

GENDER GAPS IN STUDENT ACHIEVEMENT IN TURKEY EVIDENCE FROM PISA 2015 AND TIMSS 2015



FEBRUARY 2018

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This policy note examines the results of the Programme for International Student Assessment (PISA) 2015 and the Trends in International Mathematics and Science Study (TIMSS) 2015 to better understand gender gaps in student achievement in Turkey.

Programme for International Student Assessment (PISA) is organized triennially by OECD (Organization for Economic Cooperation and Development) and it measures 15-year-old students' literacy in reading, mathematics and science. PISA aims to assess students' knowledge and life skills that are essential for full participation in modern societies. Towards this end, it focuses on the three areas listed above and evaluates students' ability to apply what they learn in the classroom to real life contexts. PISA also collects a wide range of data from students, teachers and schools such as socio-economic status, home environment, attitudes towards learning and various school characteristics.

Trends in International Mathematics and Science Study (TIMSS) is an assessment organized by the International Association for the Evaluation of Educational Achievement (IEA) every four years. TIMSS covers mathematics and science and collects data from 4th and 8th grade students. While PISA tests students' ability to apply their knowledge and skills to real life contexts, TIMSS focuses on the learning objectives in the curricula. TIMSS also uses background questionnaires to collect data from students, teachers, parents.

Their scope, continuity and international validity make PISA and TIMSS suitable tools for policy making. The extensive databases and the potential for comparative analyses provided by these studies can and should be used to improve students' academic achievements and well-being. Data collected by PISA and TIMSS can support different aspects of policymaking processes, such as curriculum and textbook preparation and development of new teaching methods. In depth analyses of PISA and TIMSS data that go beyond mere international rankings and average scores is needed in Turkey as well. Evidence put forward by these assessments should be taken into consideration while improving current policies and designing new ones.

This policy note, based on the main findings of research titled “Gender Gaps in Student Achievement in Turkey” conducted by the Aydın Doğan Foundation (ADV) and the Education Reform Initiative (ERG), examines the performance differences between girls and boys in PISA 2015 and TIMSS 2015.¹ The note first examines access to education and then looks into PISA 2015 and TIMSS 2015 results individually to identify the main determinants of the gender gap between girls and boys, and concludes with policy recommendations.

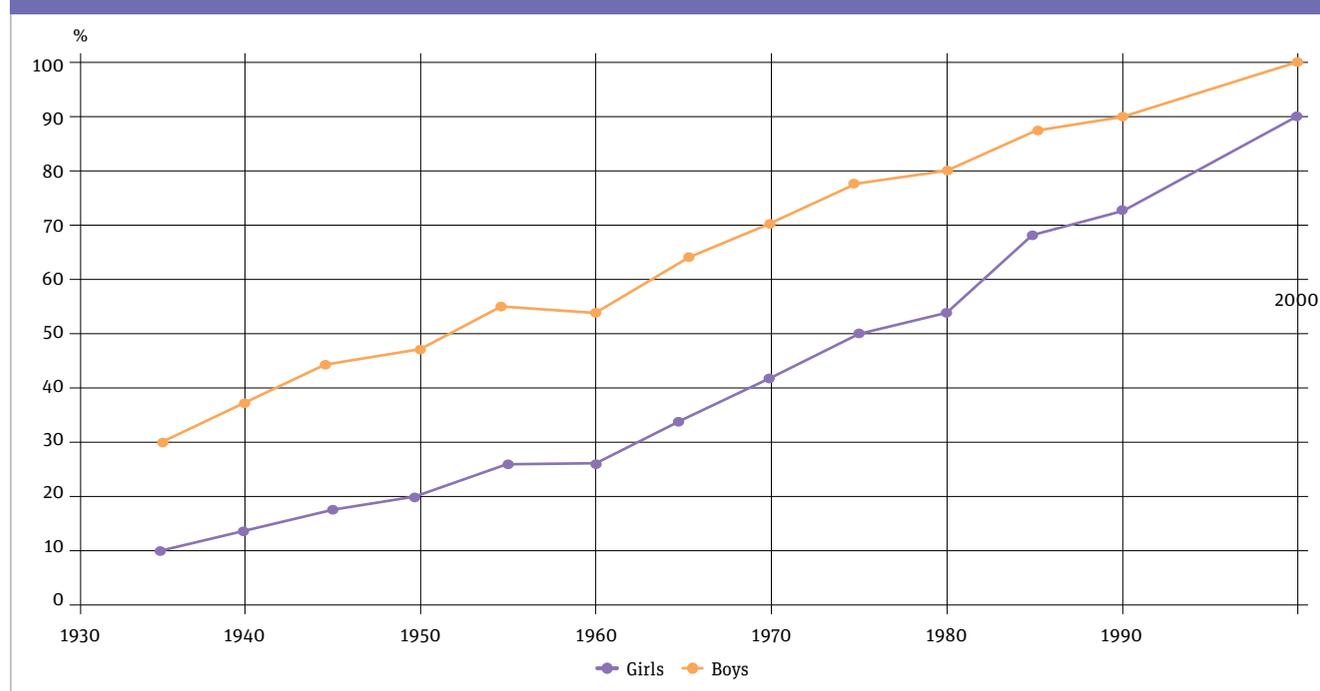
1 ERG and ADV (2017). Gender gaps in student achievement in Turkey: Evidence from the Programme for International Student Assessment (PISA) 2015. Available at: <http://en.egitimreformugirisimi.org/issue/gender-gaps-in-student-achievement-in-turkey-pisa-findings/> ERG and ADV (2017). Gender gaps in student achievement in Turkey: Evidence from Trends in International Mathematics and Science Study (TIMSS) 2015. Available at: <http://en.egitimreformugirisimi.org/issue/gender-gaps-in-student-achievement-in-turkey-timss-findings/>

ACCESS TO EDUCATION AND GENDER IN TURKEY

In recent years, enrollment rates of girls have improved significantly in Turkey. From the first years of the Republic of Turkey to 1997, when compulsory education was extended to 8 years, enrollment rates of girls in primary education increased gradually (Graph 1). Girls' enrollment rates continued to display an upward trend between 1997 and 2012-13 academic year when compulsory education was extended to 12 years, and it is still on the rise.

As of 2016-17, the gap between girls' and boys' net enrollment rates in primary and secondary education has been closed.² As for pre-primary education for 5-year-olds, the enrollment rates have been higher for boys. Nevertheless, girls' enrollment rates have been increasing since 2012-13. In the 2016-17 academic year, the preschool enrollment rate was 60.1% for boys and 57.4% for girls. At the primary education level, boys' enrollment rate was 5.1% higher than that of girls in 2005. In the 2016-17 academic year, the enrollment rates in primary education were 96.6% for girls and 96.4% for boys. A similar pattern is observed in secondary education as well. The 2005 enrollment rate for boys was 9.1% higher than that of girls. In 2016-17, the rates were 82.4% for girls and 82.7% for boys.

GRAPH 1: NET ENROLLMENT RATES OF GIRLS AND BOYS IN TURKEY (%), PRIMARY EDUCATION, 1935-2000



*Note: Data prior to 1990 is based on the 5 years of compulsory primary school education whereas the 2000 figure on 8 years of compulsory primary education. Data is compiled from Mine G. Tan (2000), *Kadın erkek eşitliğine doğru yürüyüş: Eğitim, çalışma ve siyaset* (Marching towards the equality of women-men: Education, work and politics). İstanbul: TÜSİAD. and Ministry of National Education (2010). *National education statistics: formal education 2009-2010*. Ankara: MoNE.*

2 Ministry of National Education (n.d). *National Education Statistics Formal Education (1. Semester) 2016/17*. December 2017, http://sgb.meb.gov.tr/meb_iys_dosyalar/2017_03/31152628_meb_istatistikleri_organ_egitim_2016_2017_1.pdf

Ministry of National Education's (MoNE) projects on gender equality in education have had a positive impact on girls' access to schooling and reducing the gender gap.³ The first phase of the project Increasing School Enrollment Rates Especially for Girls (KEP-I), which was carried out jointly with the European Union (EU), started in 2011 in the 16 provinces with the lowest enrollment rates. The second phase of the project (KEP-II) started in 2015 with the goal of improving students' attendance rates. Another project carried out by MoNE and co-financed by the EU and the Republic of Turkey, titled Promoting Gender Equality in Education (ETCEP), started in 2014. The aim of this two-year project was to make schools more sensitive towards gender equality.

Besides MoNE, various non-governmental organizations (NGOs) in Turkey have conducted projects focusing on girls' education. United Nations Children's Fund (UNICEF) and MoNE together conducted the Girls' Education Campaign "Haydi Kızlar Okula" between 2001-2005 in all 81 provinces. In the first year of the project, an increase of 40,000 students (30,000 of which were girls) was observed in the total number of students attending school compared to the year before. In 2005, Doğan Holding initiated the "Baba Beni Okula Gönder" (Dad, Send Me to School) campaign in collaboration with the Association for Supporting Contemporary Life (ÇYDD). As a part of the project, dormitories for girls and rural schools have been built. With the support of ÇYDD, 11,000 girls received scholarships for their education.⁴ Turkcell, a Turkish GSM operator and ÇYDD have also cooperated in running a campaign called "Kardelenler" (Snowdrops), through which education scholarships were granted to disadvantaged girls from rural areas. National Geographic (NAT GEO) and UNICEF Turkish National Committee ran a campaign called "Kızlara Ses Ver" (Give Girls a Voice). These initiatives are among the good practices of supporting gender equality in education in Turkey.

These projects and campaigns carried out by MoNE and NGOs had a positive impact on the enrollment rates of girls throughout Turkey. However, enrollment rates alone are not adequate indicators to fully understand the achievement gap between girls and boys. First, enrollment rates do not provide any information about student attendance.

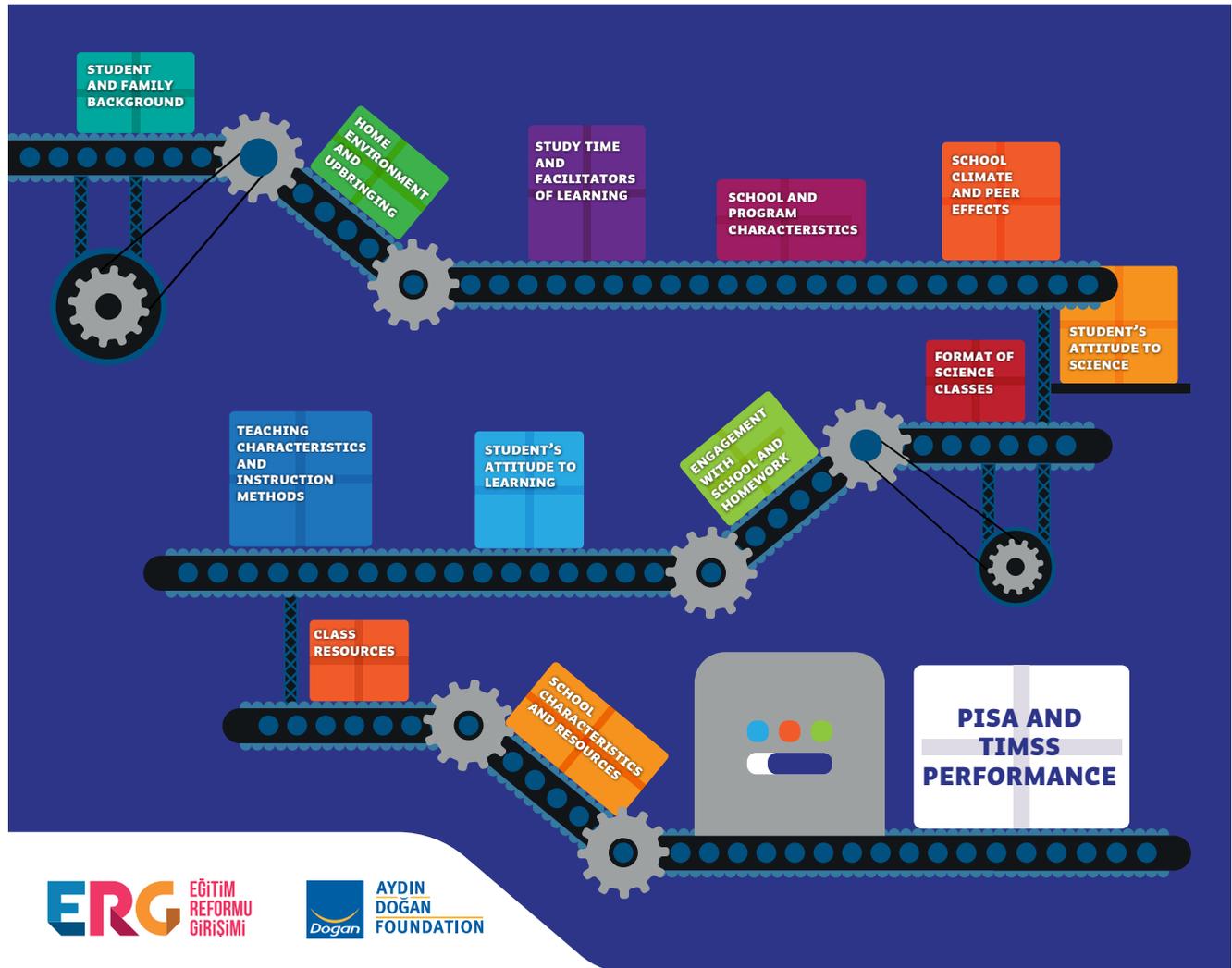
Additionally, gender equality in education goes beyond access to education, and enrollment and attendance rates. There needs to be a holistic approach that also takes into consideration learning processes (e.g. teaching materials that are free from gender bias), how academic achievement of girls and boys differ, transition from education into professional life as well as subsequent work conditions.

3 UNICEF (2016). *Gender Equality in Secondary Education. A literature review for UNICEF, NATCOM and Aydın Doğan Foundation.*

4 Baba Beni Okula Gönder (n.d). *Nasıl yola çıktık?* July 2017, <http://bababeniokulagonder.org/bbog.aspx>

GENDER GAPS IN STUDENT ACHIEVEMENT IN TURKEY: METHOD AND LIMITATIONS OF THE RESEARCH PROJECTS

The background studies on PISA 2015 and TIMSS 2015 examined the differences between girls' and boys' average scores considering student, family and school characteristics listed below. Then, regression analyses were carried out to identify the variables that predict the achievement gap. In other words, the studies explored the relationship between education outcomes (PISA and TIMSS scores) and selected inputs (student, family and school characteristics). Finally, characteristics that have resulted into advantages in terms of achievement and the extent of these advantages (endowments and returns on endowments) were analyzed for girls and boys separately.



In the research “**Gender Gap in Student Achievement in Turkey: Evidence from PISA 2015**” the following variables were analyzed:

- **Student and family background:** Ethnic background, parents’ educational attainment and employment status, socio-economic status of the family
- **Home environment and upbringing:** Student’s participation in early childhood education, level of emotional support provided by the parents, how often the student talks to his/her parents, student’s involvement in housework or paid work
- **Study time and “facilitators” of learning:** Number of hours student spends in class and to study at home, student’s achievement motivation, test anxiety, and sense of belonging at school
- **School and program characteristics:** Geographical region of the school and the program type
- **School resources and administration:** Average class size at school, student-teacher ratio, shortage of educational materials and staff, teacher quality, level of government funding, autonomy over the curricula, school type (private or public)
- **School environment:** Disciplinary climate, average socio-economic status of students, ratio of girls
- **Student’s attitude to science:** Whether the student enjoys learning science, whether the student is interested in science topics, student’s instrumental motivation to learn science
- **Format of science classes:** Teaching method used in the classroom: enquiry-based instruction, teacher-directed instruction or adaptive instruction

The study is based on the most recent PISA data, which was shared with the public in December 2016. 5,987 students from Turkey participated in the tests and completed the questionnaires in the spring of 2015. Most of the 15-year-old participants were in 9th grade or higher grades, attending high school. 123 children were middle school students.⁵ 50% of the students were girls, and 50% were boys.⁶

Enrollment rate for 15-year-old children in Turkey was 83% in spring 2015. However, PISA 2015 covers approximately 70% of all 15-year-old children in the country because students attending open education and certain other programs were not included in the sample.

5 Middle school students were excluded from the sample for several reasons. There are relatively few middle school students in the data set, making reliable analyses very difficult. More importantly, middle school students are significantly different from high school students. To clarify, middle school students had not yet taken the central exam for high school entrance, and they also have a higher chance of performing poorly and repeating a grade. Therefore, by limiting it only to high school students the sample was made more homogenous.

6 Ministry of National Education, General Directorate of Measurement, Evaluation and Examination Services (2016). Uluslararası Öğrenci Değerlendirme Programı PISA 2015 Ulusal Raporu. July 2017, http://odsgm.meb.gov.tr/test/analizler/docs/PISA/PISA2015_Ulusal_Rapor.pdf

The research “**Gender Gap in Student Achievement in Turkey: Evidence from TIMSS 2015**” looks into the following factors and variables, many of which are common with the PISA study:

- **Student and family background:** Ethnic background, parents’ educational attainment and employment status, socio-economic status of the family
- **Home environment and upbringing:** Student’s participation in early childhood education, parents’ attitudes towards mathematics and science⁷
- **Engagement with school and homework:** How often the student is absent, sense of belonging to school, homework frequency per week (4th graders), time spent on homework per week (8th graders)
- **Student’s attitude to learning:** How much the student enjoys learning mathematics and science, how confident the student feels in these fields, how much the student values mathematics and science⁸
- **Teaching characteristics and instruction methods:** Teacher’s professional experience, teacher’s education level, teacher’s sex, teaching method (enquiry-based instruction, teacher-directed or student-oriented), emphasis on science investigation (how often students engage with observation, experiments and fieldwork)
- **Class resources:** Average class size, weekly hours for mathematics and science lessons
- **School characteristics and resources:** Location of the school (village, town or city), whether the school groups students by ability in mathematics and science, shortage of materials
- **School’s climate and peer effects:** Disciplinary climate and safety at school, average socio-economic status of students, whether teaching is adversely affected by students’ needs (such as lack of sleep, disability etc.)

The research is based on the most recent TIMSS data, which was made public in November 2016. TIMSS sample includes 12,535 students from Turkey: 6,456 4th graders and 6,079 8th graders. Of the 4th grade students, 3,178 (49.2%) are girls and 3,278 (50.8%) are boys. Of the 8th grade students, 2,943 (48.4%) are girls and 3,136 (51.6%) are boys.

Neither PISA nor TIMSS provide information on out-of-school children. Therefore, children who are not enrolled in education should also be taken into account so that academic achievement could be analyzed more comprehensively. Lastly, it should be noted that the methodology of these studies does not allow for establishing causality; instead, conditional correlations are presented.

7 Data available only for 4th grade students.

8 Data available only for 8th grade students.

A 30-point score difference in PISA is about equivalent of one year of schooling.⁹

PISA 2015 FINDINGS

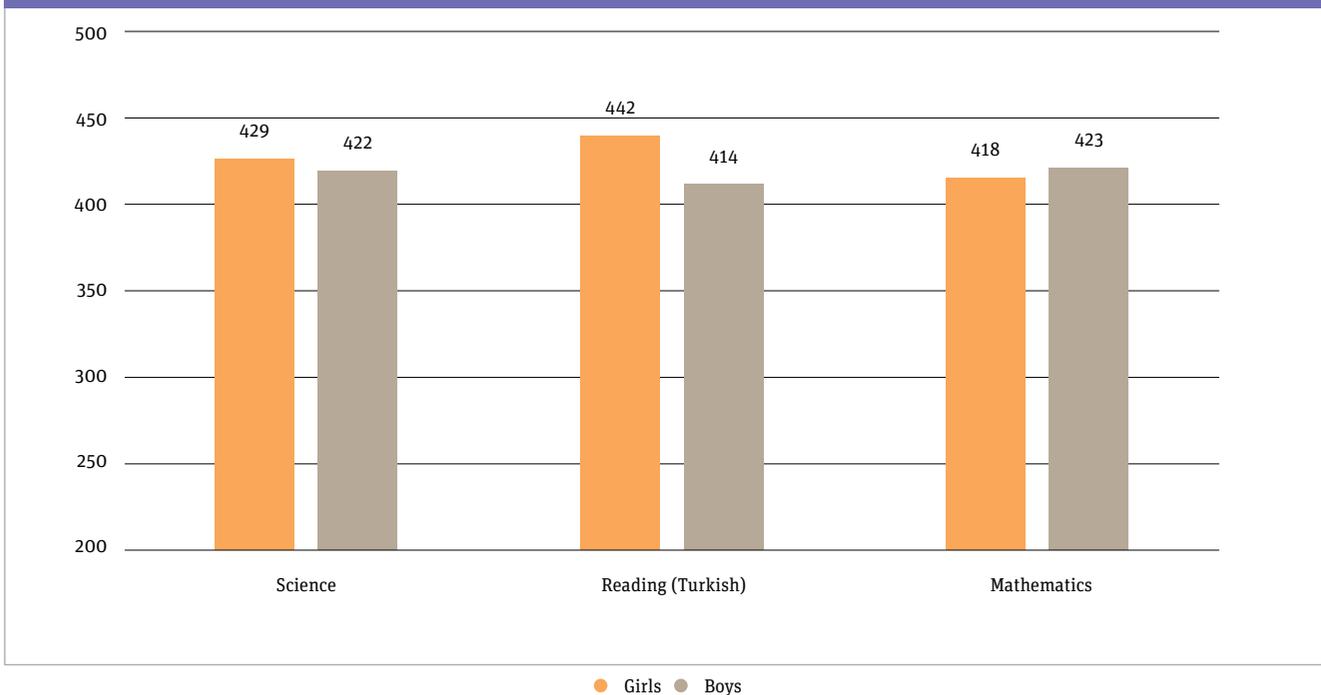
Descriptive statistics of the PISA 2015 research suggest that:

In **reading** (Turkish literacy), girls outperform boys by 28 points. **Among high school students, girls' average score is 25 points higher than boys' average score, and this difference is statistically significant.**

In **mathematics** literacy, it is common that boys perform better in OECD countries. Turkey is an exception to this trend. In Turkey, boys scored only 5 points higher than girls, and this is not a statistically significant gap. **Nevertheless, when the middle school students are excluded from the sample, the gap in favor of boys increases to 9 points and becomes statistically significant.**

In **science** literacy, girls scored 7 points higher than boys, a difference that is not statistically significant. When the sample is limited to high school students, the difference narrows down to 3 points and remains statistically insignificant. **Therefore, it can be concluded that girls and boys perform alike in science.**

GRAPH 2: AVERAGE SCORES IN SCIENCE, MATHEMATICS, AND READING (TURKISH) ACCORDING TO SEX, TURKEY, PISA 2015



In addition to disparities in performance, there are other notable differences between girls and boys:

- Levels of parental support and interaction with parents are higher for girls.
- Girls receive more hours of instruction at school, and they are less likely to be engaged in paid work.
- Girls are more likely to attend schools with more positive disciplinary climate.
- Girls have higher levels of achievement motivation as well as a higher sense of belonging to their schools. However, they feel higher levels of anxiety regarding their performance.
- Boys spend less time studying at home than girls.
- Additionally, PISA 2015 explored attitudes towards science. In Turkey, when compared to boys, girls are less interested in science. However, they display higher awareness on the importance of studying science for their lives and careers.

Although descriptive statistics show that girls have higher endowments than boys, decomposition of the gender gap reveals that girls obtain lower returns in mathematics and science. In other words, boys are better at translating their endowments, such as achievement motivation, sense of belonging etc., into high returns in science and mathematics literacy. It is only in Turkish literacy that girls obtain higher returns on their endowments. How endowments are translated into different levels of returns (as scores) for girls and boys is depicted below:

- In **mathematics** literacy, if they shared the same characteristics with boys, girls' average score would decrease by 6.5 points.
- In **science** literacy, if they shared the same characteristics with boys, girls' average score would decrease by 11.5 points. In other words, girls cannot translate their advantages into success.

The study also analyzes the relationship between selected student, family and school characteristics and PISA scores. **According to the results of the regression analysis, determinants of the gender gap in student achievement in Turkey are the following:**

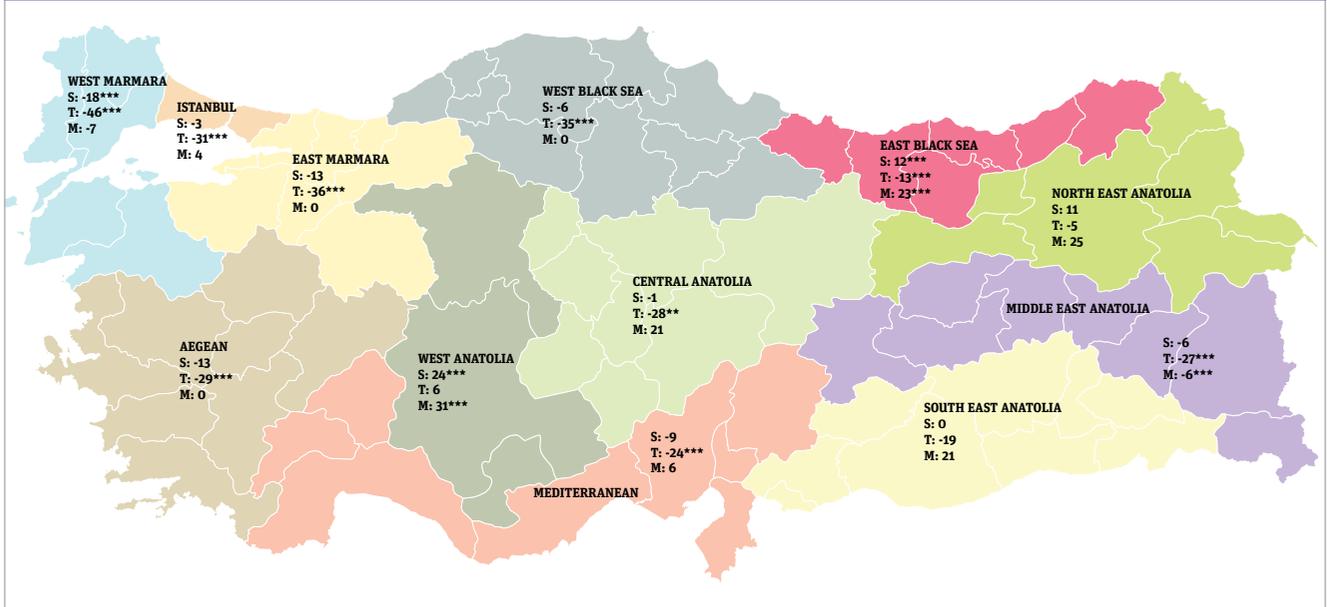
1. Geographic location of the school

In West Anatolia, Northeast Anatolia and East Black Sea regions, girls do not outperform boys even in **Turkish** literacy, which is the only subject where girls perform better than boys at the country level.

In **mathematics** literacy, the gender gap is deeper in West Anatolia and East Black Sea regions. Boys' average score is 31 points higher in West Anatolia, and 23 points higher in the latter.

In **science** literacy, girls in East Black Sea and West Anatolia regions score lower than boys by 12 and 25 points respectively.

FIGURE 1: DIFFERENCES IN AVERAGE PISA SCORES OF GIRLS AND BOYS, BY REGIONS



Note 1: S: science literacy, T: Turkish literacy, M: mathematics literacy. S, T, M values on the map indicates the difference between girls' and boys' average scores (girls' average score is subtracted from boys' average score). For example, "S: 24" means that boys score 24 points higher than girls in science in a particular region.

Note 2: Statistical significance: *** $p=0.01$, ** $p=0.05$, * $p=0.1$

2. Educational attainment of the parents

When the education levels of both parents are included in the analysis together, fathers' attainment levels seem to have a stronger relation with students' performance in **Turkish** literacy. Even after school climate and peer effects are controlled for, the effect of father having a university degree persists, especially for boys. On average, male students whose fathers have a university degree score 9.3 points higher. For girls, father's educational attainment does not appear to be quite as significant in Turkish literacy.

In **mathematics** literacy, father's educational attainment seems more important for girls. On average, daughters of fathers with a high school degree perform 9 points higher in comparison with their female peers with uneducated fathers.

In **science** literacy, father's educational attainment and PISA scores are positively correlated for both sexes, but its effect is stronger for boys. Male students whose fathers have a university degree score 11 points higher in comparison with their male peers with uneducated fathers.

3. Employment status of the parents

On average, boys whose mothers are employed score 10 points higher in **Turkish** literacy when compared to boys with unemployed mothers. Girls whose fathers are employed score 9 points higher than their female peers whose fathers are unemployed.

While the employment status of the parents does not affect **mathematics** scores of boys, having a mother in employment has a positive effect on girls' performance. Girls whose mothers are employed score 7.5 points higher than their female peers whose mothers are

unemployed. This finding might be an indicator of the positive effect of parental role models in math education.

In **science**, while mother's employment has a positive effect on both girls' and boys' performance, father's employment status does not seem to have a significant impact.

4. Socio-economic status

PISA analyzes the socio-economic status of students using the index of economic, social and cultural status (ESCS). This index takes into account highest parental education level and occupational level, and a variety of home possessions, such as the number of books in the house. Findings show that socio-economic status affects both girls' and boys' performance in all three subjects. Socio-economic status does not create a divide between girls and boys.

5. Non-Cognitive Factors

PISA does not only examine students' cognitive skills in science, math and reading, it also looks into a series of non-cognitive attributes such as attitudes, motivations, and selected personal characteristics of the students. The non-cognitive factors that were found to be associated with the gender gap in student achievement are as follows:

- **Parental emotional support:** Parental emotional support is more important for boys' performance in **Turkish** literacy. While it is not correlated with girls' performance in Turkish literacy, one unit increase in parental emotional support increases boys' scores by 3 points. Conversing with parents has great significance for both sexes. Students who talk to their parents more frequently score 20 points higher than their peers. In **mathematics** literacy however, emotional support from parents does not have the same significance either for girls or boys. Thus, boys need more support to receive high scores in Turkish literacy, and girls' performance in mathematics is not dependent on the emotional support of their parents. In **science** literacy, similar to math performance, parental emotional support is not important for girls and boys. Nonetheless, when emotional support is controlled for, talking to parents is still an important factor for both sexes.
- **Achievement motivation:** In **Turkish** and **science** literacy, achievement motivation effects mainly boys' performance. Whereas one unit increase in motivation increases boys' average scores by 5.5 and 3.5 points in Turkish and science respectively, it is not associated with girls' performance. On the other hand, achievement motivation has an effect on both boys' and girls' performance in **mathematics**. Accordingly, girls with higher levels of motivation can obtain higher scores in mathematics.
- **Sense of belonging to the school:** Sense of belonging to school is important only for girls' performance in Turkish literacy. One unit increase in girls' sense of belonging is related to a 2.7-point increase in Turkish literacy scores. In **mathematics** and **science** literacy, sense of belonging does not appear to have a significant role for either sex.
- **Test anxiety:** While test anxiety has a negative relation with girls' performance in **Turkish** literacy, it does not have a significant effect for boys. One-unit increase in girls' test anxiety is associated with a 4.3-point decrease in their performance. In **mathematics** and **science** literacy, test anxiety affects not only girls but also boys. In mathematics, one unit increase in anxiety is associated with a 4.2-point decrease in boys' performance and a 6.7-point decrease in girls' performance. In science, one unit increase in test anxiety is associated with a 3.8-point decrease in boys' and 6.4 points decrease in girls' performance.

These findings suggest that **the relationship between non-cognitive attributes and Turkish literacy scores might be gendered**. However, the relationship between mathematics literacy and non-cognitive factors appears to be less gendered. **In other words, it might be easier for girls to close the gender gap in mathematics performance than for boys to do the same with regard to Turkish literacy performance.** The relationship between non-cognitive factors and science literacy is less gendered than the relationship with Turkish literacy, and more gendered than the relationship with mathematics literacy. This might also explain why girls perform similarly to boys in science, instead of outperforming them (as in reading) or lagging behind them (as in mathematics).

6. Other determinants

There are some other student characteristics that might help explain the achievement gap between girls and boys:

- **Paid work and housework:** Both paid work and housework affect mathematics and science performance negatively, for both sexes. However, for girls attending schools with a higher socio-economic status, the negative effect of housework is not observed.
- **Attitudes to science:** In Turkey, instrumental motivation to learn science and interest in science positively affect only boys' performance. Although girls have higher motivation on average, it does not translate into higher scores. As for the teaching methods adopted in science lessons, "adaptive instruction", in which the teacher takes into consideration students' needs and knowledge and supports them individually, seems to be beneficial for girls' performance.



TIMSS 2015 FINDINGS

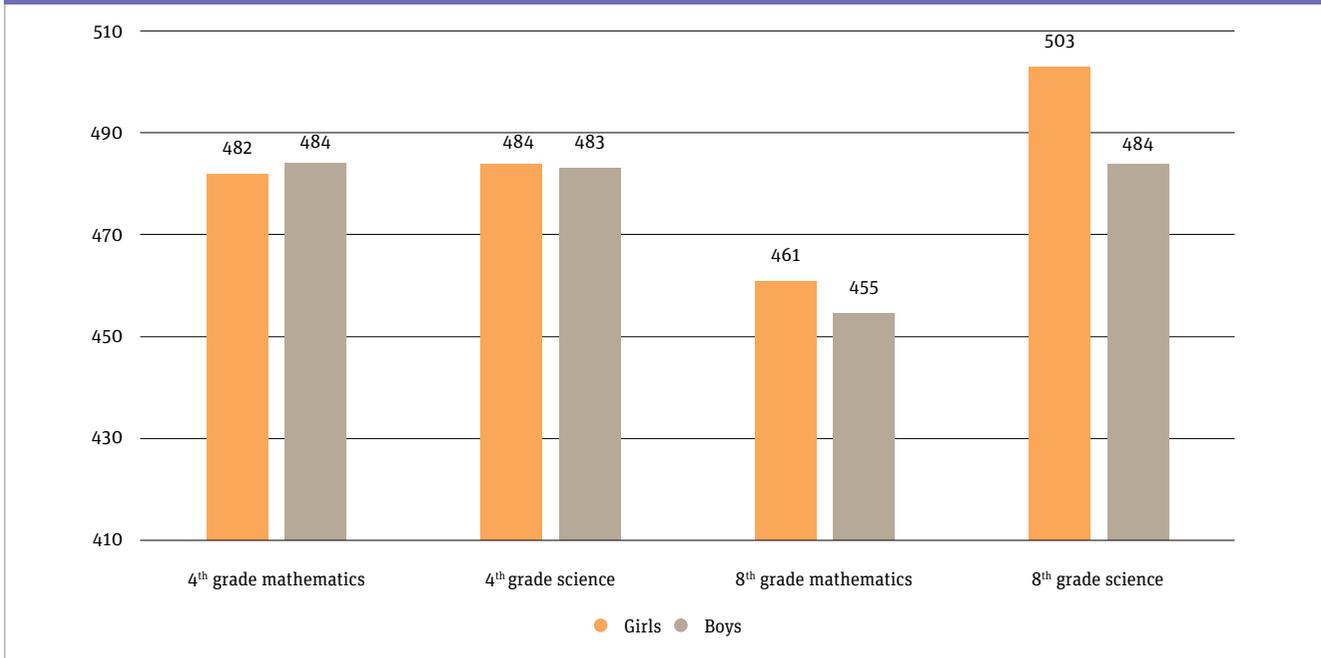
While PISA tests students' ability to apply their knowledge and skills to real life contexts, TIMSS focuses on the learning objectives in the curricula.

According to the descriptive statistics based on TIMSS 2015;

In **mathematics**, in the 4th grade, boys are 2 points ahead of girls whereas in 8th grade, girls are 6 points ahead of boys. However, these differences in scores are not statistically significant. Therefore, it can be suggested that girls and boys perform alike in mathematics.

In **science**, in the 4th grade, the difference between girls' and boys' performance is close to zero. In the 8th grade, girls' average score is 19 points higher, and this difference is statistically significant.

GRAPH 3: AVERAGE SCORES IN MATHEMATICS AND SCIENCE BY SEX, TURKEY, TIMSS 2015



In addition to TIMSS scores, the study looks into other variables to examine different characteristics of girls and boys in 4th and 8th grades. According to these differences;

Among 4th grade students:

- Girls and boys come from similar households in terms of parents' education and employment, and intellectual capital (measured by the number of books at home) and material wealth (measured by digital devices at home). In addition, time spent in early childhood education, school characteristics (resources, discipline and safety), and teacher characteristics are relatively similar for girls and boys.
- However, girls come from homes where they participated in early literacy and numeracy activities more often prior to schooling. In other words, it is more common for parents to read books and do counting activities with their daughters.
- Although girls and boys have similar attendance rates, girls are more likely to do their homework regularly.
- Girls display a stronger sense of belonging to their schools. Girls also report enjoying learning mathematics and science, especially science, more often than boys.
- On the other hand, boys are more self-confident in mathematics, whereas girls' level of self-confidence is stronger with regard to science.

Among **8th grade** students:

- Girls' and boys' family backgrounds appear to be different. At this grade level, girls are more likely to come from households with high number of books and moderate number of digital devices.
- Girls are considerably less likely to be absent from school (at least once a month) than boys. Girls also have more positive attitudes to mathematics and science -especially science- classes.
- Girls display a stronger sense of belonging to their schools, and like learning mathematics and science more than boys do.
- Girls are less confident in mathematics and more confident in science. On average, boys have teachers with longer tenures and girls attend a (slightly) higher number of mathematics and science classes per week.
- Girls attend better (characterized by higher discipline and safety) schools.

Although the descriptive statistics suggest higher endowments for girls, decomposition of the gender gap reveals that girls in the 4th grade obtain lower returns on their endowments in mathematics and science. In other words, boys' endowments, such as self-confidence, sense of belonging etc., are translated into higher TIMSS scores.

In the 8th grade, girls obtain higher returns on their endowments than boys do in science. In mathematics, differences between girls and boys in terms of endowments are negligible.

Additionally, the study examines the relationship between a series of student, family and school characteristics and TIMSS scores using regression analysis. According to the TIMSS data, **determinants of the gender gap in student achievement in Turkey are the following:**

1. Educational attainment of the parents

Parents having at least a high school degree correlates with mathematics and science scores of both 4th and 8th graders. In the 4th grade, mother's education appears to be more important for boys, and father's education is more important for girls' mathematics performance. Girls whose fathers who attended high school or further levels of education perform almost 20 points higher than girls with less educated fathers. This finding is in line with the PISA findings that suggest fathers' education is more important in girls' mathematics achievement.

2. Employment status of the parents¹⁰

Having employed parents has a positive effect on math scores of both girls and boys in the 4th grade, yet it disappears when other variables such as students' attitude to mathematics and school characteristics are included in the model. Therefore, parents' employment status is not an important factor for either sex.

¹⁰ Parents' employment status is not known for 8th graders.

3. Socio-economic status

TIMSS measures intellectual capital by the number of books at home, and material wealth by the number of digital devices at home. Both for 4th and 8th grade students, the number of books at home correlates positively with mathematics and science scores of girls and boys. For example, girls who report that they have more than 200 books at home score 48.5 points higher than girls who report to have less than 10 books; this difference is 44 points for boys. This finding is consistent with the PISA finding that shows that socio-economic status affects both girls' and boys' scores.

The effect of the number of digital devices (tablets, smartphones, etc.) stands out more for girls in 4th grade. However, very high numbers of digital devices appear to be harmful, possibly because it creates distraction from studies.

4. Early childhood education

TIMSS data reveal that attending early childhood education improves mathematics scores in the 4th grade for both girls and boys. The effect is larger and more persistent for girls. Compared to having received none, attending one year or less in early childhood education improves girls' mathematics scores by 12 points. Additionally, participation in literacy and numeracy activities prior to schooling is beneficial for both girls and boys. In science, the positive effect of having spent a year in early childhood education is observed only for girls.

5. Sense of belonging to the school

Contrary to the PISA finding that suggests no significant effect of sense of belonging on science and mathematics scores for either sex, TIMSS data shows that the sense of belonging is important for 4th grade students' achievement in both subjects. It seems especially important for girls as one unit increase in the sense of belonging is associated with a 3-point increase in mathematics scores for girls attending 4th grade.

6. Enjoying learning mathematics and science; self-confidence in mathematics and science

In the 4th grade, the positive effect of enjoying learning mathematics on mathematics scores is observed only for boys. In other words, girls' interest in mathematics does not translate into higher scores. **This is in line with the PISA 2015 data which suggests that girls lag behind boys in translating their achievement motivation into mathematics performance.** Moreover, in both grades and for both sexes, self-confidence in mathematics and science seem very crucial for student achievement. For example, one unit increase in self-confidence in mathematics is associated with a 19-point increase for boys and 21-point increase for girls who attend 8th grade.

7. Experience of the teacher and teaching methods

In the 4th grade, girls benefit from experienced teachers more than boys do. One more year of experience is correlated with a 1.5-point increase in mathematics and a 1.7-point increase in science scores for girls in the 4th grade.

POLICY IMPLICATIONS

Gender-based analyses of PISA and TIMSS data reveal that **girls in Turkey lag behind boys in translating their endowments, such as self-confidence, sense of belonging to school, achievement motivation and enjoyment from learning, into returns and scores**. Besides, both international assessments show that parents' education and employment, and socio-economic status are related to all students' achievement regardless of gender.

Another common finding of PISA 2015 and TIMSS 2015 analyses is that the factors affecting gender gap in student achievement can vary considerably across subjects. For example, while parental emotional support is important for reading skills, it does not have the same positive effect on mathematics performance. Thus, **variation in the gender gap should be investigated closely, and different dynamics observed in relation to different subjects need to be taken into account while designing initiatives to eliminate the gender gap.**

Based on the findings of "Gender Gap in Student Achievement in Turkey" studies, a number of policy measures are recommended to eliminate the gender gaps in education by improving the performance of students, especially girls. While some of these recommendations are specifically about parents, teachers, school managers, others are related to the overall education system.

- **Girls systematically underperform in all three PISA subjects, Turkish, mathematics, and science literacy, only in West Anatolia and East Black Sea regions.** Local dynamics in these regions should be analyzed in detail, and the reasons behind the gender gap should be identified.
- Girls are more motivated than boys, however this advantage does not translate into their science and reading scores in PISA, whereas boys obtain high returns on their endowments in all subjects. According to TIMSS data, among the 4th grade students, enjoying learning mathematics increases only boys' scores. Similarly, among the 8th grade students, enjoying learning science increases only boys' scores. This is problematic given that in both grade levels on average girls like learning science and mathematics more than boys do. **Therefore, further insights from education research are needed to understand why girls' endowments do not translate into high returns.**
- Role models can help especially girls perform better in mathematics and science. In cases where parents cannot fulfill these roles, other people, for example the math and science teachers or inspiring people that students could meet at school or civil society events could act as role models.
- Evidence from TIMSS shows that the positive effect of early childhood education on student achievement is stronger for girls than it is for boys. **Sensitizing parents on the significance of early childhood education as well as literacy and numeracy activities prior to schooling, would support academic performance of all students, especially girls.** Additionally, education policies should be guided towards improving the enrollment rates, which are relatively low, and the quality of early childhood education.

In addition to interventions that specifically target girls, there is also a need for policies targeting all students in order to allow them to perform to their full potential:

- Time devoted to house chores and paid labor is detrimental to academic achievement of both girls and boys. Boys get involved in paid work more often than girls and this negatively affects their performance in every subject area. **As children working for pay**

or doing housework are more prevalent in households with financial hardships, social policies such as welfare support programs, conditional cash transfers and employment generation must be expanded in order to help dissipate the financial challenges in households with a single parent and/or a high number of siblings.

- Evidence shows that home environment matters for student achievement. Conversing regularly with parents is crucial for both girls' and boys' performance in science, mathematics and Turkish literacy. However, boys receive less attention than girls both in terms of parental emotional support and talking to their parents. **Therefore, sensitizing parents about the significance of parent-child interaction can have a positive effect on academic achievement of both sexes.**
- Girls suffer from performance anxiety much more than boys do, and this affects their scores negatively in every subject area. On the other hand, boys have a weaker sense of belonging to their school. **Efforts should be made in order to sensitize parents, teachers and school managers about the importance of providing girls with less stress-inducing educational environments, and boys with environments that would reinforce their sense of belonging.**
- Considering that girls in Turkey are less interested in science according to the PISA 2015 findings, it can be suggested that using teaching methods that foster the enjoyment of science would benefit all students, especially girls. Therefore, also keeping in mind that girls and boys are interested in different sub-areas of science, teaching methods to spark girls' interest in science must be developed. When formulating such strategies, it should be taken into consideration that enquiry-based instruction harms student performance while adaptive instruction is associated with higher science achievement.



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