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Time use and the academic performance gender gap among middle school and high school students: evidence from Brazil

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Abstract

This article analyses the influence of time use in various extracurricular activities, such as household chores, paid work, leisure activities and private study, on the gender gap in literacy and mathematics among middle school and high school students in Brazil in 2021, amid the coronavirus disease (COVID-19) pandemic. The Oaxaca-Blinder decomposition is used, enabling results to be broken down to evaluate how structural factors—in particular time use across these activities—affect student performance in Brazil. Our results indicate that unobserved effort in the activity influences performance more than time spent, as returns on activities are more influential than differences in observable gender characteristics for comparable groups. The analysis also concluded that cultural factors remain the primary barrier to reducing the gender gap. The time allocated to extracurricular activities rises in tandem with students' grade levels, suggesting that prejudice, stereotypes and cultural beliefs increase with age.

Keywords: students, academic achievement, school success, children, time management, cultural aspects, gender equality, mathematical analysis, Brazil.

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Resumen

Este artículo analiza la influencia del uso del tiempo en diversas actividades extracurriculares, como las tareas domésticas, el trabajo remunerado, las actividades de ocio y el estudio particular, en la brecha de género en cuanto al nivel de alfabetización y matemáticas entre los estudiantes de secundaria y bachillerato en el Brasil en 2021, durante la pandemia de COVID-19. Se utiliza la descomposición Oaxaca-Blinder, que permite desglosar los resultados para evaluar cómo los factores estructurales, en particular el uso del tiempo en estas actividades, afectan el desempeño de los estudiantes en el Brasil. Nuestros resultados indican que el esfuerzo no observado en la actividad influye en el desempeño más que el tiempo dedicado, ya que los rendimientos de las actividades son más influyentes que las diferencias en las características de género observables para grupos comparables. El análisis también concluye que los factores culturales siguen siendo el principal obstáculo para reducir la brecha de género. El tiempo dedicado a actividades extracurriculares aumenta paralelamente al grado escolar de los alumnos, lo que sugiere que los prejuicios, los estereotipos y las creencias culturales aumentan con la edad.

Palabras claves: alumnos, rendimiento escolar, éxito escolar, niños, gestión de tiempo, aspectos culturales, igualdad de género, análisis matemático, Brasil.

Resumo

Este artigo analisa a influência do uso do tempo em várias atividades extracurriculares, como tarefas domésticas, trabalho remunerado, atividades de lazer e estudo privado, na lacuna de gênero em alfabetização e matemática entre alunos do ensino fundamental e médio no Brasil em 2021, durante a pandemia de COVID-19. Utiliza-se a decomposição de Oaxaca-Blinder, permitindo que os resultados sejam discriminados para avaliar como fatores estruturais (particularmente o uso do tempo nessas atividades) afetam o desempenho escolar no Brasil. Nossos resultados indicam que o esforço não observado na atividade influencia mais o desempenho do que o tempo gasto, já que os retornos das atividades são mais influentes do que diferenças nas características de gênero observáveis para grupos comparáveis. A análise também concluiu que os fatores culturais continuam sendo a principal barreira na redução da lacuna de gênero. O tempo gasto em atividades extracurriculares aumenta juntamente com o nível de escolaridade dos alunos, sugerindo que preconceitos, estereótipos e crenças culturais aumentam com a idade.

Palavras-chave: estudantes, desempenho acadêmico, sucesso escolar, crianças, gerenciamento de tempo, aspectos culturais, igualdade de gênero, análise matemática, Brasil.

Introduction

Women are underrepresented in science, technology, engineering and mathematics (STEM) careers, an asymmetry that may be attributed to a lack of incentive or to disinclination. It is also known that sociopsychological processes that affect self-assessments of ability may disadvantage girls who are cognitively inclined towards STEM (Ashlock, Stojnic and Tufekci, 2022). In some cases, sociocognitive influences are positively correlated with parental behaviours and housework (Solaz and Wolff, 2015). Similarly, Correll (2001) argues that cultural beliefs drive a biased female self-assessment in STEM careers. This bias begins in elementary school, increases during adolescence and persists in adulthood, spilling over into the next generation (Dotti Sani, 2018). However, a controlled experiment shows that men and women aspire to STEM careers in equal measure (Moss-Racusin and others, 2018).

Ethos (defined as cultural beliefs, gender biases and stereotypes) is closely tied to the stigmatization and devaluation of certain groups within the educational system (ECLAC, 2022). The prejudiced constructs of ethos form the foundation of a system that often fails to promote specific positive cultural identities to children and perpetuates biased attitudes as children transition into adulthood (UNESCO, 2017). Unequal resource distribution in schools and unbalanced gender representation undermine girls' confidence and abilities in STEM fields. Moreover, from their earliest years in school, girls are exposed to a predominantly male-centred culture, which influences their time use.

The acronym “STEM” originated in the United States in the 1990s. With the advent of home computers, school curricula became outdated as passive learning no longer met labour market needs. STEM education thus emerged as a means of revolutionizing teaching methods (Pugliese, 2020).

According to the National Academies (2007), the lag in the United States educational system in mathematics, engineering and science was reducing its competitive advantage compared with other developed countries. The Organisation for Economic Co-operation and Development (OECD) found that the performance of students in the United States in 2003 was below the average for OECD countries, which indicates a weaker interest in the sciences (OECD, 2004, p. 294). Wong, Dillon and King (2016, p. 17) found that student behaviour was similar in England, under a STEM policy that failed to widen participation to groups that seldom considered careers in science, only ensuring “that a higher proportion of the traditional participants chose to study science”. Since, historically, STEM participants were mostly male, the revolution in study methods ended up propagating the false idea that only men were destined for careers in mathematics (UNESCO, 2017).

The focus on STEM gained global momentum with the 2030 Agenda for Sustainable Development, which emphasizes its role in achieving sustainable development and highlights the importance of including women in mathematics and related fields (UNESCO, 2017; ECLAC, 2022). In 2014, Brazil enacted the 2014–2024 National Education Plan, which included a goal to strengthen science. Of particular importance is its fourteenth target

(strategy 14.8), which aims to encourage women's participation in postgraduate studies, especially in fields such as engineering, mathematics, physics, chemistry, informatics and other scientific disciplines (Brazil, 2014).

Considering that strong academic performance in subjects such as mathematics can boost women's interest in and access to STEM careers, this study aims to analyse the gender gap in children's academic performance, taking into account time use in various daily activities, and assessing the latent ethos in Brazilian contexts, such as leisure activities, household chores, paid work and studying (e.g. homework, schoolwork and private tutoring). Against this backdrop, we hypothesize that structural factors (ethos) contribute to gender gaps.

Time management and time pressure play a crucial role in children's and adolescents' autonomy, and girls are at a significant disadvantage in that regard (Hilbrecht, Zuzanek and Mannell, 2008). Evaluating these contexts thus helps to understand the gender gap in Brazilian schools, enabling the implementation of public policies or the distribution of resources to narrow the gap and to support the rights and well-being of girls who aspire to work in STEM fields.

In the scientific community, some researchers attribute the imbalance in STEM participation to lifestyle factors, such as the choice to focus on child and family care. However, in their literature review, Ceci and Williams (2011, p. 3157) concluded that, whether free or constrained, "choices could be influenced and better informed through education". This seems to be the case in Brazil. In a 2017 study, Alvarenga and Braga (2024) found that Brazilian women in STEM fields were less likely to harbour implicit gender stereotypes regarding STEM than women in the humanities, and that underrepresentation was a structural outcome that might not be linked with ethos.

Previous studies using data from the United States and Italy have shown that girls spend more time on household chores and less on leisure activities than boys (Wight and others, 2009; Mencarini, Pasqua and Romiti, 2019). Nevertheless, social perceptions (ethos) of task competence foster the gender gap in STEM careers (Correll, 2001), as reflected in women's lower likelihood of being hired in the field of mathematics (Reuben, Sapienza and Zingales, 2014) or for management positions (Moss-Racusin and others, 2012), or of receiving academic mentoring (Milkman, Akinola and Chugh, 2012).

Studies conducted in rural areas are also relevant. Hilbrecht, Zuzanek and Mannell (2008) show that boys aged 12–14 spend more time on agricultural activities than girls. However, this involvement decreases significantly as boys age, while the time girls dedicate to such activities remains constant throughout their lives. This is a vestige in rural areas of the assignment of specific chores to girls from an early age, while the opportunities available to rural boys become more diverse as they grow.

In Bangladesh, as noted in Siddiqa and Braga (2019), although girls are interested in STEM fields, the institutional and social conditions in rural areas are precarious. There are few female teachers and infrastructure is inadequate. Some families choose to send girls to study in urban areas, where they live with relatives, while others worry about the challenges

of a long commute. In the latter case, the primary concerns are violence and the risk of rape, as girls often need to wake up early and walk to the bus stop while it is still dark. In rural schools, lack of Internet access and other technologies that support STEM education are significant barriers. Nevertheless, some 10% of rural Bangladeshi girls maintain their interest in STEM disciplines, striving for a better future (Siddiqa and Braga, 2019).

The challenges in Brazil, where some girls living in rural areas demonstrate a strong determination to overcome barriers, are similar to those in rural Bangladesh. Bearing this in mind, this article also contributes to the discussion by examining the academic performance gap and time use in rural areas. In both rural and urban contexts, we analyse the first and final year of middle school and the final year of high school. Literacy and mathematics gaps are analysed to better understand the detrimental effects of time use on performance in each subject.

Explaining the terms used in this study is important for comparison purposes and to prevent confusion. In Brazil, “middle school” in the United States is known as “basic school”, which, in the system of England, corresponds to key stage 3 (ages 11 to 14), while United States “high school” corresponds to middle school or key stage 4 (ages 15 to 17) for England. Throughout this study, we will use the terms as they are understood in the United States.

The analysis of these age groups contributes to the literature by spotlighting gender gap patterns during the transition from childhood to adolescence and then to adulthood. This study also examines the perception of ethos in academic performance by decomposing the time use of target groups, comparing effects for rural and urban samples.

The literature contains various methods to identify the gender gap and its effects. Ashlock, Stojnic and Tufekci (2022) utilized ordinary least squares to examine gender differences in computer science occupations. Gracia and others (2022) used the same method to compare gender-related differences in time use in Finland, Spain and the United Kingdom. Mencarini, Pasqua and Romiti (2019) innovated by using the differences-in-differences method to compare the gender gap between traditional families and those headed by single mothers.

This study is based on the Oaxaca-Blinder technique (Oaxaca, 1973; Blinder, 1973) and 2021 data from Brazil’s Basic Education Assessment System (SAEB). The students who filled in the questionnaire may have left some questions blank, resulting in missing data and more information on females than males, or vice versa. Moreover, since the subject is gender, both groups (male and female) are naturally unbalanced in terms of statistical observations. According to Robins, Rotnitzky and Zhao (1994) and as emphasized by Kline (2011), the Oaxaca-Blinder technique is doubly robust because it minimizes the mean squared errors attributable to missing and unbalanced control groups.

The database of the 2021 round of SAEB was used because its questions differ from those posed in other periods, and because the structural break stemming from the COVID-19 pandemic presented a major obstacle for longitudinal assessment. The simultaneous and prolonged lockdown of parents and children enabled more intense observation of time-use patterns by gender, allowing them to be linked to boys’ and girls’ literacy and mathematics performance.

According to Reichelt, Makovi and Sargsyan (2021), women's professional responsibilities suffer when they transition to working from home, as they are pressured to take on almost all housework. In this regard, the lockdown amplified the part of ethos that favoured gender discrimination, facilitating the linkage of time use with academic performance.

The findings of the present study show that the situation in Brazil aligns with that described by the above-mentioned scholars in relation to the STEM gender gap, time use, prejudice, cultural beliefs and gender stereotypes. Regarding the STEM gender gap, we highlight Correll (2001), Ceci and Williams (2011), Bertrand and Pan (2013), Reuben, Sapienza and Zingales (2014), Moss-Racusin and others (2018), UNESCO (2017), Alvarenga (2020) and Alvarenga and Braga (2024). On time use, sufficient —albeit not exhaustive— insight is presented in Hilbrecht, Zuzanek and Mannell (2008), Wight and others (2009), Gracia and others (2022), Ashlock, Stojnic and Tufekci (2022) and UNICEF (2024). Lastly, although ethos is identified as an explanatory factor to some degree in much of this research, the following studies are recommended for their robust reviews of the subject: Milkman, Akinola and Chugh (2012), Moss-Racusin and others (2012), Mencarini, Pasqua and Romiti (2019) and ECLAC (2022).

The findings of the present study reveal that inequalities in some areas, such as ethos, may be linked to structural issues, such as boys being incentivized to seek paid employment while girls are encouraged to continue performing household chores. Even when boys and girls spend the same amount of time on extracurricular activities, the type of activity affects the gender differential in educational outcomes. These results are consistent across families irrespective of socioeconomic status. However, in terms of lifestyle, while the urban sample suggests that these inequalities can be attributed to how leisure time is spent, this factor is negligible in rural areas.

In addition to this introduction, the article is divided into three further sections and one annex. The next section presents the methodology used, including the empirical strategy and the database. The following section presents the results and the final section presents the conclusions. The annex contains additional results.

A. Methods

1. Empirical strategy: counterfactual decomposition

Given the diverse nature of the questions in the SAEB database, the structural disruptions stemming from the pandemic —which hindered parallel behavioural trend assumptions— and the study's focus on examining the assumed intensification of ethos, attributable to social isolation rather than to direct changes in behaviour, the difference-in-differences method was considered unsuitable. Accordingly, the Oaxaca-Blinder methodology (Oaxaca, 1973; Blinder, 1973) was used to evaluate the effect of time use on educational outcomes. This methodology allows for counterfactual comparisons between disadvantaged groups and a theoretical control group, enabling a nuanced analysis of disparities without assuming that gender discrimination is the sole explanatory factor.

According to Kline (2011), the Oaxaca-Blinder methodology is a doubly robust model, since it seeks to minimize mean square error in unbalanced control groups as well as any missing data. Conversely, according to Robins, Rotnitzky and Zhao (1994), if the model for the outcomes is correct, Oaxaca-Blinder decomposition will identify the true coefficient even where the common support condition—which ensures identification—fails or the implicit model for the propensity score is incorrect.

With that in mind, differences in academic performance are estimated first, as the model enables the residual error to be broken down, defining in what measure the factors contribute to the gender gap. In this regard, the model is a production function that relates academic performance to a set of inputs to education (such as school management and teacher characteristics) and to family background, represented by socioeconomic status (Hanushek, 2020).

Socioeconomic status is an important factor for verifying the ethos underlying boys' and girls' time use, as academic performance may be linked to latent family characteristics, such as mothers who hold a master's or doctoral degree, which could influence girls in breaking the masculine paradigm. However, ethos may also play a role, since even in cases of latent equality, gender bias continues to favour boys.

The characteristics that influence the academic performance gender gap may be identified by using counterfactual decomposition and separating inequalities into two components: compositional effects and structural compositions. The Oaxaca-Blinder model also enables evaluation of the contribution of each independent variable to these two components. Thus, the linear equation that estimates the education production function for individual i in group g is:

$$Y_{i,g} = X_{i,g}\beta_g + \varepsilon_{i,g} \mid g = H, L \quad (1)$$

where $Y_{i,g}$ is academic performance, measured by test scores; X_{ig} is a vector with latent characteristics, including time use in the activities; and β_g is the angle coefficient of the variables. It is assumed that outcomes are positive for group H and negative for group L .

According to Alvarenga (2020), Brazilian boys shine in STEM disciplines, while girls perform better in the humanities. Thus, the first group corresponds to boys (H) and the second group to girls (L). According to Blinder (1973), differences in academic performance are measured as follows:

$$\bar{Y}_H - \bar{Y}_L = (\bar{X}_H - \bar{X}_L)\beta_H + (\beta_H - \beta_L)\bar{X}_L + (\bar{X}_H - \bar{X}_L)(\beta_H - \beta_L) \quad (2)$$

If the average differences are positive, then the gender gap favours group H . The first decomposition term, $(\bar{X}_H - \bar{X}_L)\beta_H$, represents the composition effects, i.e. the share of inequality attributable to the latent characteristics of each group. In turn, $(\beta_H - \beta_L)\bar{X}_L$ represents the difference resulting from these characteristics, assuming a counterfactual

situation where the groups have the same attributes. The effects of ethos (structural effects) can be associated with part of this term, which also includes a term interaction effect, the difference in performance attributable to latent characteristics.

The coefficient estimations are derived using the ordinary least squares methodology because it yields consistent results for both conditional and unconditional estimations (Angrist and Pischke, 2009). The total effect attributable to each component can be determined by assessing the contribution of each time-use category variable using the Yun (2005) procedure.

2. Database

The study draws on Brazilian microdata from the SAEB database, which contains data, beginning in 1990, on the first and final years of Brazilian middle school (students in key stage 3, aged around 11 and 13, respectively) and the final year of Brazilian high school (students in key stage 4, aged around 17). This database also contains students' socioeconomic status factors and the school balance sheet, which is a comprehensive overview of schools' performance and quality metrics (INEP, 2022). SAEB assessments are conducted every two years. In that context, 2021 was chosen, as it presents behaviour during the COVID-19 pandemic and time use essentially in the home, owing to the lockdown, reflecting a structural break. Furthermore, only the 2021 round of SAEB enables assessment of girls' and boys' behaviour in high school, providing access to valuable information on the transition to adulthood.

Most classes in the Brazilian educational system were conducted remotely during the pandemic, asynchronously and synchronously. This placed parents and children in the same environment at the same time over a prolonged period, under relatively controlled circumstances, enabling observation of how ethos affected girls' and boys' time use. Regular teaching, the minimum workload required by law, is examined for the three grade levels, without distinguishing between classes that were full-time or part-time owing to remote learning.

Because of the inequalities between public and private schools, this study only examines public schools, for which learning outcomes are lower. In total, excluding the missing values, there are some 972,645 observations, with 172,736 for the first year of middle school, 363,933 for the final year of middle school and 435,976 for the final year of high school. Table 1 provides information on the missing observations, which were excluded.

The exclusion of missing values is justified by the law of large numbers. Moreover, the percentage of missing values is approximately equal across genders, which supports the assumption of randomness, preserving properties even following their exclusion.

Variables related to school resources were included to control for differences across the Brazilian public education system, including in human resources (teachers and administrative staff) and financial resources, as well as in schools' location and socioeconomic level, measured by socioeconomic status indicator (see table A1.1).

Table 1
Missing values, by gender and time-use category
(Percentages)

| Time use | Gender | First year of middle school | Final year of middle school | Final year of high school |
|-----------------------|--------|--------------------------------|--------------------------------|------------------------------|
| Household chores | Boys | 9.9 | 6.7 | 5.9 |
| | Girls | 8.1 | 5.1 | 4.7 |
| Paid work | Boys | 12.2 | 7.4 | 5.9 |
| | Girls | 10.7 | 6.5 | 5.6 |
| Leisure activities | Boys | 9.6 | 5.4 | 4.6 |
| | Girls | 7.5 | 4.0 | 3.7 |
| Private study | Boys | 8.9 | 4.7 | 4.0 |
| | Girls | 7.0 | 3.4 | 3.2 |

Source: Prepared by the authors.

Inequalities are thus estimated using variables to control for possible confounding factors in the link between gender gap and time use, such as changes in school routines, continuity of studies (evaluated for the final year of each stage), socioeconomic status (measured by the socioeconomic status indicator),³ family members' schools (including brothers and sisters if applicable), and schools' level of human resources and region. These variables are presented in the annex.

The time-use category variables are as follows: household chores, paid work, leisure activities and private study. The time intervals⁴ used are those of the 2021 SAEB questionnaires.

B. Results

This section presents the results of the analysis of boys' and girls' time use in Brazilian public schools during the pandemic, focusing on four key areas: household chores, paid work, leisure activities and private study. Differences in time use are presented in table 2. Notably, differences are observed between groups in each grade. Boys in the first year of middle school have fewer household responsibilities, with around 20% stating that they do not perform household chores at all, compared to roughly 10% of girls. In the final year of high school, around 46% of girls dedicate more than two hours a day to household chores, compared to roughly 23% of their male counterparts. For the same group, paid work is the predominant extracurricular activity for boys, to which 52% dedicate more than two hours a day, while the corresponding figure for their female counterparts is about 39%. This pattern is generalized across all educational stages evaluated, with girls reporting a higher proportion of household chores and boys a higher proportion of paid work.

³ The indicator includes variables for students' socioeconomic status, assessed on the basis of families' purchases of goods and services and parents' schooling (INEP, 2022).

⁴ See [online] https://download.inep.gov.br/saeb/questionarios/questionario_aluno_5_ano_do_ensino_fundamental.pdf, https://download.inep.gov.br/saeb/questionarios/questionario_aluno_do_9_ano_do_ensino_fundamental.pdf, and https://download.inep.gov.br/saeb/questionarios/questionario_aluno_3-4_serie_do_ensino_medio.pdf.

Table 2
Mean differences by time-use category, gender and school year, 2021
(Percentages)

| Time use (daily) | First year of middle school | | | Final year of middle school | | | Final year of high school | | |
|---------------------------|-----------------------------|-------|------------|-----------------------------|-------|------------|---------------------------|-------|------------|
| | Boys | Girls | Difference | Boys | Girls | Difference | Boys | Girls | Difference |
| Household chores | | | | | | | | | |
| None | 20.1 | 10.4 | 0.097* | 12.2 | 3.4 | 0.088* | 11.8 | 3.1 | 0.087* |
| Less than 1 hour | 40.2 | 37.8 | 0.024* | 35.4 | 22.2 | 0.131* | 34.3 | 17.4 | 0.169* |
| 1–2 hours | 22.1 | 29.1 | -0.070 * | 31.3 | 37.3 | -0.059* | 31.2 | 33.5 | -0.023* |
| More than 2 hours | 17.6 | 22.7 | -0.052 * | 21.0 | 37.1 | -0.160* | 22.8 | 46.0 | -0.232* |
| Paid work | | | | | | | | | |
| None | 78.7 | 87.6 | -0.089 * | 61.0 | 78.4 | -0.174* | 37.9 | 52.7 | -0.149* |
| Less than 1 hour | 8.1 | 5.2 | 0.028* | 6.3 | 4.0 | 0.023* | 5.3 | 4.1 | 0.013* |
| 1–2 hours | 4.7 | 3.0 | 0.017* | 5.1 | 3.7 | 0.014* | 4.8 | 4.3 | 0.005* |
| More than 2 hours | 8.5 | 4.2 | 0.043* | 27.6 | 13.9 | 0.136* | 52.0 | 38.9 | 0.131* |
| Leisure activities | | | | | | | | | |
| None | 6.4 | 4.4 | 0.020* | 3.7 | 2.3 | 0.014* | 4.4 | 3.5 | 0.009* |
| Less than 1 hour | 15.5 | 15.0 | 0.006* | 9.3 | 9.7 | -0.004* | 13.6 | 15.6 | -0.020* |
| 1–2 hours | 18.0 | 21.0 | -0.030* | 17.9 | 19.9 | -0.020* | 23.8 | 26.0 | -0.022* |
| More than 2 hours | 60.1 | 59.6 | 0.005 | 69.1 | 68.0 | 0.011* | 58.3 | 54.9 | 0.033* |
| Private study | | | | | | | | | |
| None | 9.8 | 5.8 | 0.041* | 11.2 | 5.2 | 0.060* | 12.0 | 4.8 | 0.073* |
| Less than 1 hour | 48.5 | 47.0 | 0.015* | 44.1 | 38.3 | 0.058* | 44.4 | 36.8 | 0.075* |
| 1–2 hours | 30.1 | 36.3 | -0.062* | 36.5 | 45.3 | -0.089* | 34.0 | 43.7 | -0.097* |
| More than 2 hours | 11.6 | 11.0 | 0.006* | 8.2 | 11.2 | -0.030* | 9.6 | 14.7 | -0.051* |

Source: Prepared by the authors, on the basis of research results.

Note: Statistical significance: * $p < 0.05$.

Most students reported spending more than two hours a day on leisure activities, a situation that was more common for boys in the final year of middle school and of high school than for girls. Moreover, the proportion of students who reported spending no time on leisure activities was low.

More girls than boys used their time for private study in the final year of middle school and of high school, with differences of 11.9 and 14.8 percentage points, respectively. This factor may enhance their academic efficiency across all time-use categories. It is concerning that at all stages, more than 50% of boys dedicated less than one hour a day to private study, which was also the case for girls in middle school.

Table 3 presents the average scores of each group at each stage.

Table 3
Gender gap in literacy and mathematics performance, 2021
(Scores ranging from 0 to 1,000)

| Group | First year of middle school | | Final year of middle school | | Final year of high school | |
|---------------------------|-----------------------------|------------------------|-----------------------------|------------------------|---------------------------|------------------------|
| | Literacy | Mathematics | Literacy | Mathematics | Literacy | Mathematics |
| Boys | 206.7973*** (0.357) | 224.3702*** (0.347) | 258.0663*** (0.268) | 266.1270*** (0.258) | 275.4532*** (0.292) | 279.2630*** (0.328) |
| Girls | 220.3668*** (0.353) | 222.0712*** (0.344) | 270.6813*** (0.248) | 258.3760*** (0.239) | 285.2060*** (0.251) | 270.7074*** (0.271) |
| Difference | -13.5695*** (0.457) | 2.2990*** (0.430) | -12.6150*** (0.315) | 7.7510*** (0.298) | -9.7528*** (0.298) | 8.5557*** (0.311) |
| Effect | | | | | | |
| Composition effects | -6.7060*** (0.151) | -5.3913*** (0.136) | -6.9432*** (0.124) | -6.3913*** (0.122) | -4.1643*** (0.118) | -3.8132*** (0.119) |
| Return on characteristics | -7.8221*** (0.447) | 7.4985*** (0.421) | -5.4291*** (0.313) | 13.2868*** (0.298) | -3.9016*** (0.296) | 13.0323*** (0.310) |
| Interaction | 0.9586*** (0.101) | 0.1917** (0.096) | -0.2427 (0.126) | 0.8555*** (0.124) | -1.6870*** (0.127) | -0.6635*** (0.132) |
| Observations | 172 736 | | 363 933 | | 435 976 | |

Source: Prepared by the authors, on the basis of research results.

Note: Standard errors are in parentheses (estimated for cluster class). Statistical significance: ** $p < 0.05$, *** $p < 0.01$.

The results predicted by Alvarenga (2020) appear to have remained constant through the pandemic, with boys performing better in mathematics and girls in literacy. When the difference in score is broken down, a similar pattern is observed between school stages for the composition effects and return on characteristics effects.

Notably, on average, girls have an advantage in literacy in the first year of middle school, which is explained by the factors observed. However, the score for boys is 2.30 higher than that for girls in mathematics, on average. In a counterfactual situation, in which the same factors were observed for girls and boys, boys' performance would increase their score to 7.5. This pattern is consistent for all grades and stages of school. In the absence of the composition effect, the performance gap in mathematics would be around 13 points in favour of boys, while in literacy, both effects would also favour girls in the final year of each school stage.

Tables A1.5 to A1.7, in the annex, present the time-use categories for each grade without control variables. For most components of inequality, the signs and significance are comparable to those observed in the estimates that include all control variables. However, there are minor changes in magnitude, resulting from the association between the activities analysed and student and school characteristics.

In relation to household chores and leisure time, the changes in patterns are significant for the return on characteristics effect on students' mathematics scores in the final year of middle school, suggesting that the omission of control variables is primarily responsible for the inequality resulting from the time spent on these activities. For students in the final year of high school, the portion of the disparity related to leisure time was less robust, considering the changes in the patterns of the composition effect and interaction effects in literacy, and the composition effect and return on characteristics effects in mathematics.

Overall, given the changes in the magnitude of most components associated with disparities in academic performance between school grades there is a greater need to control for the effects of time-use categories on academic performance. These associations are therefore analysed controlling for the factors outlined in the methodological section.

Student activities are broken down in tables 4 and 6 for all observations and school grades and stages analysed, with control variables included. Tables A1.2 to A1.4, in the annex, contain the results for all variables. When interpreting the tables, it is important to note that a negative effect favours girls, while a positive effect favours boys.

Table 4
Mean inequality in literacy and mathematics performance, by time-use category,
first year of middle school, 2021
(Points)

| Variable | Literacy | | | Mathematics | | |
|--------------------|-----------------------|---------------------------|----------------------|-----------------------|---------------------------|----------------------|
| | Composition effect | Return on characteristics | Interaction | Composition effect | Return on characteristics | Interaction |
| Household chores | -0.8888*** (0.058) | -4.0002*** (0.556) | 0.4773*** (0.070) | -0.6810*** (0.054) | -1.8379*** (0.530) | 0.2255*** (0.067) |
| Paid work | -1.4004*** (0.051) | 0.0136 (0.071) | 0.0367 (0.052) | -0.9004*** (0.043) | -0.1521** (0.067) | -0.1094** (0.049) |
| Leisure activities | -0.5241*** (0.039) | -2.4800*** (0.857) | 0.0918*** (0.023) | -0.4085*** (0.034) | -0.4561 (0.825) | 0.0410 (0.022) |
| Private study | -1.1752*** (0.044) | -4.2472*** (0.762) | 0.1975*** (0.040) | -0.9342*** (0.038) | -2.8377*** (0.711) | 0.1260*** (0.037) |

Source: Prepared by the authors, on the basis of research results.

Note: Standard errors are in parentheses (estimated for cluster class). Statistical significance: ** $p < 0.05$, *** $p < 0.01$. Estimates of differentials were controlled for students' socioeconomic characteristics and schools' human resources and location.

Beginning in the first year of middle school, girls have more advantages in observed factors (variables in tables A1.2 and A1.4) and unobserved factors (ethos), which helps to narrow the gender gap in mathematics and increases their advantage in literacy across almost all time-use categories. With regard to household chores, the greater the difference in time use between boys and girls, the smaller the gender gap: it is -0.89 in literacy and -0.68 in mathematics. The return on characteristics of these activities also widens the gender gap by an average of around 4 and 2 points, respectively.

The difference in the amount of time spent on paid work also lowers boys' scores. However, the return on characteristics and interaction effects are only significant for mathematics scores. Moreover, the return for time spent on private study increases girls' scores more than boys'.

When both groups (boys and girls) spend the same amount of time on tasks under analysis, the literacy performance gap is wider by around 4 points, favouring girls. In mathematics, equality is possible if the variable effect equals zero. However, there is a significant gender gap in return that increases boys' mathematics score by around 0.13 points, although it narrows the literacy gap by 0.20 points.

The findings and observations in table 3 show that participation in all activities is low, indicating that differences in scores are attributable mainly to other factors, particularly composition effects (table 3) related to time allocations, present in the decomposition (see table 4). Although the aggregate return effect for mathematics is positive, the effect of extracurricular activities is negative, suggesting that the gender gap is caused by other factors. For more details, see tables A1.2 to A1.4 in the annex.

Tables 5 and 6 show that students' behaviour is different in the final grade of both middle school and high school, especially with regard to household chores. Moreover, the effect of this is greater than in the first year of middle school.

Table 5
Mean inequality in literacy and mathematics performance, by time-use category,
final year of middle school, 2021
(Points)

| Variable | Literacy | | | Mathematics | | |
|--------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| | Composition effect | Return | Interaction | Composition effect | Return | Interaction |
| Household chores | -0.6635*** (0.065) | 3.1312*** (0.633) | 0.0307 (0.085) | -1.0241*** (0.065) | 0.7030 (0.629) | 0.5341*** (0.084) |
| Paid work | -0.9504*** (0.045) | -0.8628*** (0.071) | -0.7928*** (0.061) | -0.2609*** (0.044) | -0.4663*** (0.069) | -0.3805*** (0.059) |
| Leisure activities | -0.2676*** (0.026) | -1.5076 (0.823) | 0.0170 (0.014) | -0.2337*** (0.024) | -0.9092 (0.820) | 0.0080 (0.014) |
| Private study | -1.5473*** (0.038) | -4.3891*** (0.562) | 0.5143*** (0.045) | -1.3969*** (0.037) | -4.9092*** (0.542) | 0.6215*** (0.044) |

Source: Prepared by the authors, on the basis of research results.

Note: Standard errors are in parentheses (estimated for cluster class). Statistical significance: ** $p < 0.05$, *** $p < 0.01$. Estimates of differentials were controlled for students' socioeconomic characteristics and schools' human resources and location.

Table 6
**Mean inequality in literacy and mathematics performance, by time-use category,
 final year of high school, 2021**
(Points)

| Variable | Literacy | | | Mathematics | | |
|--------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| | Composition effect | Return | Interaction | Composition effect | Return | Interaction |
| Household chores | 0.3551*** (0.068) | 5.1342*** (0.609) | -0.0266 (0.093) | 0.0595 (0.071) | 1.4873** (0.637) | 0.6726*** (0.098) |
| Paid work | -0.7429*** (0.032) | -3.8327*** (0.134) | -1.3074*** (0.048) | -0.3734*** (0.032) | -2.8930*** (0.140) | -0.9739*** (0.049) |
| Leisure activities | 0.0319 (0.021) | -2.3893*** (0.678) | 0.0484*** (0.013) | -0.0117 (0.018) | -0.4498 (0.702) | 0.0482*** (0.014) |
| Private study | -2.0188*** (0.043) | -3.3612*** (0.534) | 0.5557*** (0.053) | -2.0078*** (0.044) | -2.3285*** (0.541) | 0.5057*** (0.055) |

Source: Prepared by the authors, on the basis of research results.

Note: Standard errors are in parentheses (estimated for cluster class). Statistical significance: ** $p < 0.05$, *** $p < 0.01$. Estimates of differentials were controlled for students' socioeconomic characteristics and schools' human resources and location.

On average, girls in the final year of middle school had higher literacy scores than boys, by around 12.6 points, as shown in table 3. However, when both groups spent the same amount of time on household chores, the difference in scores increased by 3.55 points in favour of boys, albeit at the cost of a decline in overall academic performance. In mathematics, where boys scored around 13 points higher, devoting time to household chores might not affect the mean gender gap. The difference in return owing to unequal time use (interaction effect) in favour of boys widens the gender gap by around 0.56 points.

Although boys do not spend a significant amount of time on paid work, it poses a considerable risk for their academic performance in all areas and disciplines. Table 5 shows that the difference in performance in literacy widens the gap by 0.95 points, while the return on this activity widens the gap by 0.86 points. The interaction of this effect contributes around 0.8 points to the score differences.

In table 5, the time spent on leisure activities, when broken down, is significantly positively correlated with the gap in both literacy and mathematics, at around -0.2 points in favour of girls. Regarding time spent on private study, the results suggest that girls have both observed and unobserved advantages, because the literacy score gap increases in tandem with the difference in time use. In a counterfactual situation, the return is also greater for girls, increasing the difference in the score by 4.4 points. The pattern is similar in mathematics, but in this case, the behaviour favours equalization of the scores. Nevertheless, the interaction effect favours boys, by 0.5 points for literacy and 0.6 points for mathematics.

In the final year of high school, table 6 shows a positive effect on the score gaps, as the time spent on household chores negatively affects girls. For this group of students, the structural effect is detrimental in both disciplines, increasing the overall gender gap.

Regarding paid work, the pattern in the final year of high school is similar to the final year of middle school, but with larger return effects, leading to a lower mean for boys in literacy and mathematics, by 3.8 and 2.9 points, respectively.

Outcomes vary for the school grades and stages analysed, in particular with regard to the effect of household chores, revealing a shift in structural inequalities. Compared to the first year of middle school, where the return effect is negative, girls' growing responsibilities as they age are negatively associated with the time they dedicate to learning.

Upon breaking down the data, paid work also emerges as a significant factor that may be related to biases grounded in ethos. Just as older girls take on more household responsibilities, older boys increasingly engage in paid work. However, the nature of household chores differs for boys and girls even when the total number of hours spent is the same.

As the impact of unproductive activities on students is greater in the final year of high school, table 7 presents the findings broken down by subsample, considering individual socioeconomic status and parents' education.

Table 7
Mean inequality in literacy and mathematics performance, by time-use category
and subsample, final year of high school, 2021
(Points)

| Variable | Literacy | | | Mathematics | | |
|--|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| | Composition effect | Return | Interaction | Composition effect | Return | Interaction |
| Individual socioeconomic status<=2 | | | | | | |
| Household chores | -0.7667*** (0.174) | 4.3309*** (1.314) | -0.0210 (0.249) | -1.1183*** (0.179) | 2.3575 (1.379) | 0.5257** (0.257) |
| Paid work | 0.0609 (0.088) | -2.5435*** (0.286) | -1.3269*** (0.146) | 0.2296*** (0.087) | -0.9009*** (0.298) | -0.4387*** (0.151) |
| Leisure activities | -0.7586*** (0.081) | -2.8023*** (0.928) | 0.1842*** (0.049) | -0.6936*** (0.071) | -2.7247*** (0.959) | 0.1823*** (0.051) |
| Private study | -0.9944*** (0.078) | -3.0209** (1.319) | 0.3888*** (0.111) | -1.0011*** (0.077) | -1.6379 (1.349) | 0.3372*** (0.114) |
| University-educated mother | | | | | | |
| Household chores | 0.5868*** (0.140) | 4.9158*** (1.493) | -0.0010 (0.197) | 0.7591*** (0.153) | 2.0924 (1.613) | 0.3332 (0.210) |
| Paid work | -1.1798*** (0.077) | -3.8902*** (0.287) | -1.3690*** (0.110) | -0.8542*** (0.078) | -3.1659*** (0.307) | -1.1238*** (0.115) |
| Leisure activities | -0.2143*** (0.044) | -4.3230 (2.379) | 0.0656** (0.032) | -0.1901*** (0.038) | 1.6303 (2.451) | 0.0156 (0.033) |
| Private study | -2.6945*** (0.121) | -3.4032** (1.455) | 0.6787*** (0.145) | -2.9720*** (0.129) | -2.0357 (1.476) | 0.5868*** (0.155) |

| Variable | Literacy | | | Mathematics | | |
|-----------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| | Composition effect | Return | Interaction | Composition effect | Return | Interaction |
| University-educated father | | | | | | |
| Household chores | 1.0370*** (0.156) | 5.6708*** (1.729) | -0.2454 (0.224) | 0.9200*** (0.171) | -0.7483 (1.909) | 0.5446** (0.241) |
| Paid work | -1.0833*** (0.084) | -2.8920*** (0.342) | -0.8711*** (0.112) | -0.6801*** (0.083) | -3.2453*** (0.366) | -0.9728*** (0.121) |
| Leisure activities | -0.1128** (0.055) | -4.0011 (3.043) | 0.0379 (0.039) | -0.1382*** (0.046) | 0.7439 (3.185) | 0.0063 (0.041) |
| Private study | -2.3771*** (0.138) | -1.9107 (1.815) | 0.4882*** (0.165) | -2.6961*** (0.148) | 0.4250 (1.819) | 0.3999** (0.174) |

Source: Prepared by the authors, on the basis of research results.

Note: Standard errors are in parentheses (estimated by cluster class). Statistical significance: ** $p < 0.05$, *** $p < 0.01$. Estimates of differentials were controlled for students' socioeconomic characteristics and schools' human resources and location. The individual socioeconomic status index ranges from zero to five.

For students in the two lowest socioeconomic strata, as measured by individual socioeconomic status, table 7 shows a pattern similar to that of the group with students from all strata, except for the composition effect related to household chores, which lowers the literacy score. This indicates that, for poorer students, there is no statistically significant difference in mathematics scores and no difference on the basis of structural factors or ethos in terms of household chores.

All else being equal, the composition effect in the time spent on paid work significantly influences the mathematics score, in boys' favour. However, boys are more disadvantaged when both time uses are equal in both disciplines. This is compounded by the result in return from unequal time use, as illustrated in the complete dataset. Regarding the influence of both observed and unobserved leisure activities and private study, for students in the two lowest socioeconomic strata, the pattern is similar to that observed in the complete dataset.

Furthermore, for students whose mothers are university-educated, while girls' mathematics scores are more closely aligned with boys', the gender gap in literacy reflects greater disadvantages for boys (see table A1.8). This aligns with findings that show that children from households headed by university-educated single mothers fare better in STEM careers (Mencarini, Pasqua and Romiti, 2019). When their fathers have a university education, girls' performance in literacy is better but their performance in mathematics is unchanged. This suggests that investment in girls' education may stem from the mother's knowledge or ethos.

For time-use category effects, there is no structural effect linked to leisure activities for students with university-educated mothers. Moreover, leisure activities have no influence on inequalities in mathematics scores resulting from interaction effects. However, in a counterfactual scenario in which the burden of activities is the same for girls and boys, girls remain disadvantaged in mathematics.

The negative influence of paid work on boys' performance persists even if their parents have a university education. Moreover, observed differences reduce the literacy score gap by around 1 point and the return by 2.89 points if the father has a university

education or by 3,89 points if the mother has a university education. The contribution of leisure activities to the scores is solely the result of the composition effect, and structural factors, or ethos, do not influence private study.

In line with Hilbrecht, Zuzanek and Mannell (2008), which showed the differences in time use depending on whether the child or adolescent lived in a rural or urban area, table 8 shows how a rural or urban environment, an essential structural factor, affects inequalities in academic performance. In rural areas, the literacy scores of girls are higher than those of boys.

Table 8
Mean inequality in literacy and mathematics performance in urban and rural schools, by time-use category, last year of high school, 2021
(Points)

| Variable | Literacy | | | Mathematics | | |
|--------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| | Composition effect | Return | Interaction | Composition effect | Return | Interaction |
| Urban | | | | | | |
| Household chores | 0.4050*** (0.069) | 4.9855*** (0.625) | 0.0126 (0.095) | 0.1204 (0.072) | 1.3609** (0.655) | 0.7094*** (0.100) |
| Paid work | -0.7310*** (0.031) | -3.8895*** (0.137) | -1.2704*** (0.047) | -0.3702*** (0.031) | -2.9505*** (0.144) | -0.9507*** (0.048) |
| Leisure activities | 0.0306 (0.021) | -2.6208*** (0.709) | 0.0519*** (0.014) | -0.0110 (0.018) | -0.6264 (0.733) | 0.0506*** (0.014) |
| Private study | -2.0633*** (0.044) | -3.2586*** (0.545) | 0.5479*** (0.054) | -2.0431*** (0.045) | -2.0956*** (0.552) | 0.4820*** (0.056) |
| Rural | | | | | | |
| Household chores | -0.7542** (0.372) | 7.3874*** (2.701) | -0.6769 (0.476) | -1.2540*** (0.372) | 3.5572 (2.666) | 0.1232 (0.494) |
| Paid work | -0.6856*** (0.250) | -2.5812*** (0.546) | -2.1069*** (0.397) | -0.1925 (0.255) | -1.7230*** (0.577) | -1.3992*** (0.410) |
| Leisure activities | 0.1203 (0.127) | 0.4192 (2.203) | -0.0133 (0.062) | 0.0361 (0.113) | 1.3291 (2.324) | 0.0169 (0.067) |
| Private study | -1.0573*** (0.180) | -5.1720 (2.686) | 0.6070*** (0.220) | -1.2652*** (0.180) | -7.5457*** (2.803) | 0.8897*** (0.232) |

Source: Prepared by the authors, on the basis of research results.

Note: Standard errors are in parentheses (estimated by cluster class). Statistical significance: ** $p < 0.05$, *** $p < 0.01$. Estimates of differentials were controlled for students' socioeconomic characteristics and schools' human resources and location.

In urban areas, gender inequalities in education are significantly influenced by time use in various activities. Performing household chores has a positive impact on boys' literacy and mathematics performance when boys' and girls' time use is similar, indicating that domestic tasks are more detrimental for girls than for boys. However, paid work harms boys' performance in both subjects, and affects literacy in particular for both genders. Leisure activities reduce literacy scores, particularly for boys.

In contrast, private study is associated with better performance in both literacy and mathematics, suggesting that because of the composition effect, investing in additional study time in Brazil will support the objectives of the National Education Plan, which aims to increase women's participation in professional careers requiring greater proficiency in the “hard” sciences.

In rural areas, unlike in urban areas, girls' literacy and mathematics performance is remarkably resilient, since performing household chores increases their scores. This suggests stronger community or family support. However, for boys in rural areas, as in urban areas, having paid work significantly harms performance in both literacy and mathematics. Unlike in urban areas, in rural areas there is no significant impact from the leisure activities of children on academic outcomes. When girls and boys spend the same amount of time on private study, no significant effect is observed on literacy. However, private study has a positive and significant effect on girls' outcomes in mathematics.

C. Conclusion

This article aims to analyse the gender gap in children's academic performance, assessing the effect of ethos in Brazil in latent contexts such as leisure, private study, household chores and paid work, on their educational outcomes in literacy and mathematics. Although literacy is also analysed, the study focuses primarily on the mathematics gap, which is directly linked with STEM careers and with strategy 14.8 of the 2014–2024 National Education Plan, which seeks to encourage the participation of women in postgraduate STEM studies.

Breaking down inequalities in academic performance into observed, unobserved and interaction factors reveals links to structural issues of ethos to the detriment of both genders. Boys are encouraged to take on paid work more than girls are, while girls have more responsibilities in relation to household chores. Similarly, in a counterfactual situation where both genders allocate the same amount of time to an extracurricular activity, the type of activity, which is an unobservable factor, appears to influence academic performance.

In this context, the detrimental effect of child labour on boys' educational path is greater at all stages of school. Conversely, girls face greater challenges related to the unobservable aspects of household chores, which increase with age and affect them more in their final year of high school. This situation is more prevalent among families in lower socioeconomic strata and those with less structured environments, such as families without university-educated parents.

The study highlights that girls generally dedicate more time and, importantly, use their private study time more efficiently than boys, with a higher proportion of them studying over two hours daily. This greater investment and efficiency in private study significantly boosts their academic performance, particularly in literacy, and narrows the gender gap in mathematics. However, despite this advantage, broader gender disparities remain. Girls, especially in their final year of high school, tend to spend more time on household chores,

while boys allocate more time to paid work. These differences in time allocation across activities continue to shape unequal educational outcomes. Therefore, while our hypothesis that structural factors, or ethos, contribute to gender gaps is supported, the findings underscore the need for targeted interventions to address these persistent inequalities and promote greater educational equity.

A comprehensive analysis of the literature reveals several ways to correct such discrepancies. However, the heterogeneity in Brazil calls for an analysis of the conditions in each school. A research agenda is suggested in which Internet connectivity in schools is assessed. Baskets of high-tech products should also be provided to students, irrespective of their gender. Furthermore, providing training to school principals and teachers is essential to mitigate gender differences. Therefore, it would be important to evaluate the questions posed to teachers and school principals to identify the best policies and where and how to implement them.

Lastly, the analysis is limited by the microdata on time, which identify only a range and a maximum number of hours spent on specific activities along with their categories. The data also include students' perceptions of their time use, which also reflect structural effects linked with issues of ethos, as suggested by the differences in returns on household chores and academic performance.

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Annex A1

Table A1.1
Time-use and control variables

| Variable | Category | Variable | Category |
|---|--------------------------------------|---|---------------------|
| Student | | Teacher | |
| Time use (daily) | | Percentage of male teachers | |
| Household chores | None | Percentage of teachers with up to 5 years of experience | |
| Paid work | | | |
| Leisure activities | | | |
| Private study | Less than 1 hour | | |
| | 1–2 hours | | |
| | More than 2 hours | | |
| Student and family characteristics | | School principal | |
| Age | Six dummies that vary by grade | Principal's gender | 1 = Male, 0 = other |
| First year of school | Nursery school | School financial resources are roughly sufficient | Totally disagree |
| | Preschool | | Disagree |
| | First grade | | Agree |
| | After first grade | | Totally Agree |
| Failed a grade | 1 = yes, 0 = no | Teacher attendance | Totally disagree |
| Dropped out | 1 = yes, 0 = no | | Disagree |
| Future prospects (Excluding fifth grade of middle school) | Stay in school | | Agree |
| | Drop out and only take paid work | | |
| | Stay in school and also work | Totally agree | |
| | Don't know | | |
| Mother's education | None or incomplete elementary school | | |
| | Grade 1 of elementary school | | |
| | Middle school | | |
| | High school | | |
| | University education | | |
| Father's education | None or incomplete elementary school | | |
| | Grade 1 of elementary school | | |
| | Middle school | | |
| | High school | | |
| | University education | | |
| Student has siblings | 1 = yes, 0 = no | | |

Source: Prepared by the authors.

Table A1.2
**Mean inequality in literacy and mathematics performance, all variables,
 first year of middle school, 2021**
(Points)

| Variable | Literacy | | | Mathematics | | |
|---------------------------------|-----------------------|-----------------------|----------------------|-----------------------|-----------------------|----------------------|
| | Composition effect | Return | Interaction | Composition effect | Return | Interaction |
| Household chores | -0.8888*** (0.058) | -4.0002*** (0.556) | 0.4773*** (0.070) | -0.6810*** (0.054) | -1.8379*** (0.530) | 0.2255*** (0.067) |
| Paid work | -1.4004*** (0.051) | 0.0136 (0.071) | 0.0367 (0.052) | -0.9004*** (0.043) | -0.1521** (0.067) | -0.1094** (0.049) |
| Leisure activities | -0.5241*** (0.039) | -2.4800*** (0.857) | 0.0918*** (0.023) | -0.4085*** (0.034) | -0.4561 (0.825) | 0.0410* (0.022) |
| Private study | -1.1752*** (0.044) | -4.2472*** (0.762) | 0.1975*** (0.040) | -0.9342*** (0.038) | -2.8377*** (0.711) | 0.1260*** (0.037) |
| Age | -0.2800*** (0.040) | -0.3173 (0.665) | -0.0612 (0.046) | -0.3228*** (0.034) | 0.7210 (0.624) | -0.0529 (0.042) |
| First year of school | -0.1294*** (0.019) | -0.3995** (0.161) | 0.0164* (0.010) | -0.1503*** (0.020) | -0.4108*** (0.152) | 0.0222** (0.010) |
| Failed a grade | -1.5130*** (0.053) | -1.2445*** (0.270) | 0.2163*** (0.047) | -1.3222*** (0.047) | -0.0285 (0.248) | 0.0049 (0.043) |
| Dropped out | -0.2939*** (0.023) | -0.4868 (0.338) | 0.0347 (0.024) | -0.2253*** (0.020) | 0.1832 (0.313) | -0.0130 (0.022) |
| Future prospects | | | | | | |
| Mother's education | -0.3734*** (0.034) | 0.2919*** (0.101) | -0.0246 (0.017) | -0.3250*** (0.029) | 0.3445*** (0.096) | -0.0360** (0.016) |
| Father's education | -0.1333*** (0.019) | 0.1315* (0.068) | -0.0178 (0.014) | -0.1086*** (0.016) | 0.0660 (0.065) | -0.0065 (0.013) |
| Student has siblings | 0.0473*** (0.010) | 0.3205** (0.137) | -0.0119** (0.006) | 0.0317*** (0.007) | 0.2772** (0.130) | -0.0103** (0.005) |
| Individual socioeconomic status | 0.0057 (0.023) | -0.0922 (0.344) | 0.0007 (0.003) | 0.0226 (0.027) | 1.0342*** (0.340) | -0.0089 (0.006) |

| Variable | Literacy | | | Mathematics | | |
|---|-----------------------|-----------------------|----------------------|-----------------------|-----------------------|---------------------|
| | Composition effect | Return | Interaction | Composition effect | Return | Interaction |
| Future prospects | | | | | | |
| Percentage of male teachers | -0.0095** (0.005) | -0.0799 (0.106) | -0.0017 (0.002) | -0.0092** (0.005) | -0.1724* (0.101) | -0.0038 (0.003) |
| Percentage of teachers with up to 5 years of experience | 0.0002 (0.001) | 0.0386 (0.108) | -0.0003 (0.001) | -0.0002 (0.001) | 0.0598 (0.102) | -0.0005 (0.001) |
| Gender of principal | -0.0007 (0.001) | 0.4748** (0.213) | -0.0013 (0.002) | -0.0010 (0.002) | 0.3676* (0.200) | -0.0010 (0.002) |
| Financial resources | -0.0136** (0.006) | 0.1665 (0.221) | 0.0028 (0.004) | -0.0178** (0.008) | 0.4621** (0.210) | 0.0068 (0.004) |
| Teacher attendance | -0.0030 (0.003) | -1.7746** (0.698) | 0.0031 (0.003) | -0.0022 (0.003) | -1.2723* (0.679) | 0.0017 (0.002) |
| Urban or rural residence | -0.0137** (0.007) | 0.5016 (0.332) | -0.0036 (0.003) | -0.0089** (0.004) | 0.5551* (0.310) | -0.0040 (0.003) |
| Brazilian macroregion | -0.0072 (0.007) | -0.5046 (0.712) | 0.0038 (0.006) | -0.0278** (0.012) | -1.0901 (0.667) | 0.0100 (0.006) |
| Constant | | 5.8659*** (1.630) | | | 11.6855*** (1.549) | |
| Total | -6.7060*** (0.151) | -7.8221*** (0.447) | 0.9586*** (0.101) | -5.3913*** (0.136) | 7.4985*** (0.421) | 0.1917** (0.096) |

Source: Prepared by the authors, on the basis of research results.

Note: Standard errors are in parentheses (estimated for cluster class). Statistical significance: ** p<0.05, *** p<0.01.

Table A1.3
**Mean inequality in literacy and mathematics performance, all variables,
 final year of middle school, 2021**
(Points)

| Variable | Literacy | | | Mathematics | | |
|----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| | Composition effect | Return | Interaction | Composition effect | Return | Interaction |
| Household chores | -0.6635*** (0.065) | 3.1312*** (0.633) | 0.0307 (0.085) | -1.0241*** (0.065) | 0.7030 (0.629) | 0.5341*** (0.084) |
| Paid work | -0.9504*** (0.045) | -0.8628*** (0.071) | -0.7928*** (0.061) | -0.2609*** (0.044) | -0.4663*** (0.069) | -0.3805*** (0.059) |
| Leisure activities | -0.2676*** (0.026) | -1.5076* (0.823) | 0.0170 (0.014) | -0.2337*** (0.024) | -0.9092 (0.820) | 0.0080 (0.014) |
| Private study | -1.5473*** (0.038) | -4.3891*** (0.562) | 0.5143*** (0.045) | -1.3969*** (0.037) | -4.9092*** (0.542) | 0.6215*** (0.044) |
| Age | -0.5335*** (0.036) | -0.4470 (0.465) | 0.0464 (0.046) | -0.6681*** (0.036) | 0.7134 (0.459) | -0.0577 (0.045) |
| First year of school | -0.1649*** (0.012) | -0.3276* (0.199) | 0.0105 (0.009) | -0.1561*** (0.011) | -0.2992 (0.196) | 0.0093 (0.010) |
| Failed a grade | -2.0112*** (0.046) | -1.2099*** (0.194) | 0.3104*** (0.050) | -2.0852*** (0.046) | -1.5245*** (0.187) | 0.3911*** (0.048) |
| Dropped out | 0.0510*** (0.009) | 0.4169 (0.342) | -0.0139 (0.011) | 0.0343*** (0.008) | 0.3752 (0.332) | -0.0125 (0.011) |
| Future prospects | -1.8451*** (0.046) | 0.7725*** (0.183) | -0.0370 (0.051) | -1.6665*** (0.045) | 0.6751*** (0.178) | -0.0258 (0.050) |
| Mother's education | 0.2719*** (0.016) | -0.1423* (0.077) | -0.0597*** (0.016) | 0.2680*** (0.015) | -0.0930 (0.076) | -0.0562*** (0.016) |
| Father's education | 0.1628*** (0.013) | -0.3154*** (0.054) | -0.0350** (0.014) | 0.1078*** (0.011) | -0.1746*** (0.054) | -0.0030 (0.014) |
| Student has siblings | 0.0649*** (0.007) | 0.2736*** (0.092) | -0.0220*** (0.008) | 0.0419*** (0.006) | 0.3909*** (0.091) | -0.0315*** (0.008) |

| Variable | Literacy | | | Mathematics | | |
|---|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| | Composition effect | Return | Interaction | Composition effect | Return | Interaction |
| Individual socioeconomic status | 0.4958*** (0.022) | 0.5055** (0.243) | -0.2196*** (0.028) | 0.6621*** (0.025) | 0.6850*** (0.245) | -0.1421*** (0.028) |
| Percentage of male teachers | 0.0030 (0.003) | -0.0514 (0.160) | 0.0002 (0.001) | 0.0049 (0.005) | 0.2706* (0.160) | -0.0009 (0.001) |
| Percentage of teachers with up to 5 years of experience | -0.0001 (0.002) | -0.1123 (0.081) | 0.0001 (0.001) | -0.0002 (0.003) | -0.2356*** (0.082) | 0.0001 (0.001) |
| Gender of principal | 0.0004 (0.001) | 0.1800*** (0.061) | 0.0023 (0.002) | 0.0001 (0.001) | 0.1157* (0.061) | 0.0015 (0.001) |
| Financial resources | 0.0023 (0.003) | 0.2361* (0.122) | 0.0020 (0.001) | 0.0040 (0.004) | 0.0928 (0.123) | -0.0003 (0.002) |
| Teacher attendance | 0.0005 (0.003) | 0.5053** (0.256) | -0.0041** (0.002) | -0.0038 (0.004) | 0.4728* (0.250) | -0.0030 (0.002) |
| Urban or rural residence | 0.0002 (0.007) | 0.5639*** (0.197) | 0.0000 (0.001) | 0.0001 (0.003) | 1.0170*** (0.202) | 0.0001 (0.003) |
| Brazilian macroregion | -0.0124 (0.009) | 0.8064 (0.523) | 0.0077* (0.004) | -0.0189* (0.011) | -0.2704 (0.484) | 0.0032 (0.005) |
| Constant | | -3.4553*** (1.312) | | | 16.6574*** (1.295) | |
| Total | -6.9432*** (0.124) | -5.4291*** (0.313) | -0.2427* (0.126) | -6.3913*** (0.122) | 13.2868*** (0.298) | 0.8555*** (0.124) |

Source: Prepared by the authors, on the basis of research results.

Note: Standard errors are in parentheses (estimated for cluster class). Statistical significance: ** p<0.05, *** p<0.01.

Table A1.4
**Mean inequality in literacy and mathematics performance, all variables,
 final year of high school, 2021**
(Points)

| Variable | Literacy | | | Mathematics | | |
|----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| | Composition effect | Return | Interaction | Composition effect | Return | Interaction |
| Household chores | 0.3551*** (0.068) | 5.1342*** (0.609) | -0.0266 (0.093) | 0.0595 (0.071) | 1.4873** (0.637) | 0.6726*** (0.098) |
| Paid work | -0.7429*** (0.032) | -3.8327*** (0.134) | -1.3074*** (0.048) | -0.3734*** (0.032) | -2.8930*** (0.140) | -0.9739*** (0.049) |
| Leisure activities | 0.0319 (0.021) | -2.3893*** (0.678) | 0.0484*** (0.013) | -0.0117 (0.018) | -0.4498 (0.702) | 0.0482*** (0.014) |
| Private study | -2.0188*** (0.043) | -3.3612*** (0.534) | 0.5557*** (0.053) | -2.0078*** (0.044) | -2.3285*** (0.541) | 0.5057*** (0.055) |
| Age | -0.4986*** (0.024) | -1.1478*** (0.300) | 0.1657*** (0.024) | -0.5457*** (0.025) | -0.1547 (0.317) | 0.1184*** (0.026) |
| First year of school | -0.0523*** (0.007) | -0.4784* (0.286) | 0.0212*** (0.006) | -0.0691*** (0.007) | -0.4465 (0.294) | 0.0269*** (0.008) |
| Failed a grade | -1.3860*** (0.034) | -0.3464** (0.147) | 0.0803** (0.034) | -1.4073*** (0.034) | 0.1400 (0.155) | -0.0325 (0.036) |
| Dropped out | 0.0516*** (0.006) | 0.1091 (0.273) | -0.0019 (0.005) | 0.0396*** (0.005) | 0.2430 (0.276) | -0.0043 (0.005) |
| Future prospects | -1.5778*** (0.036) | 1.5596*** (0.195) | -0.3824*** (0.041) | -1.2800*** (0.035) | 2.1295*** (0.210) | -0.4407*** (0.042) |
| Mother's education | 0.5353*** (0.021) | -0.5128*** (0.058) | -0.3382*** (0.028) | 0.5025*** (0.021) | -0.4229*** (0.061) | -0.2223*** (0.029) |
| Father's education | 0.4528*** (0.019) | -0.1324** (0.056) | -0.0792*** (0.026) | 0.2718*** (0.018) | -0.2509*** (0.059) | 0.0322 (0.027) |
| Student has siblings | 0.0065** (0.003) | -0.0370 (0.068) | 0.0006 (0.001) | 0.0055** (0.002) | 0.0791 (0.071) | -0.0012 (0.001) |

| Variable | Literacy | | | Mathematics | | |
|--|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| | Composition effect | Return | Interaction | Composition effect | Return | Interaction |
| Individual socioeconomic status | 0.7316*** (0.033) | 1.1760*** (0.199) | -0.4417*** (0.045) | 1.0676*** (0.036) | 1.4055*** (0.217) | -0.3769*** (0.047) |
| Percentage of male teachers | 0.0019 (0.002) | 0.0642 (0.211) | 0.0002 (0.001) | 0.0006 (0.001) | 0.4346* (0.230) | 0.0011 (0.001) |
| Percentage of teachers with up to five years of experience | -0.0005 (0.001) | -0.0201 (0.079) | -0.0001 (0.000) | -0.0004 (0.001) | -0.0676 (0.085) | -0.0004 (0.001) |
| Gender of principal | 0.0016 (0.002) | -0.0700** (0.029) | 0.0012 (0.001) | 0.0024 (0.003) | -0.0843*** (0.031) | 0.0014 (0.002) |
| Financial resources | 0.0088** (0.004) | -0.0246 (0.119) | 0.0038* (0.002) | 0.0115** (0.005) | -0.1172 (0.130) | 0.0058** (0.003) |
| Teacher attendance | -0.0250*** (0.008) | -0.5393** (0.255) | 0.0059* (0.003) | -0.0452*** (0.012) | -0.2091 (0.269) | 0.0012 (0.003) |
| Urban or rural residence | -0.0074 (0.005) | 0.9321*** (0.332) | -0.0022 (0.002) | -0.0053 (0.004) | 0.9873*** (0.354) | -0.0024 (0.002) |
| Brazilian macroregion | -0.0320** (0.013) | 0.5348 (0.525) | 0.0098 (0.008) | -0.0281** (0.014) | 0.3186 (0.543) | -0.0224** (0.009) |
| Constant | | -0.5195 (1.222) | | | 13.2320*** (1.259) | |
| Total | -4.1643*** (0.118) | -3.9016*** (0.296) | -1.6870*** (0.127) | -3.8132*** (0.119) | 13.0323*** (0.310) | -0.6635*** (0.132) |

Source: Prepared by the authors, on the basis of research results.

Note: Standard errors are in parentheses (estimated for cluster class). Statistical significance: ** p<0.05, *** p<0.01.

Table A1.5
**Mean inequality in literacy and mathematics performance, all variables, no control variables,
 first year of middle school, 2021**
(Points)

| Variable | Literacy | | | Mathematics | | |
|--------------------|-----------------------|---------------------------|----------------------|-----------------------|---------------------------|-----------------------|
| | Composition effect | Return on characteristics | Interaction | Composition effect | Return on characteristics | Interaction |
| Household chores | -1.0444*** (0.052) | -2.8333*** (0.494) | 0.3063*** (0.061) | -0.8389*** (0.048) | -0.7958* (0.467) | 0.0908 (0.058) |
| Paid work | -1.8828*** (0.050) | -0.0416 (0.065) | -0.0050 (0.048) | -1.3157*** (0.042) | -0.2530*** (0.061) | -0.1727*** (0.045) |
| Leisure activities | -0.8382*** (0.048) | -3.5341*** (0.696) | 0.1427*** (0.020) | -0.6985*** (0.043) | -0.2730 (0.665) | 0.0654*** (0.020) |
| Private study | -1.7140*** (0.047) | -5.2811*** (0.679) | 0.2427*** (0.036) | -1.4139*** (0.041) | -3.0700*** (0.626) | 0.1263*** (0.033) |
| Total | -5.4794*** (0.102) | -8.6910*** (0.193) | 0.6868*** (0.083) | -4.2671*** (0.090) | 6.7964*** (0.184) | 0.1098 (0.079) |

Source: Prepared by the authors, on the basis of research results.

Note: Standard errors are in parentheses (estimated by cluster class). Statistical significance: ** $p < 0.05$, *** $p < 0.01$.

Table A1.6

**Mean inequality in literacy and mathematics performance, all variables, no control variables,
final year of middle school, 2021**
(Points)

| Variable | Literacy | | | Mathematics | | |
|--------------------|-----------------------|---------------------------|-----------------------|-----------------------|---------------------------|-----------------------|
| | Composition effect | Return on characteristics | Interaction | Composition effect | Return on characteristics | Interaction |
| Household chores | -0.6361*** (0.057) | 6.5269*** (0.567) | -0.3814*** (0.073) | -0.9925*** (0.057) | 3.9704*** (0.561) | 0.0952 (0.072) |
| Paid work | -1.2015*** (0.039) | -1.4085*** (0.062) | -1.2213*** (0.051) | -0.5001*** (0.038) | -1.0307*** (0.061) | -0.8492*** (0.050) |
| Leisure activities | -0.3908*** (0.032) | -4.9744*** (0.699) | 0.0586*** (0.012) | -0.3555*** (0.030) | -3.2891*** (0.698) | 0.0393*** (0.012) |
| Private study | -1.9775*** (0.035) | -3.8899*** (0.482) | 0.5734*** (0.039) | -1.8360*** (0.034) | -4.7088*** (0.467) | 0.6963*** (0.039) |
| Total | -4.2059*** (0.084) | -8.3770*** (0.140) | -0.9707*** (0.096) | -3.6841*** (0.083) | 10.7446*** (0.140) | -0.0184 (0.095) |

Source: Prepared by the authors, on the basis of research results.

Note: Standard errors are in parentheses (estimated by cluster class). Statistical significance: ** p<0.05, *** p<0.01.

Table A1.7
**Mean inequality in literacy and mathematics performance, all variables, no control variables,
 final year of high school, 2021**
(Points)

| Variable | Literacy | | | Mathematics | | |
|--------------------|-----------------------|---------------------------|-----------------------|-----------------------|---------------------------|-----------------------|
| | Composition effect | Return on characteristics | Interaction | Composition effect | Return on characteristics | Interaction |
| Household chores | 0.8645*** (0.059) | 7.9975*** (0.523) | -0.4169*** (0.078) | 0.6624*** (0.062) | 5.0413*** (0.547) | 0.2654*** (0.082) |
| Paid work | -0.6365*** (0.025) | -5.2759*** (0.113) | -1.6859*** (0.038) | -0.3334*** (0.026) | -4.2979*** (0.120) | -1.3617*** (0.040) |
| Leisure activities | 0.0868*** (0.025) | -5.7247*** (0.544) | 0.0080 (0.011) | 0.0499** (0.022) | -2.3479*** (0.564) | 0.0246** (0.011) |
| Private study | -2.7960*** (0.038) | -3.5241*** (0.427) | 0.6374*** (0.043) | -2.7719*** (0.039) | -2.4765*** (0.429) | 0.5653*** (0.045) |
| Total | -2.4813*** (0.077) | -6.1070*** (0.138) | -1.4573*** (0.095) | -2.3930*** (0.077) | 12.0590*** (0.149) | -0.5065*** (0.099) |

Source: Prepared by the authors, on the basis of research results.

Note: Standard errors are in parentheses (estimated by cluster class). Statistical significance: ** $p < 0.05$, *** $p < 0.01$.

Table A1.8

Mean inequality in literacy and mathematics performance, by subsample, final year of high school, 2021*(Scores ranging from 0 to 1,000)*

| Group | Urban | | Rural | | Individual socioeconomic status<=2 | | Mother's education | | Father's education | |
|---------------------------|------------------------|------------------------|------------------------|------------------------|------------------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| | Literacy | Mathematics | Literacy | Mathematics | Literacy | Mathematics | Literacy | Mathematics | Literacy | Mathematics |
| Boys | 276.2487*** (0.300) | 279.9275*** (0.337) | 259.4684*** (1.241) | 266.0018*** (1.398) | 259.8793*** (0.428) | 263.8808*** (0.452) | 286.4395*** (0.572) | 291.5119*** (0.676) | 288.8512*** (0.673) | 293.4758*** (0.824) |
| Girls | 285.8556*** (0.258) | 271.2625*** (0.279) | 271.2503*** (0.866) | 258.8916*** (0.899) | 269.5548*** (0.322) | 256.4425*** (0.327) | 300.5177*** (0.488) | 286.1216*** (0.572) | 300.4347*** (0.588) | 285.1813*** (0.696) |
| Difference | -9.6069*** (0.307) | 8.6651*** (0.320) | -11.7819*** (1.363) | 7.1102*** (1.348) | -9.6756*** (0.498) | 7.4383*** (0.507) | -14.0782*** (0.661) | 5.3903*** (0.717) | -11.5835*** (0.783) | 8.2945*** (0.872) |
| Effect | | | | | | | | | | |
| Composition effect | -4.1228*** (0.119) | -3.7798*** (0.121) | -4.2112*** (0.686) | -3.7702*** (0.672) | -6.2478*** (0.283) | -6.1661*** (0.283) | -7.5610*** (0.264) | -5.5775*** (0.283) | -4.6004*** (0.303) | -4.3540*** (0.331) |
| Return on characteristics | -3.8524*** (0.305) | 13.0857*** (0.319) | -4.5620*** (1.336) | 12.1300*** (1.332) | -2.5036*** (0.574) | 13.4339*** (0.591) | -6.9022*** (0.710) | 11.7269*** (0.708) | -5.7280*** (0.775) | 13.4898*** (0.860) |
| Interaction | -1.6316*** (0.129) | -0.6408*** (0.134) | -3.0087*** (0.767) | -1.2496 (0.764) | -0.9241*** (0.343) | 0.1704 (0.359) | 0.2417 (0.271) | -0.7591** (0.312) | -1.2551*** (0.329) | -0.8413** (0.349) |
| Observations | 417,220 | | 18,756 | | 70,902 | | 76,178 | | 49,497 | |

Source: Prepared by the authors, on the basis of research results.**Note:** Standard errors are in parentheses (estimated by cluster class). Statistical significance: ** p<0.05, *** p<0.01.