Researching education, improving learning

# EQUITY IN EDUCATION

## EVIDENCE OF TIMSS 2023

## SERIES #3

Lessons from TIMSS 2023

## About the Series

Education begins with the belief that every student can learn, develop, and thus fully realize their potential. To make this possible, education policy must be inclusive and focused on ensuring access to quality education and creating equal learning conditions. Equity in education does not only mean equal distribution of resources—it implies a fair approach that considers and supports students' needs, abilities, and diversity.

Equal access does not imply identical learning outcomes. Educational equity means that differences in students' outcomes are not linked to their background or to social, economic, or other circumstances beyond their control.

*Do all students have the appropriate conditions to learn, develop, and realize their unique potential?* TIMSS offers reliable evidence to explore this question.

In this series, the TIMSS results are presented here through the lens of fundamental values that should underpin modern education systems: fairness, equity, and the full realization of each student's unique potential. The report analyzes the extent to which the education system has succeeded in creating equal and fair learning opportunities for all students, regardless of their socioeconomic background, place of residence, or other factors.

Improving the quality and accessibility of education is one of the strategic goals of education policy. The analysis of TIMSS results from 2007 to 2023 reflects both progress and challenges; the findings point to the need for systemic, targeted, and evidence-based reforms to achieve fair, equitable, and high-quality education.

To explore the key findings, see the **summary**.

***The report was prepared by the National Center for Educational Research (NCER)***

# Content

## Graphs and illustrations

## Equity in Education: Concept, Operationalization, and the Importance of Assessment

UNESCO defines equity as "systematic and targeted efforts that ensure all students—regardless of gender, family background, ethnicity, or place of residence—have equal opportunities to receive quality education" (UNESCO, 2017).

Equity in education is one of the most important principles that international assessments, including TIMSS, pay particular attention to. According to this principle, students' academic success should not be determined by factors beyond their control (e.g., family and social background, location of residence/school, gender, or school type). TIMSS allows for assessing not only students' average achievement levels but also the differences caused by social background or other structural factors mentioned above. In the TIMSS study, these differences are calculated by comparing the outcomes/achievements between different student groups (achievement gaps). Evaluating equity in TIMSS involves analyzing results based on **background characteristics** that should not hinder a student's academic development. Such disparities usually indicate systemic inequities and require a policy response.

When discussing equity in education, three dimensions are often distinguished:

- **Horizontal equity**: equal treatment of students with similar needs—equal conditions and opportunities for participation and development in education.
- **Vertical equity**: a "compensatory" approach toward students with different needs. It aims to neutralize the structural conditions that create inequality. This approach acknowledges students' differences and diverse needs and seeks to address them through targeted, extra support services.

**In general, equity** and fairness are critical components of analyzing systemic opportunities in educational outcomes. Though closely related, they are emphasized differently. According to the OECD, fairness in education means "structuring the education system in a way that provides all students with quality and relevant support, acknowledges differing individual needs, and ensures they are addressed" (OECD, 2012).The goal of fairness is not simply to provide "equal opportunities for all," but to develop interventions that match real needs.

Research shows that upward social mobility[1] is more common in countries where educational equity is relatively high—such as the Scandinavian countries (Holmlund & Nybom, 2023, May 24). Social mobility and educational mobility are interconnected. Today, as economic inequality reaches record highs (OECD, 2018), it is especially important to plan policies and implement measures that ensure equal access to education.

Measuring equity plays a crucial role in education systems. It not only helps ensure fair and targeted resource allocation but also supports the system's adequacy, promotes social justice, and enhances a country's international competitiveness. To achieve this goal, it is essential to ensure continuous monitoring of educational equity, which is defined by six key objectives (Equity and Inclusion, 2023):

[1] **Example of upward social mobility:**
*A person from a low-income family receives a quality education, gets a good job, and becomes a well-paid professional.*

***Monitoring and evaluation***

- Monitoring student academic outcomes and overall well-being, including dimensions such as diversity, socioeconomic background, and geographic location;
- Monitoring student achievement over time, which clearly indicates dynamics of progress or regress;
- Policy monitoring, which helps us understand how specific reforms or initiatives affect students and the education system;
- Monitoring demographic, administrative, and contextual data that may explain education system outcomes;

***Evidence-based governance***

- Providing information to all stakeholders;
- Using research-based evidence for policy development and implementation.

The assessment of equity has several key effects in supporting fairness within the system: identifying mismatches and differences between specific groups enables authorities and policy actors to accurately determine how resources should be allocated, creating the opportunity to implement so-called compensatory policies for students with different needs and to neutralize the structural conditions that cause inequality.

Research has shown that systems that ensure equity and inclusiveness achieve higher results at the international level. An example of this is Finland's education system, which is both equity-oriented and distinguished by high student achievement.

According to an OECD report, every country's education system has gaps that indicate systemic inequities (Equity and Inclusion, 2023). The results of the 2022 Program for International Student Assessment (PISA) clearly reflect inequality within the Georgia's education system. In Georgia, students living in cities perform better than those in rural areas, and students from socially and economically advantaged backgrounds have better academic achievement than their peers from vulnerable groups. Likewise, students whose language of instruction is Georgian perform better than those who receive education in Azeri language. In addition, private school students achieve higher results than public school students (UNICEF, 2024*).*

*So, what does TIMSS tell us about inequity in Georgia's education system?* International assessments, including TIMSS, are important analytical tools that provide complex data on students' academic achievements, the impact of social conditions, long-term trends, and the effectiveness of education policies. Therefore, they offer a unique opportunity to design targeted interventions and develop evidence-based education policy to ensure equity in the system.

## Inequality through the Lens of TIMSS:

### Hierarchical regression analysis for analyzing socioeconomic and gender aspects

In TIMSS, equity is understood as the fair distribution of both outcomes (achievement) and opportunities (resources), meaning that all students should have equal chances and conditions to achieve educational success. TIMSS assesses inequality to help participating countries ensure equal opportunities among students and minimize achievement gaps driven by factors such as **gender**, family **socioeconomic status**, school **location** (urban/rural), school **type** (public/private), etc.

TIMSS offers Georgia's education system a unique opportunity to evaluate how well it provides equitable access to education for all students. This report will analyze, in its various chapters, the extent to which the existing educational environment provides equal access to learning opportunities for diverse student groups and how this access is reflected in the differentiation of student achievement. Specifically, four key aspects will be examined, which are critical for ensuring equity in education:

- **School location (rural vs. urban)** – reflects geographic disparities that may affect access to resources and student achievement.
- **Socioeconomic composition** – highlights the extent of differences in learning outcomes between schools with varying social backgrounds.
- **School status (public vs. private)** – offers insights into whether school type is associated with academic performance.
- **Student gender** – indicates whether there are significant differences in mathematics and science performance between boys and girls.
- **Family socioeconomic status** – allows for the assessment of how strongly family resources influence learning and educational success.

***Does every student have adequate conditions to learn, develop, and fully realize their unique potential?***

Answering this fundamental question relies on evidence obtained through the use of the Hierarchical Linear Modeling (HLM) method. This method is based on the principle that students' educational outcomes are influenced not only by their individual characteristics but also by the school environment in which they learn. By applying HLM, it is possible to simultaneously assess the factors operating at the individual, class, and school levels, as well as the impact of each on students' educational outcomes.This method also allows for a more precise estimation of the effect of a selected factor (for example, school location or school status) on student outcomes—independently of the influence of other variables—thus providing a more accurate analysis of equity.

Accordingly, alongside the variables selected for the analysis of equity, the hierarchical model also incorporates additional factors that influence students' educational outcomes and the degree of equity. These factors include: **clarity of instruction**—the extent to which students understand lesson objectives, instructions, and assignments; **school emphasis on academic success**—whether the school fosters expectations and goals aimed at achieving high academic performance, which often shapes students' motivation and engagement; and **early learning experiences at home**—for instance, reading and engaging in arithmetic games during the preschool years, which help develop children's foundational skills and attitudes toward learning.

The analysis also takes into account school discipline, availability of resources (e.g., the effect of shortages in mathematics or science materials on learning), and several other relevant contextual factors.

**About HLM**

TIMSS data have a hierarchical structure—students are nested within classes, and classes within schools. Accordingly, student outcomes may depend not only on individual characteristics (such as gender, motivation, or family educational resources) but also on the **social and educational context** in which teaching and learning take place (for example, class climate, teaching practices, or the school's organizational culture[2]). Therefore, when assessing equity and examining the impact of such factors as school location or students' socioeconomic status, it is also important to account for additional factors that may substantially affect both student achievement and the degree of equity.

Using HLM allows us to simultaneously analyze the influence of factors operating at the **individual level** (e.g., students' socioeconomic background) and **contextual characteristics** at the school or classroom level, and to estimate the effect of each. Moreover, hierarchical regression analysis enables not only the assessment of unique effects of specific factors but also their **interactions**—that is, how one factor may amplify or compensate for another's effect. Assessing interaction effects helps us better understand how certain factors operate across different social groups, evaluate whether an effect is uniform for all students, and gain a more detailed and accurate picture of the determinants of student achievement. Such an approach is particularly important, for example, when we want to determine the extent to which the **school environment helps mitigate (or compensate for)** initial inequalities stemming from students' social background.[3]. Identifying such **compensatory or reinforcing effects** becomes possible through the use of a complex analytical method like **hierarchical regression analysis**, which allows us to examine not only direct effects but also the **interactions among variables**—an aspect that is critically important for assessing the degree of equity in education.

**It is important to note that the software we used is limited in that it cannot account for the so-called plausible values in the TIMSS data and relies solely on the first plausible value for the analysis.*

### TIMSS 2023: Which factors are considered in the analysis of equity?

According to the TIMSS 2023 data, in addition to the selected variables used for equity analysis (such as school location, school status, and others), the hierarchical model also includes or controls[4] for additional factors that influence students' educational outcomes and the degree of equity.

These factors include:

- **Clarity of instruction** – the extent to which students understand lesson objectives, instructions, and assignments;

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[2] Van Dusen, B., & Nissen, J. (2019). Modernizing use of regression models in physics education research: A review of hierarchical linear modeling. Physical Review Physics Education Research, 15(2), 020108. https://doi.org/10.1103/PhysRevPhysEducRes.15.020108

[3] For example, access to high-quality educational resources at school may, at least partially, compensate for the negative effects of low socio-economic status at home on a student's academic achievement.

[4] Controlling refers to accounting for the effects of other factors in order to estimate the "net" influence or effect of the selected variable.

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- **School emphasis on academic success** – whether the school sets clear expectations and goals for high academic achievement, which often shapes students' motivation and engagement;
- **Early learning experiences at home** – for example, reading and engaging in arithmetic games during the preschool years, which help develop children's foundational skills and attitudes toward learning.

**Socio-economic status (SES)** of the family is used both as a key factor explaining differences in student outcomes and as a control variable to account for the effect of initial social capital. The presented models also analyze factors such as **school discipline**, **availability of learning resources** (e.g., shortages of materials needed for mathematics and science), and other relevant characteristics that help explain the existing differences in students' educational achievement. By controlling for these variables, the analysis aims to estimate the "net" effect of school location, school status, and other variables of interest included in the study.

## Educational Opportunities for All Students – The Effect of School Location

School location often has a significant impact on students' educational achievement. Differences between rural and urban areas in terms of resources, infrastructure, and other opportunities may shape and/or reinforce educational inequality. In many countries, rural schools and students face these challenges, which are reflected in students' academic outcomes.

Among the potential factors contributing to inequality are: school infrastructure; teacher qualifications (including difficulties in attracting and retaining qualified teachers in rural areas and limited opportunities for professional development); scarce financial resources to address challenges faced by schools; and limited opportunities for learning beyond school (such as access to museums, libraries, and other educational institutions). However, it should also be noted that, alongside these challenges, rural schools have certain advantages compared to urban ones. Specifically, rural communities tend to be more cohesive and close-knit, which allows teachers to maintain stronger relationships with students and their families, better understand their backgrounds, and take students' individual needs into account in the learning process. Moreover, rural schools often provide a safer environment where bullying is less frequent (Johnson, 2021).

Research evidence generally shows that students in urban schools demonstrate substantially higher achievement than their peers in rural schools. For example, based on TIMSS 2019 data, Jošić (2021) analyzed the mathematics and science achievement of Grade 4 students in seven Eastern European countries (Albania, Bosnia and Herzegovina, Kosovo, Montenegro, Serbia, Croatia, and North Macedonia) by school location. The analysis revealed that in each of these countries, student achievement in mathematics and science differs significantly between urban and rural schools (with the exception of Montenegro, where a significant difference was found only in science).

Clearly, it is the responsibility of the education system to ensure that all schools have access to the resources and conditions necessary for success. The amount and quality of knowledge a student acquires should not depend solely on the geographical location of their school—whether it is in a rural or urban area.

***What is the situation in Georgia in this regard?***

We begin discussion with an analysis of the 16-year trend in student achievement in urban and rural schools. First, it should be noted that approximately 74% of students participating in the study attend urban schools, while 26% attend rural schools.

TIMSS results confirm that from 2007 to 2023, students in **both urban and rural schools** in Georgia have significantly improved their performance in mathematics and science.

***Illustration 1.*** *Trends in mathematics and science achievement among Georgian Grade 4 students by school location*
** The asterisk indicates that, in a given year, the difference between the mean scores of students in urban and rural schools is statistically significant.*

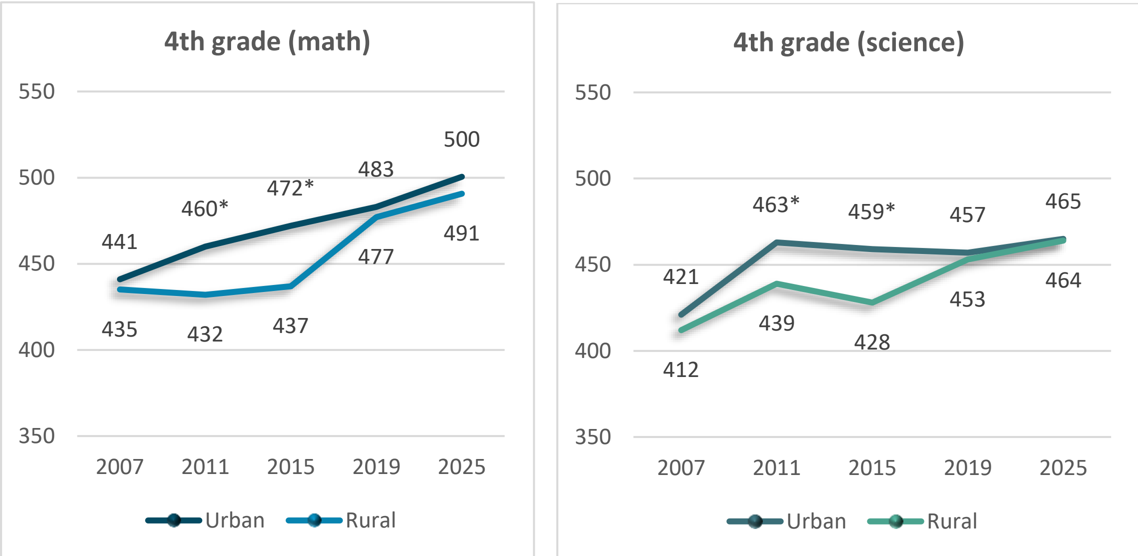
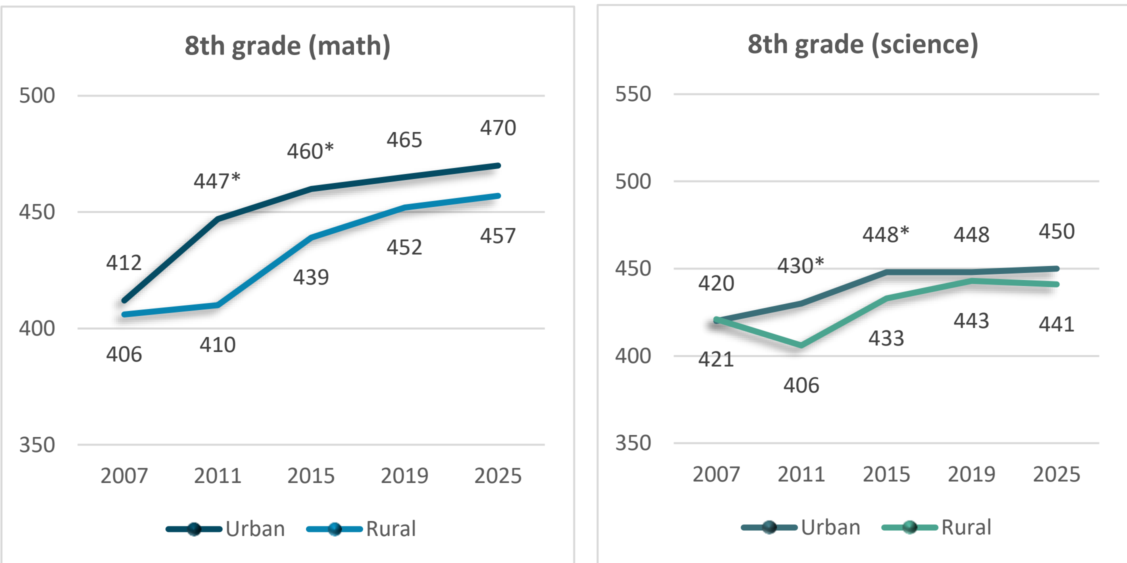



***Illustration 2.*** *Trends in the Achievement of Georgian eighth-Grade Students in Mathematics and Science by School Location*

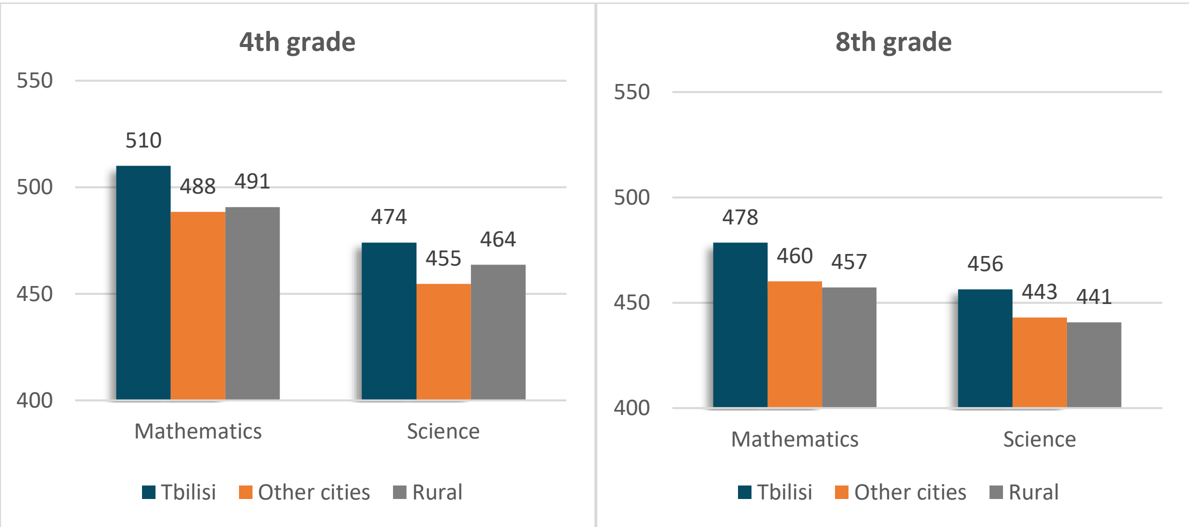
**An asterisk indicates that the difference in average scores between students in urban and rural schools is statistically significant for that year.*



The illustrations show that in 2007, the average achievement levels of students in both urban and rural schools were quite low. Although students in urban schools performed slightly better, the difference between their results and those of students in rural schools was not statistically significant. However, the absence of such a difference cannot be interpreted as evidence of true educational equity — rather, the low performance observed in both segments (urban and rural) in 2007 reflected broader systemic challenges that equally affected students' outcomes across both school types.

A statistically significant difference between the achievement of urban and rural school students was recorded in the 2011 and 2015 cycles (for both Grade 4 and Grade 8, and in both mathematics and science). This gap was mainly driven by the improvement in **urban students' performance. Since 2015, however, the improvement trend has been stronger in rural schools than in urban ones.** Compared with 2007, the progress in 2023 is particularly visible in mathematics, where students in both urban and rural schools—at both Grade 4 and Grade 8 levels — improved their average scores by about 50 to 60 points. The TIMSS 2023 results show that there is no longer a statistically significant difference between the mean achievement of students in urban and rural schools. Nevertheless, students in Tbilisi still outperform their peers from regional towns and rural schools in terms of average achievement.

***Illustration 3.*** *Achievement of Georgian students in mathematics and science by school location, 2023 (Tbilisi schools shown separately)*




The resources and conditions available in Tbilisi are generally more developed compared to other regions, which may explain part of the difference in student achievement and, more broadly, the potential causes of inequality within the education system. Taking into account the patterns observed in student achievement by school location, a hierarchical regression analysis was conducted using two different models. In both models, the predictor variable is school location; however, in the first model it is represented as a two-category variable (rural/urban), while in the second model Tbilisi is treated as a separate group, forming a three-category variable (Tbilisi, regional cities, and rural areas). Separating Tbilisi as a distinct group allowed for a more detailed and accurate assessment of regional disparities in student achievement.

***(1) Hierarchical Regression Analysis: Urban and Rural Schools***

The results of the TIMSS 2023 hierarchical regression analysis also confirm that when Tbilisi and other cities are combined into a single category ("urban"), the effect of school location on student achievement at the primary level is not statistically significant. For example, in mathematics, urban students scored on average 10.1 points higher than rural students, but the standard error was relatively large (SE = 7.6), making this difference statistically insignificant. A similar pattern was observed in science.

At the basic level, a different trend was found. Unlike in primary education, at the initial stage (before controlling for individual or contextual factors), school location had a significant effect on the achievement of Grade 8 students in both mathematics and science. On average, urban students outperformed their rural peers by 20 points in mathematics and 14 points in science (Mathematics: B = 20.7, SE = 10.3; Science: B = 14.0, SE = 6.6). However, this effect lost statistical significance once the **clarity of instruction** was taken into account. This suggests that the advantage of urban schools may be partly explained by better organization of the teaching process and/or generally higher quality of instruction. (**See Appendix 2** - **Tables 2.1, 2.2, 2.3 and 2.4** for details).

***(2) Hierarchical Regression Analysis: Tbilisi, Regional Cities, and Rural Schools***

The effect of school location on student achievement in Georgia appears differently—and more sharply—when Tbilisi is treated as a separate analytical category (*Tbilisi, regional cities, rural areas*). Defining Tbilisi as a separate analytical unit allows for a more accurate evaluation of the differentiation of educational opportunities and the real scale of inequality. The analysis shows that Tbilisi's advantage is stable and, unlike in the "urban vs. rural" model, remains statistically significant even after controlling for other individual and school-level factors (**See Appendix 1** - **Tables 1.1, 1.2, 1.3 and 1.4** for details).

Specifically, the results of the hierarchical regression analysis indicate a similar pattern across educational levels. Both at the **primary level (Grade 4)** (**See Appendix 1** - **Tables 1.1 and 1.2**) and the **basic level (Grade 8)** (**See Appendix 1** - **Tables 1.3 and 1.4**), students in Tbilisi schools (Tbilisi vs. urban/rural areas) perform, on average, better than students in regional town and village schools in both mathematics and science. The effect is stable and consistent: even after controlling[5] for individual factors (such as family socioeconomic status) and school-level factors (such as clarity of instruction, availability of learning resources, and the school's emphasis on academic achievement), the effect of school location remains statistically significant (Grade 4: mathematics and science; Grade 8: mathematics). The only exception is Grade 8 science, where the effect of school location—although quite strong in the initial models—disappears once various individual and learning environment factors are taken into account.

These results can be considered as evidence of **inequality in access to educational resources** and **regional differentiation in learning opportunities**.

[5] Controlling implies the assumption that we compare the results of students who have identical socioeconomic status and other characteristics included in the hierarchical model across Tbilisi, urban, and rural schools. This approach allows for a more accurate estimation of the effect of school location, independent of the influence of other variables.

*What factors explain the effect of school location on student achievement?*

The hierarchical analysis indicates that the lower achievement of rural students is partly explained by the quality of instruction and availability of school resources, and partly by family socio-economic status (SES). Family socioeconomic status (SES), clarity of instruction, and shortage of mathematics resources are factors that have a statistically significant effect on learning outcomes, suggesting that students' lower achievement is associated with limited access to resources—and vice versa. Among school-level factors, the school's emphasis on academic success[6] proved particularly important.

Overall, the data analysis confirms that regional inequality within Georgia's education system is driven not only by social factors (e.g., family socio-economic status) but also by systemic and structural factors. Therefore, targeted education policies should aim to strengthen the resources and improve the quality of teaching in rural and regional schools. Policies focused on enhancing rural and regional school capacity, improving teaching quality, and promoting equal opportunities are essential—not only for improving academic outcomes but also for **ensuring educational equity** overall.

**Results of Hierarchical Regression Analysis: The Effect of School Location on Student Achievement** *(Tbilisi, Regional Cities, and Rural Areas)*

***Primary Level – Grade 4***

**Mathematics.** Students in Tbilisi schools, on average, score **20 points higher** than students in rural schools (SE = 3.6, $p < .01$). Tbilisi also has an advantage compared to regional cities. The so-called *"Tbilisi effect"* is statistically significant and quite stable; it remains significant even when important factors such as *family socioeconomic status, clarity of instruction in mathematics lessons, school socioeconomic composition, school emphasis on academic achievement, and school discipline are taken into account.* Under full control of all these factors, the effect does not disappear — it even increases slightly, from **10.9 to 11.7 points** (SE ≈ 3.6–3.4, $p < .001$). This increase can be interpreted as the *"net" or "direct" effect* of school location that emerges after controlling for all other relevant individual and school-level variables.

**Science.** The effect of school location is somewhat weaker in science but remains stable and statistically significant. In the initial models, without controlling for family socioeconomic status (SES), students in Tbilisi schools scored on average (15.6 – 7.8 points) higher (B = 7.8, SE = 3.6, $p < .05$). After controlling for family SES, the effect of school location not only persists but slightly increases (B = 8.8, $p < .001$). This increase can be explained by the fact that family SES partly masks the effect of location — students with higher SES are proportionally more likely to live in Tbilisi. Consequently, once SES is controlled for, the differences between regional cities, rural areas, and Tbilisi become more evident. Two factors have a particularly strong and consistent influence on student achievement in science: **clarity of instruction** (B = 8.4, SE = 0.7, $p < .001$) and **school emphasis on academic achievement** (B = 5.2, SE = 1.6, $p < .01$). When these are controlled for, the effect of school location decreases; however, the *"Tbilisi effect"* remains statistically significant even in the fully adjusted model (B = 8.8, SE = 3.4, $p < .05$).

[6] The school's strategic focus on developing students' knowledge and skills, maximizing their academic outcomes, and providing additional support when needed.

***Basic Level – Grade 8***

**Mathematics.** Eighth-grade students from Tbilisi schools achieve significantly higher results in mathematics. Specifically, compared to rural schools, the learning advantage in Tbilisi averages **31 points**, and compared to other urban areas, **15.4 points** ($B = 12.4$, $SE = 5.3$, $p < 0.01$).

Among the Level 1 variables, students' mathematics achievement was positively predicted by home educational resources ($B = 12.4$ points, $SE = 1.0$, $p < 0.001$) and clarity of instruction in mathematics lessons ($B = 3.1$, $SE = 0.9$, $p < 0.001$). Student gender was also found to be significantly associated with academic achievement. At Level 2, the *shortage of mathematics resources had a statistically significant effect on learning outcomes* ($B = 4.8$, $SE = 2.3$, $p < 0.05$; $\beta = 5.9$, $SE = 2.4$, $p < 0.05$), indicating that lower student achievement is associated with limited school resources. In the final model, after controlling for all factors—including home educational resources, clarity of instruction, other school-level characteristics, and cross-level interactions—the effect of school location remained statistically significant ($B = 11.2$, $SE = 5.7$, $p < 0.05$).

**Science.** At the lower secondary level, the effect of school location on science achievement is statistically significant in the initial model, but it loses significance once other important variables are taken into account. Specifically, students in Tbilisi and regional city schools score on average 11 to 22 points higher than those in rural schools ($B = 11.0$, $SE = 3.5$, $p < .01$). However, unlike mathematics, the advantage in science is smaller and decreases to about 6 points ($B = 6.0$, $SE = 3.0$, $p > .057$) after controlling for all factors, becoming statistically insignificant. This finding suggests that the lower performance of rural students in science is largely explained by *school environment factors and limited access to educational resources*.

*See Annex 1 for details*

### Effect of School Status

Research consistently indicates that students attending private schools achieve significantly higher results across various subjects than those in public schools (e.g., Braun, 2006; Anders, 2024). The type of school a student attends—private or public—can be considered one of the key indicators of the student's socioeconomic status, since students from higher-SES families are more likely to afford schools that are better resourced. Moreover, they typically have access to more educational resources at home, enjoy greater parental support, hold higher academic expectations, and have more professional "role models." By contrast, students from lower-SES families are constrained both in their choice of schools and in their access to other resources. Studies (Braun, 2006; Anders, 2024) show that the performance gap between private and public school students substantially decreases—or even loses statistical significance—once family socioeconomic status[7] is controlled for. In other words, when comparing students with similar socioeconomic backgrounds, the achievement difference between those attending private and public schools is either nonexistent or minimal. These findings suggest that school status (private or public), by itself, is not a determining factor of educational

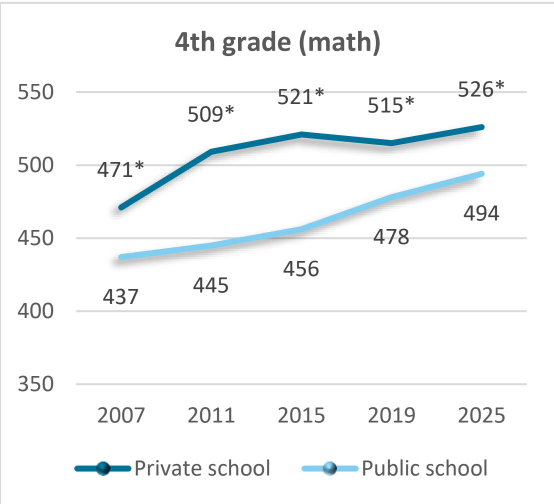
[7] Family socioeconomic status generally refers to parents' education, employment, occupation, and income.

quality. Rather, the family's social background plays a more significant and powerful role in shaping students' academic achievement than the type of school they attend.

*What is the situation in Georgia in this regard?* The discussion begins with an analysis of the 16-year trend in the achievement of students from private and public schools. First, it should be noted that approximately 91% of students participating in the study attend public schools and 9% - private schools.

Between 2007 and 2023, students in both Grade 4 and Grade 8 improved their performance in mathematics and science (see Illustrations 4 and 5). However, in all cases, students attending private schools achieved higher results than those in public schools.

***Illustration 4.*** *Trends in Mathematics and Science Achievement of Georgian Grade 4 Students by School Status*
** The asterisk indicates that in the given year, the difference between the mean scores of students in private and public schools is statistically significant.*



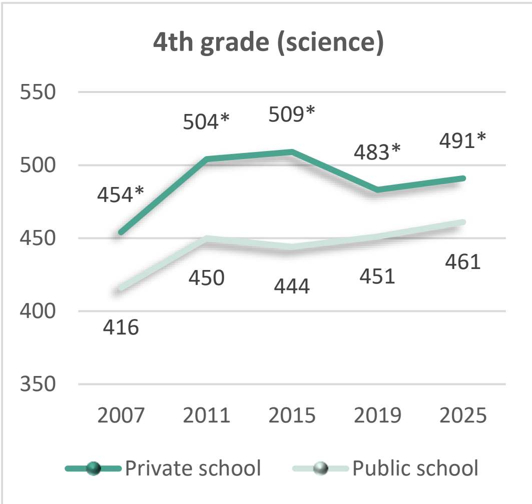
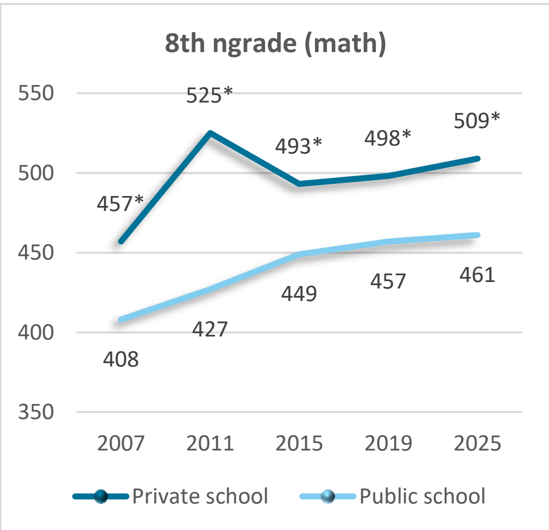
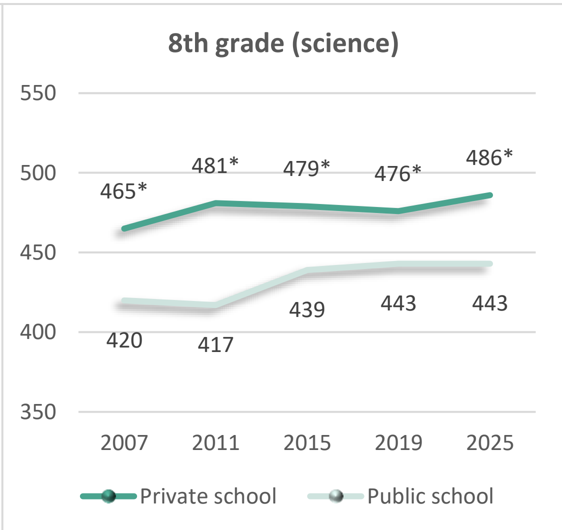



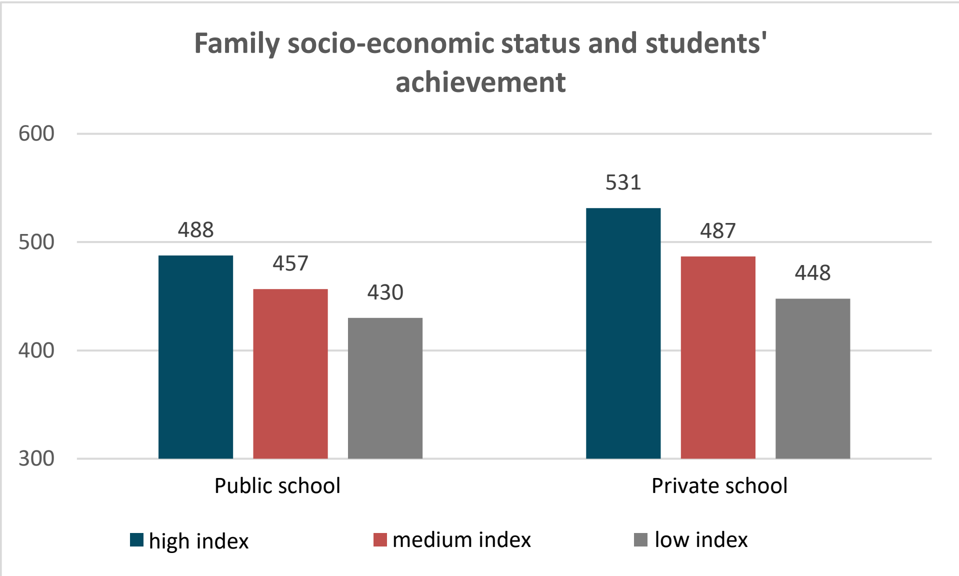

***Illustration 5****. Trends in Mathematics and Science Achievement of Georgian Grade 8 Students by School Status*
** The asterisk indicates that in the given year, the difference between the mean scores of students in private and public schools is statistically significant.*



The difference in average scores between private and public schools (reflecting the advantage of private schools) is largely associated with the high social capital[8] of students' families. This is clearly illustrated in the accompanying figure: in both public and private schools, there is a consistent and pronounced relationship between socioeconomic status (SES**)** and student achievement. Regardless of whether students attend private or public schools, those from high-SES families (high index) perform significantly better than their peers from medium- or low-SES families (medium and low indices).

***Illustration 6****. Relationship Between Georgian Students' Achievement, Family Socioeconomic Status, and School Type (Grade 8, Mathematics)*




*What factors are related to the better achievements of private school students?* The results of hierarchical regression analysis based on TIMSS 2023 data provide a clearer picture of this issue.

The analysis confirms the **significant impact of school status** on student achievement in both mathematics and science, at both the primary and lower secondary levels. At the primary level, students in private schools outperform those in public schools by *an average of 31–32 points* in both mathematics and science. At the lower secondary level, the difference becomes even more pronounced: private school students score about 50 points higher in mathematics and 43 points higher in science than their peers in public schools. In the final model—after controlling for additional individual and school-level factors—private schools retain a positive and statistically significant effect. This suggests that there may be other factors not directly captured in the analysis (such as school resources**,** management quality, or school culture, etc.) that contribute to higher performance in private schools.

Moreover, the analysis shows that the achievement gap between private and public school students cannot be explained by any single factor, including *family socioeconomic status (SES***)** (see detailed results in the appendix). Family background and social capital remain important determinants of

[8] Students from high socioeconomic status (SES) families, whose households possess greater financial and educational resources, often attend private schools**.**

student performance, yet private school advantage is also shaped by instructional quality (clarity of instruction) and school environment (focus on academic achievement, discipline, etc.).

In summary, the private school advantage observed in TIMSS 2023 data appears to be an artifact that cannot be attributed solely to SES. Rather, it reflects a multifactorial, composite effect, combining students' social capital, instructional quality, and the broader school environment. Private school status largely functions as an **indicator of systemic advantage**, reflecting better-organized teaching and a stronger culture of high expectations.

**Results of Hierarchical Regression Analysis: The Effect of School Type on Student Achievement**

**Primary Level**

**Mathematics.** In the baseline model, private school students scored on average 32 points higher than public school students, and this difference was statistically significant ($B = 32.1$, $SE = 7.2$, $p < .001$). After controlling for individual-level variables and the school's socioeconomic composition, the effect decreased to 25 points ($B = 25.5$, $SE = 7.2$, $p < .001$). The strongest predictor of student achievement in mathematics was family socioeconomic status (SES), which was associated with an average 10–13 point advantage**.** Interaction analysis (School Type × SES) showed that high-SES students in private schools performed even better than those with similar SES in public schools.

However, the private school effect was not stable: when school emphasis on academic success was controlled for (Model 8), the effect dropped to 15 points ($SE = 8.1$) and became statistically nonsignificant[9]. This suggests that academic emphasis is strongly correlated with school type—private schools typically have clearer academic goals and better resources. Once academic emphasis is controlled for, the private school effect is largely absorbed. In the final model—after accounting for all individual and contextual factors—the direct effect of school type remained statistically significant, though it was reduced by about 41% overall (from 32.1 to approximately 19 points; see Appendix 1, Table 1.1).

**Science.** A similar trend was observed in science: students in private schools scored on average 31 points higher than those in public schools ($B = 31.0$, $SE = 7.9$, $p < .001$). In the final model, the school-type effect decreased to 23 points, though the difference between private and public school students remained statistically significant. Part of this gap can be explained by family SES, which reduced the private school effect by only 5% (from 31.0 to 29.4). Interaction analysis (School Type × SES) showed that high-SES students in private schools performed even better, though unlike in mathematics, this interaction was not statistically significant ($B = 7.1$, $SE = 4$, $p > .05$). Overall, the private school effect in science decreased by 26% (from 31.0 to 23 points). It should be noted that at the primary level, the **most important school-level characteristic** explaining the public–private gap was **school emphasis on academic achievement**—when private and public schools share similar academic orientations, the performance difference between their students largely disappears.

**Basic Level**

**Mathematics.** Private school students scored on average **50 points higher** than public school students ($B = 50.2$, $SE = 10.2$, $p < .001$). The effect of **home educational resources** was statistically significant, but controlling for it reduced the effect only minimally—by **0.4 points** ($B = 49.9$, $SE = 10.3$, $p < .001$). Adding **clarity of instruction** to the model further reduced the effect by **2.8 points** ($B = 47.1$, $SE = 10.1$, $p < .001$).

[9] However, after school discipline is introduced into the model, the difference increases again and becomes statistically significant.

In the final model, the gap decreased to **44.4 points**, and the private school effect remained statistically significant ($p < .001$).

**Science.** Private school status was also associated with higher achievement in science ($B = 42.8$, $SE = 7.4$, $p < .001$). After controlling for all variables in the final model, the school-type effect decreased to **38.4 points** ($B = 38.4$, $SE = 7.7$, $p < .001$).

*See Appendix 1 for details*

## Equity in Education: The Impact of Socioeconomic Factors on Student Achievement

TIMSS allows us to analyze how students' academic outcomes relate to various social and economic factors. Research clearly shows that evaluating equity by test scores alone is insufficient—it is also necessary to consider the disparities that exist for different social groups within the system. Students' achievement is shaped by socioeconomic factors operating at the micro level (family conditions, access to educational resources) and the meso level (school socioeconomic profile, learning climate). Accordingly, it is especially important to identify inequities arising both from school-level and family-level socioeconomic status. Studies (e.g., Sirin, 2005[10]; OECD, 2018[11]) demonstrate that these factors critically determine students' educational opportunities and outcomes.

This chapter provides a more detailed analysis of the influence of family socio-economic status and school socio-economic composition on student achievement. It is worth noting that, according to analyses of data from various TIMSS cycles, both family and school socio-economic status have a significant impact on students' academic performance, which is considered an indicator of systemic inequality in education.

Through the analysis presented here, we aim to assess how equitably the education system distributes resources and opportunities among students from different social backgrounds and how effectively it supports the development of their individual potential. Analyzing socio-economic factors based on TIMSS data enables us to expand the discussion of equity in education beyond formal access to include effective access—that is, to examine whether students have the resources and support they need to achieve meaningful learning outcomes. This approach aligns with numerous studies that consider equity not only from the perspective[12] of equal opportunities but also from that of equal outcomes or equal opportunities for development (Espinoza, 2007; Reardon, 2011)[13].

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[10] Sirin, S. R. (2005). "Socioeconomic Status and Academic Achievement: A Meta-Analytic Review of Research." Review of Educational Research, 75(3), 417–453. DOI: 10.3102/00346543075003417

[11] **OECD** (2018). *Education at a glance 2018: OECD indicators*. OECD Publishing. https://www.oecd.org/education/education-at-a-glance-2018.htm

[12] What truly matters is that children not only **receive equal opportunities** at school but also, when necessary, achieve equitable **outcomes** through additional support.

[13] Espinoza, J. (2007). The impact of socioeconomic status on educational outcomes. Educational Review, 58(3), 245-259. https://doi.org/10.1080/00131910701418195

### School Socioeconomic Composition

The socioeconomic composition of a school reflects the overall social and economic background of its students and indicates the types of families they come from—their parents' education and occupation, as well as their material living conditions. It shows the proportion of socially and economically disadvantaged students within a given school.

TIMSS data confirm that school socioeconomic composition significantly influences student outcomes. Schools where most students come from disadvantaged backgrounds tend to have fewer educational resources and support systems. Average achievement in these schools is generally lower, indicating systemic inequities that go beyond individual motivation or ability and are largely determined by environmental conditions. TIMSS 2023 international results reflect the same trend. However, when considering school socio-economic composition, the level of differentiation in Georgia appears relatively low—the differences in student achievement by socio-economic status seem minor at first glance. For instance, in Grade 4 science, the gap between socio-economic groups is small: students in schools with a high socio-economic composition index score an average of 469 points, while those in schools with a low index score 466 points. In mathematics, the results are almost identical across all groups (500–498 points).

According to the results of hierarchical regression analysis, the effect of school socio-economic composition on students' individual academic achievement in mathematics and science (both in Grade 4 and Grade 8) is not statistically significant. Therefore, based on TIMSS 2023 data, no conclusion can be drawn regarding a systemic or decisive influence of this factor.

International trends, however, show sharper contrasts. In Georgia, the relatively weak or absent effect of school composition may be explained not by a high level of equity, but rather by the overall "evenly balanced" low performance across the system. The challenges and problems within the country's education system appear to be shared and similarly reflected in both high- and low-socio-economic-composition schools.

For a more in-depth understanding of these issues, an additional ***moderation analysis*** was conducted, introducing the school's *emphasis on academic success*[14] as a moderator[15] variable. This indicator reflects the extent to which a school is clearly, systematically, and consistently oriented toward achieving high academic outcomes. The moderation analysis assesses whether the impact of school socio-economic composition on student achievement differs across varying levels of a school's academic orientation (e.g., average versus high emphasis on academic success).

The results show that as **a school's academic orientation decreases, the negative impact of socio-economic composition on student achievement increases**. This means that in schools with a strong academic focus, a low socio-economic composition is less detrimental to student outcomes—academically oriented schools, despite challenging socio-economic contexts, manage to maintain high academic standards and achieve better results at the **primary level**.

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[14] Schematically, moderation analysis involves examining whether factor **A** affects **B** in the same way across all cases, or whether the strength or direction of this effect depends on the value of another variable — the moderator**,** C**.**?

[15] A moderator variable is a variable that changes (either strengthens or weakens) the relationship between two other variables.

**Moderation Analysis**

The results of a simple moderation analysis (using Hayes' PROCESS macro, version 4.2; Model 1) show that the interaction between school socio-economic composition and the school's academic orientation has a statistically significant effect on students' mathematics achievement ($b = 7.15$, $SE = 1.98$, $t = 3.61$, $p < .001$, 95% CI [3.27, 11.03]).

This finding indicates that a school's orientation toward academic achievement acts as a **compensatory mechanism** that enables schools to cope with challenges arising from socio-economic disadvantage. This trend underscores that the quality of teaching and a success-oriented school culture can serve as powerful tools for reducing social inequality. Specifically, maintaining a strong focus on high academic achievement within the learning process may help to narrow the performance gaps caused by socio-economic disparities. This aspect represents an important prerequisite for achieving both **horizontal equity** (ensuring equal opportunities among students) and **vertical equity** (enabling advancement regardless of social background) in education.

At the same time, students' individual social resources and family background appear to have a stronger influence on their academic achievement than the school's social environment. The results presented in the next chapter show that, compared with the effect of school socio-economic composition, the impact of **family socio-economic status** on achievement is more consistent and pronounced. This highlights the fact that students' academic performance is shaped more substantially by their initial social conditions and family capital than by the broader social context of schools.

### Family Socioeconomic Status

Family socio-economic status is one of the key factors determining students' academic achievement and level of development, as evidenced by findings from all previous TIMSS cycles. Children from families with higher socio-economic status typically have greater access to educational resources—including books, technological tools, and intellectual stimulation—which gives them a clear academic advantage. Consequently, differences in student achievement often reflect not only individual effort but also the broader environment and conditions that either support or limit the full development and realization of their potential.

Data from TIMSS 2023, as well as from previous cycles, clearly show that family socio-economic status has a significant impact on students' educational achievement. Students from high-status families outperform their peers from low-status families by an average of 40 to 60 points or more in both mathematics and science. Specifically, in mathematics, students with a high family socio-economic index score an average of 523 points, while those from families with a low index score 461 points on average, indicating that in Georgia, family social and economic status plays an especially important—sometimes even decisive—role in determining student achievement.

***Table 1.*** *Family Socio-Economic Status and Student Achievement (Grade 4)*

| | High index | | Medium index | | Low index | |
|---|---|---|---|---|---|---|
| | % of students | Average achievement | % of students | Average achievement | % of students | Average achievement |
| ***Georgia's results*** | | | | | | |
| Math | 36% (1.2) | 523 (3.5) | 52% (1.1) | 490 (3.2) | 12% (0.8) | 461 (9.1) |
| Science | 36% (1.2) | 484 (3.3) | 52% (1.1) | 459 (3.7) | 12% (0.8) | 441 (9.4) |
| ***TIMSS International average*** | | | | | | |
| Math | 30% (0.2) | 544 (0.8) | 48% (0.2) | 502 (0.5) | 22% (0.2) | 459 (0.9) |
| Science | 30% (0.2) | 535 (0.8) | 48% (0.2) | 490 (0.5) | 22% (0.2) | 444 (0.9) |

TIMSS 2023 shows that the influence of family socio-economic status is clearly evident in both mathematics and science. The differences in achievement between students from high- and low-status families are statistically significant, and ***hierarchical regression analysis*** (HLM) confirms that social background remains one of the main determinants of learning opportunities and academic achievement.

Hierarchical regression analysis demonstrates that family socio-economic status is a significant and stable predictor of students' academic outcomes—its effect is statistically significant across all models. Even when controlling for various individual and school-level factors, family socio-economic status retains its significance. Both family socio-economic status and family educational resources (the latter used as a variable in Grade 8) have a substantial and clearly observable impact on students' academic performance, at both primary and lower secondary levels, in mathematics as well as science. The better the family conditions (parents' education, occupation, and material well-being), the higher the student's achievement in mathematics.

**Primary level** (see Appendix 1 - **Tables 1.1 and 1.2**): For example, in Models 4–7, a one-unit increase in family socio-economic status is associated, on average, with an 11-point increase in mathematics scores (e.g., Model 4: $B = 12.1$, $SE = 1.0$, $p < 0.001$) and a 9-point increase in science scores (e.g., Model 4: $B = 8.8$, $SE = 0.9$, $p < 0.001$). These results indicate that students from higher socio-economic status families perform, on average, 9–11 points better in both subjects.

**Basic level** (see Appendix 1, Tables 1.3 and 1.4): In Grade 8, family educational resources are an important determinant of students' academic achievement in both mathematics and science. A one-standard-deviation increase in family educational resources is associated with an 11–12 point increase in average student achievement in both subjects.

These findings highlight the substantial and persistent influence of family socio-economic status on students' academic success at both primary and lower secondary levels. This underscores the ongoing challenges of equity in education and confirms the need for school and state policies, as well as targeted interventions, aimed at reducing social inequalities, so that all students have equal access to quality education regardless of their starting conditions.

## Analysis of Student Achievement by Gender

The belief that boys are naturally stronger in mathematics and technical subjects than girls has long been widespread. Such stereotypical attitudes can demotivate children and influence both their beliefs about what is expected of them in society and their self-perception of what they can and cannot do well (Master, 2021). These stereotypes have a significant impact on girls' behavior and their performance in mathematics (Spencer, 1999). It can be assumed that such attitudes contribute to the low number of women interested in science, technology, engineering, and mathematics (STEM) fields (Master, 2021). To address these challenges and overcome gender asymmetries, many countries are developing egalitarian education policies[16] aimed at ensuring equal opportunities for all students.

The influence of stereotypes may determine not only educational outcomes but also long-term issues of equity in education. That is why this section analyzes the 2023 TIMSS results, which describe the differences in achievement between girls and boys in mathematics and science. The results show that in most participating countries, 4th grade boys had statistically significantly higher average scores in mathematics than girls (40 countries, representing 69% of participants). In 8th grade, the number of such countries is relatively lower—boys outperform girls in mathematics in 21 countries (50% of participants). As for science, there are far fewer countries where boys significantly outperform girls (see attached table).

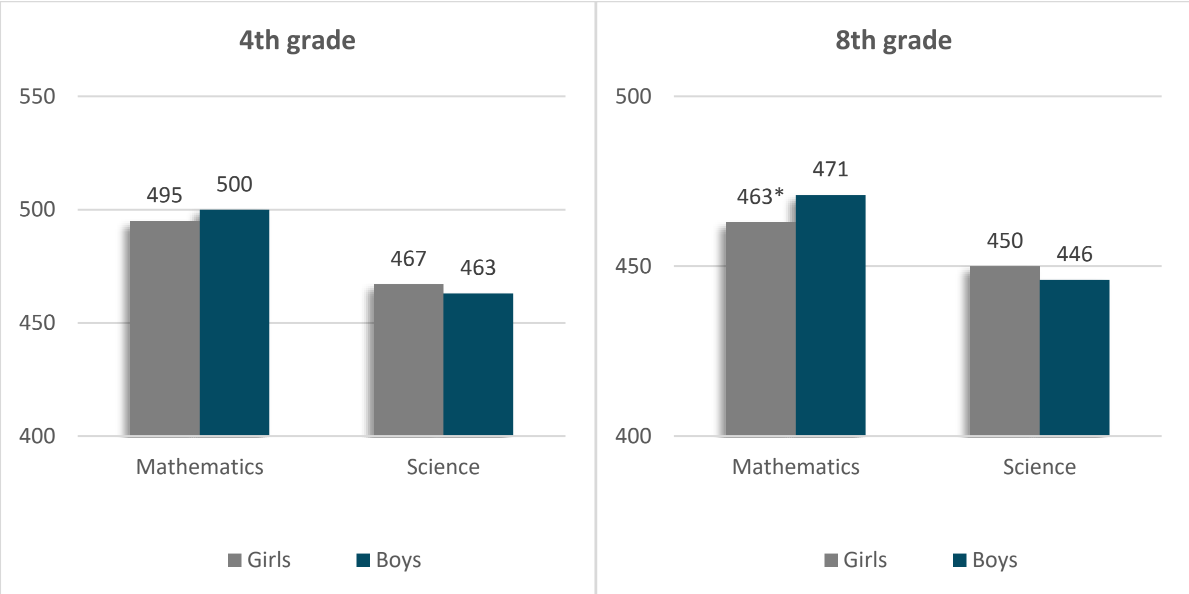
***Table 2.*** *Student achievement by gender*

| | | Math | | Science | |
|---|---|---|---|---|---|
| | | 4th grade | 8th grade | 4th grade | 8th grade |
| > | Number of countries where boys outperform girls | 40 | 21 | 20 | 12 |
| > | Number of countries where girls outperform boys | 1 | 4 | 12 | 11 |
| = | Number of countries where there is no difference between achievements | 17 | 17 | 26 | 19 |
| | **Total number of countries** | **58** | **42** | **58** | **42** |

In Georgia, a trend has been observed where boys have higher average scores in mathematics, while girls perform better in science subjects. However, this difference is statistically significant only in the case of average mathematics scores in Grade 8.

[16] State policy based on egalitarianism (from the French *égalité* – equality) envisions the unconditional equality of rights between women and men, where every citizen, regardless of gender, is genuinely provided with equal and full opportunities for development and self-realization.

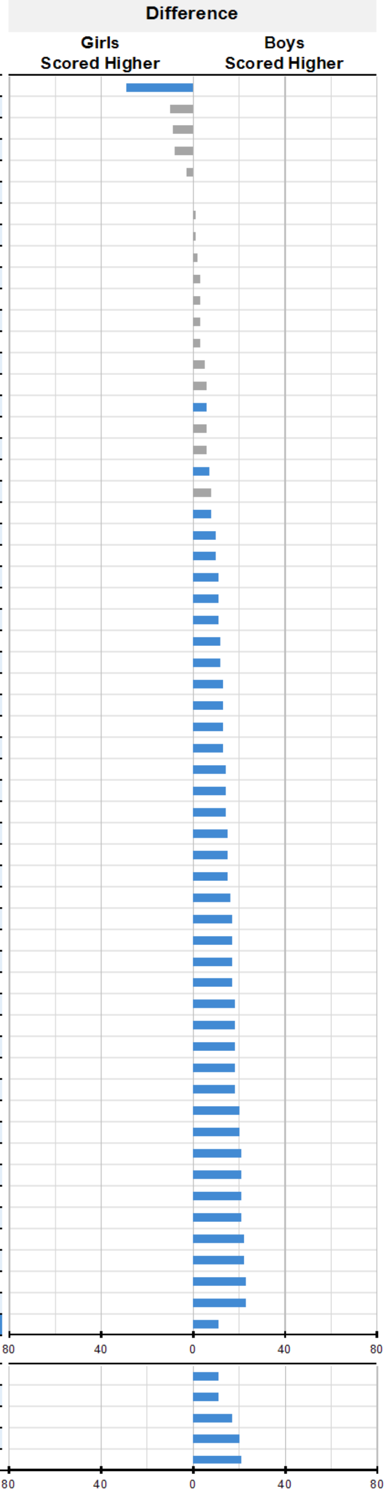
***Illustration 7.*** *Achievement of Georgian students in mathematics and science by gender*
*The asterisk indicates that the difference between the average scores of girls and boys is statistically significant.




Below is similar information for all countries that participated in the study – how girls and boys from different countries perform on tasks related to mathematics and science. The countries are sorted by the difference between the average achievement of girls and boys. A negative value indicates that girls have higher achievement than boys, while a positive value indicates that boys outperform girls.

***Table 3.*** *Student Achievement by Gender (Grade 4, Mathematics)*
*Mathematics: Average achievement scores among girls and boys*

| Country | Girls: Percent of Students | Girls: Average Scale Score | Boys: Percent of Students | Boys: Average Scale Score | Difference |
|---|---|---|---|---|---|
| South Africa (5) | 50 (0.7) | 376 (3.7) | 50 (0.7) | 348 (4.3) | -29 (3.9) |
| Ψ Iran, Islamic Rep. of | 49 (1.6) | 425 (5.1) | 51 (1.6) | 414 (6.1) | -10 (7.6) |
| Jordan | 52 (2.6) | 431 (8.4) | 48 (2.6) | 422 (5.8) | -9 (9.9) |
| Bahrain | 48 (1.1) | 466 (5.5) | 52 (1.1) | 458 (5.1) | -8 (6.5) |
| Azerbaijan | 46 (0.8) | 496 (4.1) | 54 (0.8) | 493 (3.6) | -3 (3.3) |
| North Macedonia | 50 (0.7) | 474 (3.7) | 50 (0.7) | 474 (4.1) | 0 (3.1) |
| Oman | 50 (0.6) | 421 (3.9) | 50 (0.6) | 422 (4.4) | 1 (2.3) |
| [2] Armenia | 49 (1.0) | 512 (3.3) | 51 (1.0) | 513 (3.0) | 1 (2.9) |
| Morocco | 48 (0.9) | 392 (4.9) | 52 (0.9) | 394 (5.2) | 2 (4.1) |
| [3] Saudi Arabia | 49 (1.0) | 418 (6.0) | 51 (1.0) | 421 (5.2) | 3 (7.5) |
| [2] ≡ Albania | 48 (1.8) | 510 (5.2) | 52 (1.8) | 513 (5.4) | 3 (3.7) |
| [1] Bosnia & Herzegovina | 50 (1.1) | 445 (3.4) | 50 (1.1) | 449 (3.8) | 3 (3.1) |
| Bulgaria | 47 (0.8) | 528 (3.8) | 53 (0.8) | 532 (4.2) | 3 (3.5) |
| [1] Georgia | 50 (0.8) | 495 (3.5) | 50 (0.8) | 500 (3.7) | 5 (3.8) |
| Uzbekistan | 49 (0.9) | 441 (3.6) | 51 (0.9) | 446 (3.5) | 6 (3.2) |
| Finland | 49 (0.9) | 526 (2.8) | 51 (0.9) | 532 (2.9) | 6 (2.7) |
| [2] ≡ Romania | 49 (1.0) | 539 (5.2) | 51 (1.0) | 545 (5.3) | 6 (4.2) |
| Ireland | 49 (1.3) | 542 (3.8) | 51 (1.3) | 549 (3.4) | 6 (4.0) |
| Chinese Taipei | 48 (0.5) | 603 (2.0) | 52 (0.5) | 611 (2.2) | 7 (2.3) |
| Kuwait | 51 (2.1) | 378 (6.1) | 49 (2.1) | 386 (6.4) | 8 (8.9) |
| Latvia | 49 (1.2) | 530 (3.6) | 51 (1.2) | 538 (3.0) | 8 (3.6) |
| Slovenia | 49 (0.8) | 509 (2.2) | 51 (0.8) | 519 (2.2) | 10 (2.5) |
| Japan | 51 (0.5) | 586 (2.5) | 49 (0.5) | 596 (2.7) | 10 (2.5) |
| [2] Kosovo | 48 (0.9) | 446 (3.4) | 52 (0.9) | 457 (4.3) | 11 (3.5) |
| [2] Poland | 50 (0.9) | 541 (2.4) | 50 (0.9) | 551 (2.7) | 11 (3.2) |
| [2] Serbia | 51 (0.9) | 518 (3.5) | 49 (0.9) | 528 (4.0) | 11 (3.7) |
| [2] Montenegro | 48 (0.8) | 471 (2.7) | 52 (0.8) | 483 (2.1) | 12 (2.4) |
| [3] Singapore | 49 (0.5) | 609 (3.1) | 51 (0.5) | 621 (3.1) | 12 (2.4) |
| [2] Lithuania | 49 (0.8) | 554 (3.2) | 51 (0.8) | 567 (3.2) | 13 (2.5) |
| [2] Ψ Brazil | 50 (0.6) | 394 (3.5) | 50 (0.6) | 406 (4.0) | 13 (2.9) |
| [2] Kazakhstan | 49 (0.6) | 480 (3.9) | 51 (0.6) | 494 (3.8) | 13 (2.6) |
| Germany | 49 (0.7) | 517 (2.5) | 51 (0.7) | 530 (2.5) | 13 (2.6) |
| United Arab Emirates | 49 (0.7) | 491 (1.8) | 51 (0.7) | 505 (1.5) | 14 (2.2) |
| † Hong Kong SAR | 49 (1.2) | 587 (4.3) | 51 (1.2) | 601 (4.4) | 14 (3.3) |
| [3] Türkiye (5) | 48 (1.2) | 546 (4.5) | 52 (1.2) | 560 (5.0) | 14 (4.7) |
| [2] Norway (5) | 50 (0.8) | 523 (2.4) | 50 (0.8) | 538 (2.4) | 15 (2.7) |
| [2] Czech Republic | 49 (0.7) | 523 (2.2) | 51 (0.7) | 538 (2.8) | 15 (2.6) |
| † Denmark | 51 (0.8) | 516 (2.4) | 49 (0.8) | 532 (2.6) | 15 (2.6) |
| [2] Sweden | 51 (0.8) | 522 (3.0) | 49 (0.8) | 538 (3.3) | 16 (2.8) |
| [2] † Chile | 47 (1.1) | 435 (3.0) | 53 (1.1) | 452 (3.3) | 17 (2.9) |
| Slovak Republic | 50 (0.9) | 506 (3.8) | 50 (0.9) | 523 (3.1) | 17 (3.2) |
| Korea, Rep. of | 50 (0.5) | 586 (3.1) | 50 (0.5) | 603 (2.9) | 17 (2.9) |
| † Netherlands | 50 (0.8) | 528 (2.5) | 50 (0.8) | 546 (2.4) | 17 (2.8) |
| [2] Spain | 49 (0.6) | 489 (2.1) | 51 (0.6) | 507 (2.6) | 18 (2.1) |
| [2] † United States | 49 (0.5) | 508 (3.0) | 51 (0.5) | 526 (3.5) | 18 (2.1) |
| Hungary | 50 (0.9) | 511 (3.3) | 50 (0.9) | 529 (4.3) | 18 (2.8) |
| [2] England | 50 (0.9) | 543 (3.5) | 50 (0.9) | 561 (3.1) | 18 (3.5) |
| [2] † Belgium (Flemish) | 49 (0.7) | 511 (3.2) | 51 (0.7) | 530 (2.8) | 18 (3.5) |
| Macao SAR | 48 (0.7) | 572 (1.4) | 52 (0.7) | 592 (1.6) | 20 (2.1) |
| [1] [3] Canada | 51 (0.6) | 494 (2.1) | 49 (0.6) | 514 (2.5) | 20 (2.2) |
| [2] Cyprus | 49 (0.8) | 506 (2.6) | 51 (0.8) | 526 (3.3) | 21 (3.2) |
| [2] Belgium (French) | 50 (0.9) | 479 (2.7) | 50 (0.9) | 500 (2.8) | 21 (2.4) |
| [2] † New Zealand | 49 (0.9) | 479 (3.0) | 51 (0.9) | 501 (3.3) | 21 (3.3) |
| Qatar | 49 (1.2) | 453 (4.2) | 51 (1.2) | 474 (4.4) | 21 (4.9) |
| Portugal | 50 (0.7) | 506 (3.1) | 50 (0.7) | 528 (3.3) | 22 (3.0) |
| [2] Italy | 48 (0.8) | 501 (2.9) | 52 (0.8) | 524 (3.2) | 22 (2.6) |
| Australia | 52 (1.0) | 514 (2.9) | 48 (1.0) | 537 (3.1) | 23 (3.3) |
| [2] France | 50 (0.8) | 473 (3.2) | 50 (0.8) | 496 (3.2) | 23 (2.9) |
| **International Average** | **49 (0.1)** | **498 (0.5)** | **51 (0.1)** | **508 (0.5)** | **11 (0.5)** |
| **Benchmarking Participants** | | | | | |
| Abu Dhabi, UAE | 50 (0.4) | 453 (2.0) | 50 (0.4) | 464 (2.5) | 11 (2.3) |
| Sharjah, UAE | 48 (0.7) | 498 (4.3) | 52 (0.7) | 509 (2.8) | 11 (3.1) |
| Dubai, UAE | 48 (2.2) | 548 (2.7) | 52 (2.2) | 565 (1.8) | 17 (3.2) |
| [2] Quebec, Canada | 50 (0.8) | 505 (3.0) | 50 (0.8) | 525 (3.1) | 20 (2.7) |
| [3] Ontario, Canada | 52 (1.0) | 493 (3.4) | 48 (1.0) | 514 (4.4) | 21 (3.7) |



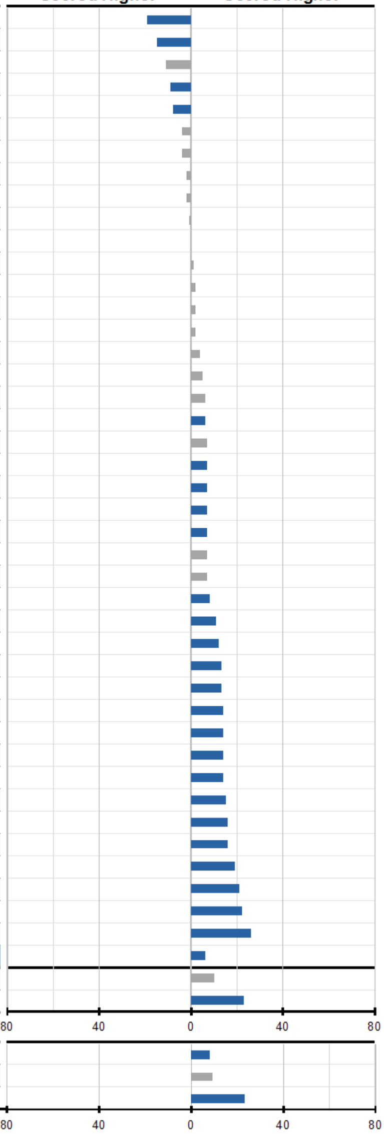

Difference statistically significant ($p < 0.05$)
Difference not statistically significant

Students' gender information was obtained from school tracking data.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
See Appendix B.2 for population coverage notes 1, 2, and 3. See Appendix B.5 for sampling guidelines and sampling participation notes †, ‡, and ≡.
Ψ Reservations about reliability because the percentage of students with achievement too low for estimation exceeds 15% but does not exceed 25%.

***Table 4.** Student Achievement by Gender (Grade 8, Mathematics)*

*Mathematics: Average achievement scores among girls and boys*

| Country | Girls: Percent of Students | Girls: Average Scale Score | Boys: Percent of Students | Boys: Average Scale Score | Difference |
|---|---|---|---|---|---|
| Ψ Palestinian Nat'l Auth. | 49 (2.7) | 391 (4.1) | 51 (2.7) | 372 (4.2) | -19 (5.8) |
| Oman | 48 (0.8) | 418 (3.2) | 52 (0.8) | 404 (3.7) | -15 (4.3) |
| Jordan | 48 (2.1) | 394 (4.1) | 52 (2.1) | 383 (5.3) | -11 (7.1) |
| Bahrain | 49 (0.8) | 431 (2.7) | 51 (0.8) | 422 (3.7) | -9 (4.3) |
| Ψ South Africa (9) | 51 (0.8) | 401 (3.6) | 49 (0.8) | 393 (3.4) | -8 (2.9) |
| Chinese Taipei | 48 (0.8) | 605 (3.4) | 52 (0.8) | 600 (3.8) | -4 (3.7) |
| [2] Saudi Arabia | 48 (0.5) | 399 (4.3) | 52 (0.5) | 395 (4.6) | -4 (6.0) |
| Azerbaijan | 48 (0.8) | 480 (3.9) | 52 (0.8) | 478 (4.4) | -2 (3.8) |
| [3] † Türkiye | 51 (1.7) | 509 (4.5) | 49 (1.7) | 508 (5.8) | -2 (5.8) |
| Malaysia | 52 (1.1) | 411 (3.7) | 48 (1.1) | 410 (3.9) | -1 (3.1) |
| Ψ Iran, Islamic Rep. of | 49 (1.4) | 423 (5.5) | 51 (1.4) | 423 (5.2) | 0 (8.0) |
| [2] Norway (9) | 47 (0.7) | 500 (2.7) | 53 (0.7) | 501 (2.6) | 1 (2.8) |
| Finland | 49 (0.9) | 503 (2.8) | 51 (0.9) | 505 (3.0) | 2 (2.7) |
| ≡ Romania | 48 (1.1) | 495 (5.4) | 52 (1.1) | 496 (5.3) | 2 (4.5) |
| Ψ Kuwait | 49 (1.4) | 398 (5.5) | 51 (1.4) | 400 (8.2) | 2 (9.3) |
| Kazakhstan | 47 (0.8) | 452 (4.0) | 53 (0.8) | 456 (3.6) | 4 (2.7) |
| Cyprus | 49 (0.7) | 491 (3.2) | 51 (0.7) | 496 (3.2) | 5 (3.4) |
| Korea, Rep. of | 49 (1.0) | 593 (3.6) | 51 (1.0) | 599 (3.5) | 6 (3.5) |
| Malta | 50 (0.7) | 496 (1.9) | 50 (0.7) | 502 (2.0) | 6 (3.1) |
| [3] Singapore | 48 (2.3) | 602 (6.9) | 52 (2.3) | 608 (8.3) | 7 (9.4) |
| [2] Austria | 49 (1.0) | 509 (2.4) | 51 (1.0) | 515 (2.8) | 7 (2.6) |
| [2] Sweden | 49 (0.7) | 514 (2.8) | 51 (0.7) | 521 (2.8) | 7 (2.7) |
| Morocco | 50 (0.6) | 374 (3.4) | 50 (0.6) | 381 (3.1) | 7 (2.4) |
| [2] Lithuania | 50 (0.8) | 510 (3.1) | 50 (0.8) | 517 (3.9) | 7 (3.2) |
| Qatar | 48 (2.1) | 448 (4.9) | 52 (2.1) | 455 (5.9) | 7 (6.8) |
| † Hong Kong SAR | 49 (1.6) | 571 (5.5) | 51 (1.6) | 578 (6.4) | 7 (6.3) |
| [1] Georgia | 49 (0.8) | 463 (3.5) | 51 (0.8) | 471 (3.9) | 8 (3.6) |
| Uzbekistan | 50 (0.9) | 416 (3.7) | 50 (0.9) | 426 (5.8) | 11 (4.7) |
| France | 50 (0.7) | 473 (3.5) | 50 (0.7) | 484 (3.4) | 12 (2.8) |
| United Arab Emirates | 49 (0.4) | 482 (1.9) | 51 (0.4) | 495 (2.2) | 13 (2.2) |
| Australia | 47 (1.7) | 502 (4.2) | 53 (1.7) | 515 (4.3) | 13 (5.0) |
| † Japan | 49 (1.3) | 588 (3.4) | 51 (1.3) | 601 (3.5) | 14 (3.5) |
| Ireland | 47 (1.6) | 514 (3.5) | 53 (1.6) | 528 (3.0) | 14 (3.5) |
| ≡ United States | 49 (0.7) | 481 (4.3) | 51 (0.7) | 495 (4.4) | 14 (2.6) |
| Portugal | 49 (1.0) | 468 (3.4) | 51 (1.0) | 482 (2.9) | 14 (3.3) |
| [3] Israel | 50 (1.0) | 480 (4.2) | 50 (1.0) | 495 (4.6) | 15 (4.5) |
| Hungary | 50 (1.0) | 498 (3.8) | 50 (1.0) | 514 (4.6) | 16 (4.0) |
| Italy | 49 (0.7) | 492 (3.4) | 51 (0.7) | 509 (3.3) | 16 (3.0) |
| [2] Czech Republic | 48 (0.7) | 508 (2.5) | 52 (0.7) | 528 (2.6) | 19 (2.4) |
| Ψ Brazil | 50 (0.5) | 368 (2.8) | 50 (0.5) | 388 (3.2) | 21 (2.4) |
| † Chile | 49 (1.1) | 405 (3.5) | 51 (1.1) | 427 (3.7) | 22 (3.2) |
| [2] England | 50 (2.0) | 512 (5.0) | 50 (2.0) | 538 (5.9) | 26 (6.5) |
| **International Average** | **49 (0.2)** | **475 (0.6)** | **51 (0.2)** | **481 (0.7)** | **6 (0.7)** |
| Ж Cote d'Ivoire | 49 (1.4) | 258 (8.7) | 51 (1.4) | 268 (3.7) | 10 (8.7) |
| New Zealand | 46 (1.7) | 473 (5.2) | 54 (1.7) | 496 (5.8) | 23 (7.5) |
| **Benchmarking Participants** | | | | | |
| Abu Dhabi, UAE | 50 (0.5) | 450 (3.3) | 50 (0.5) | 458 (3.5) | 8 (3.9) |
| Sharjah, UAE | 50 (0.8) | 491 (5.3) | 50 (0.8) | 500 (5.3) | 9 (4.7) |
| Dubai, UAE | 48 (0.7) | 534 (3.4) | 52 (0.7) | 557 (3.8) | 23 (4.6) |




Difference statistically significant ($p$ < 0.05)

Difference not statistically significant

Students' gender information was obtained from school tracking data.

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

See Appendix B.7 for population coverage notes 1, 2, and 3. See Appendix B.10 for sampling guidelines and sampling participation notes †, ‡, and ≡.

Ψ Reservations about reliability because the percentage of students with achievement too low for estimation exceeds 15% but does not exceed 25%.

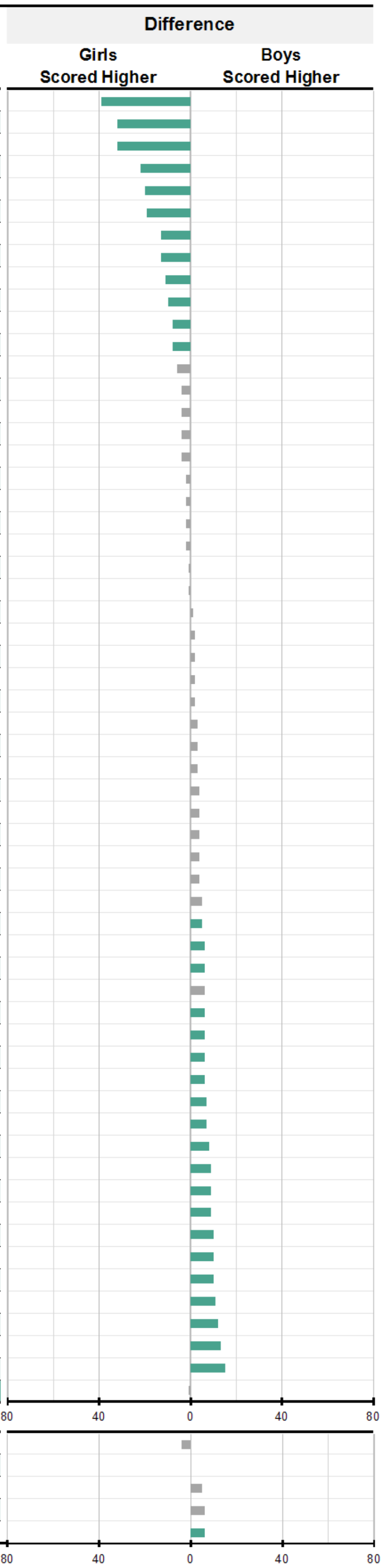
Ж Average achievement not reliably measured because the percentage of students with achievement too low for estimation exceeds 25%.

New Zealand did not satisfy guidelines for minimum school participation rates. Achievement could not be reliably estimated for Cote d'Ivoire.

SOURCE: IEA's Trends in International Mathematics and Science Study - TIMSS 2023

***Table 5.** Student Achievement by Gender (Grade 4, Science)*
*Mathematics: Average achievement scores among girls and boys*

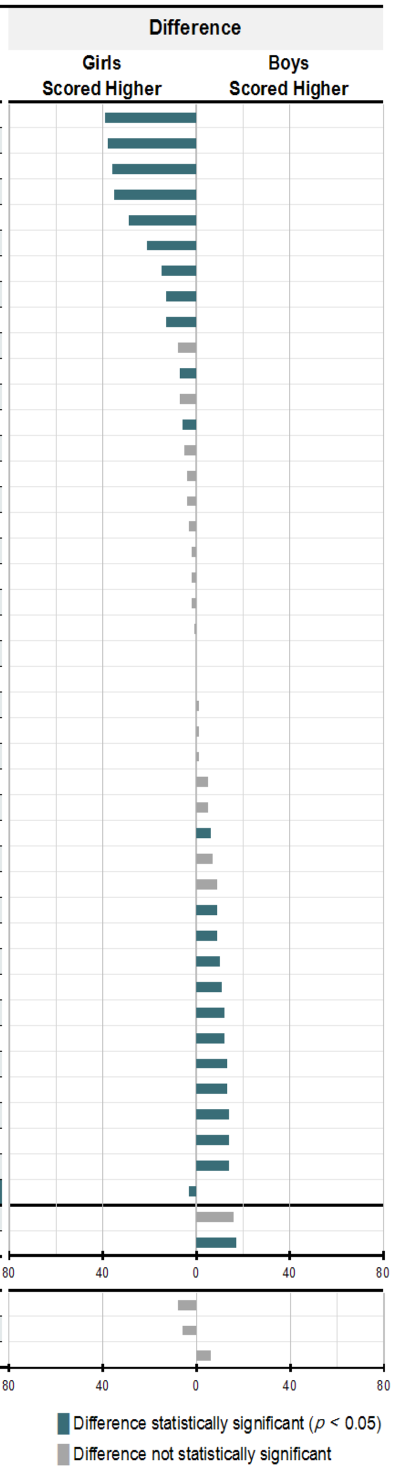
| Country | Girls: Percent of Students | Girls: Average Scale Score | Boys: Percent of Students | Boys: Average Scale Score | Difference |
|---|---|---|---|---|---|
| Ж South Africa (5) | 50 (0.7) | 328 (5.2) | 50 (0.7) | 289 (5.3) | -39 (4.7) |
| Bahrain | 48 (1.1) | 492 (5.3) | 52 (1.1) | 459 (4.8) | -32 (6.4) |
| [3] Saudi Arabia | 49 (1.0) | 444 (5.9) | 51 (1.0) | 412 (4.9) | -32 (7.5) |
| Jordan | 52 (2.6) | 428 (7.7) | 48 (2.6) | 406 (5.4) | -22 (9.0) |
| Ψ Kuwait | 51 (2.1) | 383 (6.6) | 49 (2.1) | 363 (8.1) | -20 (9.8) |
| Iran, Islamic Rep. of | 49 (1.6) | 442 (5.5) | 51 (1.6) | 423 (6.5) | -19 (8.3) |
| Morocco | 48 (0.9) | 397 (5.7) | 52 (0.9) | 384 (5.6) | -13 (3.9) |
| Oman | 50 (0.6) | 439 (4.3) | 50 (0.6) | 426 (4.7) | -13 (2.9) |
| Azerbaijan | 46 (0.8) | 428 (3.4) | 54 (0.8) | 416 (3.7) | -11 (2.8) |
| Finland | 49 (0.9) | 547 (2.9) | 51 (0.9) | 537 (3.5) | -10 (2.5) |
| [2] ≡ Albania | 48 (1.8) | 495 (4.8) | 52 (1.8) | 487 (5.0) | -8 (4.1) |
| North Macedonia | 50 (0.7) | 442 (4.2) | 50 (0.7) | 435 (4.3) | -8 (3.5) |
| [1] Bosnia & Herzegovina | 50 (1.1) | 451 (3.5) | 50 (1.1) | 446 (4.7) | -6 (3.6) |
| Ireland | 49 (1.3) | 534 (3.9) | 51 (1.3) | 530 (3.5) | -4 (3.8) |
| [2] Lithuania | 49 (0.8) | 539 (3.0) | 51 (0.8) | 535 (3.3) | -4 (2.5) |
| [1] Georgia | 50 (0.8) | 467 (4.0) | 50 (0.8) | 463 (3.6) | -4 (3.2) |
| Latvia | 49 (1.2) | 527 (3.5) | 51 (1.2) | 524 (3.4) | -4 (3.2) |
| Bulgaria | 47 (0.8) | 531 (4.8) | 53 (0.8) | 529 (5.5) | -2 (3.9) |
| [2] ≡ Romania | 49 (1.0) | 527 (4.9) | 51 (1.0) | 525 (5.2) | -2 (3.4) |
| [2] Norway (5) | 50 (0.8) | 531 (3.0) | 50 (0.8) | 530 (2.8) | -2 (2.7) |
| Germany | 49 (0.7) | 516 (3.1) | 51 (0.7) | 515 (3.3) | -2 (3.0) |
| † Denmark | 51 (0.8) | 523 (2.9) | 49 (0.8) | 521 (2.8) | -1 (2.6) |
| [2] Poland | 50 (0.9) | 550 (2.7) | 50 (0.9) | 549 (2.6) | -1 (2.9) |
| United Arab Emirates | 49 (0.7) | 494 (2.1) | 51 (0.7) | 496 (2.3) | 1 (2.6) |
| [2] Sweden | 51 (0.8) | 532 (3.3) | 49 (0.8) | 534 (3.7) | 2 (2.8) |
| [2] Armenia | 49 (1.0) | 456 (2.8) | 51 (1.0) | 458 (3.3) | 2 (2.8) |
| [2] † Chile | 47 (1.1) | 478 (3.1) | 53 (1.1) | 480 (3.2) | 2 (3.4) |
| [2] Spain | 49 (0.6) | 503 (2.1) | 51 (0.6) | 505 (2.7) | 2 (2.3) |
| [2] † New Zealand | 49 (0.9) | 516 (3.5) | 51 (0.9) | 518 (3.4) | 3 (3.9) |
| Qatar | 49 (1.2) | 471 (4.5) | 51 (1.2) | 474 (4.6) | 3 (5.5) |
| [2] Kosovo | 48 (0.9) | 401 (3.1) | 52 (0.9) | 405 (4.6) | 3 (3.2) |
| [3] Türkiye (5) | 48 (1.2) | 568 (3.8) | 52 (1.2) | 572 (4.0) | 4 (3.8) |
| [2] Serbia | 51 (0.9) | 508 (3.3) | 49 (0.9) | 512 (4.0) | 4 (3.6) |
| [2] England | 50 (0.9) | 555 (2.9) | 50 (0.9) | 559 (3.4) | 4 (3.4) |
| [2] Montenegro | 48 (0.8) | 458 (2.3) | 52 (0.8) | 463 (2.5) | 4 (2.6) |
| Uzbekistan | 49 (0.9) | 410 (3.5) | 51 (0.9) | 414 (4.1) | 4 (3.4) |
| [2] Kazakhstan | 49 (0.6) | 464 (3.7) | 51 (0.6) | 469 (3.9) | 5 (2.9) |
| Slovenia | 49 (0.8) | 523 (2.6) | 51 (0.8) | 528 (2.7) | 5 (2.5) |
| [1 3] Canada | 51 (0.6) | 518 (2.2) | 49 (0.6) | 524 (2.4) | 6 (2.0) |
| Chinese Taipei | 48 (0.5) | 570 (2.1) | 52 (0.5) | 575 (2.4) | 6 (2.9) |
| Slovak Republic | 50 (0.9) | 518 (4.1) | 50 (0.9) | 523 (3.1) | 6 (3.1) |
| † Netherlands | 50 (0.8) | 514 (3.1) | 50 (0.8) | 520 (3.2) | 6 (2.4) |
| Japan | 51 (0.5) | 552 (2.5) | 49 (0.5) | 558 (2.8) | 6 (2.3) |
| [2] Czech Republic | 49 (0.7) | 523 (2.4) | 51 (0.7) | 529 (3.1) | 6 (2.9) |
| Hungary | 50 (0.9) | 521 (3.2) | 50 (0.9) | 527 (3.7) | 6 (2.5) |
| [2] Belgium (French) | 50 (0.9) | 477 (3.2) | 50 (0.9) | 484 (2.9) | 7 (2.5) |
| [2] † United States | 49 (0.5) | 529 (2.9) | 51 (0.5) | 536 (3.2) | 7 (2.4) |
| [2] Cyprus | 49 (0.8) | 483 (3.6) | 51 (0.8) | 491 (3.6) | 8 (3.7) |
| [2] France | 50 (0.8) | 484 (3.4) | 50 (0.8) | 492 (3.1) | 9 (2.6) |
| [2] Brazil | 50 (0.6) | 420 (3.7) | 50 (0.6) | 430 (3.9) | 9 (2.9) |
| [2] Italy | 48 (0.8) | 506 (2.6) | 52 (0.8) | 515 (3.0) | 9 (2.7) |
| [3] Singapore | 49 (0.5) | 603 (3.0) | 51 (0.5) | 612 (3.0) | 10 (2.4) |
| Australia | 52 (1.0) | 545 (2.8) | 48 (1.0) | 555 (2.9) | 10 (3.4) |
| † Hong Kong SAR | 49 (1.2) | 540 (4.6) | 51 (1.2) | 550 (3.9) | 10 (3.5) |
| Macao SAR | 48 (0.7) | 530 (1.6) | 52 (0.7) | 541 (2.1) | 11 (2.4) |
| [2] † Belgium (Flemish) | 49 (0.7) | 482 (3.2) | 51 (0.7) | 494 (2.8) | 12 (2.8) |
| Portugal | 50 (0.7) | 504 (2.7) | 50 (0.7) | 517 (2.9) | 13 (3.1) |
| Korea, Rep. of | 50 (0.5) | 576 (3.0) | 50 (0.5) | 591 (2.9) | 15 (3.1) |
| **International Average** | **49 (0.1)** | **495 (0.5)** | **51 (0.1)** | **494 (0.5)** | **-1 (0.5)** |
| **Benchmarking Participants** | | | | | |
| Abu Dhabi, UAE | 50 (0.4) | 448 (2.6) | 50 (0.4) | 444 (3.3) | -4 (2.8) |
| Sharjah, UAE | 48 (0.7) | 503 (4.6) | 52 (0.7) | 503 (3.9) | 0 (3.0) |
| Dubai, UAE | 48 (2.2) | 560 (2.7) | 52 (2.2) | 565 (2.2) | 5 (3.3) |
| [3] Ontario, Canada | 52 (1.0) | 522 (3.4) | 48 (1.0) | 528 (3.8) | 6 (3.2) |
| [2] Quebec, Canada | 50 (0.8) | 504 (3.0) | 50 (0.8) | 511 (3.3) | 6 (3.2) |




Students' gender information was obtained from school tracking data.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
See Appendix B.2 for population coverage notes 1, 2, and 3. See Appendix B.5 for sampling guidelines and sampling participation notes †, ‡, and ≡.
Ψ Reservations about reliability because the percentage of students with achievement too low for estimation exceeds 15% but does not exceed 25%.
Ж Average achievement not reliably measured because the percentage of students with achievement too low for estimation exceeds 25%.

***Table 6.*** *Student Achievement by Gender (Grade 8, Science)*
*Mathematics: Average achievement scores among girls and boys*

| Country | Girls: Percent of Students | Girls: Average Scale Score | Boys: Percent of Students | Boys: Average Scale Score | Difference |
|---|---|---|---|---|---|
| Bahrain | 49 (0.8) | 472 (2.6) | 51 (0.8) | 432 (3.9) | -39 (4.0) |
| Oman | 48 (0.8) | 476 (3.1) | 52 (0.8) | 437 (3.2) | -38 (3.8) |
| [2] Saudi Arabia | 48 (0.5) | 438 (4.5) | 52 (0.5) | 402 (4.7) | -36 (6.1) |
| Palestinian Nat'l Auth. | 49 (2.7) | 411 (3.9) | 51 (2.7) | 376 (4.0) | -35 (5.6) |
| Kuwait | 49 (1.4) | 434 (5.0) | 51 (1.4) | 405 (9.3) | -29 (9.5) |
| Jordan | 48 (2.1) | 424 (4.3) | 52 (2.1) | 403 (5.9) | -21 (7.6) |
| Ψ South Africa (9) | 51 (0.8) | 370 (4.6) | 49 (0.8) | 355 (4.2) | -15 (3.7) |
| Qatar | 48 (2.1) | 488 (4.9) | 52 (2.1) | 475 (5.7) | -13 (6.5) |
| Cyprus | 49 (0.7) | 471 (3.6) | 51 (0.7) | 458 (3.6) | -13 (4.1) |
| Iran, Islamic Rep. of | 49 (1.4) | 423 (5.3) | 51 (1.4) | 415 (5.2) | -8 (7.7) |
| Finland | 49 (0.9) | 534 (3.5) | 51 (0.9) | 527 (3.5) | -7 (3.1) |
| [3] † Türkiye | 51 (1.7) | 533 (3.8) | 49 (1.7) | 526 (5.0) | -7 (5.2) |
| Azerbaijan | 48 (0.8) | 414 (3.1) | 52 (0.8) | 408 (3.5) | -6 (2.9) |
| United Arab Emirates | 49 (0.4) | 489 (2.0) | 51 (0.4) | 484 (2.8) | -5 (2.6) |
| Malaysia | 52 (1.1) | 428 (4.0) | 48 (1.1) | 424 (4.1) | -4 (3.3) |
| [1] Georgia | 49 (0.8) | 450 (3.4) | 51 (0.8) | 446 (3.0) | -4 (2.7) |
| [2] Lithuania | 50 (0.8) | 521 (2.7) | 50 (0.8) | 518 (4.0) | -3 (3.2) |
| Chinese Taipei | 48 (0.8) | 573 (2.6) | 52 (0.8) | 571 (3.2) | -2 (3.5) |
| [2] Norway (9) | 47 (0.7) | 490 (2.9) | 53 (0.7) | 487 (3.2) | -2 (3.2) |
| ≡ Romania | 48 (1.1) | 467 (4.3) | 52 (1.1) | 465 (4.7) | -2 (4.0) |
| Ψ Morocco | 50 (0.6) | 327 (3.5) | 50 (0.6) | 327 (4.2) | -1 (3.7) |
| [2] Sweden | 49 (0.7) | 521 (3.4) | 51 (0.7) | 521 (3.5) | 0 (3.6) |
| Malta | 50 (0.7) | 501 (2.2) | 50 (0.7) | 501 (2.7) | 0 (3.7) |
| [3] Israel | 50 (1.0) | 480 (3.9) | 50 (1.0) | 481 (4.4) | 1 (4.0) |
| Uzbekistan | 50 (0.9) | 395 (3.0) | 50 (0.9) | 396 (5.1) | 1 (3.9) |
| Kazakhstan | 47 (0.8) | 442 (3.4) | 53 (0.8) | 443 (3.2) | 1 (2.6) |
| France | 50 (0.7) | 484 (3.5) | 50 (0.7) | 489 (3.6) | 5 (3.2) |
| Korea, Rep. of | 49 (1.0) | 543 (2.8) | 51 (1.0) | 548 (2.7) | 5 (3.1) |
| [2] Austria | 49 (1.0) | 509 (2.8) | 51 (1.0) | 515 (2.8) | 6 (3.0) |
| [3] Singapore | 48 (2.3) | 603 (6.6) | 52 (2.3) | 609 (7.9) | 7 (9.2) |
| † Hong Kong SAR | 49 (1.6) | 523 (5.9) | 51 (1.6) | 532 (5.4) | 9 (6.0) |
| Ireland | 47 (1.6) | 520 (4.2) | 53 (1.6) | 529 (3.9) | 9 (4.0) |
| Portugal | 49 (1.0) | 501 (3.1) | 51 (1.0) | 510 (2.6) | 9 (3.1) |
| Italy | 49 (0.7) | 496 (3.6) | 51 (0.7) | 505 (3.7) | 10 (3.5) |
| ≡ United States | 49 (0.7) | 508 (4.0) | 51 (0.7) | 519 (4.2) | 11 (3.0) |
| [2] Czech Republic | 48 (0.7) | 521 (2.3) | 52 (0.7) | 533 (2.3) | 12 (2.1) |
| † Japan | 49 (1.3) | 551 (4.0) | 51 (1.3) | 563 (3.4) | 12 (4.3) |
| Hungary | 50 (1.0) | 515 (3.3) | 50 (1.0) | 528 (4.2) | 13 (3.9) |
| Australia | 47 (1.7) | 513 (4.1) | 53 (1.7) | 526 (3.8) | 13 (4.7) |
| Brazil | 50 (0.5) | 413 (2.5) | 50 (0.5) | 427 (3.0) | 14 (2.2) |
| [2] England | 50 (2.0) | 524 (5.1) | 50 (2.0) | 538 (5.5) | 14 (6.3) |
| † Chile | 49 (1.1) | 448 (2.9) | 51 (1.1) | 462 (3.3) | 14 (3.1) |
| **International Average** | **49 (0.2)** | **480 (0.6)** | **51 (0.2)** | **477 (0.7)** | **-3 (0.7)** |
| Ж Cote d'Ivoire | 49 (1.4) | 175 (13.9) | 51 (1.4) | 191 (6.3) | 16 (13.8) |
| New Zealand | 46 (1.7) | 493 (4.7) | 54 (1.7) | 510 (5.8) | 17 (7.0) |
| **Benchmarking Participants** | | | | | |
| Abu Dhabi, UAE | 50 (0.5) | 447 (4.2) | 50 (0.5) | 440 (4.8) | -8 (4.9) |
| Sharjah, UAE | 50 (0.8) | 502 (5.2) | 50 (0.8) | 495 (5.9) | -6 (5.1) |
| Dubai, UAE | 48 (0.7) | 544 (3.3) | 52 (0.7) | 550 (4.4) | 6 (4.7) |

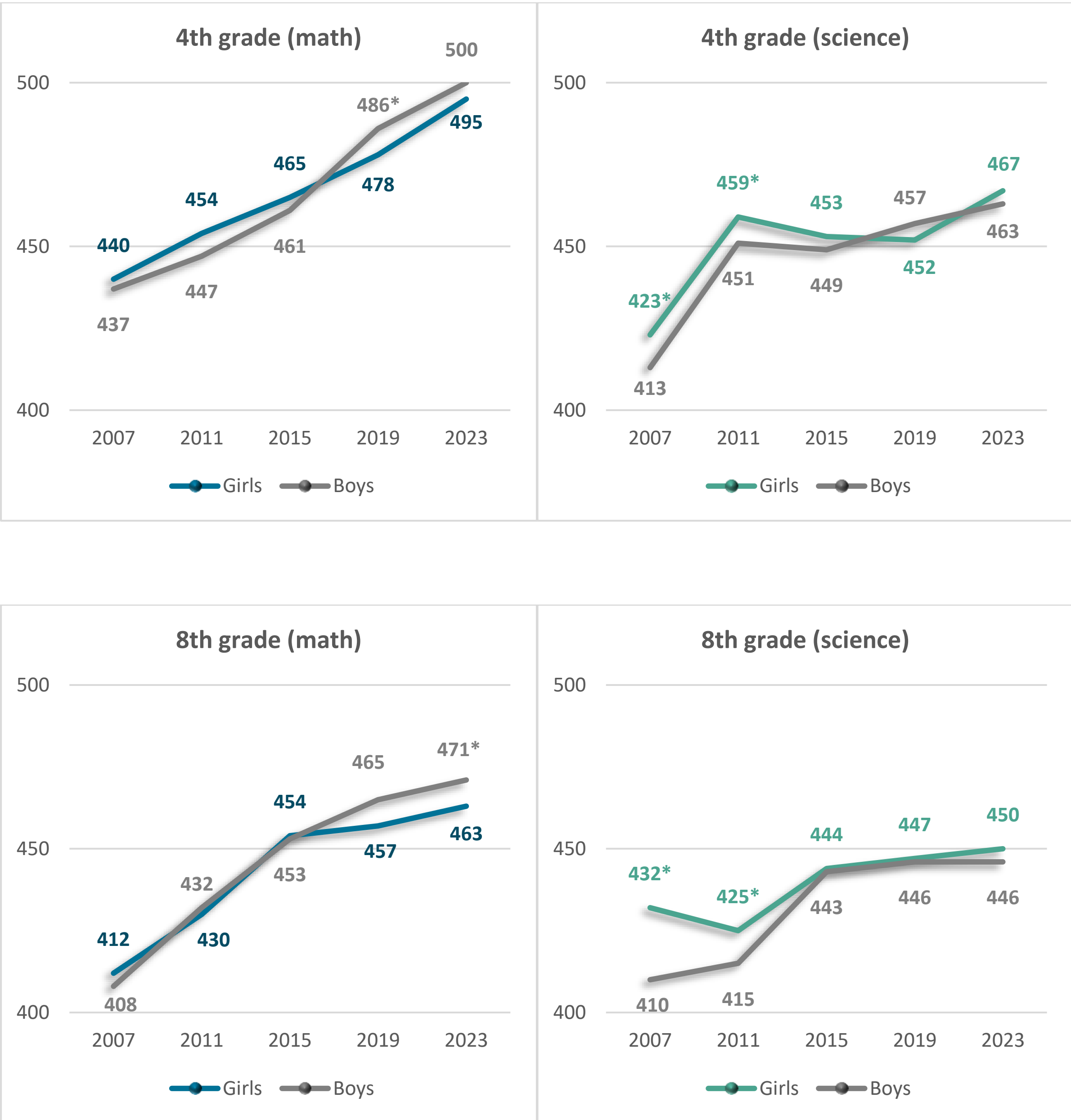



Students' gender information was obtained from school tracking data.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
See Appendix B.7 for population coverage notes 1, 2, and 3. See Appendix B.10 for sampling guidelines and sampling participation notes †, ‡, and ≡.
Ψ Reservations about reliability because the percentage of students with achievement too low for estimation exceeds 15% but does not exceed 25%.
Ж Average achievement not reliably measured because the percentage of students with achievement too low for estimation exceeds 25%.
New Zealand did not satisfy guidelines for minimum school participation rates. Achievement could not be reliably estimated for Cote d'Ivoire.

Looking at Georgia's data over a 16-year period, we can see that, compared with 2007, the average achievement of both girls and boys in Grade 4 has increased in mathematics and science. The upward trend is more pronounced among boys (mathematics: +63 points; science: +50 points) than among girls (mathematics: +55 points; science: +44 points). A similar trend is observed in Grade 8: since 2007, boys have improved by 63 points in mathematics and 36 points in science, while the corresponding increases for girls are 51 points in mathematics and 18 points in science.

**Illustration 28:** Trend in Achievement of Georgian 4th-Grade Students in Mathematics and Science by gender

**The asterisk indicates that, in a given year, the difference between private and public school students' average scores is statistically significant.*




Hierarchical regression analysis was used to assess the effect of gender on students' academic achievement. The analysis shows that **gender has a significant and stable impact on mathematics achievement**, and the magnitude of this effect increases with age. Even when controlling for other factors (socio-economic status, school type, location, clarity of instruction, and availability of resources), the effect of gender remains statistically significant. No statistically significant interactions were found between gender and school type, location, or other contextual variables, indicating that the gender gap in achievement manifests consistently across different educational contexts.

Regarding science achievement, the effect of gender is not statistically significant. This may be explained by subject-specific characteristics and the varying intensity of stereotypical expectations associated with science subjects. Contemporary research (OECD, 2021; Mullis et al., 2023)[17], also shows that gender differences are more pronounced in mathematics, as the subject is more strongly associated with "male-typed" competencies and requires higher-level abstract and symbolic reasoning. Science learning, on the other hand, is less dependent on gendered self-perceptions and stereotypes, reducing the likelihood of widening gaps between boys' and girls' performance.

**Results of hierarchical regression analysis: Gender effect on mathematics achievement**

Gender has a statistically significant effect on Grade 4 students' mathematics achievement. In all models including gender, boys' average scores are significantly higher than girls' scores ($B$ = 10.7, $SE$ = 2.3, $p$ < .001). Boys consistently outperform girls on mathematics tests. The effect of gender persists even when other variables are included in the model, such as family socio-economic status, school type (private/public), school location (rural, urban, Tbilisi), and instructional factors like clarity of instruction, availability of resources, and school discipline. This indicates that gender differences in mathematics achievement are not fully explained by social or school-related characteristics. The gender coefficient is positive and statistically significant in nearly all models, highlighting a strong and consistent trend favoring boys.

Gender also has a significant impact on mathematics achievement in Grade 8. The analysis shows that the gender gap in mathematics increases over time. In Grade 4, boys scored approximately 10 points higher on average than girls, whereas in Grade 8 the difference rises to 15 points. The advantage of boys ranges from 7.9 to 14.9 points ($p$ < .01 or $p$ < .001), with the largest effect observed in models accounting for school type and family educational resources ($B$ = 14.9, $SE$ = 2.6, $p$ < .001).

*See Appendix 1 for details*

[17] Mullis, I. V. S., Martin, M. O., Foy, P., & Hooper, M. (2023). *TIMSS 2019 International Results in Mathematics and Science.* International Association for the Evaluation of Educational Achievement (IEA).
OECD. (2021). *Gender differences in students' attitudes and performance in mathematics and science.* In *OECD Education at a Glance 2021.* Paris: OECD Publishing.

## Summary

The analysis of TIMSS 2007–2023 data shows that, despite general progress, Georgia's education system continues to face several significant challenges related to quality and equity in education. Equity, a key measure of a modern education system, reflects the extent to which the system can ensure that each student's potential is fully realized, regardless of socio-economic background, place of residence, or other factors.

*To what extent is Georgia's education system able to provide all children with equally high-quality and development-oriented learning?*

TIMSS 2023 provides a clear analytical picture of equity in the Georgian education system.

### General Trends in Educational Equity

The challenges of inequality in education are reflected in the persistent influence of students' background characteristics—such as family socioeconomic status, school type, and school location—on their academic achievement, even though these factors should not constrain students' educational development. Schools in Tbilisi continue to maintain a stable advantage over schools in regional cities and rural areas, while students in private schools significantly outperform their peers in public schools. Noticeable gender differences in mathematics achievement also persist, likely reflecting the impact of social stereotypes and educational practices. The initial social inequality, determined by family socioeconomic status, continues to have a systematic effect on students' academic outcomes.

A comprehensive analysis of the factors driving differences in educational outcomes shows that variations in student achievement result from a multifactorial, composite effect, in which students' social capital and the school environment (institutional quality of schools, teaching effectiveness, and academic orientation) interact. Moreover, the study indicates that high academic standards combined with effective teaching and instruction can reduce these disparities, including partially compensating for the influence of a student's family social capital. The analysis of individual and contextual factors driving differences in student achievement highlights the crucial role of teaching quality (clarity of instruction) and the school's academic environment (the school's focus on academic success) in ensuring equity and enabling students to realize their potential. Accordingly, alongside the efficient allocation of resources—which takes into account the specific conditions and needs of each school—these factors should be given particular attention in policies and interventions to reduce disparities in school outcomes.

### Findings by contextual/background characteristics:

**Effect of school location:** Differences between rural and urban school students have decreased in recent years, reflecting a positive trend toward equity. However, location still significantly affects academic outcomes. Tbilisi schools, even when controlling for other factors, show higher average achievement than rural or regional schools. A significant part of the effect of a school's location on students' academic achievement is largely explained by accompanying contextual conditions (such as the social environment, resources, and other factors), which vary across different geographical locations (Tbilisi, other cities, and rural areas).

Separating the city of Tbilisi as a distinct unit revealed that the inequality within the country is less associated with the urban–rural dichotomy, and the differences in achievement largely reflect the

**dominance of the resource-rich capital**. Tbilisi represents a clearly distinct educational ecosystem, where high achievement is driven by better learning conditions, high-quality instruction, and abundant social capital. The study shows that, compared with rural areas and other cities, Tbilisi constitutes a distinct tier of educational opportunities. For education policy, this means that strategies to reduce inequality should include targeted interventions aimed at improving the conditions of schools in rural areas and regional cities. Despite some positive trends, education policy must address this challenge with additional measures to ensure that regional and rural schools have equal opportunities and resources to improve student outcomes.

**School type:** The status of a private school has a stronger predictive power than the school's location, particularly at the basic education level. The study shows that students in private schools achieve better results than their peers in public schools. The advantage of private schools in student achievement partly reflects the influence of family capital (the concentration of socially privileged students in private schools) and partly the institutional strength of private schools (manifested in the school's orientation toward academic achievement and the quality of instruction). This further indicates that inequality in education is linked both to systemic social factors and to certain institutional differences between private and public schools.

**Family socio-economic status (SES):** Family status remains one of the most important factors influencing student achievement. The results described above indicate a systemic relationship between students' achievements and their family's social capital. Although the effect of family socio-economic status (SES) may sometimes appear relatively modest when analyzing student outcomes by specific background characteristics, its role remains significant—students from higher SES families achieve, on average, better results across all grades and subjects. Moreover, they are disproportionately represented in private schools and in Tbilisi, which partially explains the effect of these schools on student achievement.

Overall, these findings indicate that family social capital is not limited to its individual impact on a student's academic abilities (i.e., the direct effect of high SES on individual achievement) but also operates systemically, contributing to the advantages observed in Tbilisi and private schools through the concentration of high-SES students.

One of the major challenges for the education system can be considered the mitigation of the effects of SES at different levels. The TIMSS 2023 results show that the system has not yet succeeded in compensating for students' initial social inequalities, highlighting the need for targeted policies and interventions, particularly for socially and economically vulnerable, low-income groups.

**Gender differences:** In Georgia, gender differences in mathematics are observed at both the primary and lower secondary levels. Girls perform significantly lower academically than boys, and the magnitude of this effect increases with age. The achievement gap between boys and girls is consistent across different educational contexts (private or public schools, rural or urban schools); even after accounting for other factors (socio-economic status, school type, location, clarity of instruction, and resources), the gender effect remains statistically significant. These differences are likely related to socio-cultural attitudes toward subjects, gender expectations, and stereotypical influences. It can be said that this limits equal access to opportunities and constrains girls' career development in STEM fields.

## Key Policy Directions

The research findings highlight the importance of effectively implementing targeted interventions and inclusive approaches. It is essential to develop policies specifically aimed at strengthening regional and rural schools, increasing resource availability in public schools, and enhancing mechanisms to support families—such as social assistance and economic incentives that help low-income families cover education-related expenses (e.g., school materials, transportation, access to technology). Additionally, child-centered services focusing on well-being, including psychological support, nutrition programs, and access to healthcare, are crucial. Strengthening collaboration between schools and families is also important; educational equity begins with the joint efforts of families and schools and is fully realized through systemic support for all students. Ultimately, such policies **will create fairer and more equal educational opportunities for all students, particularly those from socially vulnerable households.**

The strategic development of Georgia's general education system should be grounded in a thorough analysis of student achievement data from both international and national assessments, as well as an evaluation of the factors that facilitate or hinder progress. Evidence-based policies focused on equity and inclusion represent the only viable path to ensuring quality and fairness in education across the entire system.

For taking effective steps toward improving access to and the quality of education, the analysis of TIMSS 2007–2023 data serves as a critically important resource—it clearly shows where progress has been made and where systemic barriers exist that hinder the achievement of equity in education. The strategic development of Georgia's general education system should be based on a thorough analysis of student achievement in international and national assessments, as well as an evaluation of the factors that facilitate or impede progress. Evidence-based policies focused on equity and inclusiveness are the only way to ensure high-quality education and equal opportunities across the entire system.

*Excerpt from the UNICEF Education and Equity Strategy (2018), developed to address inequality at the national level:*

- ***Improving the statistical visibility of the invisible*** *– A key step to promoting inclusion is enhancing data collection according to characteristics such as gender, ethnicity, disability, age, and reasons for exclusion from learning. Such information is critically important for the development of effective policies.*
- ***Analysis of bottlenecks*** *– Developing a national-level methodology to measure inequality and analyze bottlenecks, which provides the basis for designing cost-effective, equity-oriented strategies in education sector plans and reforms to support marginalized populations.*
- ***Guiding principles*** *for addressing challenges in teacher recruitment, deployment, and professional development in marginalized regions and among disadvantaged groups.*
- ***School readiness and learning*** *– Supporting the introduction of early learning policies and standards and expanding access to early learning.*
- ***Child-focused schools*** *– The goal is to adapt the sectoral approach of Child-Friendly Schools (CFS) to more holistic principles that integrate equal access, quality, and learning outcomes, as well as formal and non-formal approaches, climate change and environmental education, and learning methodologies. Emphasis is placed on learning assessments and using results to monitor and improve learning for all, based on evidence-based data collection and analysis. Early childhood education, particularly in the form of school readiness, will ultimately form part of this approach.*

# Appendix

## Hierarchical Regression Analysis

**Appendix 1:**

This section presents the results of the hierarchical regression analysis in which school location was defined as a three-category variable (Tbilisi, urban, rural).

*The conclusions and interpretations provided in the text are primarily based on the results presented in this appendix.*

**Appendix 2:**

This section presents the results of the hierarchical regression analysis in which school location was defined as a dichotomous variable (urban, rural).

*The results included here were used solely to assess the effect of school location.*

# Appendix 1

***Appendix. Table 1. 1.*** *Hierarchical regression analysis: Mathematics 4th grade*

| Mathematics 4th grade | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| | 500.4 (2.6) *** | 496.8 (2.7) *** | 492.9 (2.9) *** | 493.5 (3.0) *** | 496.3 (2.9) *** | 497.7 (2.9) *** | 497.4 (2.9) *** | 491.5 (6.4) *** | 496.9 (6.3) *** | 495.4 (6.2) *** |
| Gender (boy = 1, girl = 0) | | | 8.0 (2.3) *** | 9.4 (2.2) *** | 11.8 (2.2) *** | 10.6 (2.4) *** | 10.7 (2.3) *** | 10.9 (2.3) *** | 11.0 (2.3) *** | 10.9 (2.3) *** |
| School status (private = 1, public =0) | | 32.1 (7.2) *** | 32.0 (7.2) *** | 31.3 (7.3) *** | 27.8 (6.7) *** | 27.7 (6.7) *** | 28.9 (6.5) *** | 25.5 (7.2) *** | 15.5 (8.1) | 19.0 (8.7) * |
| School location (Tbilisi = 2, city =1, village =0) | | | | | | | | | | |
| **დონე 1** | | | | | | | | | | |
| Family's socio-economic status | | | | 13.2 (1.0) *** | 12.1 (1.0) *** | 11.1 (1.0) *** | 10.2 (1.0) *** | 10.5 (1.0) *** | 10.5 (1.0) *** | 10.5 (1.0) *** |
| Clarity of instruction on math lessons | | | | | 6.5 (0.7) *** | 6.2 (0.8) *** | 6.2 (0.8) *** | 6.4 (0.8) *** | 6.4 (0.8) *** | 6.4 (0.8) *** |
| Number-related tasks before entering school | | | | | | 6.1 (0.7) *** | 6.2 (0.6) *** | 6.0 (0.7) *** | 6.0 (0.7) *** | 6.0 (0.7) *** |
| Interaction (school type X family's socio-economic status) | | | | | | | 7.3 (3.1) * | 7.4 (3.2) * | 7.4 (3.2) * | 7.4 (3.2) * |
| Interaction (school location X family's socio-economic status) | | | | | | | | | | |
| **Level 2** | | | | | | | | | | |
| school composition according to socio-economic status | | | | | | | | 3.3 (3.0) | 1.2 (2.9) | 1.7 (2.8) |
| School emphasis on academic success (school principle's position) | | | | | | | | | 5.1 (1.3) *** | 4.4 (1.5) ** |
| School discipline | | | | | | | | | | 2.7 (1.1) * |
| The impact of the shortage of mathematics resources on learning | | | | | | | | | | –0.2 (1.7) |

***Appendix. Table 1. 1.*** *Hierarchical regression analysis: Mathematics 4th grade*

| Mathematics 4th grade | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|
| | 484.8 (5.5) *** | 480.9 (5.7) *** | 480.4 (5.7) *** | 482.9 (5.5) *** | 484.5 (5.4) *** | 484.5 (5.4) *** | 475.0 (7.7) *** | 482.8 (7.8) *** | 479.1 (7.8) *** | 479.2 (7.9) *** |
| Gender (boy = 1, girl = 0) | | 8.0 (2.3) ** | 9.4 (2.2) *** | 11.8 (2.2) *** | 10.6 (2.4) *** | 10.6 (2.4) *** | 10.8 (2.4) *** | 10.8 (2.4) *** | 10.7 (2.4) *** | 10.7 (2.4) *** |
| School status (private = 1, public =0) | | | | | | | | | | |
| School location (Tbilisi = 2, city =1, village =0) | 10.9 (3.6) ** | 10.9 (3.6) ** | 11.6 (3.6) ** | 11.6 (3.5) *** | 11.3 (3.4) ** | 11.3 (3.4) ** | 10.9 (3.4) ** | 10.2 (3.3) ** | 11.6 (3.4) *** | 11.7 (3.4) *** |
| **Level 1** | | | | | | | | | | |
| Family's socio-economic status | | | 13.2 (1.0) *** | 12.1 (1.0) *** | 10.1 (1.0) *** | 12.0 (2.2) *** | 12.3 (2.2) *** | 12.3 (2.2) *** | 12.3 (2.2) *** | 12.3 (2.2) *** |
| Clarity of instruction on math lessons | | | | 6.5 (0.7) *** | 6.2 (0.8) *** | 6.2 (0.8) *** | 6.3 (0.8) *** | 6.3 (0.8) *** | 6.3 (0.8) *** | 6.3 (0.8) *** |
| Number-related tasks before entering school | | | | | 6.1 (0.7) *** | 6.1 (0.7) *** | 5.9 (0.7) *** | 5.9 (0.7) *** | 5.9 (0.7) *** | 5.9 (0.7) *** |
| Interaction (school type X family socio-economic status) | | | | | | | | | | |
| Interaction (school location X family socio-economic status) | | | | | | –0.7 (1.3) | –0.7 (1.4) | –0.7 (1.4) | –0.7 (1.4) | –0.7 (1.4) |
| **Level 2** | | | | | | | | | | |
| school composition according to socio-economic status | | | | | | | 5.1 (2.9) | 1.8 (2.9) | 2.6 (2.8) | 2.4 (2.8) |
| School emphasis on academic success (school principle's position | | | | | | | | 5.6 (1.2) *** | 4.9 (1.2) *** | 4.7 (1.5) ** |
| School discipline | | | | | | | | | 3.0 (1.2) * | 3.0 (1.2) * |
| The impact of the shortage of mathematics resources on learning | | | | | | | | | | 0.5 (1.6) |

***Appendix. Table 1. 2.*** *Hierarchical regression analysis: Science 4th grade*

| Science 4th garde | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| | 467.3 (2.5) *** | 463.8 (2.5) *** | 464.5 (2.7) *** | 465.2 (2.7) *** | 467.8 (2.6) *** | 467.7 (2.6) *** | 469.1 (6.1) *** | 474.0 (6.1) *** | 472.9 (6.1) *** | 472.7 (6.1) *** |
| Gender (boy = 1, girl = 0) | | | –1.3 (2.1) | 0.0 (2.1) | 2.2 (2.1) | 2.4 (2.1) | 2.5 (2.1) | 2.5 (2.1) | 2.5 (2.1) | 2.5 (2.1) |
| School status (private = 1, public =0) | | 31.0 (7.9) *** | 31.0 (7.9) *** | 29.4 (7.9) *** | 28.4 (7.7) *** | 28.4 (7.7) *** | 29.2 (8.4) *** | 19.9 (9.2) * | 22.4 (9.4) * | 23.0 (9.8) * |
| School location (Tbilisi = 2, city =1, village =0) | | | | | | | | | | |
| **Level 1** | | | | | | | | | | |
| Family's socio-economic status | | | | 9.3 (0.9) *** | 8.8 (0.9) *** | 8.0 (0.9) *** | 8.2 (0.8) *** | 8.2 (0.8) *** | 8.2 (0.8) *** | 8.2 (0.8) *** |
| Clarity of instructions on science lessons | | | | | 8.2 (0.7) *** | 8.2 (0.7) *** | 8.4 (0.7) *** | 8.4 (0.7) *** | 8.4 (0.7) *** | 8.4 (0.7) *** |
| Interaction (school type X family socio-economic status) | | | | | | 7.1 (4.0) | 6.9 (4.2) | 6.9 (4.2) | 6.9 (4.2) | 6.9 (4.2) |
| Interaction (school location X family socio-economic status) | | | | | | | | | | |
| **Level 2** | | | | | | | | | | |
| School composition according to socio-economic status | | | | | | | –0.2 (2.9) | –2.2 (2.9) | –1.8 (2.8) | –1.8 (2.8) |
| School emphasis on academic success (school principle's position) | | | | | | | | 4.6 (1.4) *** | 4.0 (1.4) ** | 4.3 (1.5) ** |
| School discipline | | | | | | | | | 1.9 (1.2) | 1.9 (1.2) |
| The impact of the shortage of sciences resources on learning | | | | | | | | | | –0.5 (1.4) |

***Appendix. Table 1. 2.*** *Hierarchical regression analysis: Science 4th grade*

| **Science 4th grade** | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|
| | 456.1 (5.6) *** | 456.7 (5.8) *** | 456.6 (5.7) *** | 458.3 (5.4) *** | 458.3 (5.4) *** | 454.6 (7.8) *** | 462.6 (8.0) *** | 460.3 (8.2) *** | 460.4 (8.3) *** |
| Gender (boy = 1, girl = 0) | | –1.2 (2.1) | 0.0 (2.1) | 2.2 (2.1) | 2.2 (2.1) | 2.4 (2.1) | 2.4 (2.1) | 2.4 (2.1) | 2.4 (2.1) |
| School status (private = 1, public =0) | | | | | | | | | |
| School location (Tbilisi = 2, city =1, village =0) | 7.8 (3.6) * | 7.8 (3.6) * | 8.3 (3.5) * | 8.8 (3.4) ** | 8.8 (3.4) ** | 8.7 (3.4) * | 7.9 (3.3) * | 8.8 (3.4) * | 8.8 (3.4) * |
| **Level 1** | | | | | | | | | |
| Family's socio-economic status | | | 9.3 (0.9) *** | 8.8 (0.9) *** | 8.7 (2.0) *** | 8.8 (2.0) *** | 8.8 (2.0) *** | 8.8 (2.0) *** | 8.8 (2.0) *** |
| Clarity of instructions on science lessons | | | | 8.2 (0.7) *** | 8.2 (0.7) *** | 8.4 (0.7) *** | 8.4 (0.7) *** | 8.4 (0.7) *** | 8.4 (0.7) *** |
| Interaction (school type X family socio-economic status) | | | | | | | | | |
| Interaction (school location X family socio-economic status) | | | | | 0.1 (1.2) | 0.1 (1.2) | 0.1 (1.2) | 0.1 (1.2) | 0.1 (1.2) |
| **Level 2** | | | | | | | | | |
| School composition according to socio-economic status | | | | | | 2.2 (2.9) | –1.1 (2.9) | –0.7 (2.8) | –0.7 (2.9) |
| School emphasis on academic success (school principle's position) | | | | | | | 5.7 (1.3) *** | 5.7 (1.3) *** | 5.2 (1.6) ** |
| School discipline | | | | | | | | 1.8 (1.3) | 1.8 (1.3) |
| The impact of the shortage of sciences resources on learning | | | | | | | | | 0.2 (1.4) |

***Appendix. Table 1. 3.*** *Hierarchical regression analysis: Mathematics 8th grade*

| **Mathematics 8th grade** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| | 473.6 (4.0) *** | 468.8 (4.1) *** | 464.7 (4.2) *** | 463.6 (4.2) *** | 465.7 (4.2) *** | 464.9 (4.2) *** | 464.9 (4.2) *** | 464.5 (9.9) *** | 465.4 (10.6) *** | 467.8 (10.6) *** |
| Gender (boy = 1, girl = 0) | | | 7.9 (2.6) ** | 11.4 (2.6) *** | 13.2 (2.6) *** | 14.9 (2.6) *** | 14.9 (2.6) *** | 13.9 (2.7) *** | 13.9 (2.7) *** | 13.9 (2.7) *** |
| School status (private = 1, public =0) | | 50.2 (10.2) *** | 50.3 (10.2) *** | 49.9 (10.3) *** | 47.1 (10.2) *** | 55.2 (10.4) *** | 55.3 (10.5) *** | 52.9 (11.3) *** | 50.8 (11.7) *** | 44.4 (12.1) *** |
| School location (Tbilisi = 2, city =1, village =0) | | | | | | | | | | |
| **Level 1** | | | | | | | | | | |
| Family's educational resources | | | | 12.4 (1.0) *** | 11.6 (1.0) *** | 11.7 (1.0) *** | 11.8 (1.1) *** | 11.8 (1.1) *** | 11.8 (1.1) *** | 11.8 (1.1) *** |
| Clarity of instruction on math lessons | | | | | 3.1 (0.9) *** | 3.1 (0.9) *** | 3.1 (0.9) *** | 3.0 (0.9) *** | 3.0 (0.9) *** | 3.0 (0.9) ** |
| Interaction (school type X gender) | | | | | | −16.3 (8.6) | −16.6 (8.9) | −15.4 (9.4) | −15.4 (9.4) | −15.5 (9.4) |
| Interation (school type X family's educational resources) | | | | | | | −1.8 (3.8) | −2.3 (4.1) | −2.3 (4.1) | −2.3 (4.1) |
| Interaction (school location X gender) | | | | | | | | | | |
| Interaction (school location X family's educational resources) | | | | | | | | | | |
| **Level 2** | | | | | | | | | | |
| School composition according to socio-economic status | | | | | | | | 0.6 (3.8) | 0.2 (4.1) | −1.0 (4.1) |
| School emphasis on academic success (school principle's position) | | | | | | | | | 1.6 (2.1) | 1.5 (2.5) |
| school discipline | | | | | | | | | | −4.4 (2.4) * |
| The impact of the shortage of mathematics resources on learning | | | | | | | | | | 4.8 (2.3) * |

***Appendix. Table 1. 3.*** *Hierarchical regression analysis: Mathematics 8th grade*

| **Mathematics 8th grade** | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|
| | 451.6 (7.4) *** | 447.4 (7.5) *** | 445.5 (7.5) *** | 448.4 (7.4) *** | 449.5 (7.7) *** | 449.6 (7.7) *** | 442.8 (11.8) *** | 444.7 (12.3) *** | 447.1 (12.6) *** | 451.7 (12.9) *** |
| Gender (boy = 1, girl = 0) | | 7.9 (2.6) ** | 11.4 (2.6) *** | 13.2 (2.6) *** | 10.9 (5.5) * | 10.8 (5.6) | 11.8 (5.8) * | 11.8 (5.8) * | 11.8 (5.8) * | 11.7 (5.8) * |
| School status (private = 1, public =0 | | | | | | | | | | |
| School location (Tbilisi = 2, city =1, village =0) | 15.4 (5.3) ** | 15.5 (5.3) ** | 15.9 (5.3) ** | 15.3 (5.3) ** | 14.4 (5.5) ** | 14.3 (5.4) ** | 13.8 (5.8) * | 14.0 (5.9) * | 12.4 (5.6) * | 11.2 (5.7) * |
| **Level 1** | | | | | | | | | | |
| Family's educational resources | | | 12.4 (1.0) *** | 11.6 (1.0) *** | 11.7 (1.0) *** | 10.9 (2.2) *** | 10.5 (2.2) *** | 10.5 (2.2) *** | 10.5 (2.2) *** | 10.5 (2.2) *** |
| Clarity of instruction on math lessons | | | | 3.1 (0.9) *** | 3.1 (0.9) *** | 3.1 (0.9) *** | 3.0 (0.9) ** | 3.0 (0.9) ** | 3.0 (0.9) ** | 3.0 (0.9) ** |
| Interaction (school type X gender) | | | | | | | | | | |
| Interation (school type X family's educational resources) | | | | | | | | | | |
| Interaction (school location X gender) | | | | | 1.8 (3.6) | 1.9 (3.7) | 0.5 (3.8) | 0.5 (3.8) | 0.5 (3.8) | 0.5 (3.8) |
| Interaction (school location X family's educational resources) | | | | | | 0.6 (1.4) | 0.9 (1.4) | 0.9 (1.4) | 0.9 (1.4) | 0.9 (1.4) |
| **Level 2** | | | | | | | | | | |
| School composition according to socio-economic status | | | | | | | 3.6 (3.9) | 2.5 (4.3) | 2.5 (4.3) | 0.7 (4.2) |
| School emphasis on academic success (school principle's position) | | | | | | | | 3.2 (2.1) | 3.8 (2.4) | 2.3 (2.4) |
| school discipline | | | | | | | | | –1.9 (2.2) | –3.6 (2.3) |
| The impact of the shortage of mathematics resources on learning | | | | | | | | | | 5.9 (2.4) * |

***Appendix. Table 1. 4.*** *Hierarchical regression analysis: Science 8th grade*

| **Science 8th grade** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| | 452.5 (2.7) *** | 448.4 (2.7) *** | 451.4 (2.8) *** | 450.4 (2.7) *** | 458.0 (2.8) *** | 457.7 (2.8) *** | 457.7 (2.8) *** | 456.1 (6.7) *** | 456.3 (7.0) *** | 457.3 (6.9) *** |
| Gender (boy = 1, girl = 0) | | | −5.9 (2.3) * | −1.9 (2.3) | 4.1 (2.5) | 4.7 (2.7) | 4.8 (2.7) | 4.2 (2.7) | 4.2 (2.7) | 4.2 (2.7) |
| School status (private = 1, public =0) | | 42.8 (7.4) *** | 42.7 (7.4) *** | 42.1 (7.5) *** | 39.2 (6.4) *** | 41.45 (6.7) *** | 42.0 (6.7) *** | 41.3 (7.2) *** | 40.9 (7.4) *** | 38.4 (7.7) *** |
| School location (Tbilisi = 2, city =1, village =0) | | | | | | | | | | |
| **ლონე 1** | | | | | | | | | | |
| Family's educational resources | | | | 13.1 (0.9) *** | 12.2 (1.0) *** | 12.2 (1.0) *** | 12.7 (1.1) *** | 12.7 (1.1) *** | 12.7 (1.1) *** | 12.7 (1.1) *** |
| Clarity of instruction on Biology lessons | | | | | 0.9 (1.0) | 0.9 (1.0) | 0.9 (1.1) | 1.2 (1.1) | 1.2 (1.1) | 1.2 (1.1) |
| Clarity of instruction on Chemistry lessons | | | | | 4.2 (0.9) *** | 4.2 (0.9) *** | 4.1 (0.9) *** | 4.5 (0.9) *** | 4.5 (0.9) *** | 4.4 (0.9) *** |
| Clarity of instruction on Physics lessons | | | | | 1.2 (0.9) | 1.2 (0.9) | 1.2 (0.9) | 1.0 (1.0) | 1.0 (1.0) | 1.0 (1.0) |
| Clarity of instruction on Geography lessons | | | | | 0.3 (1.0) | 0.3 (1.0) | 0.2 (1.0) | −0.1 (1.0) | −0.1 (1.0) | −0.1 (1.0) |
| Interaction (school type X gender) | | | | | | −4.7 (7.3) | −5.9 (7.5) | −4.7 (8.1) | −4.7 (8.1) | −4.8 (8.1) |
| Interaction (school type X family's educational resources) | | | | | | | −4.6 (3.1) | −5.5 (3.2) | −5.5 (3.2) | −5.5 (3.2) |
| Interaction (school location X gender) | | | | | | | | | | |
| Interaction (school location X family's educational resources) | | | | | | | | | | |
| **Level 2** | | | | | | | | | | |
| School composition according to socio-economic status | | | | | | | | 0.9 (2.7) | 0.9 (2.8) | 0.5 (2.7) |
| School emphasis on academic ssuccess (school principle's position) | | | | | | | | | 0.3 (1.3) | 1.0 (1.6) |
| School discipline | | | | | | | | | | −3.2 (1.5) * |
| The impact of the shortage of science subject resources on learning | | | | | | | | | | 1.2 (1.6) |

*Appendix. Table 1. 5. Hierarchical regression analysis: Science 8th grade*

| Science 8th grade | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|
| | 436.8 (4.8) *** | 439.9 (4.9) *** | 438.1 (4.8) *** | 447.5 (4.4) *** | 449.6 (4.6) *** | 449.6 (4.6) *** | 441.7 (7.7) *** | 442.8 (7.8) *** | 445.7 (8.0) *** | 448.1 (7.9) *** |
| Gender (boy = 1, girl = 0) | | −5.9 (2.3) * | −1.9 (2.3) | 4.1 (2.5) | −0.3 (5.8) | −0.3 (5.8) | 0.4 (6.0) | 0.4 (6.0) | 0.4 (6.0) | 0.4 (6.0) |
| School status (private = 1, public =0) | | | | | | | | | | |
| School location (Tbilisi = 2, city =1, village =0) | 11.0 (3.5) ** | 11.0 (3.5) ** | 11.5 (3.5) ** | 10.0 (3.3) ** | 8.4 (3.5) * | 8.5 (3.5) * | 8.4 (3.7) * | 8.5 (3.7) * | 6.6 (3.7) | 6.0 (3.7) |
| **Level 1** | | | | | | | | | | |
| Family's educational resources | | | 13.1 (0.9) *** | 12.2 (1.0) *** | 12.2 (1.0) *** | 12.9 (2.5) *** | 12.5 (2.5) *** | 12.5 (2.5) *** | 12.5 (2.5) *** | 12.5 (2.5) *** |
| Clarity of instruction on Biology lessons | | | | 0.9 (1.0) | 1.0 (1.0) | 1.0 (1.0) | 1.0 (1.0) | 1.2 (1.0) | 1.2 (1.0) | 1.2 (1.1) |
| Clarity of instruction on Chemistry lessons | | | | 4.2 (0.9) *** | 4.2 (0.9) *** | 4.2 (0.9) *** | 4.4 (1.0) *** | 4.4 (1.0) *** | 4.4 (1.0) *** | 4.4 (1.0) *** |
| Clarity of instruction on Physics lessons | | | | 1.2 (0.9) | 1.1 (0.9) | 1.1 (0.9) | 0.9 (1.0) | 0.9 (1.0) | 0.9 (1.0) | 0.9 (1.0) |
| Clarity of instruction on Geography lessons | | | | 0.3 (1.0) | 0.3 (1.0) | 0.3 (1.0) | −0.1 (1.0) | −0.1 (1.0) | −0.1 (1.0) | −0.1 (1.0) |
| Interaction (school type X gender) | | | | | | | | | | |
| Interaction (school type X family's educational resources) | | | | | | | | | | |
| Interaction (school location X gender) | | | | | 3.4 (3.7) | 3.3 (3.7) | 2.5 (3.8) | 2.5 (3.8) | 2.5 (3.8) | 2.5 (3.8) |
| Interaction (school location X family's educational resources) | | | | | | −0.5 (1.5) | −0.2 (1.5) | −0.2 (1.5) | −0.2 (1.5) | −0.2 (1.5) |
| **Level 2** | | | | | | | | | | |
| School composition according to socio-economic status | | | | | | | 3.6 (2.8) | 3.0 (3.0) | 3.0 (3.0) | 2.0 (2.9) |
| School emphasis on academic ssuccess (school principle's position) | | | | | | | | 1.8 (1.4) | 2.5 (1.6) | 1.9 (1.6) |
| School discipline | | | | | | | | | −2.2 (1.4) | −3.0 (1.5) |
| The impact of the shortage of science subject resources on learning | | | | | | | | | | 2.5 (1.6) |

## Appendix 2

***Appendix. Table 2. 1.*** *Hierarchical analysis: Mathematics 4th grade*

| Mathematics 4th grade | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| | 491.5 (7.0) *** | 487.4 (7.2) *** | 486.4 (7.1) *** | 488.8 (6.9) *** | 490.1 (6.8) *** | 490.1 (6.8) *** | 479.8 (8.5) *** | 490.6 (8.9) *** |
| Gender (boy = 1, girl = 0) | | 8.1 (2.3) *** | 9.5 (2.2) *** | 11.8 (2.2) *** | 10.6 (2.4) *** | 10.6 (2.4) *** | 10.8 (2.4) *** | 10.8 (2.4) *** |
| School status (private = 1, public =0) | | | | | | | | |
| School location (urban =1, rural =0) | 10.1 (7.6) | 10.2 (7.6) | 12.1 (7.5) | 12.6 (7.3) | 12.1 (7.1) | 12.1 (7.1) | 12.6 (7.2) | 7.9 (7.3) |
| **Level 1** | | | | | | | | |
| Family's socio-economic status | | | 13.2 (1.0) *** | 12.1 (1.0) *** | 11.1 (1.0) *** | 11.2 (2.6) *** | 11.2 (2.6) *** | 11.2 (2.6) *** |
| Clarity of instructions on Math lessons | | | | 6.5 (0.7) *** | 6.2 (0.8) *** | 6.2 (0.8) *** | 6.3 (0.8) *** | 6.3 (0.8) *** |
| Number-related tasks before entering school | | | | | 6.1 (0.7) *** | 6.1 (0.7) *** | 6.0 (0.7) *** | 6.0 (0.7) *** |
| Interaction (School status X family's socio-economic status) | | | | | | | | |
| Interaction (School location X family's socio-economic status) | | | | | | –0.2 (2.8) | 0.1 (2.8) | 0.1 (2.8) |
| **Level 2** | | | | | | | | |
| School compozition according to socio-economic status | | | | | | | 4.9 (2.9) | 1.7 (2.9) |
| School emphasis on academic success (school principle's position) | | | | | | | | 5.6 (1.3) *** |

***Appendix. Table 2. 2.*** *Hierarchical analysis: Science 4th grade*

| Science 4th grade | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| | 465.6 (7.4) *** | 466.2 (7.5) *** | 465.5 (7.4) *** | 467.2 (7.0) *** | 467.2 (7.0) *** | 462.8 (8.8) *** | 474.2 (9.5) *** |
| Gender (boy = 1, girl = 0) | | –1.2 (2.1) | 0.0 (2.1) | 2.2 (2.1) | 2.2 (2.1) | 2.4 (2.1) | 2.4 (2.1) |
| School status (private = 1, public =0) | | | | | | | |
| School location (urban =1, rural =0) | 1.9 (7.8) | 1.9 (7.8) | 3.3 (7.8) | 4.2 (7.3) | 4.2 (7.3) | 4.9 (7.4) | –0.1 (7.5) |
| **Level 1** | | | | | | | |
| Family's socio-economic status | | | 9.3 (0.9) *** | 8.8 (0.9) *** | 8.2 (2.4) *** | 8.2 (2.4) *** | 8.2 (2.4) *** |
| Clarity of instructions on science lessons | | | | 8.2 (0.7) *** | 8.2 (0.7) *** | 8.4 (0.7) *** | 8.4 (0.7) *** |
| Interaction (School status X family's socio-economic status) | | | | | | | |
| Interaction (School location X family's socio-economic status) | | | | | 0.6 (2.6) | 0.1 (2.6) | 0.9 (2.6) |
| **Level 2** | | | | | | | |
| School compozition according to socio-economic status | | | | | | 2.1 (2.9) | –1.2 (2.9) |
| School emphasis on academic success (school principle's position) | | | | | | | 5.9 (1.4) *** |

***Appendix. Table 2. 3***. *Hierarchical analysis: Mathematics 8th grade*

| **Mathematics 8th grade** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| | 455.3 (9.4) *** | 451 (9.5) *** | 449.7 (9.5) *** | 452.6 (9.5) *** | 456.0 (10.0) *** | 456.2 (10.0) *** | 449.9 (14.5) *** | 452.8 (15.7) *** |
| Gender (boy = 1, girl = 0) | | 7.8 (2.6) ** | 11.3 (2.6) *** | 13.2 (2.6) *** | 6.4 (7.1) | 5.8 (7.1) | 7.4 (7.3) | 7.3 (7.3) |
| School status (private = 1, public =0) | | | | | | | | |
| School location (urban =1, rural =0) | 20.7 (10.3) * | 20.7 (10.3) * | 21.1 (10.3) * | 19.9 (10.3) | 15.9 (10.9) | 15.6 (10.9) | 14.5 (11.5) | 13.2 (11.9) |
| **Level 1** | | | | | | | | |
| Family's educational resouces | | | 12.4 (1.0) *** | 11.6 (1.0) *** | 11.6 (1.0) *** | 8.4 (2.5) *** | 7.8 (2.5) ** | 7.8 (2.5) ** |
| Clarity of instructions on math lessons | | | | 3.1 (0.9) *** | 3.1 (0.9) *** | 3.1 (0.9) *** | 3.0 (0.9) *** | 3.0 (0.9) ** |
| Interaction (School type X Gender) | | | | | | | | |
| Interaction (School status X family's socio-economic status) | | | | | | | | |
| Interaction (school location X gender) | | | | | 8.2 (7.5) | 8.9 (7.5) | 6.1 (7.8) | 6.1 (7.8) |
| Interaction (school location X family's socio-economic status) | | | | | | 4.0 (2.7) | 4.7 (2.8) | 4.7 (2.8) |
| **Level 2** | | | | | | | | |
| School compozition according to socio-economic status | | | | | | | 3.5 (3.9) | 2.5 (4.2) |
| School emphasis on academic success (school principle's position) | | | | | | | | 2.9 (2.1) |

***Appendix. Table 2. 4.*** *Hierarchical analysis: Science 8th grade*

| Science 8th grade | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| | 440.0 (6.0) *** | 443.1 (6.0) *** | 441.1 (5.9) *** | 451.6 (5.2) *** | 453.9 (5.1) *** | 454.0 (5.2) *** | 446.8 (8.4) *** | 448.5 (8.8) *** |
| Gender (boy = 1, girl = 0) | | –6.0 (2.3) ** | –2.0 (2.3) | 4.1 (2.5) | –0.9 (7.3) | –1.1 (7.4) | –0.3 (7.7) | –0.3 (7.7) |
| School status (private = 1, public =0) | | | | | | | | |
| School location (urban =1, rural =0) | 14.2 (6.6) * | 14.2 (6.7) * | 15.2 (6.6) * | 11.5 (6.0) | 8.8 (6.0) | 8.7 (6.0) | 8.0 (6.3) | 7.3 (6.4) |
| **Level 1** | | | | | | | | |
| Family's educational resouces | | | 13.1 (0.9) *** | 12.2 (1.0) *** | 12.2 (1.0) *** | 10.8 (3.0) *** | 10.2 (3.0) *** | 10.2 (3.0) *** |
| Clarity of instructions on Biology lessons | | | | 0.9 (1.0) | 1.0 (1.0) | 1.0 (1.0) | 1.0 (1.0) | 1.2 (1.0) |
| Clarity of instructions on Chemistry lessons | | | | 4.2 (0.9) *** | 4.2 (0.9) *** | 4.1 (0.9) *** | 4.4 (1.0) *** | 4.4 (1.0) *** |
| Clarity of instructions on Physics lessons | | | | 1.2 (0.9) | 1.2 (0.9) | 1.2 (0.9) | 1.0 (1.0) | 1.0 (1.0) |
| Clarity of instructions on Geography lessons | | | | 0.3 (1.0) | 0.3 (1.0) | 0.3 (1.0) | –0.1 (1.0) | –0.1 (1.0) |
| Interaction (school status X gender) | | | | | | | | |
| Interaction (school type X school educational resources) | | | | | | | | |
| Interaction (school location X gender) | | | | | 6.0 (7.7) | 6.2 (7.9) | 4.8 (8.1) | 4.8 (8.1) |
| Interaction (school location X family's educational resources | | | | | | 1.8 (3.2) | 2.6 (3.2) | 2.6 (3.2) |
| **Level 2** | | | | | | | | |
| School composition according to socio-economic status | | | | | | | 3.6 (2.8) | 3.0 (2.9) |
| School emphasis on academic success (school principle's position) | | | | | | | | 1.5 (1.4) |

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