a high SES effect on student achievement (Alacaci & Erbaş, 2010). Also, PISA 2009 dataset confirms that schools are segregated by socio-economic background which further increases the student' achievement gap (Köseleci Blanchy & Şaşmaz, 2011) Similarly, in another study in which PISA 2012 Turkey

results are assessed, it is found that there was a positive and significant correlation between the highest parental education and mathematics score (Gürsakal, Murat, & Gürsakal, 2016). Assigning students in schools at the end of competitive exams intensifies the achievement and quality gaps between schools and school types and increases the influence of socio-economic background on students' achievement (Köseleci Blanchy & Şaşmaz, 2011). In PISA 2015, 9% of the differences in the student performance on all subject areas can be explained with differences in socio-economic background of the students (Arıcı et al., 2016). The achievement among students from different socio-economic profiles shows a higher unequal distribution in Turkey compare to higher performing countries in PISA 2015 which points out that social justice should be taken into consideration when plaining investment in education (Aydın, Selvitopu, & Kaya, 2018).

In the figure below, I distributed the master and doctorate thesis made on or made with PISA in the Turkey according to the years by utilizing the data from National Thesis Center.

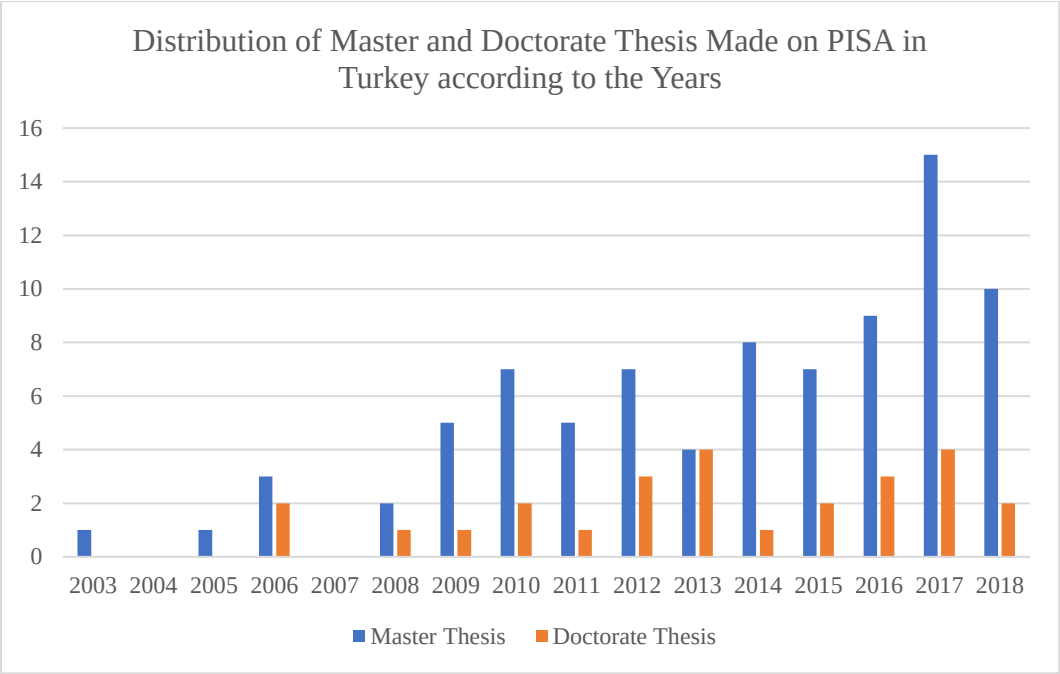

Figure 2.1 Distribution of master and doctorate thesis made on PISA in Turkey according to the years

We can see that the first thesis made in 2003 in Turkey. However, from 2003 to 2008 only 10 theses made on PISA. Beginning from 2009, we can see that there is an increase in the number of the thesis made on PISA. Especially, in 2017, after PISA 2015, there is a peak in the number of the thesis made on PISA with 15 master thesis and 4 doctorate theses. When the amount of the researches that done with the PISA data in Turkey is interpreted, the cost of attending PISA should be mentioned. OECD (n.d.) states that financial source of PISA is exclusively direct contributions of the participating countries and economies' government authorities which is typically ministry of education. Though PISA is conducted every three years, OECD gives the numbers of cost per annum. The cost that each participation country had to pay consists of international costs and national costs. International PISA costs for OECD members vary widely according to original agreement of the country when it joined OECD with an average per annum cost of around €150,000. For non-OECD members, the average per annum cost is around €45,000. Also, national costs vary by country, according to population size, the number of languages in use and the nature of the

political system, etc. In that sense, PISA may cost €75,000 per annum for a small country, €300,000 per annum medium-sized country; and two or three times the latter amount for a large country. Despite the direct cost of the PISA for Turkey is not available, one can estimate that as an OECD member and as a large country, Turkey pays huge amounts of money to attend the PISA on annual base. Despite there is a gap in the literature on cost of participation PISA apart from discussion on misuse or lack of use the results beyond ranking tables and average scores, the approximate numbers of cost of attending PISA stated above draw attention to the use and ultimate worth of assessment (Engel & Rutkowski, 2018).

2.2 Student Achievement

In this section, a detailed analysis of student achievement is presented. Firstly, literature on the factors that are associated with student achievement has been presented. Then, literature on achievement gap has been mentioned.

2.2.1 Factors Associated with Student Achievement

This section of the literature review presents the factors that are associated with student achievement under two categories. Firstly, family factors that are associated with student achievement are mentioned. Secondly, school factors that are associated with student achievement are mentioned.

2.2.1.1 Family Factors

In this section, family factors that are associated with student achievement are presented under the subheadings of parents' educational level, parents' occupational status, immigration status, language at home, parents' emotional support, cultural

possessions and educational resources at home and, economic, social and cultural status.

Parents' Education Level: Eccles (2005, pp. 201–202) asserted that the relationship between parents' education and children's academic achievement and motivation is mediated by very specific beliefs and behaviors. For example, parents' number of years of schooling is linked to parents' language competence which is expected to influence parents' communication with their children. Then, parental education will probably influence children's achievement scores in linguistic competence in standardized tests through the impact of parental education on the parents' linguistic competence. Hanushek and Zhang (2009) states that individuals who have more educated mothers tend to have higher cognitive skills which can be explained with improvement in learning environment within the family and child's increased chance to obtain more human capital. The association of the higher parental education with higher student achievement can be also explained with showing more interest and care to the academic performance and choice of subject and career of their children (Khan, Iqbal, & Tasneem, 2015).

In Turkey with respect to regional parental education level, compare to the highest performing regions which are Marmara, Aegean, and Central Anatolia region, the students in Southeastern and Eastern Anatolia had parents with less education (Erberber, 2009). Yetişir (2014) have found in his study which is conducted by TIMMS 2011 Turkey data, parent's education was significantly and positively associated with science achievement. Again in another study which is done with PISA 2012 Turkey data, it has been found that both mother and father education has significant effect on math literacy performances of students and one unit increase in mother education was leading to 1.92 points increase in math performance while interestingly one unit increase in father education was leading to 3.16 points decrease in math performance (Aksu, Güzeller, & Eser, 2017). The parental education is not only a positive predictor of math achievement but also verbal fluency as well

(Aksamovic, Djordjevic, Malec, & Memisevic, 2019; Long & Pang, 2016). To sum up, it can be said that higher parental education and family income have a strong positive effect on students' academic performance (Muller, 2018).

Parents' Occupational Status: Expectancy-value theory of achievement motivation suggest that achievement related choices are motivated by expectations for success and subjective task value in a domain for an individual (Leaper, 2011). Educational expectations of both parents and children are driven by between-family social capital which is related to family-community relationships and within-family social capital which is generated from parent-child interactions in learning activities and this agreement between parents and children on educational expectations gives the opportunity of achievement to the children (Hao & Bonstead-Bruns, 1998). Children's ability-related beliefs and subjective values develop across the school years and relate to performance and choice (Wigfield & Eccles, 2000). In a study which is done by both Chinese and American students' data, it has been found that in both countries, high-income parents were more likely to expect from their children to at least complete collage compare to low-income parents (Tsui, 2005). Socioeconomic status can indirectly explain math achievement of the students through parental expectations (Long & Pang, 2016). When it is taken into consideration that parental expectations are a function of the family SES (Stull, 2013), parents' occupational status which is directly related to family SES needed to be taken into consideration when examining student achievement.

Class position which is associated with parents' occupational status influences critical aspects of family life which are time use, language use and kin ties and parents transmit their advantages to their children with sufficiently consistent and identifiable patterns to be described as a "cultural logic" of childrearing (Lareau, 2002). This classed child-raring practices lead failing in education and leaving schools earlier for students from working-class backgrounds (Çelik, 2017a). Similarly, Reay and Lucey (2000) states that there is a strong pattern of class-related orientation in school choice

process because social class is significantly related to the ways process of choosing a school at secondary level. Middle-class families try to guide and channel the student which leads accepting the choice positively by students while working-class families in general deferred to the students' judgement.

Immigration Status: Parents' beliefs and expectations indirectly influence children's achievement trajectories by parent involvement (Sy & Schulenberg, 2005). Thus, apart from the direct effect of immigration status' on reaching the sources needed for academic achievement or adaptation to new society, indirect effect of it on the academic achievement can be considered through parents' expectation and beliefs about their children's academic trajectory resulting from their immigration status. For example, Hao and Bonstead-Bruns (1998) have found that for Chinese and Korean families immigrant status increases expectations which has a positive effect on children's achievement more than Mexican families and having a Chinese background has a positive effect on the achievement, but Mexican background has a harmful effect on the achievement. Also, in various European countries, the descendants of Turkish immigrants are more deprived in terms of both education and in the labour market compare to other immigrant groups (Çelik, 2019). This is in line with the Coleman report in which it has been found that some minority groups have high academic performance at school while other minority groups do not have (Coleman et al., 1966). Fordham and Ogbu's (1986) attributes this achievement differences among the minorities to the classification of the minorities into three types as autonomous minorities who are primarily considered as minorities in numerical sense; immigrant minorities who came to America with the expectation of improving their social, political and economic status and more or less voluntarily; and caste like or subordinate minorities who are incorporated into American society involuntarily and permanently through slavery or conquest.

In line with the attributing the achievement differences among minority groups to the classification of the minority groups by Fordham and Obgu (1986), Çelik (2017a, pp.

11–12) argues that children from middle class feel like “wish in water” when they are at school but children from working class feel like “fish out of water” due to difference between home and school but students who are from working-class ethnic minority background experience doubly being “fish out of water” when the school disapproves both their ethnic identity and their class simultaneously. Thus, the school’s institutional habitus which means a set of predispositions, schemes of perceptions in which institutions are organized and taken-for-granted expectation plays an important role in the achievement and drop-out rate of students who have working-class minority and immigrant backgrounds. These evidences show that relative position of the immigrant or minority groups in the society and school’s position to the immigrant and minority groups are associated with the achievement of the students.

Education Reform Initiative (2019) reported that in September 2019, the number of the Syrian refugee children who are in educational age are 1.082.172. The schooling rate is around 60-65% of this population between 2017 and 2019. In 2019, with the project of Promoting Integration of Syrian Children into Turkish Education System, 20.000 Syrian refugee received early childhood education. However, beyond this project, Şimşek (2018) states that in the case of Syrian refugees in Turkey, the integration processes are class-based which means that integration process of the refugees who are skilled and do investments in Turkey are supported while unskilled and without an economic resource refugees are leaved out. This shows that overcoming the legal barriers to integration and construction of social bridges between the refugee and members of the receiving society are also supported by economic resources. Çelik and İçduygu (2019) states that after Temporary Education Centers, admitting Syrian children to the public schools emerged with gradually accepting Syrians as permanent settlers. However, while this reform represented as an inclusive policy, state schools with their monolingual organizational practices and monoculture often exclude Syrian students. Also, in public schools, Syrian parents are not able to monitor their children which leads feeling of depression and alienation for the children.

Language at Home: When Vygotsky's sociocultural theory of the mind which asserts that humans utilizes symbolic artifacts to establish an indirect relationship between ourselves and outer world and cognitive science's computational theory of mind which likened the mind to a digital computer are integrated, it can be said that mind uses language to mediate the internal and external worlds during thought (Frawley, 1997; Lantolf, 2000; Rescorla, 2017). Even at early ages, like at the age of 4, when parents and children engage in activities like playing with blocks, children's literature in the home, etc. the verbal interactions between them have potential to help children' mathematical learning which shows the importance of the language at home on the early academic earnings (Anderson, 1997). Students learning in a language other than their native language face the challenge of learning in a situation in which their main device for making meaning which is native language does not exist in the learning environment (Kozulin, Gindis, Ageyev, & Miller, 2003). When the evidences about improvement in a mother-tongue yielding more specific results for higher-order thinking skills are taken into consideration, the power of the language to influence other academic fields like math can be inferred (Cer, 2018).

In the case of the refugees, like Syrian refugees in Turkey case, language is the most important factor that both social and structural integration of the children so it is recommended to provide extra language assistance course for those children (Çelik & Erdoğan, 2017). In Turkey, beyond the refugee population who spoke a language different than Turkish at home, the students in Southeastern and Eastern Anatolia spoke Turkish less frequently at home in comparison to the highest performing regions which are Marmara, Aegean, and Central Anatolia regions and this situation has a regional achievement implication (Erberber, 2009).

Parents Emotional Support: Importance of parent involvement in children's education are supported by accumulated evidences (Bempechat, 1992). For example, after implementation of an inner-city parent involvement program, it has been found that those who gained most through the implementation of the program were the

students by significant improvements in academic achievement like raising in the reading grade equivalent mean scores from 2 years,7 months to 3 years, 1 month for third grades (Hara & Burke, 1998). On the other hand, in Turkey, Aydın (2015) found that the relationship of math achievement and parent involvement was not significant. He suggests that other variables that are included in the model weaken the relationship of this variable. Also, it is important to notice that he analyzed the relationship all over the Turkey and did not look how this relationship works on regional base.

In Turkey, in Southeastern and Eastern Anatolia which are two significantly lowest performing regions, students have less parental support for student achievement and parental involvement in school activities which are not supportive of learning and associated with low achievement (Erberber, 2009). When Erberber's findings on language in those regions are combined with parent involvement in those regions, it need to be considered that language has a vital role in order to increase parent-school interaction (Çelik & Erdoğan, 2017). Also, Çelik (2017b) states that in Turkish context, parents' ethnic background linked to the resilience of the students because ethnicity influences both parental networks as an axis of social capital and active relations with the school.

Cultural Possessions and Educational Resources at Home: It is one of the universal findings of education research that students from higher socioeconomic backgrounds have higher probability to do better on tests which assess educational achievement compare to children from poorer backgrounds mainly due to the greater access to a range of human and material resources that encourage, reward and facilitate the learning (K. N. Ross & Zuze, 2004). Tsui (2005) has found in his study which is conducted both Chinese and American students' data, in both countries nonpoor families had more learning materials than did poor families. Also, in China educational resources has been found as positive predictors of the math achievement (Long & Pang, 2016). In a study which is investigated Taiwanese eighth graders' mathematics achievement differences between town and urban areas and between

rural and urban areas by the data of TIMSS 2003 to 2011 have found that students from town and rural areas fall behind academically the students from urban areas for 0.45 and 0.57 standard deviation half of which was caused by the town-urban and rural-urban differences of home education resources (Lee, 2016).

In Turkey, the students in Southeastern and Eastern Anatolia compare to the highest performing regions of Marmara, Aegean, and Central Anatolia had fewer educational resources like books, computer, study desk and Internet connection in their homes (Erberber, 2009). By being an indicator of socioeconomic status of parents, home educational resources leads significant differences on the performance of the students in favor of the students with more educational opportunities (İnce & Gözütok, 2018). The disadvantage of a student from low socioeconomic background at school can be related to lack of an academic home environment which influences the school success (Thomson, 2018). Aydın (2015) found that home educational resources is significantly related to math achievement of the student and one unit increase in home educational resources results in 13 point increase in math achievement of the student in TIMMS 2011 Turkey data. However, in a study which is done with PISA 2012 data, it has been found that possession of computer has a negative and significant effect on math performance with one unit increase leading to 10.38 point decrease in math achievement but having a tablet has a positive and significant effect on math achievement with one unit increase leading to 8.32 points increase in math achievement (Aksu et al., 2017).

Economic, Social and Cultural Status: There is both direct and indirect effects of socioeconomic status of the family on math and problem solving achievements of adolescents (Long & Pang, 2016). In terms of effect of a family's socioeconomic status (SES) on achievement, the first effect considered is that parents who have high socioeconomic conditions have a greater opportunity to provide learning facilities at home for the children (Mariana, 2018). Also, Stull (2013) asserts that a family's SES has both direct and indirect effect on a child's educational achievement but indirect

effects are mediated by the school and they are in the realm where social policy can have an impact to compensate differences in family SES.

Stratification policies like grade repletion and early tracking which are used to organize instruction for students with different abilities and interests is also another indirect potential channel for the association between the achievement and students' socio-economic background (PISA, 2016). Researches on the tracking found that the age that tracking of the students is starts and form of tracking in an educational system are related to socioeconomic inequality in achievement and attainment by social and ethnical background (Van De Werfhorst, 2018). For example, Serdar (2016) found in his study in which he investigated socioeconomic situation of a vocational school in Turkey that vocational school students coming from less educated and low-income families and these students usually graduate from the vocational schools and starts their careers without having adequate academic skills. Also, early tracking to either an academic or vocational track reinforce existing socio-economic inequalities by negative relative-age effect of a student in a grade since this negative effect disappears for students from higher socioeconomic backgrounds in the second track while it increases for the students from lower socioeconomic backgrounds. (Schneeweis & Zweimüller, 2014). For example, Özdemir (2016) states that in PISA 2012, the difference between the performance of the students from selective academic schools and other schools is more than 100 points which equals to approximately four grade years and the school type at secondary education also represents the socioeconomic background. In Bulgaria case for example, when TIMSS 2003 data are analyzed, it has been found that there is a strong association between SES of the students and both math and science achievement. Also, in the same study, it has been found that student achievement had even stronger association with average SES of the class that student attends which means that there is an additional advantage for low SES students to attend high SES schools (Bankov, Mikova, & Smith, 2006). When this effect of the class average SES is considered, the effect of early tracking or the effect of neighborhood can be estimated.

2.2.1.2 School Factors

In this section, school factors that associated with student achievement are presented under the subheadings of educational leadership, school resources, and school climate. In the literature on school factors, Aydın (2015) has found that 35% of the total variance in math achievement was related to school in TIMMS 2011 Turkey which is lined with the previous years' TIMMS Turkey results. This means that in Turkey, schools differ from each other in ratio of 35%. On the other hand, 64% of the variability in math achievement have been found between schools in PISA 2012 data (Özberk et al., 2017). This high variations between schools shows that in order to understand the achievement differences, a careful examination should be done on the school factors.

Educational Leadership: When educational administrators are strongly committed to draw parents into their children's educational processes, very positive academic outcomes can be acquired for the children (Bempechat, 1992). Boberg and Bourgeois (2016) states that despite the direct link between student performance and leadership is not visible, the evidences indicates that principles can influence emotional and academic development of the students by fostering collective capabilities of teachers and their positive perception about their roles in the lives of students. Similarly, Ross and Gray (2006, pp. 811–812) also have found that although, there is not direct significant effect of leadership on the student performance, but teacher' professional development and their beliefs about their capacity are mediated the impact of school principals on student performance. They have found that transformational leadership have positive impact on teachers' beliefs and one standard deviation increase in transformational leadership practices leads .22 standard deviation increase in reading, writing and math performances of 3rd and 6th grades. However, in the Turkish context it has been found that a leader emerges as a parent who is taking care of followers' feeling of belonging to the family because the most dominant characteristic of the Turkish organizations is cultural collectivism and the most outstanding need is sense

of belonging (Fikret Pasa, Kabasakal, & Bodur, 2001). Also, in Turkish context, it has been found that there is a significant and positive relationship between teachers' school commitment and principals' servant leadership behaviors (Cerit, 2010). Clarke and O'Donoghue (2017) assert that for school leaders it is important to acknowledge the complexity of the context that shape educational practices including that of school leadership which are multifaceted, unstable amalgams of interdependent social, cultural, material, ideological, political, institutional, historical and geographical factors. Secondly, these contexts are multilayered and encompassing the local realities, national policies and practices and international agreement. Also, contexts are latent, volatile, ambiguous and therefore elusive.

***School Resources*:** Educational material and educational staff can be referred together as school resources. In PISA 2015, school resources are defined by two derived variables which are shortage of educational material and shortage of educational staff based on the school principals' perceptions of potential factors hindering the instruction at school (OECD, 2017). Heyneman and Loxley (1982) have found that compare to high income countries, the school and teacher characteristics can explain between two or three times more the amount of variance in achievement in poorer countries. This means that the poorer the country in economic terms, the school quality and teachers seem to have more impact on achievement. Heyneman and Loxley basically tried to demonstrate that in lower income countries where in early 1970s the results of the Second International Mathematics and Science Study (SIMSS) showed that there was a substantial variation in school quality, the impact of school related factors which are teacher and school quality were greater than socioeconomic status of the family (Nascimento, 2008).

In Turkey, the schools in Southeastern and Eastern Anatolia which are significantly lowest performing regions are not adequately equipped with instructional resources like computer hardware and software, equipment for teacher use in demonstrations, physical facilities and other instructional equipment for students' use which is a

school characteristic associated with low achievement (Erberber, 2009). When Turkey data is analyzed without dividing it to the regions, Aydın (2015) found that economic structure of the school has a positively significant relationship with math achievement with a 25 points contribution to math achievement while school mathematic resources has a positive but insignificant relationship with mat achievement. Extracurricular activities related to math at school and quality of school educational resources are associated with better performance in math (Özberk et al., 2017). Also, when Turkey 2012 PISA data examined it has been found that student-teacher ratio has negative effect on mathematics achievement because of overcrowded classroom (Aksu et al., 2017; Özberk et al., 2017). Class size have modest but significant effect on math achievement but this effect declines as the student progress through schooling (Rivkin et al., 2005). When the number of students per teacher is calculated based on the 2018 data of MONE, there is three regions in which this ratio is higher than Turkey average as South East Anatolia, İstanbul, East Anatolia respectively (Eğitim Reformu Girişimi, 2018).

School Climate: In Turkey, in two significantly lowest performing regions which are Southeastern and Eastern Anatolia, students attend schools which have climate not supportive of learning including teachers' expectations for student achievement and students' desire to do well in school, etc. (Erberber, 2009). Treatment and practices in schools towards a positive climate are very important to cope with the disadvantaged family and neighborhood conditions which are largely stable background characteristics (Çelik, 2011). A learning environment which is healthy, secure, sterile in terms of violence, facilitating the communication between teacher, student and parents, and equipped with necessary materials affects positively the learning outcomes (Eğitim Reformu Girişimi, 2018).

In terms of the effect of diverse variables' association with the math achievement, Aydın (2015) has found that in TIMMS 2011 Turkey data, participation of students to learning activities which can be considered among the student factors that affect

school climate has a significantly positive relationship with math achievement but when the other factors related to student are controlled, the relationship becomes insignificant. Also, in the same study it has been found that the importance given academic achievement has a positively significant relationship with math achievement. On the other hand, school discipline and security have a positive but insignificant relationship with math achievement. Also, the study found that attitude of the teachers toward the school has a significant relationship with math achievement with a 28 points contribution to math achievement which is higher than the contribution of the attitude toward the teacher profession which is also has a significant relationship with math achievement. When Turkey 2012 PISA has been analyzed, it has been found that student-related factors affecting school climate are significantly associated with performance in math (Özberk et al., 2017).

The school climate not only associated with the math performance of the students, but also parent participation levels of the families as well. Ertem and Gökalp (2018) have found that the families who perceive the school climate more positively, show higher levels of parent participation in school. Also, as another student dimension of the school climate, according to the PISA 2015 data, sense of belonginess of students to school in Turkey are below the OECD average and it had positive but insignificant effect on science achievement (Yetişir, Güneş, & Batı, 2019). In terms of teacher moral level which can be relate to the school climate has a positive and significant effect on math achievement with one unit increase leading 12.94 points increase in math scores (Aksu et al., 2017).

Also, school climate can be discussed within the frame of habitus. Bourdieu (2002) defines habitus as the practical mastery of a small number of implicit principles which are not based on obedience to any formal rules and leading to infinitely many practices and these patterns are emerge spontaneously. Habitus is the product of the structures it tends to reproduce. More specifically, institutional habitus refers to impact of a social class or cultural group on individual behavior with the influence of an

organization (McDonough, 1997). Çelik and İçduygu's (2019) study suggests that public schools serve to an "imagined" homogenous community and pushing consequently the students who are coming from diverse background out of school like Syrian refugee children in Turkey case. This assumption of homogeneity and its' implication of the higher achievement levels of the "imagined" community can be also discussed around the academic inbreeding and institutional habitus when the confirmation of the identity of "imagined" community member by institutional identity has been considered (Gokturk & Kandemir, 2019). Thus, Çelik and İçduygu (2019) suggest that schools should develop intercultural and inclusive institutional habitus in order to incorporate the students who are coming from diverse backgrounds.

2.2.3 Achievement Gap

In this section, achievement gap literature is explained based on its theoretical foundations. Firstly, definition of achievement gap will be provided. Secondly, under the heading of achievement gap and large-scale assessment, achievement gaps that revealed via large-scale assessments are mentioned. Finally, details about the achievement gap in Turkey will be addressed.

2.2.3.1 Definition of Achievement Gap

Researchers examined the achievement gap between minority and nonminority students for decades but this singular definition of achievement gap ignores substantial important within-group differences and singular definition may mean that policies miss the mark in raising achievement levels between and within groups (Carpenter, Ramirez, & Severn, 2006). Also, when we consider that achievement gaps are related to recognition gaps and stigmas of the disadvantaged groups, destigmatization through raising recognition of low-status groups and worth, and reduction of recognition gaps can help to reduce the achievement gaps as well (Lamont, 2018). Thus, in this study, achievement gap did not only address

achievement differences between minorities and nonminority but also other social stratification groups as well like achievement gap between high and low socioeconomic groups, or achievement gap between rural and urban, etc.

2.2.3.2 Achievement Gaps and Large-Scale Assessments

Achievement gaps can be discussed around two theoretical frameworks as functionalist theories and conflict theories. Geiger (1955) discusses social stratification as a societal process distributing scare goods. He asserts that functionalist theories suggest that inequalities in education are functional and functional demands determine the educational process. On the other hand, conflict approach handles social inequality as structurally determined and constitutive of society. Thus, formal education reflects the norms and values of the ruling groups and essentially has the function of confirming and stabilizing existing class difference. In Turkey case, when PISA 2012 data has been analyzed, it has been found that inequalities in education are not functional which is suggested by functionalist theories and more equity brings more success (Özdemir, 2015).

Achievement gaps has economic costs when it exists within the country as well apart from its cost on international level for the country. For example, Auguste, Hancock, and Laboissiere (2009) have found that if America has been able to close the gap between white and Asian students and Hispanic and black students by 1998, the Gross Domestic Product in 2008 would have been about $400 to $500 billion higher. Furthermore, if the gap between low-income students and the other students had been similarly narrowed, in 2008 GDP would have been $400 to $670 billion higher which is 3 to 5 percent of GDP. Likewise, if the gap between America's low-performing states and remaining had been similarly narrowed, GDP in 2008 would have been $425 billion to $700 billion higher which is or 3 to 5 percent of GDP.

In the sample of the study of Fordham and Ogbu's (1986), underachieving black students appear to have ability to perform high in the school, at least better compare to their current achievement level but they apparently have decided to avoid "acting white" consciously or unconsciously because they associate efforts for performing well in the school with being white. When academically able black students confront both pressures from black peers and doubts from white on their ability, this burden of acting white becomes heavier. Still, compared to earlier studies, Fryer and Levitt's study (2004) provides reason for optimism since earlier researches found much greater black and white test scores gaps while across multiple data sets, recent cohorts show smaller black and white achievement gap in the raw data. One possible explanation is that the current cohort of blacks has made real gains relative to whites compare to the cohorts attending kindergarten 10-30 years ago.

Replying the needs of students who are coming from diverse backgrounds and narrowing the student performance gaps is a hard challenge for all countries. Countries have different approach to address these demands. Some countries have comprehensive school systems which has no or only limited institutional differentiation in order to provide similar opportunities to all students by serving for the full range of student interest, abilities and backgrounds. On the other hand, some countries respond to diversity by grouping students via tracking or streaming either between schools or between classes within schools in order to serve students according to their academic potential and interests. Also, many countries combine two approaches. However, even in the countries who have comprehensive school systems, due to the socioeconomic and cultural characteristics of the communities that school serves or due to the geographical differences like between regions or between rural and urban areas, etc., there may be significant variation in performance levels between schools (OECD, 2004, pp. 160–161).

The idea of international level comparison of educational outputs which are closely tied to the economic outputs started in 1960s with the attempt of International

Association for the Evaluation of Educational Achievement (IEA), as an assessment in the areas of mathematics which has a relatively neutral, in other words culturally less involved nature with its own international symbolism, as well as lending itself to quantitative assessment in twelve technologically advanced countries (Barton & Husen, 1971). Another attempt by IEA was to compare science education endeavors within and between 19 countries (Comber & Keeves, 1973). Ornstein (2010, pp. 424–429) states that despite its advantages, there are unique limitations with large-scale international assessments. Since these assessments include the same content across countries, translation of the content and selection or representation of students who will take the test are problematic. Despite these limitations, international test comparisons have continued so far. The international surveys not only made possible international comparison but also the data obtained through those surveys made the comparisons on the national level possible as well. For example, The International Adult Literacy and Life Skills Survey (All) which analyzed the degree to which the adult population could perform mathematical tasks in daily life and the workplace found that blacks scored 63% lower than whites and Hispanics scored 75% lower.

2.2.3.3 Achievement Gaps in Turkey

Erberber's (2009) study suggests that despite Turkey has almost achieved equity in terms of access to primary schooling, equity in terms of educational outcomes at the end of primary education has not been achieved yet because at the end of compulsory education there exists significant regional disparities in student achievement for the year that she conducted her study. However, since with "Primary Education Law no 6287" adopted on 30 March 2012 which is known by public as 4+4+4 a radical decision is made in our education system and secondary education has been included in the compulsory education, in order to monitor equity in terms of educational outcomes at the end of the compulsory education, there is a need to take a glance achievement levels and skills of students at the end of the secondary education which PISA aimed to achieve (Gün & Baskan, 2014; OECD, 2017a). Erberber (2009, pp.

154–156) examined the extent of Turkey's regional differences in science achievement at eight grade by TIMSS 2007 data. Findings of her initial analysis of achievement differences across regions were not surprising but nevertheless disappointing when Turkey's persistent regional disparities in human development is considered as the socioeconomic differences between west and east corresponded to the student achievement differences at the end of compulsory education. Marmara, Aegean and Central Anatolia regions which are the socioeconomically most developed regions were the highest performing regions. On the other hand, Eastern Anatolia, particularly Southeastern Anatolia which are the two least developed regions were the significantly lowest performing regions in science in TIMMS 2007 which means that already low educational quality is not distributed evenly across the country. Inequalities in science achievement occurred even though all students in Turkey are intended to be provided with similar content and similar teaching time by the end of primary education which means that there are some background factors associated with regional differences in educational achievement. After identifying these factors with exploratory analyses, by using HLM, she found that controlling home background factors might result in reduced achievement differences between regions. Also, controlling school context factors might reduce regional achievement differences. Furthermore, when home background factors and school factors were controlled together, there were no longer statistically significant achievement differences across regions. Her study implies that if similar opportunities in terms of the school characteristics and home backgrounds of the students are provided across regions, the significant achievement gaps between regions could be greatly reduced. Findings of the Erberber's (2009) confirms Hanushek and Woessmann (2008) who suggest that rather than mere school attainment, the cognitive skills of the population are powerfully related to individual earnings, to the economic growth and the distribution of income.

In Turkey, there are substantial differences in terms of economic and social criteria among the regions which shows that socio-economic sources of the countries does not

distributed evenly and these differences among the regions establish a ground to very serious problems (Ersungur, Kızıltan, & Polat, 2010). In Turkey there is a strong dimension of geography when educational provision and performance taken into consideration and the achievement inequality persists and becomes deeper in Turkey together with achievement inequalities between income groups and socio-economic groups (Ataç, 2017).

Karahasan and Uyar (2009) studied spatial distribution of education and regional inequalities to link educational disparities with regional income inequalities in Turkey. They found that there are diverse inequality paths of education indicators for between and within regional inequalities. Also, for primary and secondary education, geographical dependency is detected but this dependency is found stronger in the educationally and economically underdeveloped regions of Turkey which are South East and Eastern Anatolia. Students from lower socioeconomic backgrounds and students from eastern regions are found to be disadvantaged in terms of math performance (Özdemir, 2016). Also, Özdemir (2015) have found that in Turkey education system is neither equitable nor excellent. Moreover, in the same study it has been found that existing social inequalities are worsens by current educational structure of Turkey.

2.3 Summary of the Literature Review

Based on this review of the literature, it can be inferred that there is an achievement gap among the regions of the Turkey. Considering the economic and social costs of this gap both at individual level and country level, and even international level, clearly regional achievement gaps need to be questioned and studied on. When, it is considered that one standard deviation increase in mathematics performance at the end of high schools translates into 20% higher annual earnings, in this study math achievement of the students have been chosen as dependent variable of the study due

to its high capacity of estimating economic condition of the individual and cumulatively economic condition of the region (Hanushek & Zhang, 2009).

Since academic achievement is a cumulative function of current and prior family, school and community experiences, in order to comprehend the reasons and mechanism under the regional achievement gaps in math, some family and school factors associated with student achievement have been chosen based on the literature (Rivkin et al., 2005).

PISA 2015 data has been chosen as the data source in this study since PISA has comprehensive sample and background questionnaire and it is the last available PISA data. Also, a multilevel methodology has been chosen in this study by considering the structure of the data and the between school variations found in the analyses of the previous large-scale assessments.

CHAPTER 3

METHOD

This chapter includes design of the study, population and sample, instrumentation, the data and their collection, and data analyses.

3.1 Design of the Study

Quantitative approach is utilized in this study. Student questionnaire of PISA 2015 which contains student background questions as well as math performance of the students and school questionnaire which contains school administrators' answers to the questions related to the school will be utilized. Causal comparative design and a multilevel methodology will be used in this study in order to investigate the regional achievement gaps in Turkey in math. Secondary data analysis will be utilized in this study. Johnston (Johnston, 2014) states since technical advance lead to vast amounts of data collected, compiled and achieved and now easily available, utilizing existing data form research is becoming more prevalent and consequently secondary data analysis. She describes secondary data analysis as analysis of data that was collected by someone else for another primary purpose. In secondary data analysis, which is an empirical exercise, the same basic principles as studies utilizing primary data and the steps in the primary data analysis to be followed just as any research method should be applied. This study will be conducted by two-level hierarchical linear modelling (HLM) method. Since students are nested in the school in this study, it is appropriate to use HLM which takes into consideration the nested structure of the data (Raudenbush & Bryk, 2002).

3.2 Research Questions

The following research questions are addressed in this study:

1. Is there a significant difference between mathematics achievement of the students in Aegean Region which had the highest student achievement in mathematics in PISA 2015 in Turkey and the other Nomenclature of Territorial Units for Statistics (NUTS) Level-1 Regions of Turkey?

2. Is there a significant difference in mathematics performance of the students in Aegean Region and the other NUTS Level-1 Regions of Turkey when we control the family-related variables (i.e., mother's education, father's education, the international socio-economic index of occupational status of father, the international socio-economic index of occupational status of mother, immigration status, language at home, parents emotional support, cultural possessions at home, home educational resources, and the PISA index of economic, social and cultural status)?

3. Is there a significant difference in mathematics performance of the students in Aegean Region and the other NUTS Level-1 Regions of Turkey when we control the school-related variables (i.e., the overall scale for leadership, school resources which includes the index on staff shortage and the index on shortage of educational material, and school climate which includes student related factors and teacher related factors affecting school climate)?

4. Is there a significant difference in mathematics performance of the students in Aegean Region of Turkey and the other NUTS Level-1 Regions of Turkey when we control both specified family-related variables and school-related variables (i.e., mother's education, father's education, the international socio-economic index of occupational status of father, the international socio-economic index of

occupational status of mother, immigration status, language at home, parents emotional support, cultural possessions at home, home educational resources, the PISA index of economic, social and cultural status, the overall scale for leadership, school resources which includes the index on staff shortage and the index on shortage of educational material, and school climate which includes student related factors and teacher related factors affecting school climate)?

Controlling a variable refers to separating out the effect of one particular independent variable from the effects of the remaining variables on the dependent variable in a multivariate analysis. In statistical literature statistical control referred with the phrases such as “holding constant”, “controlling for”, “accounting for” or “correcting for the influence of” (Thomas, n.d.). In this study, in the second research question, the students are assumed to have the similar family background on the specified variables. In the third research question, students are assumed attending the similar schools in terms of the specified variables. In the fourth research question, students are assumed both to have similar family background and attending similar schools in terms of the specified variables. Then, these questions inquire is there a significant difference in mathematics performance of the students in Aegean Region of Turkey and the other NUTS Level-1 Regions of Turkey under such conditions.

3.3 Description of Variables

In this section, firstly, independent and dependent variables are described. Then, Cronbach’s Alpha values of the related variables are listed.

3.3.1 Independent Variables

Independent variables of this study consist of student-level variables and school-level variables.

3.3.1.1 Student-Level Variables

1. *Mother's Education-ISCED (MISCED):* Students' responses on questions regarding parental education were classified by using ISCED 1997 (OECD, 1999). Indices on parental education were constructed by recoding educational qualifications into these categories: (0) None, (1) ISCED 1 (primary education), (2) ISCED 2 (lower secondary), (3) ISCED Level 3B or 3C (vocational/pre-vocational upper secondary), (4) ISCED 3A (general upper secondary) and/or ISCED 4 (non-tertiary post-secondary), (5) ISCED 5B (vocational tertiary) and (6) ISCED 5A and/or ISCED 6 (theoretically oriented tertiary and post-graduate). Indices with these categories were provided for a student's mother (MISCED) and father (FISCED) (OECD, 2017).

2. *Father's Education-ISCED (FISCED):* This variable corresponds to the father's education. This variable is derived with the same way as the ISCED of mother derived.

3. *ISEI of Mother (BMMJ1):* This variable corresponds to the mother's occupational status. This variable is derived by students' responses to open ended question about their mother and father occupations. This occupational data then recoded and mapped to the international socio-economic index occupational status (ISEI) (OECD, 2017).

4. *ISEI of Father (BFMJ2):* This variable corresponds to the father's occupational status. This variable is derived with the same way as the ISEI of Mother derived.

5. *Immigrant Background (IMMIG):* In PISA, both students' and their mother and father's country of birth are asked. According to these country-specific variables, students are divided into three categories as: native students whose

at least one parents born in the country of assessment, second-generation students who born in the country but their parents born in another country and first-generation students who born outside of the country and whose parents also born outside of the country (OECD, 2017).

6. *Language Spoken at Home (LANGN):* By answers of the students on what language they usually speak at home, a variable derived as with two categories: (1) language at home is the same as the language of the assessment which is Turkish in this case, and (2) language at home is another language (OECD, 2017).

7. *Parents emotional support (EMOSUPS):* Students were asked about their perceived emotional support from their parents using the question (ST123). To produce this index, students' answers to the following items has been used with a four-point Likert scale with the response categories of "strongly agree", "agree", "disagree", and "strongly disagree" (OECD, 2017);

   "My parents are interested in my school activities."
   "My parents support my educational efforts and achievement."
   "My parents support me when I am facing difficulties at school."
   "My parents encourage me to be confident."

8. *Cultural Possessions (CULTPOSS):* This index is derived from the students answers to the availability of sixteen household items (which are a desk to study at, a room of student's own, a quiet place to study, a computer to use for school work, educational software, a link to the internet, classic literature, books of poetry, works of art, books to help with the school work, technical reference books, a dictionary, books on art, music or design and three country-specific items that are appropriate measure of family wealth in the country's

context) at home. CULTPOSS index is derived from the following items (OECD, 2017);

"Classic literature (e.g. <Shakespeare>)"
"Books of poetry"
"Works of art (e.g. <paintings>)"
"Books on art, music or design"
"Musical instruments (e.g. <guitar, piano>)"

9. *Home Educational Resources (HEDRES):* This index is also derived from the students answers to the availability of the sixteen household items stated below (OECD, 2017);

"A desk to study at"
"A quiet place to study"
"A computer you can use for schoolwork"
"Educational software"
"Books to help with your schoolwork"
"<Technical reference book>"
"A dictionary"

10. *Index of Economic, Social and Cultural Status (ESCS):* The ESCS is a composite score consists of the indicators parental education (PARED), highest parental occupation (HISEI), and home possessions (HOMEPOS) including books in the home via principal component analysis (PCA). PARED which is estimated number of years of schooling for parents is obtained by recoding the index of highest educational level of parents (HISCED). Similarly, HISEI which is highest parental occupational status takes the value of the ISEI of the either parent with higher ISEI. The reason for using these three components was that socio-economic status has

usually been considered as based on education, occupational status and income. Since there is not a direct income measure available from the PISA data, the existence of household items has been used as a proxy for family wealth. Home possession index has been produced by the answers of the students to the following questions (OECD, 2017);

"Which of the following are in your home? (ST011)"

"A desk to study at"

"A room of your own"

"A quiet place to study"

"A computer you can use for schoolwork"

"Educational software"

"Books to help with your schoolwork"

"<Technical reference book>"

"A dictionary"

"Books on art, music, or design"

"<Country-specific wealth item 1>"

"<Country-specific wealth item 2>"

"<Country-specific wealth item 3>"

"How many of these are there at your home? (ST012)"

"Televisions"

"Cars"

"Room with a bath or shower

"<Cell phones with Internet access (e.g. smartphones>"

"Computers (desktop computer, portable laptop, or notebook)"

"<Tablet computers> (e.g. <iPad>, <BlackBerry PlayBook>)

"E-book readers (e.g. <Kindle>, <Kobo>, <Bookeen>)

"Musical instruments (e.g. guitar, piano)

"How many books are there in your home (ST13Q01TA)"

3.3.1.2 School-Level Variables

School-level variables consist of variable related to school leadership, variables related to school resources and variables related to school climate.

- ***Variable Related to School Leadership***

1. *Educational leadership (LEAD):* Question SC009 which is on school leadership was developed for PISA 2012 and partially taken up again for PISA 2015 with 13 items asks about school leadership. School principals were asked to indicate the frequency of the listed activities and behaviors in their school during the previous academic year. "Did not occur", "1-2 times during the year", "3-4 times during the year", "once a month", "once a week", to "more than once a week" were the six response categories. The overall scale for leadership (LEAD) consists of all 13 question items (OECD, 2017);

   "I use student performance results to develop the school's educational goals."

   "I make sure that the professional development activities of teachers are in accordance with the teaching goals of the school."

   "I ensure that teacher work according to the school's educational goals."

   "I promote teaching practices based on recent educational research."

   "I praise teachers whose students are actively participating in learning."

   "When a teacher has problems in his/her classroom, I take initiative to discuss matters."

   "I draw the teachers' attention to the importance of pupil's development of critical and social capacities."

   "I pay attention to disruptive behavior in classrooms."

"I provide staff with opportunities to participate in school decision-making."

"I engage teachers to help build a school culture of continuous improvement."

"I ask teachers to participate in reviewing management practices."

"When a teacher brings up a classroom problem, we solve the problem together."

"I discuss the school's academic goals with teachers at faculty meetings."

- ***Variables Related to School Resources***

PISA 2015 included a question which consists of eight items about school resources, measuring the school principals' perceptions of potential factors hindering the instruction at school. "Not at all", "very little", "to some extent", to "a lot" were the four response categories. Despite a similar question was used in previous cycles, items were reduced and reworded for 2015 focusing on two derived variables which are shortage of educational material and shortage of educational staff (OECD, 2017).

2. *Shortage of educational material (EDUSHORT):* The index on shortage of educational material (EDUSHORT) was derived from four items SC017Q05NA, SC017Q06NA, SC017Q07NA, and SC017Q08NA to the question of (OECD, 2017):

"Is your school's capacity to provide instruction hindered by any of the following issues?"

"A lack of educational material (e.g. textbooks, IT equipment, library or laboratory material.)" (SC017Q05NA)

"Inadequate or poor-quality educational material (e.g. textbooks, IT equipment, library or laboratory material)" (SC017Q06NA)

"A lack of physical infrastructure (e.g. building, grounds, heating/cooling, lighting and acoustic systems)." (SC017Q07NA)
"Inadequate or poor-quality physical infrastructure (e.g. building, grounds, heating/cooling, lighting and acoustic systems)." (SC017Q08NA)

3. *Shortage of educational staff (STAFFSHORT):* The index on staff shortage (STAFFSHORT) was scaled using four items SC017Q01NA, SC017Q02NA, SC017Q03NA, and SC017Q04NA to the question of (OECD, 2017):

"Is your school's capacity to provide instruction hindered by any of the following issues?"
"A lack of teaching staff" (SC017Q01NA)
"Inadequate or poorly qualified teaching staff" (SC017Q02NA)
"A lack of assisting staff" (SC017Q03NA)
"Inadequate or poorly qualified assisting staff" (SC017Q04NA)

- ***Variables Related to School Climate***

The School Questionnaire included a trend question on school climate (SC061) which measured the school principals' perceptions of the school climate, in particular, his or her perceptions of teacher and student behavior that might influence the provision of instruction at school. "Not at all", "very little", "to some extent" and "a lot" were the four response categories. For PISA 2015, the items of the question which was used in the previous cycles were rearranged to reflect student-related factors (STUBEHA) and teacher-related factors (TEACHBEHA) affecting school climate (OECD, 2017).

4. *Student-related factors affecting school climate (STUBEHA):* This index contains 5 items which are SC061Q01TA, SC061Q02TA, SC061Q03TA, SC061Q04TA, and SC061Q05TA to the question of (OECD, 2017):

"In your school, to what extent is the learning of students hindered by the following phenomena?"

Students truancy (SC061Q01TA)

Students skipping classes (SC061Q02TA)

Students lacking respect for teachers SC061Q03TA)

Students use of alcohol or illegal drugs (SC061Q04TA)

Students intimidating or bullying other students (SC061Q05TA)

5. *Teacher-related factors affecting school climate (TEACHBEHA):* The scaling model to produce this index utilized items of SC061Q06TA, SC061Q07TA, SC061Q08TA, SC061Q09TA, and SC061Q10TA to the question of (OECD, 2017):

"In your school, to what extent is the learning of students hindered by the following phenomena?"

"Teachers not meeting individual students' needs" (SC061Q06TA)

"Teacher absenteeism" (SC061Q07TA)

"Staff resisting change" (SC061Q08TA)

"Teachers being too strict with students" (SC061Q09TA)

"Teachers not being well prepared for classes" (SC061Q10TA)

3.3.2 Dependent Variable

Math performance of the students (PV1MATH, PV2MATH, PV3MATH, PV4MATH, PV5MATH, PV6MATH, PV7MATH, PV8MATH, PV9MATH, PV10MATH): 10 math plausible values which are computed for one individual student will be utilized as the indicator of math performance of the students. HLM7 has an advantage of handling and incorporating the 10 plausible values together for one student in the analysis but SPSS cannot. Thus, using HLM not only able us to take into consideration nested

structure of the data but also correctly utilize and incorporate the plausible values in the analysis.

In large-scale assessments programs like PISA, TIMSS and NAEP, students' achievement data sets provided for secondary analyses contains plausible values which are multiple imputations of the observable latent achievement for each student (Wu, 2005). The plausible values incorporate responses to test items and information about the background of responses; therefore, they cannot be used to compare individuals. Rather, they will provide consistent estimates of population characteristics despite they are not generally unbiased estimates of the individual proficiency. In PISA 2015, for each student 10 plausible value is computed (OECD, 2017a). Using plausible has several methodological advantages compare to classical Item Response Theory (IRT) estimates by returning unbiased estimates of population performance parameters, percentages of students per proficiency level as they are on a continuous scale and bivariate or multivariate indices of relations between performance and background variables (OECD, 2009).

3.3.3 The Cronbach's Alpha Values

In PISA 2015, Cronbach's alpha (the scale reliability) was used in order to check the internal consistency of each scale within the countries and in order to compare it between the countries. The coefficient takes values between 0 and 1. Higher values indicates higher internal consistency. Cut-off values are generally accepted as 0.9 to signify excellent, 0.8 to signify good, and 0.7 for acceptable internal consistency. Some countries preferred to delete one or two items and a footnote added in the tables to note the deleted item (OECD, 2017a). Related Cronbach's Alpha values of the selected variables for Turkey represented in Table 3.1 below:

Table 3. 1
Cronbach's Alpha Values of the Selected Variables for Turkey

Variable	*Value*
Parents emotional support (EMOSUPS)	0.856
Cultural Possessions (CULTPOSS)	0.641
Home Educational Resources (HEDRES)	0.650
Index of Economic, Social and Cultural Status (ESCS)	0.680
Educational leadership (LEAD)	0.909
Shortage of educational material (EDUSHORT)	0.905
Shortage of educational staff (STAFFSHORT)	0.804
Student-related factors affecting school climate (STUBEHA)	0.802
Teacher-related factors affecting school climate (TEACHBEHA)	0.751

3.4 Populations and Sample

The target population of the study is 1.324.089 15-year-old students all over the Turkey in 2015. The experimentally accessible population of the study is 925.366 who could attend the PISA 2015 test. The sample is 5895 15-year-old students from 61 city of the Turkey and 187 school as representative of 12 regions (Özgürlük, Erbay, Arıcı, & Taş, 2016).

Turkey's PISA data will be split according to the Level-1 Nomenclature of Territorial Units for Statistics (NUTS). Level-1 NUTS consists of 12 regions which are:

1. Istanbul Region (TR1)
2. West Marmara Region (TR2)
3. Aegean Region (TR3)
4. East Marmara Region (TR4)
5. West Anatolia Region (TR5)
6. Mediterranean Region (TR6)
7. Central Anatolia Region (TR7)
8. West Black Sea Region (TR8)

9. East Black Sea Region (TR9)
10. Northeast Anatolia Region (TRA)
11. Central East Anatolia Region (TRB)
12. Southeast Anatolia Region (TRC)

These are statistical regional units of the Turkey which are formed according to economic, social and regional properties. HLM analysis will be conducted by taking Aegean Region which has the highest Math performance as reference region and including rest of the 11 regions in the HLM models. However, there is no Turkey's NUTS variables in original PISA data. Rather, the data are split into 36 stratums by splitting each NUTS region into three as:

1. Basic Education
2. General Secondary
3. Vocational and Technical Secondary.

Three stratums of each NUTS level-1 region will be combined to form the NUTS region variables.

Below PISA 2015 Turkey Sample distributions are presented according to different criterions. Table 3.2 which shows number and percentages of the students attended in PISA with respect to NUTS Level-1 Regions, Table 3.3 which shows percentages of the students attended in PISA with respect to grades and Table 3.4 which shows distribution of PISA 2015 Turkey sample with respect to school types are presented:

Table 3. 2
Number and Percentages of the Students Attended in PISA with respect to NUTS1 Regions

NUTS1 Code	Name of the Region	Number of Students	Student Percentage
TR1	Istanbul Region	1070	18.15
TR2	West Marmara Region	245	4.16
TR3	Aegean Region	707	11.99
TR4	East Marmara Region	510	8.65
TR5	West Anatolia Region	553	9.38
TR6	Mediterranean Region	817	13.86
TR7	Central Anatolia Region	334	5.67
TR8	West Black Sea Region	303	5.14
TR9	East Black Sea Region	194	3.29
TRA	Northeast Anatolia Region	199	3.38
TRB	Central East Anatolia Region	276	4.68
TRC	Southeast Anatolia Region	687	11.65
TOTAL		5895	100

(Özgürlük, Erbay, Arıcı, & Taş, 2016)

Table 3. 3
Percentages of the Students Attended in PISA with respect to Grades

Grade	Percentage of Students
7	0.6
8	2.6
9	20.7
10	72.9
11	3.0
12	0.1

(Özgürlük, Erbay, Arıcı, & Taş, 2016)

Table 3. 4
Distribution of PISA 2015 Turkey Sample with respect to School Types

School Type	Percentage of Students
Junior High School	2.0
Anatolian High School	38.1
Science High School	2.1
Social Sciences High School	1.4
Fine Arts High School	0.7
Vocational and Technical Anatolian High School	36.4
Multi-program Anatolian High School	4.1
Anatolian Religious High School	14.4
Non-responded	0.3
Inaccessible	0.5
TOTAL	100

(Özgürlük, Erbay, Arıcı, & Taş, 2016)

Furthermore, distribution of the students who attended PISA 2015 in Turkey according to their genders was same. 50% of the students was female and 50% of the students was male in the PISA 2015 Turkey sample (Özgürlük, Erbay, Arıcı, & Taş, 2016).

3.5 Instrumentation

In the PISA, before the implementation of the test, students are given student questionnaire which includes background questions in order to identify economic, social, and cultural status (ESCS) of them. In PISA, many questionnaire items were designed to be combined in some way in order to measure latent constructs that cannot be observed directly (e.g., a student's achievement motivation or economic, social and cultural background). Transformations or scaling procedures were applied to construct meaningful indices from these items. These indices are referred to as 'derived variables' in the Technical Report of PISA 2015 (OECD, 2017). The independent variables of this study are selected among these derived variables which are obtained from student and school questionnaire of the PISA. Also, the dependent

variable of the study is math performance of the students which are also obtained from the student questionnaires.

In this study, student questionnaire of PISA 2015 which contains math scores of the students as well, will be used to receive student-level variables which are mother's education, father's education, the international socio-economic index of occupational status of father, the international socio-economic index of occupational status of mother, immigration status, language at home, parents emotional support, cultural possessions at home, home educational resources, and the PISA index of economic, social and cultural status (ESCS). The student-level variables are family-related variables which include the ESCS and the variables that are considered to have a cause and effect relation with ESCS of the family. Also, school questionnaire of PISA 2015 will be used to receive school-level variables which are educational leadership, shortage of educational material, shortage of educational staff, student-related factors affecting school climate, and teacher-related factors affecting school climate.

3.6 Data Collection

PISA which is an aged-based survey assesses 15-year-old students from grade 7 or higher in the domains of science, reading, mathematic, financial literacy and collaborative problem-solving domains. Furthermore, Student Questionnaires are used to collect information from students about their home, family, school background. Also, School Questionnaires are used to collect information from schools about different aspects of educational provision and organization. PISA 2015 is conducted as computer-based in Turkey with the participation of 5895 students. While the population of 15-year-old students is 1.324.089 students, the accessible population which can attend the assessment has been determined as 925.366 students. Firstly, the schools which will be attend PISA 2015 are selected with a cluster sampling by using NUTS Level-1 regions, education type, school type, the location of the schools,

administration types of the schools. Then, students who will be attend PISA 2015 are chosen by random sampling within these schools (Özgürlük et al., 2016).

In order to apply PISA, firstly the questionnaire and test items are translated into Turkish and they are checked by the experts in the field. Also, in order to make ready the schools which are selected for the sample for PISA, a series of educational meeting are conducted targeting the province and school administrators and the educational materials like brochures are aimed to make ready all the stakeholders. Test operators are employed to the sample schools by Turkish Ministry of National Education in order to help students about the operation of the system while they were answering the questions from the computers and in the case of experiencing a problem related to the computers during the assessment. By this way, it is targeted to minimize the data loss. After the assessment, the open-ended questions answered by the students are graded by the experts of the field and sent to International Center (Özgürlük et al., 2016).

3.7 Data Analyses

The data sets like students nested within classrooms, students nested within classrooms nested within schools, etc. are multilevel data sets which are hierarchical in structure (Roberts, 2004). Group members of a "nest" might share some unique similarities that might not be shared among other groups (Crook, Todd, & Barilla, 2005). Before the development of HLM, fixed parameter simple linear regression techniques were generally utilized for the assessment of hierarchical data but since these techniques were neglecting the shared variance, they were insufficient for such analyses (Woltman, Feldstain, Mackay, & Rocchi, 2012). When error terms are not independent and clustered due to a grouping factor like classroom, school, region, etc., it leads to computing wrong coefficients in regression. However, hierarchical linear models handle data where observations are not independent and correctly model the correlated error (Garson, 2014). Thus, HLM preferred in that research in order to

investigate the regional achievement gaps in Turkey in math and to determine the variables which are helpful to close the achievement gap for each region. HLM7 software is used for the analyses.

3.8 Limitations of the Study

This study is designed as a multilevel analysis which examined the correlations between different levels. This study done with PISA 2015 math data. Thus, its generability is limited to 2015. Also, this study was a quantitative study. However, there are deep sociological roots of each variable that is used in this study. Thus, if qualitative study can be mixed with quantitative study on the regional achievement gaps in this study, the study would have further explanatory power compare to solely a qualitative study. However, due to the limitation of time and the space in terms of reaching all regions of the Turkey, quantitative study is preferred. Also, as another limitation of the study, since this study focused on the regional achievement gaps and the variable sets that are effective to close the achievement gap for each region, the individual variables' significances are overlooked due to the complexity of the model. Thus, while this study concentrated on the group of the variables' effect on the achievement gap, inability in distinguishing the individual variable's significance in terms of the relationship with math performance is a limitation in this study.

CHAPTER 4

RESULTS

This chapter includes descriptive statistics and correlation of the variables for Turkey, results related to unconditional model, results related to base model, results related to family model, results related to school model and results related to full model. Full maximum likelihood utilized as the method of estimation with robust standard errors to non-normality has been used for HLM analysis.

4.1 Descriptive Statistics and Correlation of the Variables for Turkey

Descriptive statistics and correlation tables of the variables which are used in this study are presented below for Turkey. For the variable of math performance of the students, despite all 10 plausible values are used for HLM analysis, for the correlation analysis of the variables with SPSS only one plausible value (PV1Math) has been used. Despite it is recommended to use all plausible values together even on large samples in order to guarantee consistency between results published by the OECD, due to the inability of the SPSS program handling 10 plausible values together only one plausible value has been used. Still, since on large samples using one plausible value or ten plausible values does not really make a substantial difference, one plausible value has been used due to the limitation of the SPSS software (OECD, 2009). Below, Table 4.1 shows the descriptive statistics of the specified variables for Turkey and Table 4.2 shows the correlation between these variables:

Table 4. 1
Descriptive Statistics of the Specified Variables for Turkey

Variable	*M*	*SD*
1. Mother's Education-ISCED (MISCED)	2.20	1.84
2. Father's Education-ISCED (FISCED)	2.67	1.89
3. ISEI of Mother (BMMJ1)	39.53	22.42
4. ISEI of Father (BFMJ2)	34.95	18.67
5. Immigrant Background (IMMIG)	1.01	.13
6. Language Spoken at Home (LANGN)	381.49	133.54
7. Parents emotional support (EMOSUPS)	-.27	1.08
8. Cultural Possessions (CULTPOSS)	-.26	.87
9. Home Educational Resources (HEDRES)	-.58	1.13
10. Index of Economic, Social and Cultural Status (ESCS)	-1.45	1.17
11. Educational leadership (LEAD)	.64	1.02
12. Shortage of educational material (EDUSHORT)	.21	1.25
13. Shortage of educational staff (STAFFSHORT)	.56	1.14
14. Student-related factors affecting school climate (STUBEHA)	.265	.92
15. Teacher-related factors affecting school climate (TEACHBEHA)	.14	.87
16. Plausible Value 1 in Mathematics (PV1Math)	416.14	81.55

Note. M and *SD* are used to represent mean and standard deviation respectively.

Table 4. 2
Correlations of the Specified Variables for Turkey

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
2	.56**	1													
3	.58**	.47**	1												
4	.30**	.48**	.48**	1											
5	.07**	.07**	.01	.02	1										
6	-.13**	-.11**	.02	-.12**	.10**	1									
7	.05**	.09**	.15**	.11**	-.03*	-.07**	1								
8	.25**	.29**	.36**	.27**	.03*	-.08**	.20**	1							
9	.26**	.28**	.29**	.29**	.00	-.23**	.24**	.45**	1						
10	.66**	.78**	.72**	.72**	.05**	-.20**	.16**	.48**	.55**	1					
11	.05**	.05**	.06*	.09**	.02	-.04**	.13	.08**	.10**	.01**	1				
12	-.10**	-.12**	-.21**	-.17**	-.01	.19**	-.07**	-.14**	-.15**	-.20**	-.07**	1			
13	-.13**	-.14**	-.25**	-.15**	.02	.08**	-.06**	-.14**	-.13**	-.20**	-.13**	.51**	1		
14	-.04**	-.06**	-.19**	-.10**	.03*	.01	-.08**	-.10**	-.07**	-.10**	-.18**	.30**	.35**	1	
15	.03*	.02	-.01	-.04**	-.03	-.01	-.02	-.00	-.02	-.01	-.26**	.27**	.32**	.46**	1
16	.11**	.19**	.32**	.27**	-.02	-.16**	.15**	.19**	.25**	.30**	.08**	-.22**	-.20**	-.25**	-.10**

Note. * indicates *p<.05*; ** indicates *p<.01*. The numbers indicates; 1:Mother's Education-ISCED (MISCED), 2: Father's Education-ISCED (FISCED), 3: ISEI of Mother (BMMJ1), 4: ISEI of Father (BFMJ2), 5: Immigrant Background (IMMIG), 6: Language Spoken at Home (LANGN), 7: Parents emotional support (EMOSUPS), 8: Cultural Possessions (CULTPOSS), 9: Home Educational Resources (HEDRES), 10: Index of Economic, Social and Cultural Status (ESCS), 11: Educational leadership (LEAD), 12: Shortage of educational material (EDUSHORT), 13: Shortage of educational staff (STAFFSHORT), 14: Student-related factors affecting school climate (STUBEHA), 15: Teacher-related factors affecting school climate (TEACHBEHA), and 16: Plausible Value 1 in Mathematics (PV1Math).

4.2 Results Related to the Unconditional Model

The first analysis performed with unconditional model, also called the null model. The unconditional model is a kind of random intercept model that predicts the level 1 intercept of the dependent variable which is the math score of the student as a random effect of the level 2 grouping variable which is the school variable without any predictors at level 1 which is the student level in this study. The unconditional model allows to test whether there is an agency effect which is school effect in this case so that it answers whether HLM analysis is necessary or not (Garson, 2014). The unconditional model is as follows:

Level-1: $PVMATH_{ij} = \beta_{0j} + r_{ij}$

Level-2: $\beta_{0j} = \gamma_{00} + u_{0j}$

Mixed model for the unconditional model: $PVMATH_{ij} = \gamma_{00} + u_{0j} + r_{ij}$

$PVMATH_{ij}$ represents the math score of the student *i* in school *j*. β_{0j} represents the intercept which is grand mean of math scores of all students. u_{0j} represents the random error associated with the school j. r_{ij} represents the random error associated with student *i* in school *j*.

The intraclass correlation coefficient (ICC) is computed based on the unconditional model run. The ICC shows the degree that variation between students' mathematics scores can be explained with the school's variation. The ICC computed with the following formula:

ICC = $\rho = \frac{\tau 00}{\tau 00 + \sigma 2}$ (Crook et al., 2005).

According to the ICC formula with $\sigma^2 = 3342.47$ and $\tau_{00} = 3425.13$, ICC is 0,51. This shows that % 51 variation in the math scores of the students can be explained with the

variation among the schools. More importantly, the chi-square test results showed a statistically significant nonzero score for the variation of student achievement between schools, $x^2(185, N = 186) = 6401.34$, $p < .001$. Since there is a high variation among the schools, this shows that we should use HLM instead of regular regression in order to take account the schools as the nest units. Below, Table 4.3 shows the results of unconditional model:

Table 4. 3
Results of Unconditional Model

γ00 (Grand Mean)	407.76
Between-class variability (τ)	3425.13
Within-class variability across all students (σ^2)	3342.47
Intraclass correlation (ICC)	0,51

4.3 Results Related to the Base Model

The first question asked in this study is that whether there is a significant difference between mathematics achievement of the students in Aegean Region of the Turkey which had the highest student achievement in mathematics in PISA 2015 and the other TR Level-1 Regions of the Turkey (Özgürlük et al., 2016). To answer this question, the base model has been formed by only adding TR regions as new variables to the unconditional model at level 2. Thus, the base model and the final estimation of fixed effects (with robust standard errors) on base model which are represented in Table 4.4 are as follows:

Level-1: $PVMATH_{ij} = \beta_{0j} + r_{ij}$

Level-2: $\beta_{0j} = \gamma_{00} + \gamma_{01}*(TR1_j) + \gamma_{02}*(TR2_j) + \gamma_{03}*(TR4_j) + \gamma_{04}*(TR5_j) + \gamma_{05}*(TR6_j) + \gamma_{06}*(TR7_j) + \gamma_{07}*(TR8_j) + \gamma_{08}*(TR9_j) + \gamma_{09}*(TRA_j) + \gamma_{010}*(TRB_j) + \gamma_{011}*(TRC_j) + u_{0j}$

Mixed model for the base model: $PVMATH_{ij} = \gamma_{00} + \gamma_{01}*TR1_j + \gamma_{02}*TR2_j + \gamma_{03}*TR4_j + \gamma_{04}*TR5_j + \gamma_{05}*TR6_j + \gamma_{06}*TR7_j + \gamma_{07}*TR8_j + \gamma_{08}*TR9_j + \gamma_{09}*TRA_j + \gamma_{010}*TRB_j + \gamma_{011}*TRC_j + u_{0j} + r_{ij}$

Table 4. 4
Final Estimation of Fixed Effects (with Robust Standard Errors) on Base Model

Fixed Effect	Coefficient	Standard error	*t*-ratio	Approx. *d. f.*	*p*-value
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	431.485456	17.251075	25.012	174	<0.001
TR1, γ_{01}	-12.764312	20.885856	-0.611	174	0.542
TR2, γ_{02}	-8.496983	26.342360	-0.323	174	0.747
TR4, γ_{03}	-1.389064	24.358952	-0.057	174	0.955
TR5, γ_{04}	-5.714301	21.234747	-0.269	174	0.788
TR6, γ_{05}	-14.933030	21.910357	-0.682	174	0.496
TR7, γ_{06}	-16.239388	26.560078	-0.611	174	0.542
TR8, γ_{07}	-26.168131	23.904051	-1.095	174	0.275
TR9, γ_{08}	**-36.451849**	**19.686875**	**-1.852**	**174**	**0.066**
TRA, γ_{09}	-39.117586	32.256211	-1.213	174	0.227
TRB, γ_{010}	**-82.377604**	**27.127128**	**-3.037**	**174**	**0.003**
TRC, γ_{011}	**-60.279424**	**21.196579**	**-2.844**	**174**	**0.005**

The base model shows that there is a statistically significant difference between mathematics achievement of the students in Aegean Region and Central East Anatolia Region (TRB) (p = 0.003). Only being in Central East Anatolia Region (TRB) decreases the mathematics score of a student approximately -82.38 points compare to a student from Aegean Region. Again, there is a statistically highly significant difference between mathematics achievement of the students in Aegean Region and Southeast Anatolia Region (TRC) (p = 0.005). Only being in Southeast Anatolia

Region (TRC) decreases the mathematics score of a student approximately -60.28 points compare to a student from Aegean Region. Also, it has been seen that there is a statistically marginally significant difference between mathematics achievement of the students in Aegean region and East Black Sea region ($p = 0.066$). The model shows that only being in East Black Sea Region decreases the mathematics score of a student approximately -36.45 points compare to a student from Aegean Region.

4.4 Results Related to the Family Model

The second question that this study tries to find an answer is that whether there is a significant difference in mathematics performance of the students in Aegean Region and the other NUTS Level-1 Regions of the Turkey when the specified family-related variables are controlled. Family related variables consist of mother's education (MISCED), father's education (FISCED), the international socio-economic index of occupational status of father (BFMJ2), the international socio-economic index of occupational status of mother (BMMJ1), immigration status (being native has been chosen as reference and being first and second generation immigrant included into model as FIRSTGNR and SECONDGNR variable), language at home (speaking Turkish has been chosen as reference and speaking other languages included into model as OTHERLANG variable), parents emotional support (EMOSUPS), cultural possessions at home (CULTPOSS), home educational resources (HEDRES), and the PISA index of economic, social and cultural status (ESCS). The family model represented below:

Level-1: $PVMATH_{ij} = \beta_{0j} + \beta_{1j}*(MISCED_{ij}) + \beta_{2j}*(FISCED_{ij}) + \beta_{3j}*(BMMJ1_{ij}) + \beta_{4j}*(BFMJ2_{ij}) + \beta_{5j}*(EMOSUPS_{ij}) + \beta_{6j}*(CULTPOSS_{ij}) + \beta_{7j}*(HEDRES_{ij}) + \beta_{8j}*(ESCS_{ij}) + \beta_{9j}*(SECONDGN_{ij}) + \beta_{10j}*(FIRSTGNR_{ij}) + \beta_{11j}*(OTHERLAN_{ij}) + r_{ij}$

Level-2: $\beta_{0j} = \gamma_{00} + \gamma_{01}*(TR1_j) + \gamma_{02}*(TR2_j) + \gamma_{03}*(TR4_j) + \gamma_{04}*(TR5_j) + \gamma_{05}*(TR6_j) + \gamma_{06}*(TR7_j) + \gamma_{07}*(TR8_j) + \gamma_{08}*(TR9_j) + \gamma_{09}*(TRA_j) + \gamma_{010}*(TRB_j) + \gamma_{011}*(TRC_j) + u_{0j}$

$\beta_{1j} = \gamma_{10}$

$\beta_{2j} = \gamma_{20}$

$\beta_{3j} = \gamma_{30}$

$\beta_{4j} = \gamma_{40}$

$\beta_{5j} = \gamma_{50}$

$\beta_{6j} = \gamma_{60}$

$\beta_{7j} = \gamma_{70}$

$\beta_{8j} = \gamma_{80}$

$\beta_{9j} = \gamma_{90}$

$\beta_{10j} = \gamma_{100}$

$\beta_{11j} = \gamma_{110}$

(BMMJ1 BFMJ2 EMOSUPS CULTPOSS HEDRES ESCS have been centered around the grand mean.)

Mixed model for the family model: $PVMATH_{ij} = \gamma_{00} + \gamma_{01}*TR1_j + \gamma_{02}*TR2_j + \gamma_{03}*TR4_j + \gamma_{04}*TR5_j + \gamma_{05}*TR6_j + \gamma_{06}*TR7_j + \gamma_{07}*TR8_j + \gamma_{08}*TR9_j + \gamma_{09}*TRA_j + \gamma_{010}*TRB_j + \gamma_{011}*TRC_j + \gamma_{10}*MISCED_{ij} + \gamma_{20}*FISCED_{ij} + \gamma_{30}*BMMJ1_{ij} + \gamma_{40}*BFMJ2_{ij} + \gamma_{50}*EMOSUPS_{ij} + \gamma_{60}*CULTPOSS_{ij} + \gamma_{70}*HEDRES_{ij} + \gamma_{80}*ESCS_{ij} + \gamma_{90}*SECONDGN_{ij} + \gamma_{100}*FIRSTGNR_{ij} + \gamma_{110}*OTHERLAN_{ij} + u_{0j} + r_{ij}$

The family model shows that there is a statistically highly significant difference between mathematics achievement of the students in Aegean Region (TR3) and East Black Sea Region (TR9) ($p = 0.006$) when the family-related variables are controlled. Here, it is important to notice that in the base model in which no variable is controlled, there was statistically marginally significant difference between mathematics

achievement of the students in Aegean Region and East Black Sea Region (TR9) (p = 0.066). However, this marginally significant difference turns into statistically highly significant difference when family-related variables are controlled. Being in East Black Sea Region (TR9) decreases the mathematics score of a student approximately -55.63 points compare to a student from Aegean Region when the family variables are controlled. On the other hand, while there was a statistically highly significant difference between mathematics achievement of the students in Aegean Region (TR3) and Central East Anatolia Region (TRB) (p = 0.003), and Southeast Anatolia Region (TRC) (p = 0.005), there is no longer statistically significant difference between mathematics achievement of the students in Aegean Region (TR3) and Central East Anatolia Region (TRB) (p = 0.141), and Southeast Anatolia Region (TRC) (p = 0.764) when the family variables are controlled.

Also, this can be seen that only the effect of the international socio-economic index of occupational status of mother (BMMJ1) is statistically marginally significant (p = 0.058). A one unit increase in the international socio-economic index of occupational status of mother (BMMJ1) will cause an increase of 0.29 points in mathematics scores of the students.

Table 4.5 which shows the final estimation of fixed effects (with robust standard errors) on family model is represented below:

Table 4. 5
Final Estimation of Fixed Effects (with Robust Standard Errors) on Family Model

Fixed Effect	Coefficient	Standard error	*t*-ratio	Approx. *d.f.*	*p*-value
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	451.601867	16.577368	27.242	133	<0.001
TR1, γ_{01}	-13.563034	19.477810	-0.696	133	0.487
TR2, γ_{02}	-6.028992	26.315517	-0.229	133	0.819
TR4, γ_{03}	-3.999128	21.841904	-0.183	133	0.855
TR5, γ_{04}	-3.005213	20.928415	-0.144	133	0.886
TR6, γ_{05}	-10.798197	21.366770	-0.505	133	0.614
TR7, γ_{06}	4.139482	30.273726	0.137	133	0.891
TR8, γ_{07}	-16.165261	22.250060	-0.727	133	0.469
TR9, γ_{08}	**-55.630814**	**19.983726**	**-2.784**	**133**	**0.006**
TRA, γ_{09}	-29.162595	56.831044	-0.513	133	0.609
TRB, γ_{010}	-53.938305	35.654786	-1.513	30	0.141
TRC, γ_{011}	-10.272627	34.177062	-0.301	133	0.764
For MISCED slope, β_1					
INTRCPT2, γ_{10}	-2.693457	2.034181	-1.324	82	0.189
For FISCED slope, β_2					
INTRCPT2, γ_{20}	-0.572621	1.853274	-0.309	212	0.758
For BMMJ1 slope, β_3					
INTRCPT2,γ_{30}	**0.292395**	**0.154146**	**1.897**	**874**	**0.058**
For BFMJ2 slope, β_4					
INTRCPT2, γ_{40}	0.178705	0.162056	1.103	106	0.273
For EMOSUPS slope, β_5					
INTRCPT2, γ_{50}	-0.673300	2.635662	-0.255	44	0.800
For CULTPOSS slope, β_6					
INTRCPT2, γ_{60}	1.614606	3.058242	0.528	152	0.598
For HEDRES slope, β_7					
INTRCPT2, γ_{70}	-2.024582	2.983351	-0.679	71	0.500
For ESCS slope, β_8					
INTRCPT2, γ_{80}	8.850935	5.594855	1.582	386	0.114
For SECONDGN slope, β_9					
INTRCPT2, γ_{90}	-15.451379	19.367331	-0.798	32	0.431
For FIRSTGNR slope, β_{10}					
INTRCPT2, γ_{100}	2.197489	32.445645	0.068	393	0.946
For OTHERLAN slope, β_{11}					
INTRCPT2, γ_{110}	-6.686697	17.913091	-0.373	62	0.710

4.5 Results Related to the School Model

The third question of the study is that whether there is a significant difference in mathematics performance of the students in Aegean Region of the Turkey and the other NUTS Level-1 Regions of the Turkey when we control the specified school-related variables. School related variables consist of the overall scale for leadership (LEAD), school resources which includes the index on staff shortage (STAFFSHO) and the index on shortage of educational material (EDUSHORT), and school climate which includes student-related factors (STUBEHA) and teacher-related factors affecting school climate (TEACHBEH). The school model and Table 4.6 which shows final estimation of fixed effects (with robust standard errors) on school model are represented below:

Level-1: $PVMATH_{ij} = \beta_{0j} + r_{ij}$

Level-2: $\beta_{0j} = \gamma_{00} + \gamma_{01}*(LEAD_j) + \gamma_{02}*(EDUSHORT_j) + \gamma_{03}*(STAFFSHO_j) + \gamma_{04}*(STUBEHA_j) + \gamma_{05}*(TEACHBEH_j) + \gamma_{06}*(TR1_j) + \gamma_{07}*(TR2_j) + \gamma_{08}*(TR4_j) + \gamma_{09}*(TR5_j) + \gamma_{010}*(TR6_j) + \gamma_{011}*(TR7_j) + \gamma_{012}*(TR8_j) + \gamma_{013}*(TR9_j) + \gamma_{014}*(TRA_j) + \gamma_{015}*(TRB_j)+\gamma_{016}*(TRC_j)+u_{0j}$

(LEAD EDUSHORT STAFFSHO STUBEHA TEACHBEH have been centered around the grand mean.)

Mixed model for the school model: $PVMATH_{ij} = \gamma_{00} + \gamma_{01}*LEAD_j + \gamma_{02}*EDUSHORT_j + \gamma_{03}*STAFFSHO_j + \gamma_{04}*STUBEHA_j + \gamma_{05}*TEACHBEH_j + \gamma_{06}*TR1_j + \gamma_{07}*TR2_j + \gamma_{08}*TR4_j + \gamma_{09}*TR5_j + \gamma_{010}*TR6_j + \gamma_{011}*TR7_j + \gamma_{012}*TR8_j + \gamma_{013}*TR9_j + \gamma_{014}*TRA_j + \gamma_{015}*TRB_j + \gamma_{016}*TRC_j + u_{0j}+ r_{ij}$

Table 4. 6
Final Estimation of Fixed Effects (with Robust Standard Errors) on School Model

Fixed Effect	Coefficient	Standard error	*t*-ratio	Approx. *d.f.*	*p*-value
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	427.363709	15.605506	27.385	169	<0.001
LEAD, γ_{01}	-2.252619	4.525850	-0.498	169	0.619
EDUSHORT,γ_{02}	-3.444635	3.912166	-0.880	169	0.380
STAFFSHO, γ_{03}	**-9.369632**	**4.296590**	**-2.181**	**169**	**0.031**
STUBEHA, γ_{04}	**-20.550584**	**4.799768**	**-4.282**	**169**	**<0.001**
TEACHBEH,γ_{05}	8.531811	5.532193	1.542	169	0.125
TR1, γ_{06}	-12.033120	19.291304	-0.624	169	0.534
TR2, γ_{07}	4.105757	24.733651	0.166	169	0.868
TR4, γ_{08}	2.030078	20.145220	0.101	169	0.920
TR5, γ_{09}	-7.068178	18.828765	-0.375	169	0.708
TR6, γ_{010}	-12.484638	19.070445	-0.655	169	0.514
TR7, γ_{011}	-9.711392	24.622548	-0.394	169	0.694
TR8, γ_{012}	-19.549079	20.659671	-0.946	169	0.345
TR9, γ_{013}	-19.644469	20.974325	-0.937	169	0.350
TRA, γ_{014}	-33.350176	30.584989	-1.090	169	0.277
TRB, γ_{015}	**-80.143184**	**28.400600**	**-2.822**	**169**	**0.005**
TRC, γ_{016}	**-50.197726**	**19.129082**	**-2.624**	**169**	**0.009**

The school model shows that statistically marginally significant difference (p = 0.066) between mathematics achievement of the students in Aegean Region (TR3) and East Black Sea Region (TR9) (p = 0.350) disappears when the school variables are controlled. On the other hand, statistically highly significant difference between mathematics achievement of the students in Aegean Region (TR3) and Central East Anatolia Region (TRB) (p = 0.003), and Southeast Anatolia Region (TRC) (p = 0.005), still holds for Central East Anatolia Region (TRB) (p = 0.005), and Southeast Anatolia Region (TRC) (p = 0.009) in the school model. Being in Central East Anatolia Region (TRB) decreases the mathematics score of a student approximately -80.14 points and being in Southeast Anatolia Region (TRC) decreases the mathematics score of a student approximately -50.20 points compare to a student from Aegean Region when the school variables are controlled.

The school model shows that the effect of staff shortage (STAFFSHO) is statistically significant (0.031). A one unit increase in the staff shortage (STAFFSHO) will cause a decrease of -9.37 points in mathematics scores of the students. Also, the effect of student behavior (STUBEHA) is statistically very highly significant (<0.001). A one unit increase in student behavior (STUBEHA) will cause a decrease of -20.55 points in mathematics scores of the students.

4.6 Results Related to the Full Model

The last question of the study is that whether there is a significant difference in mathematics performance of the students in Aegean Region of Turkey and the other NUTS Level-1 Regions of Turkey when we control both specified family-related variables and school-related variables. The full model and Table 4. 7 which shows final estimation of fixed effects (with robust standard errors) on full model is represented below:

Level-1: $PVMATH_{ij} = \beta_{0j} + \beta_{1j}*(MISCED_{ij}) + \beta_{2j}*(FISCED_{ij}) + \beta_{3j}*(BMMJ1_{ij}) + \beta_{4j}*(BFMJ2_{ij}) + \beta_{5j}*(EMOSUPS_{ij}) + \beta_{6j}*(CULTPOSS_{ij}) + \beta_{7j}*(HEDRES_{ij}) + \beta_{8j}*(ESCS_{ij}) + \beta_{9j}*(SECONDGN_{ij}) + \beta_{10j}*(FIRSTGNR_{ij}) + \beta_{11j}*(OTHERLAN_{ij}) + r_{ij}$

Level-2: $\beta_{0j} = \gamma_{00} + \gamma_{01}*(LEAD_j) + \gamma_{02}*(EDUSHORT_j) + \gamma_{03}*(STAFFSHO_j) + \gamma_{04}*(STUBEHA_j) + \gamma_{05}*(TEACHBEH_j) + \gamma_{06}*(TR1_j) + \gamma_{07}*(TR2_j) + \gamma_{08}*(TR4_j) + \gamma_{09}*(TR5_j) + \gamma_{010}*(TR6_j) + \gamma_{011}*(TR7_j) + \gamma_{012}*(TR8_j) + \gamma_{013}*(TR9_j) + \gamma_{014}*(TRA_j) + \gamma_{015}*(TRB_j) + \gamma_{016}*(TRC_j) + u_{0j}$

$\beta_{1j} = \gamma_{10}$

$\beta_{2j} = \gamma_{20}$

$\beta_{3j} = \gamma_{30}$

$\beta_{4j} = \gamma_{40}$

$\beta_{5j} = \gamma_{50}$

$\beta_{6j} = \gamma_{60}$

$\beta_{7j} = \gamma_{70}$

$\beta_{8j} = \gamma_{80}$

$\beta_{9j} = \gamma_{90}$

$\beta_{10j} = \gamma_{100}$

$\beta_{11j} = \gamma_{110}$

(BMMJ1, BFMJ2, EMOSUPS, CULTPOSS, HEDRES, and ESCS have been centered around the grand mean. Also, LEAD, EDUSHORT, STAFFSHO, STUBEHA, and TEACHBEH have been centered around the grand mean.)

Mixed model for the full model: $PVMATH_{ij} = \gamma_{00} + \gamma_{01}*LEAD_j + \gamma_{02}*EDUSHORT_j + \gamma_{03}*STAFFSHO_j + \gamma_{04}*STUBEHA_j + \gamma_{05}*TEACHBEH_j + \gamma_{06}*TR1_j + \gamma_{07}*TR2_j + \gamma_{08}*TR4_j + \gamma_{09}*TR5_j + \gamma_{010}*TR6_j + \gamma_{011}*TR7_j + \gamma_{012}*TR8_j + \gamma_{013}*TR9_j + \gamma_{014}*TRA_j + \gamma_{015}*TRB_j + \gamma_{016}*TRC_j + \gamma_{10}*MISCED_{ij} + \gamma_{20}*FISCED_{ij} + \gamma_{30}*BMMJ1_{ij} + \gamma_{40}*BFMJ2_{ij} + \gamma_{50}*EMOSUPS_{ij} + \gamma_{60}*CULTPOSS_{ij} + \gamma_{70}*HEDRES_{ij} + \gamma_{80}*ESCS_{ij} + \gamma_{90}*SECONDGN_{ij} + \gamma_{100}*FIRSTGNR_{ij} + \gamma_{110}*OTHERLAN_{ij} + u_{0j} + r_{ij}$

Table 4. 7
Final Estimation of Fixed Effects (with Robust Standard Errors) on Full Model

Fixed Effect	Coefficient	Standard error	*t*-ratio	Approx. *d.f.*	*p*-value
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	446.468644	15.045302	29.675	128	<0.001
LEAD, γ_{01}	-2.227983	5.766547	-0.386	128	0.700
EDUSHORT,γ_{02}	-4.405518	4.794904	-0.919	128	0.360
STAFFSHO, γ_{03}	**-9.389629**	**4.961843**	**-1.892**	**128**	**0.061**
STUBEHA, γ_{04}	**-25.679896**	**5.282540**	**-4.861**	**128**	**<0.001**
TEACHBEH,γ_{05}	7.646471	6.237537	1.226	128	0.222
TR1, γ_{06}	-13.164271	17.498418	-0.752	128	0.453
TR2, γ_{07}	9.434448	23.303110	0.405	128	0.686
TR4, γ_{08}	-1.412845	17.610778	-0.080	128	0.936
TR5, γ_{09}	-5.374399	18.733542	-0.287	128	0.775
TR6, γ_{010}	-23.927773	18.205942	-1.314	128	0.191
TR7, γ_{011}	11.926884	29.529532	0.404	128	0.687
TR8, γ_{012}	-14.874554	20.073717	-0.741	128	0.460
TR9, γ_{013}	-31.236506	24.640073	-1.268	128	0.207
TRA, γ_{014}	-35.908039	55.699895	-0.645	128	0.520
TRB, γ_{015}	-52.115333	34.289412	-1.520	27	0.140
TRC, γ_{016}	-12.751318	33.260019	-0.383	128	0.702
For MISCED slope, β_1					
INTRCPT2, γ_{10}	-2.624681	2.028672	-1.294	82	0.199
For FISCED slope, β_2					
INTRCPT2, γ_{20}	-0.512163	1.876135	-0.273	215	0.785
For BMMJ1 slope, β_3					
INTRCPT2, γ_{30}	**0.264176**	**0.154060**	**1.715**	**874**	**0.087**
For BFMJ2 slope, β_4					
INTRCPT2, γ_{40}	0.177962	0.162019	1.098	108	0.274
For EMOSUPS slope, β_5					
INTRCPT2, γ_{50}	-0.581297	2.619253	-0.222	44	0.825
For CULTPOSS slope, β_6					
INTRCPT2, γ_{60}	1.106024	3.033690	0.365	148	0.716
For HEDRES slope, β_7					
INTRCPT2, γ_{70}	-1.887732	3.004321	-0.628	71	0.532
For ESCS slope, β_8					
INTRCPT2, γ_{80}	8.625183	5.543263	1.556	391	0.121
For SECONDGN slope, β_9					
INTRCPT2, γ_{90}	-12.202778	19.254495	-0.634	31	0.531
For FIRSTGNR slope, β_{10}					
INTRCPT2, γ_{100}	2.977023	31.894033	0.093	347	0.926
For OTHERLAN slope, β_{11}					
INTRCPT2, γ_{110}	-6.050251	17.731130	-0.341	60	0.734

The full model shows that there is not a statistically significant difference between mathematics achievement of the students in Aegean Region (TR3) and the other NUTS Level-1 Regions of Turkey when both specified family-related variables and school-related variables are controlled. The full model shows that the effect of staff shortage (STAFFSHO) is statistically marginally significant (0.061). A one unit increase in the staff shortage (STAFFSHO) will cause a decrease of -9.39 points in mathematics scores of the students. Moreover, the effect of student behavior (STUBEHA) is statistically very highly significant (<0.001). A one unit increase in student behavior (STUBEHA) will cause a decrease of -25.68 points in mathematics scores of the students.

Also, this can be seen that only the effect of the international socio-economic index of occupational status of mother (BMMJ1) is statistically marginally significant (p = 0.087) among the family variables in the full model. A one unit increase in the international socio-economic index of occupational status of mother (BMMJ1) will cause an increase of 0.26 points in mathematics scores of the students.

CHAPTER 5

DISCUSSION

In this chapter, the results of the HLM analysis discussed together with the evidences in the literature. Following the discussion of the results, implications of the study presented. Lastly, limitations and recommendations introduced. According to the results, there exists statistically significant difference between mathematics achievements of the students in Aegean region and certain regions of the Turkey which are Central East Anatolia and Southeast Anatolia regions. Also, the difference is marginally significant between Aegean region and East Black Sea region. When specified family and school variables are controlled separately, the difference disappears for some regions which are Central East Anatolia and Southeast Anatolia region and increases for one region which is East Black Sea region. When specified school variables are controlled, the significant difference is still consistent for Central East Anatolia and Southeast Anatolia while there is no longer any significant difference for East Black Sea region. However, when specified family and school variables controlled together, there is no longer statistically significant difference between Aegean region and any other region.

5.1 Discussion of the Results

This study is designed as a causal comparative study and multilevel methodology is used. Secondary data analysis is utilized, and the study is conducted by two-level hierarchical linear modelling (HLM) method. Aim of this study was to map the

regional achievement gaps in Turkey and to find the variables that are helpful to close the achievement gap for each region.

Throughout the analyses, it has been found that % 51 variation in the math scores of the students can be explained with the variation among the schools. Thus, in order to take into account that clustering effect, hierarchical linear modelling utilized for the analyses (Stapleton, McNeish, & Yang, 2016). This shows that more than half of the differences in the math scores of the students are related to the school they attend rather than heterogeneity among students. In another study which is done with TIMSS 2007 data, it has been found that 34% of the variation in science achievement in Turkey was related with schools (Erberber, 2009). Again, in another study which is done with TIMSS 2011 math data, it has been found that 35% variation in math achievement in Turkey was related to the schools (M. Aydın, 2015). On the other hand, in a study which is done with PISA 2012 math data, it has been found that 64% of variability in math scores was between schools (Özberk et al., 2017). It can be argued that in schools' determination on student scores on a field is higher in PISA compare to TIMSS.

This differences on variability in math scores between schools can be attributed to the differences in designs of the PISA and TIMSS. Also, the differences in the age groups who receive those tests can be another explanation. Since while 15-year-old students receive PISA and most of whom are in high schools and they already differentiated in those schools as basic education, general secondary education, and vocational and technical secondary education by partly according to their previous academic performances, eight grade students receive TIMSS exam and eight grade students did not located to their schools based on their previous academic performances. Increase in the school's role to explain the variation in the achievement scores is also a question of equity since at secondary level, school type speaks for socio-economic background of the students as well (Özdemir, 2015). For example, vocational school students are coming from less educated and low-income families (Serdar, 2016). Also, if the

degree that the school explains variation is an indicator of equity, another study in which it has been found that regional inequalities in Turkey is higher secondary education compare to primary education, and higher in university education compare to secondary education can give us a clue on why intra-class correlation coefficients are higher in TIMSS compare to PISA (Karahasan & Uyar, 2009). Explaining such high percentages of achievement with the school implies that the school a student attends, consequently the neighborhood that a student lives and comes from draws her/his academic destiny.

When we consider Turkey PISA 2015 math case, explaining variation in the student performance and figuring out the factors that affects the performance of the students is misleading without considering how the students grouped in the schools since 51% of the variation in the performance depends on the variation among the schools (Woltman, Feldstain, Mackay, & Rocchi, 2012). It is known that even in the countries which have comprehensive school systems with no institutional differentiation and no grouping students based on their academic potential, significant variation in performance between schools can be seen due to the socio-economic and cultural characteristics of the communities that are served or to geographical differences like between regions, or between rural and urban areas, etc. (Lee, 2016; OECD, 2004). Thus, exploring the variation in the performance of the students and explaining the variables that influence those variations requires to take into consideration the community and geography that school is located in.

The first research question of this study was whether there is a significant difference between mathematics achievement of the students in Aegean Region which had the highest math score in PISA 2015 and other NUTS Level-1 Regions of Turkey (Arıcı et al., 2016). HLM results demonstrated that there exists a statistically significant difference between achievement of the students in Aegean region and Central East Anatolia region. This statistically significant difference is consistent for Aegean region and Southeast Anatolia region as well. Furthermore, it has been seen that there

is a marginally significant difference between math scores of the students in Aegean region and East Black Sea region (p=0.66). Since the relatively low achievement of the East Black Sea region is also consistent throughout other PISA cycles and also there exist a socioeconomic disparity between the west regions of the Turkey and Black Sea region together with Southeastern Anatolia and Eastern Anatolia, this marginal significance worth to notice (Erberber, 2009; Ersungur et al., 2010).

These results are consistent with Erberber's (2009) study in which she identified Marmara region as the reference region since it is the most developed region and found that there is a statistically significant difference between science performance of the students from Southeastern and Eastern regions compared to Marmara region while there is no significant difference on other regions with TIMSS 2007 data. This also shows that, this achievement gap on the eastern part of the Turkey is consistent across the academic fields as well.

The second question that this study sought an answer was whether there is a significant difference in mathematics performance of the students in Aegean Region and the other NUTS Level-1 Regions of Turkey when we control the family-related variables. Despite the relationship between academic achievement and the variables that affects achievement considered to be stagnant, regression models on the predictors of the achievement are different in different districts and each district has unique local regression parameters on these relationships (Ataç, 2017). The results of this study also confirm that geographical regions respond uniquely when we control the variables related to achievement. When specified family variables are controlled, i.e., their effect to the variation in math scores of the students are eliminated, it has been seen that there is a statistically significant difference between mathematics achievement of the students in Aegean Region and East Black Sea region. On the other hand, there is no statistically significant difference between math achievement of the students in Aegean region and the other regions including Central East Anatolia and Southeast Anatolia regions when the family variables are controlled. However,

Erberber (2009) found that controlling the family variables which are index of home resources, speaking Turkish at home and parental education did not affect the regional gaps. This difference may be caused the fact that the variable parental education is the education of the parent with more education and this generally corresponds to the education level of the father. However, in this study, despite the variables related to mother's education and occupational status were not statistically significant determinants when added together with other family variables, still the variables related to mother were closer to significance compare to the variables related to father. Also, the variables that added in this study was chosen only in line with literature while Erberber (2009) used variables that was significantly affecting the achievement throughout pre-analyses and differs from region to region. In that sense, while in this study and Erberber's (2009) study, family variables are controlled, the selected variables lead closing achievement gap in this study while in Erberber's study the gap remained after controlling this variables.

The family variables that was specified in this study in line with the literature was mother's education, father's education, the international socio-economic index of occupational status of father, the international socio-economic index of occupational status of mother, immigration status, language at home, parents emotional support, cultural possessions at home, home educational resources, and the PISA index of economic, social and cultural status. The results revealed that when all these variables are controlled together, any of them is statistically significant. However, all in all, they reduce the statistically significant achievement gap between Aegean and Southeast Anatolia region and Central East Anatolia Region. On the other hand, while these variables are controlled together, the difference between students from Aegean region and East Black sea region turn to be statistically significant. These results show that these variables are interacting with each other and their interaction can contribute to the achievement gaps more than their unique contribution. Also, it is important to consider that reducing the number of the variables that are included in the study would make the remaining variables statistically significant but due to having a

comprehensive picture, it is preferred to include them in line with the literature. For example, there are studies which shows that increase in mother's education level increases the cognitive skills of the child and significantly affect in a positive direction math achievement of the students (Aksu et al., 2017; Hanushek & Zhang, 2009). Parallel to these studies, throughout pre-analyses carried out for this thesis, it has been seen that only controlling mother education and occupational status of mother closed achievement gap for Central East Anatolia and South East Anatolia. Also, only adding these two variables to the HLM, made occupational status of the mother statistically significant. However, when all family variables added, the occupational status of the mother turned to be marginally significant. Thus, due to the complexity of the model, some significant variables can be turned to be insignificant. For example, there is an extensive literature on the significance of the economic, social and cultural status on the achievement but in this study, when enter analysis together with the other variables, ESCS is insignificant on math achievement (Bankov et al., 2006; Long & Pang, 2016; Özberk et al., 2017; Özdemir, 2016; Stull, 2013). However, since the research questions do not deal with significance of each variable, rather they deal with whether these variables close the achievement gaps all together, their individual significance can be overlooked.

The third question of this study was whether there is a significant difference in mathematics performance of the students in Aegean Region and the other NUTS Level-1 Regions of Turkey when we control the school-related variables. When the specified school variables are controlled, still there is a statistically significant difference only between mathematics achievement of the students in Aegean Region and Central East Anatolia region and between Aegean region and Southeast Anatolia region. On the other hand, statistically marginally significant difference between mathematics achievement of the students in Aegean Region and East Black Sea Region disappears when the school variables are controlled.

The school variables that was selected in this study was the overall scale for leadership, school resources which includes the index on staff shortage and the index on shortage of educational material, and school climate which includes student related factors and teacher related factors affecting school climate. The results of the study show student related factors affecting school climate which are student truancy, students skipping classes, students lacking respects for teachers, usage of alcohol or illegal drugs, intimidating or bullying other students are statistically highly significant. Increase in these behaviors which are student component of school climate significantly decreases the achievement in math. Also, increase in staff shortage significantly decreases math scores of the students. On the other hand, leadership, shortage of educational material, teacher related factors affecting school climate does not significantly affect math scores of the students. While the effect of shortage of educational material on the academic achievement found to be insignificant, it should be taken into consideration that results from existing literature on the school resources' effects on some educational outcomes are highly variable due to the difficulty in controlling other achievement inputs (Rivkin et al., 2005). In that sense, this insignificance can be caused from the variables that are controlled in this model. The insignificance of teacher related factors affecting the climate while highly significant effect of student related factors affecting the climate can be interpreted as a sign which confirms the argument that importance of teacher is overstated in the academic achievement and consequently future success in academy and labor market (Rivkin et al., 2005).

This study lastly aimed to answer whether there is a significant difference in mathematics performance of the students in Aegean Region of Turkey and the other NUTS Level-1 Regions of Turkey when we control both specified family-related variables and school-related variables. The results revealed that when both specified family variables and school variables are controlled, it has been seen that there is no longer statistically significant difference between mathematics achievements of the students in Aegean region and other regions. Also, student related factors affecting

school climate is still highly significantly affecting math scores when both family variables and school variables are controlled. On the other hand, effect of staff shortage on math achievement is no longer significant when family variables are also included (p=0.061). Also, in terms of family variables, when school variables are also included, still, only mother's occupational status is marginally significant.

5.2 Implications

With respect to the current study, there are some implications in terms of theory, further research and practice. When the evidence that population's cognitive skills are highly related to individual earnings, it is fair to say that economic gaps among the regions manifest themselves as achievement gaps, and achievement gaps manifest themselves as economic gaps. As the closing the economic gap between developed and underdeveloped countries requires structural changes in schooling institutions, this can be interpreted for the regional economic and achievement gaps as well (Hanushek & Woessmann, 2008). In that sense, for such a structural change, the first thing to be done should be investigate the variables that are effective on the structure. Thus, this thesis makes a meaningful contribution to the theory by investigating the regional achievement gaps separately and diagnosing the sides of the structures as family and school which are effective on the closing achievement gap for each region in Turkey.

Although there is an extensive literature on the predictors of student achievement and achievement gaps in general, there are very limited study that investigates the predictors of student achievement on the regional base in Turkey. Particularly, there is only one study that investigates regional disparities in TIMSS in science field with different variables than the variables used in this study (Erberber, 2009). However, the achievement predicting power of the variables changes throughout the grades (Rivkin et al., 2005). Also, effect of a variable on achievement differs from field to field. Thus, this study contributes to the literature by being the first study that

investigates the regional achievement gaps and tries to reveal the factors that are effective to close the achievement gap for each region at the end of the compulsory education in Turkey.

This study showed that there is statistically significant difference between math achievement of the students in Aegean Region and Central East Anatolia Region, and between math achievement of the students in Aegean Region and South East Anatolia region. Also, there is marginally significant difference between math achievement of the students in Aegean Region and East Black Sea region. When only selected family variables are controlled, the significant differences for Central East Anatolia and South East Anatolia disappears while for East Black Sea region, the marginally significant difference to significant difference. When only selected school variables are controlled, the significant difference persists for Central East Anatolia and South East Anatolia while the marginal significant difference disappears for East Black Sea region. Lastly, when both selected family and school variables are controlled together, it has been found that, there is no statistically significant difference between math performance of the students from Aegean region and any other region. Since there is very limited study on the regional achievement gaps and the predictors of the achievement on the regional base, this study draws attention to need for investigating more in detail the regional achievement gaps in Turkey.

In terms of the practice, since the factors like family education, occupational status, and ESCS together with home education resources and cultural possessions at home are in general the product of wide scope economic and social policies, the precautions on regional disadvantages which translates themselves as achievement gaps in terms of these variables should be taken as a result of more comprehensive policy beyond only the educational policies. Also, in terms of language, despite it did not found to be significant but since it predicts the math achievement in a negative direction, further support can be provided for the students whom in the house the spoken language is another language apart from the Turkish to compensate the achievement

gap both on student level and regional level. Also, since there is a migrated population concentrated in the south regions which are already lagging behind the other regions in terms of the student achievement, the negative effect of migrated population on the achievement should be compensated for the further educational support targeting to this population.

In terms of the school variables, since staff shortage is a significant predictor and the underachieving regions are disadvantaged in terms of this variable, some incentives can be suggested for the teachers who works in these disadvantaged regions rather than obligatory service. Furthermore, despite the overall scale for school leadership did not found to be significant, the school administer is the one who have the authority at least to a certain degree to intervene the other variables. For example, student related factors affecting school climate was only highly significant variable among the all variables and in all models that it entered. And the school administer is the one who have the role of designer in terms of the school climate. Thus, the administers should try to create a positive climate to ensure a higher achievement.

In terms of the research, this study done with the variables that are considered to be effective on the math achievement of the students. Another set of the variables can reveal further facts about the regional achievement gaps. Also, apart from PISA, studies can be done with national examinations like university entry examinations which are more concreate implementations for an individual's future life standard, and collectively for the socio-economic standards of the region.

5.3 Limitations and Recommendations

This study done with PISA 2015 math data. In order to increase the generalization of the results, the whole available PISA datasets for the all years as 2003, 2006, 2009, and 2012. Also, this study done on regional achievement gaps in math. For a comprehensive understanding on regional achievement gaps, for different fields the

same study can be conducted like reading achievement on which there is no regional achievement gap study in Turkey.

Also, this study was a quantitative study. However, there are deep sociological roots of each variable that is used in this study. Thus, a qualitative study on the regional achievement gaps can have further explanatory power compare to a quantitative study.

Also, as a limitation of the study, since this study focused on the regional achievement gaps and the variable sets that are effective to close the achievement gap for each region, the individual variables' significances are overlooked due to the complexity of the model. For example, as stated before, throughout the pre-analyses of the study, it has been found that even only mother's education and occupational status was able to close the achievement gaps for the Central East Anatolia and South East Anatolia regions, in order to have a comprehensive picture on the family variables, when the other family variables are added to the model, they become insignificant in the model. Thus, while this study concentrated on the group of the variables' effect on the achievement gap, further studies can go deeply into the significance of each variable for each region as well.

Furthermore, in this study an ecological perspective is followed which asserts that in order to understand the child the environment must be fully examined together with all components of home, school, community and culture (Brofenbrenner, 1986, as cited in Burns, Warmbold-Brann, & Zaslofsky, 2015). In this study, the effect of home and school, and their collective effect on the math achievement of the student is tried to be revealed on the regional base and this study is limited only the effects of home and school to explain the math achievement in terms of regional achievement. However, since the community and culture differ substantially from one region to another, including these two components in the exploration of the regional gaps in student achievement will help to come out with more powerful results. The further studies can include community and culture aspects of the ecology and other fields like

science and reading in order to have a more comprehensive picture to understand the regional gaps in student achievement.

The last recommendation of this study is for school administrators. Beyond the high-scope educational policies, the school administrators are the ones who have access to both family in order to intervene in the case of difficulties caused by language or migration status or parents' emotional support. Also, they have control over the school climate and resources. In that sense, they should use this indirect power on the predictors of achievement for a cumulative achievement increase in their region and at the end in the country.

REFERENCES

Akinoglu, O. (2008). Primary education curriculum reforms in Turkey. *World Applied Sciences Journal*, *3*(2), 195–199.

Aksamovic, A., Djordjevic, M., Malec, D., & Memisevic, H. (2019). Relationship between the verbal fluency and academic achievement in second and third grade students: The effects of gender and parents' educational level. *Acta Neuropsychologica*, *17*(2). Retrieved from https://www.researchgate.net/publication/334045099

Aksu, G., Güzeller, C. O., & Eser, M. T. (2017). Analysis of maths literacy performances of students with Hierarchical Linear Modeling (HLM): The case of PISA 2012 Turkey. *Egitim ve Bilim*. https://doi.org/10.15390/EB.2017.6956

Alacaci, C., & Erbaş, A. K. (2010). Unpacking the inequality among Turkish schools: Findings from PISA 2006. *International Journal of Educational Development*. https://doi.org/10.1016/j.ijedudev.2009.03.006

Arena, M. J., & Uhl-Bien, M. (2016). Complexity leadership theory: Shifting from human capital to social capital. *People and Strategy*, *39*(2).

Arıcı, Ö., Ozarkan, H. B., Özgürlük, B., & Taş, U. E. (2016). *PISA 2015 Ulusal Raporu*.

Ataç, E. (2017). Modeling educational inequalities: Class, academic achievement, and regional differences in Turkey. *Education and Urban Society*, *51*(5), 659–692. https://doi.org/10.1177/0013124517747036

Auguste, B. G., Hancock, B., & Laboissiere, M. (2009). The economic cost of the US education gap | McKinsey. Retrieved November 18, 2019, Retrieved from https://www.mckinsey.com/industries/social-sector/our-insights/the-economic-cost-of-the-us-education-gap

Aydin, A., Erdağ, C., & Taş, N. (2011). A comparative evaluation of Pisa 2003-2006 results in reading literacy skills: An example of top-five OECD countries and Turkey. *Kuram ve Uygulamada Egitim Bilimleri*, *11*(2), 665–673.

Aydın, A., Selvitopu, A., & Kaya, M. (2018). Resources invested in education and pisa 2015 results: A comparative study. *Elementary Education Online*, *17*(3), 1283–1301. https://doi.org/10.17051/ilkonline.2018.466346

Aydın, M. (2015). *Öğrenci ve okul kaynaklı faktörlerin TIMMS matematik başarısına etkisi*.(Doctoral Dissertation) Necmettin Erbakan University, Konya.

Babadogan, C., & Olkun, S. (2006). Program development models and reform in Turkish primary school mathematics curriculum. *International Journal for Mathematics Teaching and Learning*. Retrieved from http://www.cimt.org.uk/journal/index.htm

Baird, J.-A., Johnson, S., Hopfenbeck, T. N., Isaacs, T., Sprague, T., Stobart, G., & Yu, G. (2016). On the supranational spell of PISA in policy. *Educational Research*, *58*(2), 121–138. https://doi.org/10.1080/00131881.2016.1165410

Baker, D. P., Goesling, B., & Letendre, G. K. (2002). Socioeconomic status, school quality, and national economic development: A cross-national analysis of the "Heyneman-Loxley effect" on mathematics and science achievement. *Comparative Education Review*, Vol. 46. https://doi.org/10.1086/341159

Bankov, K., Mikova, D., & Smith, T. M. (2006, December). Assessing between-school variation in educational resources and mathematics and science achievement in Bulgaria. *Prospects*, Vol. 36, pp. 447–473. https://doi.org/10.1007/s11125-006-9005-7

Başkanlığı, E. A. ve G. D. (2005). *PISA 2003 Projesi Ulusal Nihai Rapor*. Retrieved from www.meb.gov.tr

Boberg, J. E., & Bourgeois, S. J. (2016). The effects of integrated transformational leadership on achievement. *Journal of Educational Administration*, *54*(3), 357–374. https://doi.org/10.1108/JEA-07-2014-0086

Bourdieu, P. (2002). Pierre Bourdieu on marriage strategies. *Population and Development Review*, *28*(3), 549–558. https://doi.org/10.1111/j.1728-4457.2002.00549.x

Burns, M. K., Warmbold-Brann, K., & Zaslofsky, A. F. (2015, September 1). Ecological systems theory in School Psychology Review. *School Psychology Review*, Vol. 44, pp. 249–261. https://doi.org/10.17105/spr-15-0092.1

Carpenter, D. M., Ramirez, A., & Severn, L. (2006). Gap or gaps: Challenging the singular definition of the achievement gap. *Education and Urban Society*, *39*(1), 113–127. https://doi.org/10.1177/0013124506291792

Carvalho, L. M. (2014). The attraction of mutual surveillance performances: PISA as knowledge-policy instrument. In *Governing knowledge: Comparison, knowledge-based technologies and expertise in the regulation of education* (pp.

58–72). Retrieved from http://repositorio.ul.pt/handle/10451/27491

Çelik, Ç. (2011). *The Process of Leaving School and Meaning of Schooling: The Case of Turkish School Leavers in Germany* (Unpublished Dissertation). University of Bremen.

Çelik, Ç. (2017). *Institutional habitus and educational achievement: A comparative case study in Germany and Turkey.* IPC Istanbul Policy Center

Çelik, Ç. (2017). Parental networks, ethnicity, and social and cultural capital: The societal dynamics of educational resilience in Turkey. *British Journal of Sociology of Education*, *38*(7), 1007–1021. https://doi.org/10.1080/01425692.2016.1218753

Çelik, Ç. (2019). Educational Inequalities within the context of the Turkish Community in Germany: Family Background, Institutional Settings and Ethnic Boundaries. In *German-Turkish Relations Revisited: The European Dimension, Domestic and Foreign Politics and Transnational Dynamics* (pp. 225–242). https://doi.org/10.5771/9783748900191-225

Çelik, Ç., & Erdoğan, S. (2017). *How to organize schools for integration of Syrian children in Turkey; Constructing inclusive and intercultural institutional habitus in schools*. Retrieved from http://mirekoc.ku.edu.tr

Çelik, Ç., & İçduygu, A. (2019). Schools and refugee children: The case of Syrians in Turkey. *International Migration*, *57*(2), 253–267. https://doi.org/10.1111/imig.12488

Cer, E. (2018). A comparison of mother-tongue curricula of successful countries in PISA and Turkey by higher-order thinking processes. *Egitim Arastirmalari - Eurasian Journal of Educational Research*, *18*(73), 95–112. https://doi.org/10.14689/ejer.2018.73.6

Cerit, Y. (2010). The effects of servant leadership on teachers' organizational commitment in primary schools in Turkey. *International Journal of Leadership in Education*, *13*(3), 301–317. https://doi.org/10.1080/13603124.2010.496933

Clarke, S., & O'Donoghue, T. (2017). Educational leadership and context: A rendering of an inseparable relationship. *British Journal of Educational Studies*, *65*(2), 167–182. https://doi.org/10.1080/00071005.2016.1199772

Coleman, J. S. (1988a). Social capital in the creation of human capital. *American Journal of Sociology*, *94*, 95–120. https://doi.org/10.1086/228943

Coleman, J. S. (1988b). Social Capital in the Creation of Human Capital. *American*

Journal of Sociology. https://doi.org/10.1086/228943

Eğitim Reformu Girişimi. (2019). Eğitim İzleme Raporu 2019 | Öğrenciler ve Eğitime Erişim. Retrieved December 28, 2019, from https://www.egitimreformugirisimi.org/yayin/egitim-izleme-raporu-2019-ogrenciler-ve-egitime-erisim/

Engel, L. C., & Rutkowski, D. (2018). Pay to play: What does PISA participation cost in the US? *Discourse: Studies in the cultural politics of education*, 1-13. https://doi.org/10.1080/01596306.2018.1503591

Erberber, E. (2009). *Analyzing Turkey's data from TIMSS 2007 to investigate regional disparities in eighth grade science achievement.* (Doctoral Dissertation). Boston College, Boston. Retrieved from https://search.proquest.com/docview/304850034

Ersungur, Ş. M., Kızıltan, A., & Polat, Ö. (2010). Türkiye'de bölgelerin sosyo-ekonomik gelişmişlik sıralaması: Temel bileşenler analizi. *Atatürk Üniversitesi İktisadi ve İdari Bilimler Dergisi*, *21*(2), 55–66. Retrieved from https://dergipark.org.tr/tr/pub/atauniiibd/issue/2692/35419

Ertem, H. Y., & Gökalp, G. (2018). Parents' perceptions of school climate and parent involvement in terms of education levels of parents and grade of their children. *Hacettepe University Journal of Education*, *201*. https://doi.org/10.16986/HUJE.2018040670

Faggian, A., Modrego, F., & McCann, P. (2019). Human capital and regional development. In *Handbook of Regional Growth and Development Theories* (pp. 149–171). Edward Elgar Publishing.

Fikret Pasa, S., Kabasakal, H., & Bodur, M. (2001). Society, organisations, and leadership in Turkey. *Applied Psychology*, *50*(4), 559–589. https://doi.org/10.1111/1464-0597.00073

Fordham, S., & Ogbu, J. U. (1986). Black students' school success: Coping with the "burden of 'acting white.'" *The Urban Review*, *18*(3), 176–206. https://doi.org/10.1007/BF01112192

Foucault, M. (1979). "The birth of bio-Politics"-Michel Foucault's lecture at the Collège de France on Neo-Liberal Governmentality. *Economy and Society*, *30*(2).

Fryer, R. G., & Levitt, S. D. (2004). Understanding the black-white test score gap in the first two years of school. *Review of Economics and Statistics*, *86*(2), 447–464. https://doi.org/10.1162/003465304323031049

Girişimi, E. R. (2018). *Eğitim izleme raporu 2017-18*. Retrieved from http://www.egitimreformugirisimi.org/wp-content/uploads/2017/03/EIR_2017_2018_29.11.18.pdf

Gokturk, D., & Kandemir, A. (2019). A discussion on academic inbreeding and the construction of institutional habitus in higher education. *Mülkiye Dergisi*, *43*(3), 599–624. Retrieved from https://www.researchgate.net/publication/337185299

Grek, S. (2009). Governing by numbers: The PISA "effect" in Europe. *Journal of Education Policy, 24*(1), 23–37. https://doi.org/10.1080/02680930802412669

Gün, F., & Baskan, G. A. (2014). New education system in Turkey (4 +4 +4): A critical outlook. *Procedia - Social and Behavioral Sciences*, *131*, 229–235. https://doi.org/10.1016/j.sbspro.2014.04.109

Gür, B. S., Çelik, Z., & Özoğlu, M. (2012). Policy options for Turkey: a critique of the interpretation and utilization of PISA results in Turkey. *Journal of Education Policy, 27*(1), 1–21. https://doi.org/10.1080/02680939.2011.595509

Gürsakal, S., Murat, D., & Gürsakal, N. (2016). Assessment of PISA 2012 results with quantile regression analysis within the context of inequality in educational opportunity. *Alphanumeric Journal*, *4*(2), 41-54. https://doi.org/10.17093/aj.2016.4.2.5000186603

Hall, R. E., & Jones, C. I. (1999). Why do some countries produce so much more output per worker than others? *The Quarterly Journal of Economics, 114(*1*)*, 83-116.

Hanushek, E. A., & Woessmann, L. (2008). The role of cognitive skills in economic development. *Journal of Economic Literature*, *46*(3*)*, 607-68. https://doi.org/10.1257/jel.46.3.607

Hanushek, E. A., & Zhang, L. (2009). Quality-consistent estimates of international schooling and skill gradients. *Journal of Human Capital*, *3*(2), 107–143. https://doi.org/10.1086/644780

Haugsbakk, G. (2013). From sputnik to PISA shock–New technology and educational reform in Norway and Sweden. *Education Inquiry*, *4*(4). https://doi.org/10.3402/edui.v4i4.23222

Heyneman, S. P., & Loxley, W. A. (1982). Influences on academic achievement across high and low income countries: A re-analysis of IEA data. *Sociology of Education*, *55*(1), 13. https://doi.org/10.2307/2112607

İnce, M., & Gözütok, F. D. (2018). Effect of parental education and home educational resources to students' results of PISA reading skills test. *Elementary Education Online*, *17*(2), 947–958. Retrieved from http://ilkogretim-online.org.tr/index.php/io/article/view/2488

Johnston, M. P. (2014). Secondary data analysis: A method of which the time has come. *Qualitative and Quantitative Methods in Libraries (QQML), 3*, 619–626.

Jolls, C., Sunstein, C. R., & Thaler, R. (1998). A behavioral approach to law and economics. *Stanford Law Review*, 1471–1550. Retrieved from https://www.jstor.org/stable/1229304

Karahasan, B. C., & Uyar, E. (2009). Spatial distribution of education and regional inequalities in turkey. *Munich Personal RePEc Archive.*

Khan, R. M. A., Iqbal, N., & Tasneem, S. (2015). The influence of parents educational level on secondary school students academic achievements in district Rajanpur. *Journal of Education and Practice*, *6*(16), 76–79. Retrieved from www.ssc.wisc.edu/cde/cdew/99-19pdf

Köseleci Blanchy, N., & Şaşmaz, A. (2011). PISA 2009: Where does Turkey stand?. *Turkish Policy Quarterly*, *10*(2), 126–134. Retrieved from www.turkishpolicy.com

Lamont, M. (2018). Addressing recognition gaps: Destigmatization and the reduction of inequality. *American Sociological Review*, *83*(3), 419–444. https://doi.org/10.1177/0003122418773775

Lareau, A. (2002). Invisible inequality: Social class and childrearing in black families and white families. *American sociological review, 67*(5), 747-776.

Lee, C.-D. (2016). Using TIMSS Data to investigate rural- urban differences of Taiwanese eighth graders' mathematics achievement from 2003 to 2011. *Bulletin of Educational Research*, *62*(4), 1–40.

Long, H., & Pang, W. (2016). Family socioeconomic status, parental expectations, and adolescents' academic achievements: a case of China. *Educational Research and Evaluation*, *22*(5–6), 283–304. https://doi.org/10.1080/13803611.2016.1237369

Mariana, M. (2018). (2017, October). The Relationship between Parents Socio-Economic Background and Students' Science Literacy in Indonesia Evidence from Programme for International Students Assessment PISA 2015. In *Social Sciences, Humanities and Economics Conference (SoSHEC 2017)*. https://doi.org/10.2991/soshec-17.2018.46

McDonough, P. M. (1997). *Choosing Colleges: How Social Class and Schools Structure Opportunity*. Retrieved from https://books.google.com.tr/books?hl=tr&lr=&id=AVjdTBQdpJwC&oi=fnd&pg=PP11&dq=Choosing+Colleges:+How+Social+Class+and+Schools+Structure+Opportunity&ots=K1ZlcwLqF8&sig=XHz0EMOLTNc8b_FVvYzWRRh8qEA&redir_esc=y#v=onepage&q=Choosing Colleges%3A How Social Clas

Miguel Carvalho, L., & Costa, E. (2015). Seeing education with one's own eyes and through PISA lenses: Considerations of the reception of PISA in European countries. *Discourse: Studies in the Cultural Politics of Education*, *36*(5), 638-646. https://doi.org/10.1080/01596306.2013.871449

Muller, C. (2018). Parent involvement and academic achievement. In *Parents, Their Children, and Schools* (pp. 77–114). https://doi.org/10.4324/9780429498497-4

Nascimento, P. (2008). School resources and student achievment: Worldwide findings and methodological issues. *Educate*, *1*(1), 19–30. Retrieved from https://www.researchgate.net/publication/26598124_School_resources_and_student_achievment_worldwide_findings_and_methodological_issues

Geiger, T. (1955). A dynamic analysis of social mobility. *Acta Sociologica*, *1*(1), 26-38. Retrieved from Acta Sociologica website: https://www.jstor.org/stable/4193438?seq=1

OECD. (n.d.). FAQ - PISA, Cost of participation. Retrieved December 27, 2019, from https://www.oecd.org/pisa/pisafaq/

OECD. (2000). *Measuring student knowledge and skills*. https://doi.org/10.1787/9789264181564-en

OECD. (2004). How student performance varies between schools and the role that socio-economic background plays in this. Retrieved November 13, 2019, from OECD website: http://www.oecd.org/education/school/programmeforinternationalstudentassessmentpisa/33918016.pdf

OECD. (2006). *Education at a glance: OECD Indicators 2006*. Paris.

OECD. (2009). *PISA data analysis manual: SPSS, second edition*. https://doi.org/10.1787/9789264056275-en

OECD. (2017a). PISA 2015 technical report. In *OECD Publishing*. https://doi.org/10.1021/op8002129

OECD. (2017b). *Scaling procedures and construct validation of context questionnaire data*. https://doi.org/10.1787/9789264167872-17-en

Ornstein, A. C. (2010). Achievement gaps in education. *Society*, *47*(5), 424–429. https://doi.org/10.1007/s12115-010-9354-y

Özberk, E. H., Atalay Kabasakal, K., & Boztunç Öztürk, N. (2017). PISA 2012 matematik başarısını etkileyen faktörlerin hiyerarşik lineer model kullanılarak incelenmesi. *Hacettepe Egitim Dergisi*, *32*(3), 544–559. https://doi.org/10.16986/HUJE.2017026950

Özdemir, C. (2015). *Relationship between equity and excellence in education: Multilevel analysis of international student assessment data with a focus on Turkey*. (Doctoral dissertation), Middle East Technical University, Ankara.

Özdemir, C. (2016). Equity in the Turkish education system: A multilevel analysis of social background influences on the mathematics performance of 15-year-old students. *European Educational Research Journal*, *15*(2), 193–217. https://doi.org/10.1177/1474904115627159

PISA. (2016). PISA 2015 results in focus. In *OECD*. https://doi.org/10.1787/9789264266490-en

Pons, X. (2012). Going beyond the "PISA Shock" discourse: An analysis of the cognitive reception of PISA in six European countries, 2001-2008. *European Educational Research Journal*, *11*(2), 206–226. https://doi.org/10.2304/eerj.2012.11.2.206

Prais, S. J. (2003). Cautions on OECD'S recent educational survey (PISA). *Oxford Review of Education*, *29*(2), 139-163. https://doi.org/10.1080/0305498032000080657

Quiggin, J. (1999). Human capital theory and education policy in Australia. *Australian Economic Review*, *32*(2), 130–144. https://doi.org/10.1111/1467-8462.00100

Raudenbush, S.W., Bryk, A.S., 2002. 2nd ed. Hierarchical Linear Models: Applications and Data Analysis Methods Vol. 1 Sage, Thousand Oaks, CA.

Rautalin, M., Alasuutari, P., & Vento, E. (2019). Globalisation of education policies: Does PISA have an effect? *Journal of Education Policy*, *34*(4), 500–522. https://doi.org/10.1080/02680939.2018.1462890

Reay, D., & Lucey, H. (2000). Children, school choice and social differences. *Educational Studies*, *26*(1), 83–100. https://doi.org/10.1080/03055690097754

Rivkin, S. G., Hanushek, E. A., & Kain, J. F. (2005). Teachers, schools, and academic achievement. *Econometrica*, *73*(2), 417–458. https://doi.org/10.1111/j.1468-0262.2005.00584.x

Ross, J. A., & Gray, P. (2006). School leadership and student achievement: The mediating effects of teacher beliefs. *Canadian Journal of Education*, *29*(3), 798–822.

Ross, K. N., & Zuze, L. (2004). Traditional and alternative views of school system performance. *Educational Quality*, 8–9. Retrieved from www.bevart.co.uk

Schleicher, A. (2019). *PISA 2018: Insights and intepretations*. Retrieved from https://www.oecd.org/pisa/PISA 2018 Insights and Interpretations FINAL PDF.pdf

Schneeweis, N., & Zweimüller, M. (2014). Early tracking and the misfortune of being young. *Economics*, *116*(2), 394–428. https://doi.org/10.1111/sjoe.12046

Serdar, A. (2016). Socio-economic profile of vocational school students in Turkey: A case study on Trakya University Ipsala Vocational School students. *Journal of Suleyman Demirel University Institute of Social Sciences*, 952–961. Retrieved from https://www.researchgate.net/publication/322256236

Simon, H. A. (1956). Rational choice and the structure of the environment. *Psychological Review*, *63*(2), 129–138. https://doi.org/10.1037/h0042769

Şimşek, D. (2018). Integration processes of Syrian refugees in Turkey: 'Class-based integration.' *Journal of Refugee Studies*. https://doi.org/10.1093/jrs/fey057

Spaull, N. (2019). Who makes it into PISA? *Understanding the impact of PISA sample eligibility using Turkey as a case study (PISA 2003–PISA 2012)*. *Assessment in Education: Principles, Policy & Practice*, *26*(4), 397–421. https://doi.org/10.1080/0969594X.2018.1504742

Spence, M. (1973). Job market signaling. *The Quarterly Journal of Economics*, *87*(3), 355. https://doi.org/10.2307/1882010

Stapleton, L. M., McNeish, D. M., & Yang, J. S. (2016). Multilevel and single-level models for measured and latent variables when data are clustered. *Educational Psychologist*, *51*(3–4), 317–330. https://doi.org/10.1080/00461520.2016.1207178

Stull, J. C. (2013). Family socioeconomic status, parent expectations, and a child's achievement. *Research in Education*, *90*(1), 53-67.

https://doi.org/10.7227/RIE.90.1.4

Tan, E. (2014). Human capital theory: A holistic criticism. *Review of Educational Reserach*, *84*(3), 411–445. https://doi.org/10.3102/0034654314532696

Thomas, G. (n.d.). Statistical Control. https://doi.org/10.4135/9781412972024.n2421

Thomson, S. (2018). Achievement at school and socioeconomic background—an educational perspective. *Npj Science of Learning*, *3*(1). https://doi.org/10.1038/s41539-018-0022-0

Tomul, E., & Çelik, K. (2009). The relationship between the students' academics achievement and their socioeconomic level: cross regional comparison. *Procedia - Social and Behavioral Sciences*, *1*(1), 1199–1204. https://doi.org/10.1016/j.sbspro.2009.01.216

Unger, R. M. (2019). *The Knowledge Economy*. Retrieved from https://books.google.com.tr/books?hl=tr&lr=&id=qchqDwAAQBAJ&oi=fnd&pg=PA1&dq=The+Knowledge+Economy+unger&ots=sDPMzQ_gB5&sig=dTkAr6GkhV0_K9YBhIVMOfi20ko&redir_esc=y#v=onepage&q=The%20Knowledge%20Economy%20unger&f=false

Van De Werfhorst, H. G. (2018). Early tracking and socioeconomic inequality in academic achievement: Studying reforms in nine countries. *Research in Social Stratification and Mobility*, *58*, 22–32. https://doi.org/10.1016/j.rssm.2018.09.002

Waldow, F. (2009). What PISA did and did not do: Germany after the "PISA-shock." *European Educational Research Journal*, *8*. https://doi.org/10.2304/eerj.2009.8.3.476

Woltman, H., Feldstain, A., Mackay, J. C., & Rocchi, M. (2012). An introduction to hierarchical linear modelling. *Tutorials in Quantitative Methods for Psychology*, *8*(1), 52–69. https://doi.org/10.1002/(SICI)1097-0258(19990415)18:7<855::AID-SIM117>3.0.CO;2-7

Wu, M. (2005). The role of plausible values in large-scale surveys. *Studies in Educational Evaluation*, *31*(2–3), 114–128. https://doi.org/10.1016/j.stueduc.2005.05.005

Yetişir, M. İ. (2014). The multilevel effects of student and classroom factors on the science achievement of eighth graders in turkey. *Egitim ve Bilim*, *39*(172), 108–120.

Yetişir, M. İ., Güneş, G., & Batı, K. (2019). A comparative analysis of the effect of

students affective characteristics on their science performance between countries based on PISA 2015 data. *Hacettepe University Journal of Education*, 1–16. https://doi.org/10.16986/huje.2019050025

APPENDICES

A. HLM7 OUTPUT FOR THE UNCONDITIONAL MODEL

Problem Title: unconditional

The data source for this run = last.mdm
The command file for this run =
C:\Users\Sevil\AppData\Local\Temp\whlmtemp.hlm
Output file name = C:\Users\Sevil\Desktop\unconditional_avg.html
The maximum number of level-1 units = 5857
The maximum number of level-2 units = 186
The maximum number of iterations = 100

Method of estimation: full maximum likelihood
This is part of a plausible value analysis using the following variables:
PV1MATH
PV2MATH
PV3MATH
PV4MATH
PV5MATH
PV6MATH
PV7MATH
PV8MATH
PV9MATH
PV10MATH

Weighting Specification

	Weighting?	Weight Variable	Normalized?
Level 1	yes	W_FSTUWT	yes
Level 2	no		
Precision	no		

Summary of the model specified

Level-1 Model

$PV1MATH_{ij} = \beta_{0j} + r_{ij}$

Level-2 Model

$\beta_{0j} = \gamma_{00} + u_{0j}$

Mixed Model

$PV1MATH_{ij} = \gamma_{00} + u_{0j} + r_{ij}$

The Averaged Results for this Plausible Value Run

$\sigma^2 = 3342.46847$

Standard Error of $\sigma^2 = 119.91317$

τ

INTRCPT1,β_0	3425.13006

Standard error of τ

INTRCPT1,β_0	395.68054

Random level-1 coefficient	Reliability estimate
INTRCPT1,β_0	0.940

Final estimation of fixed effects:

Fixed Effect	Coefficient	Standard error	*t*-ratio	Approx. *d.f.*	*p*-value
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	407.756896	4.538150	89.851	185	<0.001

Final estimation of fixed effects

(with robust standard errors)

Fixed Effect	Coefficient	Standard error	*t*-ratio	Approx. *d.f.*	*p*-value
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	407.756896	5.300451	76.929	185	<0.001

Final estimation of variance components

Random Effect	Standard Deviation	Variance Component	*d.f.*	χ^2	*p*-value
INTRCPT1, u_0	58.52461	3425.13006	185	6401.33914	<0.001
level-1, *r*	57.81409	3342.46847			

B. HLM7 OUTPUT FOR THE BASE MODEL

Problem Title: base

The data source for this run = last.mdm
The command file for this run =
C:\Users\Sevil\AppData\Local\Temp\whlmtemp.hlm
Output file name = C:\Users\Sevil\Desktop\base_avg.html
The maximum number of level-1 units = 5857
The maximum number of level-2 units = 186
The maximum number of iterations = 100

Method of estimation: full maximum likelihood
This is part of a plausible value analysis using the following variables:
PV1MATH
PV2MATH
PV3MATH
PV4MATH
PV5MATH
PV6MATH
PV7MATH
PV8MATH
PV9MATH
PV10MATH

Weighting Specification

	Weighting?	Weight Variable	Normalized?
Level 1	yes	W_FSTUWT	yes
Level 2	no		
Precision	no		

Summary of the model specified

Level-1 Model

$$PV1MATH_{ij} = \beta_{0j} + r_{ij}$$

Level-2 Model

$$\beta_{0j} = \gamma_{00} + \gamma_{01}*(STR1_j) + \gamma_{02}*(STR2_j) + \gamma_{03}*(STR4_j) + \gamma_{04}*(STR5_j) + \gamma_{05}*(STR6_j) + \gamma_{06}*(STR7_j) + \gamma_{07}*(STR8_j) + \gamma_{08}*(STR9_j) + \gamma_{09}*(STR10_j) + \gamma_{010}*(STR11_j) + \gamma_{011}*(STR12_j) + u_{0j}$$

Mixed Model

$$PV1MATH_{ij} = \gamma_{00} + \gamma_{01}*STR1_j + \gamma_{02}*STR2_j + \gamma_{03}*STR4_j + \gamma_{04}*STR5_j + \gamma_{05}*STR6_j + \gamma_{06}*STR7_j + \gamma_{07}*STR8_j + \gamma_{08}*STR9_j + \gamma_{09}*STR10_j + \gamma_{010}*STR11_j + \gamma_{011}*STR12_j + u_{0j} + r_{ij}$$

The Averaged Results for this Plausible Value Run

σ^2 = 3342.34367

Standard Error of σ^2 = 119.95288

τ

INTRCPT1,β_0	2874.92141

Standard error of τ

INTRCPT1,β_0	345.05559

Random level-1 coefficient	Reliability estimate
INTRCPT1,β_0	0.931

Final estimation of fixed effects:

Fixed Effect	Coefficient	Standard error	*t*-ratio	Approx. *d.f.*	*p*-value
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	431.485456	13.081757	32.984	174	<0.001
STR1, γ_{01}	-12.764312	16.873774	-0.756	174	0.450
STR2, γ_{02}	-8.496983	26.080680	-0.326	174	0.745
STR4, γ_{03}	-1.389064	19.955961	-0.070	174	0.945
STR5, γ_{04}	-5.714301	19.165272	-0.298	174	0.766
STR6, γ_{05}	-14.933030	16.633943	-0.898	174	0.371
STR7, γ_{06}	-16.239388	22.758181	-0.714	174	0.476
STR8, γ_{07}	-26.168131	21.445630	-1.220	174	0.224
STR9, γ_{08}	-36.451849	27.594250	-1.321	174	0.188
STR10, γ_{09}	-39.117586	25.084985	-1.559	174	0.121
STR11, γ_{010}	-82.377604	23.839173	-3.456	174	<0.001
STR12, γ_{011}	-60.279424	17.019579	-3.542	174	<0.001

Final estimation of fixed effects

(with robust standard errors)

Fixed Effect	Coefficient	Standard error	*t*-ratio	Approx. *d.f.*	*p*-value
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	431.485456	17.251075	25.012	174	<0.001
STR1, γ_{01}	-12.764312	20.885856	-0.611	174	0.542
STR2, γ_{02}	-8.496983	26.342360	-0.323	174	0.747
STR4, γ_{03}	-1.389064	24.358952	-0.057	174	0.955
STR5, γ_{04}	-5.714301	21.234747	-0.269	174	0.788
STR6, γ_{05}	-14.933030	21.910357	-0.682	174	0.496
STR7, γ_{06}	-16.239388	26.560078	-0.611	174	0.542
STR8, γ_{07}	-26.168131	23.904051	-1.095	174	0.275
STR9, γ_{08}	-36.451849	19.686875	-1.852	174	0.066
STR10, γ_{09}	-39.117586	32.256211	-1.213	174	0.227
STR11, γ_{010}	-82.377604	27.127128	-3.037	174	0.003
STR12, γ_{011}	-60.279424	21.196579	-2.844	174	0.005

Final estimation of variance components

Random Effect	Standard Deviation	Variance Component	*d.f.*	χ^2	*p*-value
INTRCPT1, u_0	53.61829	2874.92141	174	5622.80390	<0.001
level-1, r	57.81301	3342.34367			

C. HLM7 OUTPUT FOR THE SCHOOL MODEL

Problem Title: school

The data source for this run = last.mdm
The command file for this run =
C:\Users\Sevil\AppData\Local\Temp\whlmtemp.hlm
Output file name = C:\Users\Sevil\Desktop\school_avg.html
The maximum number of level-1 units = 5857
The maximum number of level-2 units = 186
The maximum number of iterations = 100

Method of estimation: full maximum likelihood
This is part of a plausible value analysis using the following variables:
PV1MATH
PV2MATH
PV3MATH
PV4MATH
PV5MATH
PV6MATH
PV7MATH
PV8MATH
PV9MATH
PV10MATH

Weighting Specification

	Weighting?	Weight Variable	Normalized?
Level 1	yes	W_FSTUWT	yes
Level 2	no		
Precision	no		

Summary of the model specified

Level-1 Model

$PV1MATH_{ij} = \beta_{0j} + r_{ij}$

Level-2 Model

$\beta_{0j} = \gamma_{00} + \gamma_{01}*(LEAD_j) + \gamma_{02}*(EDUSHORT_j) + \gamma_{03}*(STAFFSHO_j) + \gamma_{04}*(STUBEHA_j) + \gamma_{05}*(TEACHBEH_j) + \gamma_{06}*(STR1_j) + \gamma_{07}*(STR2_j) + \gamma_{08}*(STR4_j) + \gamma_{09}*(STR5_j) + \gamma_{010}*(STR6_j) + \gamma_{011}*(STR7_j) + \gamma_{012}*(STR8_j) + \gamma_{013}*(STR9_j) + \gamma_{014}*(STR10_j) + \gamma_{015}*(STR11_j) + \gamma_{016}*(STR12_j) + u_{0j}$

LEAD EDUSHORT STAFFSHO STUBEHA TEACHBEH have been centered around the grand mean.

Mixed Model

$PV1MATH_{ij} = \gamma_{00} + \gamma_{01}*LEAD_j + \gamma_{02}*EDUSHORT_j + \gamma_{03}*STAFFSHO_j + \gamma_{04}*STUBEHA_j + \gamma_{05}*TEACHBEH_j + \gamma_{06}*STR1_j + \gamma_{07}*STR2_j + \gamma_{08}*STR4_j + \gamma_{09}*STR5_j + \gamma_{010}*STR6_j + \gamma_{011}*STR7_j + \gamma_{012}*STR8_j + \gamma_{013}*STR9_j + \gamma_{014}*STR10_j + \gamma_{015}*STR11_j + \gamma_{016}*STR12_j + u_{0j} + r_{ij}$

The Averaged Results for this Plausible Value Run

σ^2 = 3344.70323

Standard Error of σ^2 = 120.24211

τ

INTRCPT1,β_0	2238.59879

Standard error of τ

INTRCPT1,β_0	277.63238

Random level-1 coefficient	Reliability estimate
INTRCPT1,β_0	0.917

Final estimation of fixed effects:

Fixed Effect	Coefficient	Standard error	*t*-ratio	Approx. *d.f.*	*p*-value
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	427.363709	11.901641	35.908	169	<0.001
LEAD, γ_{01}	-2.252619	4.117724	-0.547	169	0.585
EDUSHORT, γ_{02}	-3.444635	3.735927	-0.922	169	0.358
STAFFSHO, γ_{03}	-9.369632	4.350275	-2.154	169	0.033
STUBEHA, γ_{04}	-20.550584	4.787217	-4.293	169	<0.001
TEACHBEH, γ_{05}	8.531811	5.301995	1.609	169	0.109
STR1, γ_{06}	-12.033120	15.565171	-0.773	169	0.441
STR2, γ_{07}	4.105757	23.692721	0.173	169	0.863
STR4, γ_{08}	2.030078	18.088332	0.112	169	0.911
STR5, γ_{09}	-7.068178	17.221519	-0.410	169	0.682
STR6, γ_{010}	-12.484638	15.560475	-0.802	169	0.423
STR7, γ_{011}	-9.711392	20.600579	-0.471	169	0.638
STR8, γ_{012}	-19.549079	19.326591	-1.012	169	0.313
STR9, γ_{013}	-19.644469	25.208589	-0.779	169	0.437
STR10, γ_{014}	-33.350176	23.246868	-1.435	169	0.153
STR11, γ_{015}	-80.143184	21.663673	-3.699	169	<0.001
STR12, γ_{016}	-50.197726	15.618974	-3.214	169	0.002

Final estimation of fixed effects

(with robust standard errors)

Fixed Effect	Coefficient	Standard error	*t*-ratio	Approx. *d.f.*	*p*-value
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	427.363709	15.605506	27.385	169	<0.001
LEAD, γ_{01}	-2.252619	4.525850	-0.498	169	0.619
EDUSHORT, γ_{02}	-3.444635	3.912166	-0.880	169	0.380
STAFFSHO, γ_{03}	-9.369632	4.296590	-2.181	169	0.031
STUBEHA, γ_{04}	-20.550584	4.799768	-4.282	169	<0.001
TEACHBEH, γ_{05}	8.531811	5.532193	1.542	169	0.125
STR1, γ_{06}	-12.033120	19.291304	-0.624	169	0.534
STR2, γ_{07}	4.105757	24.733651	0.166	169	0.868
STR4, γ_{08}	2.030078	20.145220	0.101	169	0.920
STR5, γ_{09}	-7.068178	18.828765	-0.375	169	0.708
STR6, γ_{010}	-12.484638	19.070445	-0.655	169	0.514
STR7, γ_{011}	-9.711392	24.622548	-0.394	169	0.694
STR8, γ_{012}	-19.549079	20.659671	-0.946	169	0.345
STR9, γ_{013}	-19.644469	20.974325	-0.937	169	0.350
STR10, γ_{014}	-33.350176	30.584989	-1.090	169	0.277
STR11, γ_{015}	-80.143184	28.400600	-2.822	169	0.005
STR12, γ_{016}	-50.197726	19.129082	-2.624	169	0.009

Final estimation of variance components

Random Effect	Standard Deviation	Variance Component	*d.f.*	χ^2	*p*-value
INTRCPT1, u_0	47.31383	2238.59879	169	4325.12783	<0.001
level-1, r	57.83341	3344.70323			

D. HLM7 OUTPUT FOR THE FAMILY MODEL

Problem Title: family

The data source for this run = last.mdm
The command file for this run =
C:\Users\Sevil\AppData\Local\Temp\whlmtemp.hlm
Output file name = C:\Users\Sevil\Desktop\family_avg.html
The maximum number of level-1 units = 5857
The maximum number of level-2 units = 186
The maximum number of iterations = 100

Method of estimation: full maximum likelihood
This is part of a plausible value analysis using the following variables:
PV1MATH
PV2MATH
PV3MATH
PV4MATH
PV5MATH
PV6MATH
PV7MATH
PV8MATH
PV9MATH
PV10MATH

Weighting Specification

	Weighting?	Weight Variable	Normalized?
Level 1	yes	W_FSTUWT	yes
Level 2	no		
Precision	no		

Summary of the model specified

Level-1 Model

$$PV1MATH_{ij} = \beta_{0j} + \beta_{1j}*(MISCED_{ij}) + \beta_{2j}*(FISCED_{ij}) + \beta_{3j}*(BMMJ1_{ij}) + \beta_{4j}*(BFMJ2_{ij}) + \beta_{5j}*(EMOSUPS_{ij}) + \beta_{6j}*(CULTPOSS_{ij}) + \beta_{7j}*(HEDRES_{ij}) + \beta_{8j}*(ESCS_{ij}) + \beta_{9j}*(SECONDGN_{ij}) + \beta_{10j}*(FIRSTGNR_{ij}) + \beta_{11j}*(OTHERLAN_{ij}) + r_{ij}$$

Level-2 Model

$$\beta_{0j} = \gamma_{00} + \gamma_{01}*(STR1_j) + \gamma_{02}*(STR2_j) + \gamma_{03}*(STR4_j) + \gamma_{04}*(STR5_j) + \gamma_{05}*(STR6_j) + \gamma_{06}*(STR7_j) + \gamma_{07}*(STR8_j) + \gamma_{08}*(STR9_j) + \gamma_{09}*(STR10_j) + \gamma_{010}*(STR11_j) + \gamma_{011}*(STR12_j) + u_{0j}$$

$$\beta_{1j} = \gamma_{10}$$

$$\beta_{2j} = \gamma_{20}$$

$$\beta_{3j} = \gamma_{30}$$

$$\beta_{4j} = \gamma_{40}$$

$$\beta_{5j} = \gamma_{50}$$

$$\beta_{6j} = \gamma_{60}$$

$$\beta_{7j} = \gamma_{70}$$

$$\beta_{8j} = \gamma_{80}$$

$$\beta_{9j} = \gamma_{90}$$

$$\beta_{10j} = \gamma_{100}$$

$$\beta_{11j} = \gamma_{110}$$

BMMJ1 BFMJ2 EMOSUPS CULTPOSS HEDRES ESCS have been centered around the grand mean.

Mixed Model

$$PV1MATH_{ij} = \gamma_{00} + \gamma_{01}*STR1_j + \gamma_{02}*STR2_j + \gamma_{03}*STR4_j + \gamma_{04}*STR5_j + \gamma_{05}*STR6_j + \gamma_{06}*STR7_j + \gamma_{07}*STR8_j + \gamma_{08}*STR9_j + \gamma_{09}*STR10_j + \gamma_{010}*STR11_j + \gamma_{011}*STR12_j + \gamma_{10}*MISCED_{ij} + \gamma_{20}*FISCED_{ij} + \gamma_{30}*BMMJ1_{ij} + \gamma_{40}*BFMJ2_{ij} + \gamma_{50}*EMOSUPS_{ij} + \gamma_{60}*CULTPOSS_{ij} + \gamma_{70}*HEDRES_{ij} + \gamma_{80}*ESCS_{ij} + \gamma_{90}*SECONDGN_{ij} + \gamma_{100}*FIRSTGNR_{ij} + \gamma_{110}*OTHERLAN_{ij} + u_{0j} + r_{ij}$$

The Averaged Results for this Plausible Value Run

σ^2 = 3112.77093

Standard Error of σ^2 = 230.46870

τ
INTRCPT1,β_0 2589.73038

Standard error of τ
INTRCPT1,β_0 421.16660

Random level-1 coefficient	Reliability estimate
INTRCPT1,β_0	0.785

Final estimation of fixed effects:

Fixed Effect	Coefficient	Standard error	*t*-ratio	Approx. *d.f.*	*p*-value
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	451.601867	14.213480	31.773	133	<0.001
STR1, γ_{01}	-13.563034	16.946574	-0.800	133	0.425
STR2, γ_{02}	-6.028992	27.299581	-0.221	133	0.826
STR4, γ_{03}	-3.999128	20.548255	-0.195	133	0.846
STR5, γ_{04}	-3.005213	20.145338	-0.149	133	0.882
STR6, γ_{05}	-10.798197	18.135798	-0.595	133	0.553
STR7, γ_{06}	4.139482	25.764015	0.161	133	0.873
STR8, γ_{07}	-16.165261	24.598863	-0.657	133	0.512
STR9, γ_{08}	-55.630814	28.326319	-1.964	133	0.052
STR10, γ_{09}	-29.162595	41.194179	-0.708	117	0.480
STR11, γ_{010}	-53.938305	57.173824	-0.943	133	0.347
STR12, γ_{011}	-10.272627	26.929228	-0.381	133	0.703
For MISCED slope, β_1					
INTRCPT2, γ_{10}	-2.693457	1.921467	-1.402	65	0.166
For FISCED slope, β_2					
INTRCPT2, γ_{20}	-0.572621	1.806860	-0.317	191	0.752
For BMMJ1 slope, β_3					
INTRCPT2, γ_{30}	0.292395	0.133387	2.192	548	0.029
For BFMJ2 slope, β_4					
INTRCPT2, γ_{40}	0.178705	0.159544	1.120	100	0.265
For EMOSUPS slope, β_5					
INTRCPT2, γ_{50}	-0.673300	2.605333	-0.258	42	0.797

For CULTPOSS slope, β_6					
INTRCPT2, γ_{60}	1.614606	2.847172	0.567	114	0.572
For HEDRES slope, β_7					
INTRCPT2, γ_{70}	-2.024582	2.876753	-0.704	61	0.484
For ESCS slope, β_8					
INTRCPT2, γ_{80}	8.850935	5.358374	1.652	325	0.100
For SECONDGN slope, β_9					
INTRCPT2, γ_{90}	-15.451379	19.768298	-0.782	34	0.440
For FIRSTGNR slope, β_{10}					
INTRCPT2, γ_{100}	2.197489	35.664009	0.062	574	0.951
For OTHERLAN slope, β_{11}					
INTRCPT2, γ_{110}	-6.686697	18.834186	-0.355	76	0.724

Final estimation of fixed effects (with robust standard errors)

Fixed Effect	Coefficient	Standard error	*t*-ratio	Approx. *d.f.*	*p*-value
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	451.601867	16.577368	27.242	133	<0.001
STR1, γ_{01}	-13.563034	19.477810	-0.696	133	0.487
STR2, γ_{02}	-6.028992	26.315517	-0.229	133	0.819
STR4, γ_{03}	-3.999128	21.841904	-0.183	133	0.855
STR5, γ_{04}	-3.005213	20.928415	-0.144	133	0.886
STR6, γ_{05}	-10.798197	21.366770	-0.505	133	0.614
STR7, γ_{06}	4.139482	30.273726	0.137	133	0.891
STR8, γ_{07}	-16.165261	22.250060	-0.727	133	0.469
STR9, γ_{08}	-55.630814	19.983726	-2.784	133	0.006
STR10, γ_{09}	-29.162595	56.831044	-0.513	133	0.609
STR11, γ_{010}	-53.938305	35.654786	-1.513	30	0.141
STR12, γ_{011}	-10.272627	34.177062	-0.301	133	0.764
For MISCED slope, β_1					
INTRCPT2, γ_{10}	-2.693457	2.034181	-1.324	82	0.189
For FISCED slope, β_2					
INTRCPT2, γ_{20}	-0.572621	1.853274	-0.309	212	0.758
For BMMJ1 slope, β_3					
INTRCPT2, γ_{30}	0.292395	0.154146	1.897	874	0.058
For BFMJ2 slope, β_4					
INTRCPT2, γ_{40}	0.178705	0.162056	1.103	106	0.273
For EMOSUPS slope, β_5					
INTRCPT2, γ_{50}	-0.673300	2.635662	-0.255	44	0.800
For CULTPOSS slope, β_6					
INTRCPT2, γ_{60}	1.614606	3.058242	0.528	152	0.598
For HEDRES slope, β_7					

INTRCPT2, γ_{70}	-2.024582	2.983351	-0.679	71	0.500
For ESCS slope, β_8					
INTRCPT2, γ_{80}	8.850935	5.594855	1.582	386	0.114
For SECONDGN slope, β_9					
INTRCPT2, γ_{90}	-15.451379	19.367331	-0.798	32	0.431
For FIRSTGNR slope, β_{10}					
INTRCPT2, γ_{100}	2.197489	32.445645	0.068	393	0.946
For OTHERLAN slope, β_{11}					
INTRCPT2, γ_{110}	-6.686697	17.913091	-0.373	62	0.710

Final estimation of variance components

Random Effect	Standard Deviation	Variance Component	*d.f.*	χ^2	*p*-value
INTRCPT1, u_0	50.88939	2589.73038	133	1069.20262	<0.001
level-1, *r*	55.79221	3112.77093			

E. HLM7 OUTPUT FOR THE FULL MODEL

Problem Title: full

The data source for this run = last.mdm
The command file for this run =
C:\Users\Sevil\AppData\Local\Temp\whlmtemp.hlm
Output file name = C:\Users\Sevil\Desktop\full_avg.html
The maximum number of level-1 units = 5857
The maximum number of level-2 units = 186
The maximum number of iterations = 100

Method of estimation: full maximum likelihood
This is part of a plausible value analysis using the following variables:
PV1MATH
PV2MATH
PV3MATH
PV4MATH
PV5MATH
PV6MATH
PV7MATH
PV8MATH
PV9MATH
PV10MATH

Weighting Specification

	Weighting?	Weight Variable	Normalized?
Level 1	yes	W_FSTUWT	yes
Level 2	no		
Precision	no		

Summary of the model specified

Level-1 Model

$$PV1MATH_{ij} = \beta_{0j} + \beta_{1j}*(MISCED_{ij}) + \beta_{2j}*(FISCED_{ij}) + \beta_{3j}*(BMMJ1_{ij}) + \beta_{4j}*(BFMJ2_{ij}) + \beta_{5j}*(EMOSUPS_{ij}) + \beta_{6j}*(CULTPOSS_{ij}) + \beta_{7j}*(HEDRES_{ij}) + \beta_{8j}*(ESCS_{ij}) + \beta_{9j}*(SECONDGN_{ij}) + \beta_{10j}*(FIRSTGNR_{ij}) + \beta_{11j}*(OTHERLAN_{ij}) + r_{ij}$$

Level-2 Model

$$\beta_{0j} = \gamma_{00} + \gamma_{01}*(LEAD_j) + \gamma_{02}*(EDUSHORT_j) + \gamma_{03}*(STAFFSHO_j) + \gamma_{04}*(STUBEHA_j) + \gamma_{05}*(TEACHBEH_j) + \gamma_{06}*(STR1_j) + \gamma_{07}*(STR2_j) + \gamma_{08}*(STR4_j) + \gamma_{09}*(STR5_j) + \gamma_{010}*(STR6_j) + \gamma_{011}*(STR7_j) + \gamma_{012}*(STR8_j) + \gamma_{013}*(STR9_j) + \gamma_{014}*(STR10_j) + \gamma_{015}*(STR11_j) + \gamma_{016}*(STR12_j) + u_{0j}$$

$$\beta_{1j} = \gamma_{10}$$

$$\beta_{2j} = \gamma_{20}$$

$$\beta_{3j} = \gamma_{30}$$

$$\beta_{4j} = \gamma_{40}$$

$$\beta_{5j} = \gamma_{50}$$

$$\beta_{6j} = \gamma_{60}$$

$$\beta_{7j} = \gamma_{70}$$

$$\beta_{8j} = \gamma_{80}$$

$$\beta_{9j} = \gamma_{90}$$

$$\beta_{10j} = \gamma_{100}$$

$$\beta_{11j} = \gamma_{110}$$

BMMJ1 BFMJ2 EMOSUPS CULTPOSS HEDRES ESCS have been centered around the grand mean.

LEAD EDUSHORT STAFFSHO STUBEHA TEACHBEH have been centered around the grand mean.

Mixed Model

$$PV1MATH_{ij} = \gamma_{00} + \gamma_{01}*LEAD_j + \gamma_{02}*EDUSHORT_j + \gamma_{03}*STAFFSHO_j + \gamma_{04}*STUBEHA_j + \gamma_{05}*TEACHBEH_j + \gamma_{06}*STR1_j + \gamma_{07}*STR2_j + \gamma_{08}*STR4_j + \gamma_{09}*STR5_j + \gamma_{010}*STR6_j + \gamma_{011}*STR7_j + \gamma_{012}*STR8_j + \gamma_{013}*STR9_j + \gamma_{014}*STR10_j + \gamma_{015}*STR11_j + \gamma_{016}*STR12_j + \gamma_{10}*MISCED_{ij} + \gamma_{20}*FISCED_{ij} + \gamma_{30}*BMMJ1_{ij} + \gamma_{40}*BFMJ2_{ij} + \gamma_{50}*EMOSUPS_{ij} + \gamma_{60}*CULTPOSS_{ij} + \gamma_{70}*HEDRES_{ij}$$

$+ \gamma_{80} * ESCS_{ij}$
$+ \gamma_{90} * SECONDGN_{ij}$
$+ \gamma_{100} * FIRSTGNR_{ij}$
$+ \gamma_{110} * OTHERLAN_{ij}$
$+ u_{0j} + r_{ij}$

The Averaged Results for this Plausible Value Run

$\sigma^2 = 3116.51136$

Standard Error of $\sigma^2 = 229.00072$

τ

INTRCPT1,β_0	1842.57498

Standard error of τ

INTRCPT1,β_0	336.33678

Random level-1 coefficient	Reliability estimate
INTRCPT1,β_0	0.731

Final estimation of fixed effects:

Fixed Effect	Coefficient	Standard error	*t*-ratio	Approx. *d.f.*	*p*-value
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	446.468644	12.999801	34.344	128	<0.001
LEAD, γ_{01}	-2.227983	4.845192	-0.460	128	0.646
EDUSHORT, γ_{02}	-4.405518	4.916863	-0.896	128	0.372
STAFFSHO, γ_{03}	-9.389629	5.016381	-1.872	128	0.064
STUBEHA, γ_{04}	-25.679896	5.909032	-4.346	128	<0.001
TEACHBEH, γ_{05}	7.646471	6.231123	1.227	128	0.222
STR1, γ_{06}	-13.164271	15.679138	-0.840	128	0.403
STR2, γ_{07}	9.434448	24.537544	0.384	128	0.701
STR4, γ_{08}	-1.412845	18.575485	-0.076	128	0.939
STR5, γ_{09}	-5.374399	17.886884	-0.300	128	0.764
STR6, γ_{010}	-23.927773	16.839796	-1.421	128	0.158
STR7, γ_{011}	11.926884	23.245501	0.513	128	0.609
STR8, γ_{012}	-14.874554	22.226615	-0.669	128	0.505
STR9, γ_{013}	-31.236506	26.003958	-1.201	128	0.232
STR10, γ_{014}	-35.908039	38.815643	-0.925	83	0.358
STR11, γ_{015}	-52.115333	53.870216	-0.967	128	0.335
STR12, γ_{016}	-12.751318	24.968689	-0.511	128	0.610
For MISCED slope, β_1					
INTRCPT2, γ_{10}	-2.624681	1.915483	-1.370	65	0.175
For FISCED slope, β_2					
INTRCPT2, γ_{20}	-0.512163	1.804133	-0.284	183	0.777
For BMMJ1 slope, β_3					
INTRCPT2, γ_{30}	0.264176	0.133540	1.978	501	0.048
For BFMJ2 slope, β_4					
INTRCPT2, γ_{40}	0.177962	0.158975	1.119	100	0.266
For EMOSUPS slope, β_5					
INTRCPT2, γ_{50}	-0.581297	2.597380	-0.224	42	0.824
For CULTPOSS slope, β_6					
INTRCPT2, γ_{60}	1.106024	2.843079	0.389	114	0.698
For HEDRES slope, β_7					
INTRCPT2, γ_{70}	-1.887732	2.878889	-0.656	60	0.515
For ESCS slope, β_8					
INTRCPT2, γ_{80}	8.625183	5.334016	1.617	335	0.107
For SECONDGN slope, β_9					
INTRCPT2, γ_{90}	-12.202778	19.767610	-0.617	34	0.541
For FIRSTGNR slope, β_{10}					
INTRCPT2, γ_{100}	2.977023	35.734782	0.083	547	0.934
For OTHERLAN slope, β_{11}					
INTRCPT2, γ_{110}	-6.050251	18.784325	-0.322	76	0.748

Final estimation of fixed effects

(with robust standard errors)

Fixed Effect	Coefficient	Standard error	*t*-ratio	Approx. *d.f.*	*p*-value
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	446.468644	15.045302	29.675	128	<0.001
LEAD, γ_{01}	-2.227983	5.766547	-0.386	128	0.700
EDUSHORT, γ_{02}	-4.405518	4.794904	-0.919	128	0.360
STAFFSHO, γ_{03}	-9.389629	4.961843	-1.892	128	0.061
STUBEHA, γ_{04}	-25.679896	5.282540	-4.861	128	<0.001
TEACHBEH, γ_{05}	7.646471	6.237537	1.226	128	0.222
STR1, γ_{06}	-13.164271	17.498418	-0.752	128	0.453
STR2, γ_{07}	9.434448	23.303110	0.405	128	0.686
STR4, γ_{08}	-1.412845	17.610778	-0.080	128	0.936
STR5, γ_{09}	-5.374399	18.733542	-0.287	128	0.775
STR6, γ_{010}	-23.927773	18.205942	-1.314	128	0.191
STR7, γ_{011}	11.926884	29.529532	0.404	128	0.687
STR8, γ_{012}	-14.874554	20.073717	-0.741	128	0.460
STR9, γ_{013}	-31.236506	24.640073	-1.268	128	0.207
STR10, γ_{014}	-35.908039	55.699895	-0.645	128	0.520
STR11, γ_{015}	-52.115333	34.289412	-1.520	27	0.140
STR12, γ_{016}	-12.751318	33.260019	-0.383	128	0.702
For MISCED slope, β_1					
INTRCPT2, γ_{10}	-2.624681	2.028672	-1.294	82	0.199
For FISCED slope, β_2					
INTRCPT2, γ_{20}	-0.512163	1.876135	-0.273	215	0.785
For BMMJ1 slope, β_3					
INTRCPT2, γ_{30}	0.264176	0.154060	1.715	874	0.087
For BFMJ2 slope, β_4					
INTRCPT2, γ_{40}	0.177962	0.162019	1.098	108	0.274
For EMOSUPS slope, β_5					
INTRCPT2, γ_{50}	-0.581297	2.619253	-0.222	44	0.825
For CULTPOSS slope, β_6					
INTRCPT2, γ_{60}	1.106024	3.033690	0.365	148	0.716
For HEDRES slope, β_7					
INTRCPT2, γ_{70}	-1.887732	3.004321	-0.628	71	0.532
For ESCS slope, β_8					
INTRCPT2, γ_{80}	8.625183	5.543263	1.556	391	0.121
For SECONDGN slope, β_9					
INTRCPT2, γ_{90}	-12.202778	19.254495	-0.634	31	0.531
For FIRSTGNR slope, β_{10}					
INTRCPT2, γ_{100}	2.977023	31.894033	0.093	347	0.926
For OTHERLAN slope, β_{11}					
INTRCPT2, γ_{110}	-6.050251	17.731130	-0.341	60	0.734

Final estimation of variance components

Random Effect	Standard Deviation	Variance Component	*d.f.*	χ^2	*p*-value
INTRCPT1, u_0	42.92523	1842.57498	128	763.57117	<0.001
level-1, *r*	55.82572	3116.51136			

F. TURKISH SUMMARY / TÜRKÇE ÖZET

Giriş

20 yılı aşkın bir süredir, milletlerin ve bölgelerin gelişmesine dair tartışmalar, toplumların giderek "bilgi ekonomisi" toplumuna dönüşmesi nedeniyle insan sermayesi merkezinde yapılmaktadır (Faggian, Modrego, & McCann, 2019; OECD, 2006). İnsanın gelecekteki verimliliğini arttıran bilgi, beceri, yetenek veya sosyal ilişkilerin tümü insan sermayesi olarak nitelendirilebilir (Faggian et al., 2019). İnsan sermayesine yapılan yatırım ve insan sermayesindeki gelişimin diğer sermaye formlarından daha hızlı olması Batı'nın ekonomik sisteminin en önemli ayırt edici özelliğidir ve bu özellik Batı ve Doğu ekonomileri arasındaki uçurumu açıklamada başvurulabilir (Salle, 2010; Schultz, 1959). Ekonomik gelişme ve ilerlemeyi sağlamak için, eğitim yoluyla insan sermayesine yatırım yapmak, fabrika, teçhizat, konut ve altyapı yoluyla fiziksel sermayeye yapılan yatırım kadar önemlidir (Horioka, Morgan, & Niimi, 2018).

Coleman (1988a), sosyal sermayenin, özellikle bir sonraki nesilde insan sermayesi oluşturmaya dair etkisi nedeniyle, önemli olduğunu söyler. Heyneman ve Loxley (1982), ailenin öğrenici başarısı üzerindeki etkisinin ülkenin gelişmişlik düzeniye göre değiştiğini ve okulun öğrenci başarısı üzerindeki etkisinin daha az gelişmiş ülkelerde ailenin etkisininden fazla olduğunu bulmuşlardır. Tomul ve Çelik (2009) ülke düzeyindeki bu etkinin yanında, aynı örüntünün ülke içinde, bölgesel bazda da göründüğünü bulmuştur. Uluslararası Öğrenci Değerlendirme Programı (PISA) 2006 datasıyla yaptıkları çalışmada, Türkiye'de öğrenci başarısını belirlemede ailenin etkisi en yüksek Ege Bölgesi'nde çıkarken, en düşük Güney Doğu Anadolu bölgesinde çıkmıştır.

Türkiye bağlamında, bölgeler arasındaki hem sosyoekonomik hem de akademik başarı farkları göz önünde bulundurulduğunda, bölgeler arasında başarı farklarını haritalama ve bu farkların kapanmasında etkili faktörlerin saptanması, bölgesel bazda beklenenden daha az başarı gösteren bölgelerin insan sermayesini arttırmaya ve kümülatif olarak bölgelerin insan sermayesindeki artışın neticesinde ülkenin toplam insan sermayesini arttırmaya yardımcı olacaktır. Türkiye'de, ulusal testlerde olduğu gibi, PISA gibi uluslararası testlerde de bölgelerin göreceli başarıları istikrarlıdır (Ataç, 2017; Erberber, 2009; Karahasan & Uyar, 2009). Ayrıca, Türkiye'de beklenenden az başarı gösteren doğudaki bölgeler, sosyoekonomik açıdan da dezavantajlı bölgelerdir. Lise sonunda matematik performansındaki bir standart sapma yükselmenin, gelecekteki yıllık kazancın %20 artmasına sebep olduğu düşünüldüğünde, matematik başarısının hem bireyin hem de kümülatif olarak bölgenin ekonomik durumunu tahmin etmedeki yüksek kapasitesi sebebiyle, bu çalışmada bağımlı değişken olarak seçilmiştir (Hanushek & Zhang, 2009).

Bu çalışmanın temel amacı Türkiye'de bölgeler arasındaki matematik başarı farklarını araştırmak ve her bir bölge için başarı farklarını açıklayan değişkenleri bulmaktır. Bu çalışmanın araştırma soruları şunlardır:

1. PISA 2015'de matematik alanında en yüksek öğrenci başarısına sahip olan Ege Bölgesi ile Türkiye'nin diğer İstatistiki Bölge Birimleri Sınıflandırması (İBBS) Düzey 1 bölgeleri arasında, matematik performansı açısından istatistiksel olarak anlamlı bir farklılık var mıdır?
2. Ege Bölgesi ile Türkiye'nin diğer İBBS Düzey 1 bölgeleri arasında, aile ile alakalı belirlenen değişkenler (annenin eğitim durumu, babanın eğitim durumu, annenin mesleğinin statüsünün uluslararası sosyoekonomik indeksi, babanın mesleğinin statüsünün uluslararası sosyoekonomik indeksi, göçmenlik statüsü, evde konuşulan dil, ebeveynin duygusal desteği, evdeki kültürel varlıklar, evdeki eğitim ile alakalı kaynaklar ve EKSD) kontrol edildiğinde matematik performansı açısından istatistiksel olarak anlamlı bir farklılık var mıdır?

3. Ege Bölgesi ile Türkiye'nin diğer İBBS Düzey 1 bölgeleri arasında, okul ile alakalı değişkenler (toplam liderlik skalası; okul kaynakları ile alakalı olarak, personel eksikliği indeksi ve materyal eksikliği indeksi; okul iklimi ile alakalı olarak da okul iklimini etkileyen öğrenci faktörleri ve okul iklimini etkileyen öğretmen faktörleri) kontrol edildiğinde matematik performansı açısından istatistiksel olarak anlamlı bir farklılık var mıdır?
4. Ege Bölgesi ile Türkiye'nin diğer İBBS Düzey 1 bölgeleri arasında hem aile hem de okul ile alakalı belirlenen (2. ve 3. soruda ifade edilen değişkenler) değişkenler kontrol edildiğinde matematik performansı açısından istatistiksel olarak anlamlı bir farklılık var mıdır?

Türkiye'de bölgesel başarı farklarına sebep olan değişkenler üzerinde çok sınırlı sayıda araştırma vardır. Özellikle, zorunlu eğitimin liseyi de kapsadığı 2012 yılından bugüne, Türkiye'de zorunlu eğitim sonundaki bölgesel başarı farklarının ardındaki faktörlere dair bir araştırma yapılmamıştır. Bu çalışma, literatürdeki bu boşluğu doldurması açısından önem arz etmektedir.

Bu çalışmada PISA 2015 verisinin seçilmesinin ilk sebebi, ikincil analizler için açıklanan son PISA datası olmasıdır. İkinci olarak, PISA 2003'de gösterilen düşük başarının ardından, 2004'de Avrupa Birliği'nden alınan bir hibe ile birlikte büyük bir müfredat değişikliği yapılmıştır (Babadogan&Olkun, 2006). PISA 2015, bu müfredat ile eğitim gören öğrencilerin girdiği ilk PISA testidir. Bu nedenle, bu çalışmanın sonuçları, PISA ve TIMSS gibi sınavlarda beklenenden düşük başarı gösterme ile tetiklenen bir müfredat reformunun ardından bölgesel başarı farklarını haritalandırdığı için önem arz etmektedir.

Öğrenci başarısı ile alakalı faktörleri inceleyen literatürle kıyaslandığında, Türkiye'de coğrafyayı bir ara değişken olarak ele alan sınırlı sayıda araştırma vardır. Literatürde, Türkiye'de matematik performansındaki bölgesel başarı farklarının ardındaki faktörleri açıklayan herhangi bir çalışma olmadığından, bu çalışma, kontrol

edildiğinde, matematikte bölgeler arasındaki başarı farklarını kapatacak değişkenleri teşhis eden ilk çalışmadır.

Alanyazın

PISA

PISA, OECD üye ülkelerinin toplu girişimiyle, 15 yaşında zorunlu eğitimin sonuna yaklaşan öğrencilerin, günümüzün bilgi toplumundaki zorluklarla başa çıkmaya ne kadar hazır olduklarını ölçmek amacıyla OECD tarafından başlatılmıştır ve toplam dünya ekonomisinin %90'ını oluşturan ülkelerin katılımıyla üç yıllık bir döngüde uygulanmaktadır (OECD, 2009; OECD, 2017a). PISA uygulamasında, öğrencilerin fen, okuma ve matematik olmak üzere üç ana alanda yeterliliklerini ölçen anketlerin yanında; öğrenci, okul, öğretmen, aile, bilgi teknolojilerine yatkınlık ve kariyer anketi dahil olmak üzere, bağlam anketleri de vardır (OECD, 2016). PISA uygulamasının amacı, uluslararası kabul gören bir metrik yardımıyla, öğrenci bilgi ve başarısını direkt olarak test etmek; performans farklarını anlamak için öğrenci yeteneklerini, öğrenci, öğretmen, okul ve sistem datası ile ilişkilendirmek; sonrasında ise ortak referans noktaları ve çevre baskısı oluşturarak iş birliği içinde dataya göre hareket etmektir (Schleicher, 2019). PISA hem farklı ülkelerdeki öğrencilerin hem de her bir ülkenin içindeki değişik demografik alt grupların, bilgi ve becerilerini izlemek için bir bilginin vücuda gelmesine sebep olmaktadır (OECD, 2016).

PISA pek çok ülkede şok dalgalarına sebep olmuş ve bu şok dalgaları eğitim sistemlerinin eleştirel olarak tekrar gözden geçirilmesine sebep olmuştur (Haugsbakk, 2013, p. 607). Waldow (2009), eğitim politikalarındaki değişikliklerin, bu değişikliklerin savunucuları tarafından PISA uygulamasındaki başarısızlıklara çare olarak gösterildiğini veya öyle yorumlandığını, fakat PISA ile meşrulaştırılan her politika değişikliğinin esasında PISA şoku ile motive olmadığını söyler.

Gür, Çelik, ve Özoğlu (2012, s. 5–9), PISA'nın Türkiye'de yapılması önceden kararlaştırılan 2005 yılında yaygınlaştırılan müfredat reformunu meşrulaştırmak için kullanıldığını söylemektedir. Fakat, PISA okul müfredatının yeterliliğini ölçmeyi amaçlamamaktadır (Prais, 2003). Akınoğlu (2008) bu müfredat reformunun, Türk Eğitim Sistemi tarihindeki diğer müfredat değişikliklerine kıyasla emsalsiz bir yönü olduğunu söyler. Çünkü bu reformda, politika yapıcılar ilk defa direkt olarak globalleşmenin eğitim söyleminden ödünç alının kavram, yetenek ve değerlere ve Avrupa Birliğine değişime duyulan ihtiyacı işaret etmek için refere etmişlerdir.

İlk PISA testi 2000 yılında yapılmış, Türkiye ise ilk olarak 2003 yılında PISA testine katılmıştır (Aydin, Erdağ, & Taş, 2011). Türkiye'nin matematik okuryazarlığındaki performansı incelendiğinde, PISA 2003'ten PISA 2012'ye yaklaşık olarak 25 puanlık bir artış olduğu, bununla beraber performans olarak hala OECD ortalamasının altında olduğu görülebilir (Özberk, Atalay Kabasakal, & Boztunç Öztürk, 2017). 2009 yılında, Türkiye'de temel yeteneklerin altında olan öğrenciler arasında anlamlı bir ilerleme görülmesine rağmen, bu ilerleme Türkiye'nin uluslararası sıralamasını anlamlı bir şekilde değiştirmemiş, OECD ülkeleri arasındaki sıralamasını 34'ten 32'ye çıkarmıştır (Köseleci Blanchy & Şaşmaz, 2011). Fakat, PISA 2015'e (420 puan) gelindiğinde, PISA 2009 (445 puan) ve PISA 2012'ye (448 puan) göre öğrencilerin matematik puanında keskin bir düşüş olduğu görülmektedir (Arıcı, Ozarkan, Özgürlük, & Taş, 2016). Ayrıca, Türkiye de öğrencilerin matematik performansı PISA 2003'ün (423 puan) de gerisine düşmüştür (Eğitimi Araştırma ve Geliştirme Dairesi Başkanlığı, 2005).

Öğrenci Başarısı ile İlişkili Aile Faktörleri

Daha yüksek eğitim seviyesine sahip olan anne baba ile akademik başarı arasında pozitif ve anlamlı bir korelasyon vardır (Aksamovic, Djordjevic, Malec, & Memisevic, 2019; Eccles, 2005; Hanushek & Zhang, 2009; Khan, Iqbal, & Tasneem, 2015; Long & Pang, 2016; Muller, 2018). Türkiye'de yüksek başarı gösteren

Marmara, Ege, İç Anadolu bölgelerine kıyasla, Güneydoğu Anadolu ve Doğu Anadolu'daki öğrencilerin ailelerinin eğitim seviyeleri daha düşüktür (Erberber, 2009). Türkiye bağlamında da ebeveynin eğitimi ile öğrencinin akademik başarısı arasında pozitif ve anlamlı bir ilişki olduğu görülmektedir (Aksu, Güzeller, & Eser, 2017; Yetişir, 2014).

Ebeveynin mesleki statüsü ve öğrenci başarısı arasında pozitif ve anlamı bir korelasyon vardır (Hao & Bonstead-Bruns, 1998; Leaper, 2011; Long & Pang, 2016; Stull, 2013; Tsui, 2005; Wigfield & Eccles, 2000) Ayrıca, sınıfsal pozisyon ile alakalı olan ebeveynin mesleki statüsü, çocuk yetiştirmenin "kültürel mantığı" olarak tanımlanan, zamanı ve dili kullanma, aile bağları gibi ebeveynden çocuğa tutarlı ve teşhis edilebilir şekilde aktarılan avantajları etkilemektedir ve bu sınıfsal çocuk yetiştirme pratikleri işçi sınıfından gelen çocukların okulu erken bırakmasına sebep olmaktadır (Çelik, 2017a).

Ailenin göçmenlik statüsü de çocuğun akademik başarısı ile alakalı faktörler arasındadır. Fakat bazı göçmenlik geçmişleri, Amerika'daki Çinli ve Koreli göçmenler gibi, akademik başarıyı olumlu şekilde yordarken, bazı göçmenlik geçmişleri, Avrupa ülkelerindeki Türkler gibi, akademik başarıyı olumsuz yönde yordar (Coleman et al., 1966; Çelik, 2019; Hao and Bonstead-Bruns, 1998).

Vygotsky'nin zihnin sosyokültürel teorisi ve bilişsel bilimlerin zihnin bilgisayım teorisi birleştirildiğinde, insan zihninin dili düşünce sırasında, iç ve dış dünya arasında aracılık etmek için kullandığı söylenebilir (Frawley, 1997; Lantolf, 2000; Rescorla, 2017). Anadili dışında bir dilde öğrenim gören öğrenci, temel anlam oluşturma aracı olan ana dilinin olmadığı bir ortamda öğrenme ile alakalı güçlükler ile yüz yüze gelir (Kozulin, Gindis, Ageyev, & Miller, 2003).

Ailenin duygusal desteği, ailenin eğitime katılımı ve eğitsel faaliyetlerde öğrenciyi desteklemesi açısından öğrenci başarısı ile yüksek düzeyde korelasyona sahiptir

(Aydın, 2015; Bempechat, 1992; Hara & Burke, 1998). Türkiye'de, istatistiksel olarak anlamlı şekilde düşük başarı gösteren bölgeler olan Güneydoğu ve Doğu Anadolu bölgelerinde, öğrencilerin başarı için daha az aile desteğine sahip olduğu ve okullardaki aile katılımının diğer bölgelere göre daha düşük olduğu görülmektedir (Erberber, 2009).

Evdeki kültürel varlıklar ve eğitim ile alakalı kaynakların varlığı ve çeşitliliği açısından, yüksek sosyoekonomik geçmişe sahip olan öğrenciler, daha düşük sosyoekonomik geçmişe sahip olan öğrencilere göre avantajlı durumdadır ve bu varlıklar öğrenci başarısını pozitif yönde ve istatistiksel olarak anlamlı şekilde yordamaktadır (Aydın, 2015; K. N. Ross & Zuze, 2004; Lee, 2016; Long & Pang, 2016; İnce & Gözütok, 2018; Thomson, 2018; Tsui, 2005). Türkiye'de Güneydoğu ve Doğu Anadolu'daki öğrencilerin, yüksek öğrenci performansına sahip bölgelerdeki öğrencilere kıyasla, evlerinde daha az eğitsel materyallere sahip olduğu bulunmuştur (Erberber, 2009).

Ailenin ekonomik, sosyal ve kültürel statüsünün (EKSD) öğrenme ile alakalı kaynaklara ulaşmayı kolaylaştırdığı için direkt olarak ve okul tarafından aracılık edilen endirekt etkileri sebebiyle öğrenci başarısı arasında pozitif ve anlamlı bir ilişki vardır (Bankov, Mikova, & Smith, 2006; Long & Pang, 2016; Mariana, 2018; Özdemir, 2016; Schneeweis & Zweimüller, 2014; Stull, 2013).

Öğrenci Başarısı ile İlişkili Okul Faktörleri

Eğitim yöneticileri, aileleri öğrencinin eğitim sürecine çekmek için ciddi olarak gayret sarf ettiğinde, çocuk açısından çok olumlu akademik çıktıların alındığı görülmektedir (Bempechat, 1992). Okuldaki liderlik ile öğrenci performansı arasında direkt olarak bir ilişki görülmese bile, müdürlerin öğretmenlerin toplu kapasitelerini teşvik ederek ve öğretmenlerin öğrencilerin hayatları üzerinde kendi rollerine dair pozitif algılara sahip olmasını sağlayarak, öğrencilerin duygusal ve akademik gelişmelerini

etkiledikleri ve dönüşümcü liderlik pratiklerinin öğrenci başarısını, öğretmenler ile alakalı faktörlere aracılık etmesi sebebiyle arttırdığı görülmektedir (Boberg and Bourgeois, 2016; Ross and Gray, 2006). Türkiye bağlamında ise, öğretmenlerin okula olan bağlılıkları ve okul müdürünün hizmetkar liderlik davranışları arasında anlamlı ve pozitif bir ilişki olduğu bulunmuştur (Cerit, 2010).

Eğitim materyalleri ve eğitim personelleri birlikte okul kaynakları olarak nitelendirilebilir (OECD, 2017). Heyneman ve Loxley (1982), yüksek gelir düzeyine sahip ülkelere kıyasla, düşük gelire sahip ülkelerdeki okul ve öğretmen karakteristiğinin başarıdaki varyasyonun iki veya üç kat daha fazla açıklayabileceğini bulmuştur. Yani ülke ne kadar fakirse, okul özellikleri ve öğretmenin başarı üzerindeki etkisi o kadar fazladır. Erberber (2009), istatistiksel olarak anlamlı şekilde düşük başarı gösteren Güney Doğu Anadolu ve Doğu Anadolu bölgelerindeki okulların, eğitsel kaynaklar ile yeterince teçhiz edilmediğini söylemektedir. Türkiye bağlamında yapılan diğer çalışmalarda, okul kaynakları ile öğrenci başarısı arasında anlamlı ve pozitif bir ilişki varken, sınıf mevcudunun negatif ve olumsuz bir ilişkisi olduğu görülmektedir (Aydın, 2015, Aksu vd., 2017, Özberk vd., 2017).

Sağlıklı, güvenli, şiddet açısından steril, öğrenci, öğretmen, ve aile arasındaki iletişimi kolaylaştıran ve gerekli materyallerle teçhiz edilmiş bir öğrenme ortamı, öğrenme çıktılarını olumlu yönde etkiler ve okul iklimi ile öğrencinin matematik performansı arasında pozitif ve anlamlı bir ilişki bulunmuştur (Aydın, 2015; Eğitim Reformu Girişimi, 2018; Özberk vd., 2017). Türkiye'de Güneydoğu ve Doğu Anadolu Bölgeleri'nde öğrencilerin öğrenme açısından destekleyici olmayan okullara devam ettiği görülmektedir (Erberber, 2009). Büyük ölçüde sabit olan geçmiş özellikleri arasında olan dezavantajlı aile ve muhit özellikleri ile başa çıkmak için okulda pozitif bir iklim oluşturmaya yönelik önlem ve pratikler önem arz etmektedir (Çelik, 2011).

Başarı Farkları

On yıllar boyunca yapılan araştırmalar, azınlık ve azınlık olmayan öğrenciler arasındaki başarı farklarını incelemiştir fakat bu tekil tanım; yüksek veya düşük sosyoekonomik gruplar arasındaki veya kırsal kesim ve kent arasındaki başarı farkları gibi grup içi önemli farklılıkları göz ardı etmektedir (Carpenter, Ramirez, & Severn, 2006). Ayrıca başarı farklarının, itibar farkları ile ve dezavantajlı grupların damgalanması ile alakalı olduğu göz önüne alındığında; damgalamaların ortadan kaldırılması suretiyle düşük statüye sahip grupların itibarının artırılmasının; ve itibar farklarının azaltılmasının başarı farklarını azaltmada yardımcı olacağı söylenebilir (Lamont, 2018).

Ülkeler arasındaki başarı farklarının ekonomik maliyetleri olduğu gibi, ülke içindeki başarı farklarının da maliyeti vardır. Örneğin, Amerika beyazlar ile Asyalı, Hispanik ve siyahi öğrenciler arasındaki başarı farkını kapatabilseydi 1998 yılında kapatmayı başarabilseydi, 2008 yılında gayri safi yıllık hasılası (GSYH) 400 ile 500 milyar arasında daha fazla olacaktı. Aynı şekilde, eğer düşük başarı gösteren eyaletler ile diğer eyaletler arasındaki başarı farkını kapatabilseydi, GSYH'sı 2008 yılında 425 ile 700 milyar arasında daha fazla olacaktı (Auguste, Hancock, and Laboissiere, 2009).

Erberber (2009, s. 154-156), Türkiye'de ilköğretimde okullaşma açısında hemen hemen eşitlik yakalanmasına rağmen, ilköğretim sonunda eğitim çıktıları açısında eşitliğe ulaşılamadığı ve bölgeler arasında anlamlı başarı farkları olduğunu bulmuştur. Türkiye'de eğitime ulaşmada ve akademik performansta güçlü bir coğrafi boyut vardır ve bu durum bölgesel gelir eşitsizlikleri ilgili olup, farklı gelir grupları ve farklı sosyoekonomik gruplar arasındaki farklar ile beraber, başarı farkları daha derin hale gelmektedir (Karahasan & Uyar, 2009; Ataç, 2017). Ayrıca Türkiye'deki var olan sosyal eşitsizliklerin, eğitimdeki yapı nedeniyle daha fazla arttığı görülmektedir (Özdemir, 2015).

Yöntem

Bu çalışmada nitel yöntem kullanılmıştır. Nedensel karşılaştırma dizaynı ve çok düzeyli modelleme kullanılmıştır. Çalışmada ikincil veri analizi yapılmıştır. Öğrencilerin sınıflar içinde, sınıfların okullar içinde kümelendiği veriler, çok düzeyli verilerdir ve hiyerarşik yapıya sahiptir (Roberts, 2004). Aynı kümenin üyeleri diğer grupların üyeleri tarafından paylaşılmayan bazı özel benzerliklere sahip olabilir (Crook, Todd, & Barilla, 2005). Hiyerarşik doğrusal modelleme, bu şekilde gözlemlerin birbirinden bağımsız olmadığı dataları ele alıp, bağlantılı hatayı doğru bir şekilde modellediği için bu çalışmada hiyerarşik doğrusal modelleme (HLM) kullanılmıştır.

Evren ve Örneklem

Araştırmanın evreni, 2015'de Türkiye'deki 1.324.089 15 yaşındaki öğrencidir. PISA uygulamasına katılabilecek, deneysel olarak ulaşılabilir öğrenci evreni ise 925.366 15 yaşındaki öğrenciden oluşabilmektedir. Örneklem ise, Türkiye'nin 61 ilinden ve 187 okulundan, 12 bölgeyi temsilen seçilen 5895 öğrencidir (Özgürlük, Erbay, Arıcı, & Taş, 2016).Türkiye'nin PISA datası İBBS Düzey 1'e göre toplanmıştır. Bu bölgeler şunlardan oluşmaktadır:

1. İstanbul Bölgesi (TR1)
2. Batı Marmara Bölgesi (TR2)
3. Ege Bölgesi (TR3)
4. Doğu Marmara Bölgesi (TR4)
5. Batı Anadolu Bölgesi (TR5)
6. Akdeniz Bölgesi (TR6)
7. Orta Anadolu Bölgesi (TR7)
8. Batı Karadeniz Bölgesi (TR8)
9. Doğu Karadeniz Bölgesi (TR9)

10. Kuzey Doğu Anadolu Bölgesi (TRA)
11. Orta Doğu Anadolu Bölgesi (TRB)
12. Güney Doğu Anadolu Bölgesi (TRC)

Veri Toplama Araçları

Bu çalışmada, bağımlı değişken olan öğrencilerin matematik skorlarını da içeren PISA 2015 öğrenci anketi, öğrenci düzeyinde seçilen bağımsız değişkenlere ulaşmak için kullanılmıştır. Ayrıca, PISA 2015 okul anketi, okul düzeyinde seçilen bağımsız değişkenlerine ulaşmak için kullanılmıştır.

Veri Toplama Süreci

PISA araştırmasındaki okul örneklemi, tabakalı seçkisiz örnekleme yöntemiyle belirlenmektedir. PISA 2015 uygulaması için birinci aşamada İstatistikî Bölge Birimleri Sınıflaması (İBBS) Düzey 1, eğitim türü, okul türü, okulların bulundukları yer ve okulların idari biçimleri tabakaları kullanılarak okullar tabakalı seçkisiz örnekleme yöntemiyle belirlenmiştir, ikinci aşamada ise bu okullarda uygulamaya katılacak olan öğrenciler seçkisiz yöntemle belirlenmiştir (Özgürlük et al., 2016).

Veri Analizi Süreci

Hata terimlerinin bağımsız olmadığı ve sınıf, okul, bölge gibi gruplama faktörleri nedeniyle kümelendiği durumlarda, regresyon katsayıları yanlış hesaplanır. Fakat HLM gözlemlerin birbirinden bağımsız olmadığı durumlarda, bağımlı hatayı doğu bir şekilde modeller (Garson, 2014). Bu nedenle, bu çalışmada HLM tercih edilmiş ve HLM7 yazılımı kullanılmıştır. Ayrıca, betimsel istatistikler için SPSS24 kullanılmıştır.

Araştırmanın Sınırlılıkları

Bu çalışma PISA 2015 datasıyla yapıldığı için, genellenebilirliği 2015 yılı ile sınırlıdır. Ayrıca, çalışmanın nicel doğası sebebiyle, bu çalışmada kullanılan değişkenlerin sosyolojik yanlarına dair açıklama getirilememiştir. Ayrıca, bu çalışmada matematik başarısını etkileyen faktörler aile ve okul faktörler olarak gruplar halinde ele alınmış, her bir değişkenin bireysel olarak matematik performansı ile ilişkisi detaylı olarak incelenememiştir.

Bulgular

Boş Model ile Alakalı Sonuçlar

Boş model, bu çalışmada okul olan, aktör etkisini test ederek, HLM'nin kullanılmasının gerekip gerekmediğine karar vermede yardımcı olur. (Garson, 2014). Boş model aşağıdaki gibidir:

$$PVMATH_{ij} = \gamma_{00} + u_{0j} + r_{ij}$$

ICC, öğrencilerin matematik skorlarındaki varyasyonun, ne derece okullar arasındaki varyasyon ile açıklanabildiğini gösteren, küme içi korelasyon katsayısı (ICC) boş modele göre hesaplanır. Bu çalışmada, ICC 0,51 olarak bulunmuştur. Bu, matematik skorlarındaki değişimin %51'inin okullar arasındaki varyasyon ile açıklanabileceğini göstermektedir. Okullar arasındaki bu yüksek varyasyon, regresyon analizi yerine HLM kullanılması gerektiğini göstermektedir.

Temel Model ile Alakalı Sonuçlar

Değişken olarak, sadece IBBS Düzey 1 bölgelerini içermekte olan temel model, 1. araştırma sorusuna cevap vermeyi amaçlamaktadır ve şu şekilde ifade edilmektedir:

$$PVMATH_{ij} = \gamma_{00} + \gamma_{01}*TR1_j + \gamma_{02}*TR2_j + \gamma_{03}*TR4_j + \gamma_{04}*TR5_j + \gamma_{05}*TR6_j + \gamma_{06}*TR7_j + \gamma_{07}*TR8_j + \gamma_{08}*TR9_j + \gamma_{09}*TRA_j + \gamma_{010}*TRB_j + \gamma_{011}*TRC_j + u_{0j} + r_{ij}$$

Temel model, Ege bölgesi ile Orta Doğu Anadolu bölgeleri arasında 82.38 puanlık bir fark ile istatistiksel olarak anlamlı ($p = 0.003$) bir farklılık olduğunu göstermektedir. Benzer şekilde Ege bölgesi ile Güney Doğu Anadolu bölgeleri arasında 60.28 puanlık bir fark ile istatistiksel olarak anlamlı ($p = 0.005$) bir farklılık vardır. Ayrıca, Ege bölgesi ile Doğu Karadeniz bölgeleri arasında 36.45 puanlık bir fark ile istatistiksel olarak sınırda anlamlı ($p = 0.066$) bir farklılık vardır.

Aile Modeli ile Alakalı Sonuçlar

Aile modeli, aile ile alakalı olarak seçilen değişkenlerin etkisi elimine edildiğinde, yani kontrol edildiğinde, bölgeler arasında başarı farklarının nasıl değiştiğini bulmayı hedefler. Aile modeli:

$$PVMATH_{ij} = \gamma_{00} + \gamma_{01}*TR1_j + \gamma_{02}*TR2_j + \gamma_{03}*TR4_j + \gamma_{04}*TR5_j + \gamma_{05}*TR6_j + \gamma_{06}*TR7_j + \gamma_{07}*TR8_j + \gamma_{08}*TR9_j + \gamma_{09}*TRA_j + \gamma_{010}*TRB_j + \gamma_{011}*TRC_j + \gamma_{10}*MISCED_{ij} + \gamma_{20}*FISCED_{ij} + \gamma_{30}*BMMJ1_{ij} + \gamma_{40}*BFMJ2_{ij} + \gamma_{50}*EMOSUPS_{ij} + \gamma_{60}*CULTPOSS_{ij} + \gamma_{70}*HEDRES_{ij} + \gamma_{80}*ESCS_{ij} + \gamma_{90}*SECONDGN_{ij} + \gamma_{100}*FIRSTGNR_{ij} + \gamma_{110}*OTHERLAN_{ij} + u_{0j} + r_{ij}$$

Aile değişkenleri kontrol edildiğinde, Ege bölgesi ile Orta Doğu Anadolu bölgeleri arasında istatistiksel olarak anlamlı ($p = 0.141$) farklılık ortadan kalkmıştır. Benzer şekilde Ege bölgesi ile Güney Doğu Anadolu bölgeleri arasındaki istatistiksel olarak anlamlı ($p = 0.764$) farklılık da ortadan kalkmıştır. Ayrıca, Ege bölgesi ile Doğu Karadeniz bölgeleri arasında 55.63 puanlık bir fark ile, istatistiksel olarak sınırda anlamlı olan farkın, anlamlı farka ($p = 0.006$) dönüştüğü görülmektedir.

Okul Modeli ile Alakalı Sonuçlar

Okul modeli, okul ile alakalı olarak seçilen değişkenler kontrol edildiğinde, bölgeler arasında başarı farklarının nasıl değiştiğini bulmayı hedefler. Okul modeli:

$$PVMATH_{ij} = \gamma_{00} + \gamma_{01}*LEAD_j + \gamma_{02}*EDUSHORT_j + \gamma_{03}*STAFFSHO_j + \gamma_{04}*STUBEHA_j + \gamma_{05}*TEACHBEH_j + \gamma_{06}*TR1_j + \gamma_{07}*TR2_j + \gamma_{08}*TR4_j + \gamma_{09}*TR5_j + \gamma_{010}*TR6_j + \gamma_{011}*TR7_j + \gamma_{012}*TR8_j + \gamma_{013}*TR9_j + \gamma_{014}*TRA_j + \gamma_{015}*TRB_j + \gamma_{016}*TRC_j + u_{0j} + r_{ij}$$

Okul değişkenleri kontrol edildiğinde, Ege bölgesi ile Orta Doğu Anadolu bölgeleri arasında istatistiksel olarak anlamlı ($p = 0.005$) farklılığın devam etmekte olduğu görülmektedir. Benzer şekilde Ege bölgesi ile Güney Doğu Anadolu bölgeleri arasındaki istatistiksel olarak anlamlı ($p = 0.009$) farklılık da devam etmektedir. Bununla beraber, Ege bölgesi ile Doğu Karadeniz bölgeleri arasındaki istatistiksel olarak sınırda anlamlı fark ortadan kalkmıştır ($p = 0.350$).

Tam Model ile Alakalı Sonuçlar

Tam model, aile ve okul ile alakalı değişkenler birlikte kontrol edildiğinde, bölgeler arasında başarı farklarının nasıl değiştiğini bulmayı hedefler. Tam model:

$$PVMATH_{ij} = \gamma_{00} + \gamma_{01}*LEAD_j + \gamma_{02}*EDUSHORT_j + \gamma_{03}*STAFFSHO_j + \gamma_{04}*STUBEHA_j + \gamma_{05}*TEACHBEH_j + \gamma_{06}*TR1_j + \gamma_{07}*TR2_j + \gamma_{08}*TR4_j + \gamma_{09}*TR5_j + \gamma_{010}*TR6_j + \gamma_{011}*TR7_j + \gamma_{012}*TR8_j + \gamma_{013}*TR9_j + \gamma_{014}*TRA_j + \gamma_{015}*TRB_j + \gamma_{016}*TRC_j + \gamma_{10}*MISCED_{ij} + \gamma_{20}*FISCED_{ij} + \gamma_{30}*BMMJ1_{ij} + \gamma_{40}*BFMJ2_{ij} + \gamma_{50}*EMOSUPS_{ij} + \gamma_{60}*CULTPOSS_{ij} + \gamma_{70}*HEDRES_{ij} + \gamma_{80}*ESCS_{ij} + \gamma_{90}*SECONDGN_{ij} + \gamma_{100}*FIRSTGNR_{ij} + \gamma_{110}*OTHERLAN_{ij} + u_{0j} + r_{ij}$$

Tam model, aile ve okul değişkenleri birlikte kontrol edildiğinde, Ege bölgesi ile diğer İBBS Düzey 1 bölgelerinden hiçbiri arasında başarı farkının kalmadığını göstermektedir.

Tartışma

HLM analizleri sonucunda, öğrencilerin matematik başarısındaki varyasyonun %51'inin okullar arasındaki varyasyon ile açıklanabileceği bulunmuştur. Bu durum, öğrencilerin başarılarındaki farkların yarısından çoğunun, öğrenciler arasındaki heterojenlikten değil, devam ettikleri okuldan kaynaklandığını göstermektedir. Okulun başarı skorları arasındaki varyasyonu açıklamadaki rolünün artması aynı zamanda bir eşitlik sorunudur. Çünkü, ortaöğretim düzeyinde, okul türü aynı zamanda öğrencinin sosyoekonomik geçmişini de temsil etmektedir (Özdemir, 2015). Örneğin, meslek lisesi öğrencileri genelde daha düşük eğitime sahip, daha düşük gelirli ailelerden gelmektedir (Serdar, 2016). Ayrıca, Türkiye'de akademik anlamdaki bölgesel eşitsizlikler, ilk öğretime göre ortaöğretimde daha fazladır; ve ortaöğretime göre yüksek öğretimde daha fazladır (Karahasan & Uyar, 2009).

Bu çalışmada, 1. araştırma sorusuna cevap veren temel modelde Ege bölgesi ile Orta Doğu Anadolu ve Güney Doğu Anadolu bölgeleri arasında istatistiksel olarak anlamı farklılık olduğu tespit edilmiştir. Ayrıca Ege ve Doğu Karadeniz bölgeleri arasında sınırda anlamlı farklılık tespit edilmiştir. Bu sonuçlar ile, Marmara bölgesini referans alarak fen alanında bölgeler arasındaki başarı farklarını ölçen ve Marmara ile Doğu Anadolu ve Güneydoğu Anadolu bölgeleri arasında anlamlı farklılık bulan Erberber'in (2009) sonuçları tutarlıdır. Bu durum, Türkiye'de başarı farklarının farklı alanlar için de tutarlı olduğunu göstermektedir.

Araştırmanın 2. sorusuna cevap veren aile modelinde, aile ile alakalı değişkenler kontrol edildiğinde, Ege ile Orta Doğu Anadolu ve Güney Doğu Anadolu arasındaki anlamlı farklılıkların ortadan kalktığı, bununla beraber Ege ile Doğu Karadeniz

bölgesi arasındaki sınırda anlamlı farklılığın anlamlı farklılığa dönüştüğü görülmektedir. Araştırmanın 3. sorusuna cevap veren okul modelinde ise, okul ile alakalı değişkenler kontrol edildiğinde, Ege ile Orta Doğu Anadolu ve Güney Doğu Anadolu arasındaki anlamlı farklılıkların devam ettiğini, bununla beraber Ege ile Doğu Karadeniz bölgesi arasındaki sınırda anlamlı farklılığın ortadan kalktığı görülmektedir. Erberber'in çalışmasında ise (2009) hem aile hem okul modelinin başarı farklarını düşürdüğü, fakat başarı farklarındaki anlamlılıkları değiştirmediği görülmektedir. Öğrenci başarısı ile öğrenci başarısını etkileyen faktörler arasındaki ilişkinin durağan olduğu düşünülmesine rağmen, başarıyı yordayıcıları ile alakalı regresyon modelleri farklı bölgeler için farklı işler ve her bir bölge bu ilişkilere dair lokal regresyon parametrelerine sahiptir (Ataç, 2017). Bu araştırmada, başarı ile alakalı faktörlerin kontrol edilmesine her bir bölgenin kendine özgün bir şekilde cevap verdiğini göstermektedir.

Araştırmanın son sorusuna cevap veren tam modelin sonuçları, aile ve okul ile alakalı değişkenler birlikte kontrol edildiğinde Ege bölgesi ile diğer İBBS Düzey 1 bölgelerinden hiçbiri arasında matematik performansı açısından anlamlı bir farklılık olmadığı görülmektedir. Bu sonuçlar Erberber'in (200) sonuçları ile de uyumludur.

Çıkarım ve Öneriler

Popülasyonun zihinsel becerileriyle, bireysel kazançların birbiriyle yüksek düzeyde alakalı olduğu göz önüne alındığında; bölgeler arasındaki eğitim farklarının, ekonomik farkların; bölgeler arasındaki ekonomik farkların ise, eğitim farklarının dışa vurumu olduğu söylenebilir. Gelişmiş ve gelişmemiş ülkeler arasındaki başarı farklarını kapatmak için okul kurumunda yapısal değişikliklerin gerekmesi, bölgesel ekonomik ve başarı farkları için de tercüme edilebilir (Hanushek & Woessmann, 2008). Bu açıdan bu türden bir yapısal değişiklik için ilk yapılması gereken şey yapı üzerinde etkili olan değişkenlerin belirlenmesidir. Bu tez, bölgeler arasındaki başarı farklarını ayrı ayrı inceleyerek ve Türkiye'nin her bir bölgesinde başarı farklarını

azaltmada etkili olan okul ve aile faktörlerini teşhis ederek, teoriye anlamlı bir katkıda bulunmaktadır.

Aile ve okul modeli, Güney Doğu Anadolu ve Doğu Anadolu bölgeleri ile Ege bölgesi için farklı yönlerde çalıştığından, bir değişkenin başarı üzerindeki etkisinin bölgeden bölgeye farklı yönlerde etki edebileceğini söylemek mümkündür. Bölgesel başarı farkları ve bölgesel olarak başarıyı yordayan faktörler üzerine çok sınırlı sayıda araştırma olduğu için, bu çalışma dikkatleri Türkiye'deki başarı farklarını daha detaylı bir biçimde araştırmanın gerekliliğine dikkat çekmektedir.

Ayrıca, aile ile alakalı olan EKSD gibi değişkenler genelde geniş ölçekli sosyal politikaların sonuçları olduğundan ve bölgesel dezavantajlar başarı farklarına tercüme edildiğinden, bu değişkenlere dair önlemler eğitim politikalarının ötesinde daha kapsamlı politikalar ile alınmalıdır. Okul değişkenleri açısından ise, beklenenden az başarı gösteren bölgeler personel eksikliği açısından dezavantajlı olduğundan, bu bölgelerde görev yapan öğretmenler için, zorunlu hizmetten ziyade bazı teşvikler sunulabilir. Ayrıca, okul müdürleri hem okul iklimine olan etkileri hem de liderlik yoluyla başarıyı dolaylı olarak yordayabildikleri için, daha yüksek başarı için pozitif bir iklim oluşturmaya çalışmalıdırlar.

Bu çalışma PISA 2015 datası ile matematik başarısı baz alınarak yapılmıştır. Ayrıca; 2003'den beri yapılan tüm PISA verilerinin kullanıldığı, okuma ve fen alanlarının da kapsandığı, aile ve okulla birlikte, toplum ve kültür boyutlarının da ele alındığı, üniversiteye giriş sınavı gibi ulusal ve öğrencinin gelecekteki yaşam standardını, bütünsel olarak da bölgenin sosyoekonomik standardını belirleyen sınavların data setlerinin kullanıldığı çalışmalar, bölgesel başarı farklarını daha kapsamlı anlamaya yardımcı olacaktır.

Son olarak, geniş ölçekli eğitim politikalarının ötesinde, okul müdürü hem dil, göçmenlik statüsü ve ailenin duygusal desteği gibi durumlarda yaşanan zorluklarda

müdahale etmek için aileye ulaşabilen kişi konumunda, hem de okul iklimi ve kaynakları üzerinde etkili kişi konumundadır. Bu açıdan, okul müdürleri hem bulundukları bölge hem de ülke için toplam bir başarı artışını sağlamak amacıyla, başarıyı yordayan faktörler üzerindeki bu dolaylı güçlerini etkili bir biçimde kullanmalıdırlar.

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