unicef
for every child

© UNICEF/UNI187475/NOORANI

SOLVING THE EQUATION:

Helping girls and boys learn mathematics

Foreword

Once more we confirm that we are in a learning crisis: more than half of the world's 10-year-olds are unable to read a simple text, and a growing body of evidence suggests prolonged school closures due to COVID-19 will further deepen this crisis. The crisis we face, however, transcends these poor learning outcomes in reading skills. The situation is similarly dire when it comes to mathematics, the other knowledge domain singled out, alongside reading, for global monitoring by the Sustainable Development Goals.

In addition to the overall level of mathematical skills, girls worldwide are lagging behind boys in mathematics, with sexism and gender stereotypes among the root causes. This report features new data analyses covering more than 100 countries and territories. It finds that boys have up to 1.3 times the odds of obtaining mathematics skills compared to girls. Gender stereotypes regarding girls' innate inability to understand mathematics held by teachers, parents and peers are contributing to the disparity. Negative stereotypes and gender norms also play out in girls' self-confidence, setting them up for failure.

An analysis of pre-pandemic data from 34 low- and middle-income countries featured in the report shows that while girls lag behind boys, three quarters of schoolchildren in Grade 4 fail to obtain foundational numeracy skills. Pre-pandemic data from 79 middle- and high-income countries show more than a third of 15-year-old schoolchildren have yet to grasp minimum proficiency in mathematics.

In addition to gender, there are other determining factors: schoolchildren from the richest households have 1.8 times the odds of obtaining numeracy skills by the time they reach fourth grade than children from the poorest households. Schoolchildren who attend early childhood education and care programmes have up to 2.8 times the odds of achieving minimum proficiency in mathematics at 15 years old.

While this data is concerning, the state of children's education today is likely far worse, particularly among girls, given the length and impact of disruption to learning caused by the COVID-19 pandemic. Moreover, these analyses focus on boys and girls who are currently in school. In countries where girls are more likely to be out of school than boys, the overall disparities in mathematics proficiency will be even wider. When assessing reading comprehension, globally, girls are more likely to attain reading skills than boys, according to pre-pandemic data.

As schools reopen around the world, UNICEF is calling for all countries to urgently implement the RAPID actions needed to recover learning: **R**each every child and keep them in school; **A**ssess learning levels regularly; **P**rioritize teaching the fundamentals; **I**ncrease the efficiency of instruction; and **D**evelop psychosocial health and wellbeing. We must act now to ensure all boys and girls catch up on missed learning and are supported in building the foundational literacy and numeracy skills they need to thrive in school, work, and life.

Robert Jenkins,
Director of Education and Adolescent Development
UNICEF

Acknowledgements

The report was produced by Anna Alejo, Manuel Cardoso, Margaret Kelly, Sakshi Mishra, Suguru Mizunoya, Oscar Onam, and Yu Song. Valuable comments and inputs were provided by colleagues from the UNICEF Education and Adolescent Development Programme Group (Line Baago-Rasmussen, Pragya Dewan, Takudzwa Kanyangarara, Divya Lata, Hsiao Chen Lin, Asma Maladwala, Nicolas Reuge, Kenneth Russell, Fumiaki Sagisaka, Patrick Walugembe, Euphrates Efosi Wose, Jean-Luc Yameogo, and Haogen Yao), and by Georgina Diallo, from the Department of Global Communications and Advocacy, as well as by Prof. Leanne Ketterlin-Geller. Copyediting was done by Nancy Vega (UNICEF Education and Adolescent Development) and report design by Big Yellow Taxi, Inc.

Arshad Ali (12) solves the math sums on the blackboard during his class at one of the UNICEF-supported schools in the Jalozai camp, Khyber Pakhtunkhwa, Pakistan.

Basic literacy and numeracy, as well as socio-emotional skills, are building blocks for lifelong learning. Basic reading skills are a gateway to learning; without them, children fail to learn other subjects. Numeracy skills are equally important, laying the groundwork for problem solving, logical reasoning and critical thinking – in school and everyday life. While reading proficiency is a proxy for foundational learning in other subjects due to strong correlations at the school and country levels,[1] it is also important to measure and understand the factors contributing to the development of numeracy skills. Early numeracy skills matter for school readiness and success: compared to reading and attention skills, they are a stronger predictor of later mathematics and reading achievement.[2]

A complementary focus on numeracy reveals other learning disparities, such as gender gaps in skills and confidence. In reading, boys are often at a disadvantage.[3] However, as will be seen here, girls often face a disadvantage in mathematics.[4] Moreover, even when achievement differences between genders are not significant, lower self-confidence in mathematics skills persists among girls, potentially affecting their future education and career choices.[5]

This report examines some factors associated with mathematical skills, with a focus on gender. It draws on data from various surveys that include an assessment of mathematics or numeracy skills across various age groups. It aims to not only uncover gender disparities, but also explore other factors, including beliefs and attitudes towards learning, that may affect mathematics achievement. The data used here reflect the pre-COVID status, likely worsened by school closures and disruptions in protective services that schools provide. We learn more every day about how COVID-19 negatively affected learning outcomes, especially among the most vulnerable, who were already lagging before the pandemic.[6] COVID-19 also exacerbated already existing gender inequalities in education.

How do we go from recovery to transformation?
With schools now open in many countries, it is critical to commit investments towards learning recovery and the continuous development of literacy and numeracy skills for all children. Initiatives launched by UNICEF include the FLN Hub, a resource website providing guidance on strengthening education systems' capacity to improve foundational literacy and numeracy. UNICEF has also made a strategic shift towards enhancing the use of social and behavioral science to advance learning outcomes and address social and gender-related barriers in and through education. And in partnership with the UN Girls' Education Initiative (UNGEI) and others, it promotes work on gender-transformative education, seeking to use all parts of an education system to transform stereotypes, attitudes, norms and practices.

Data and analytical approach

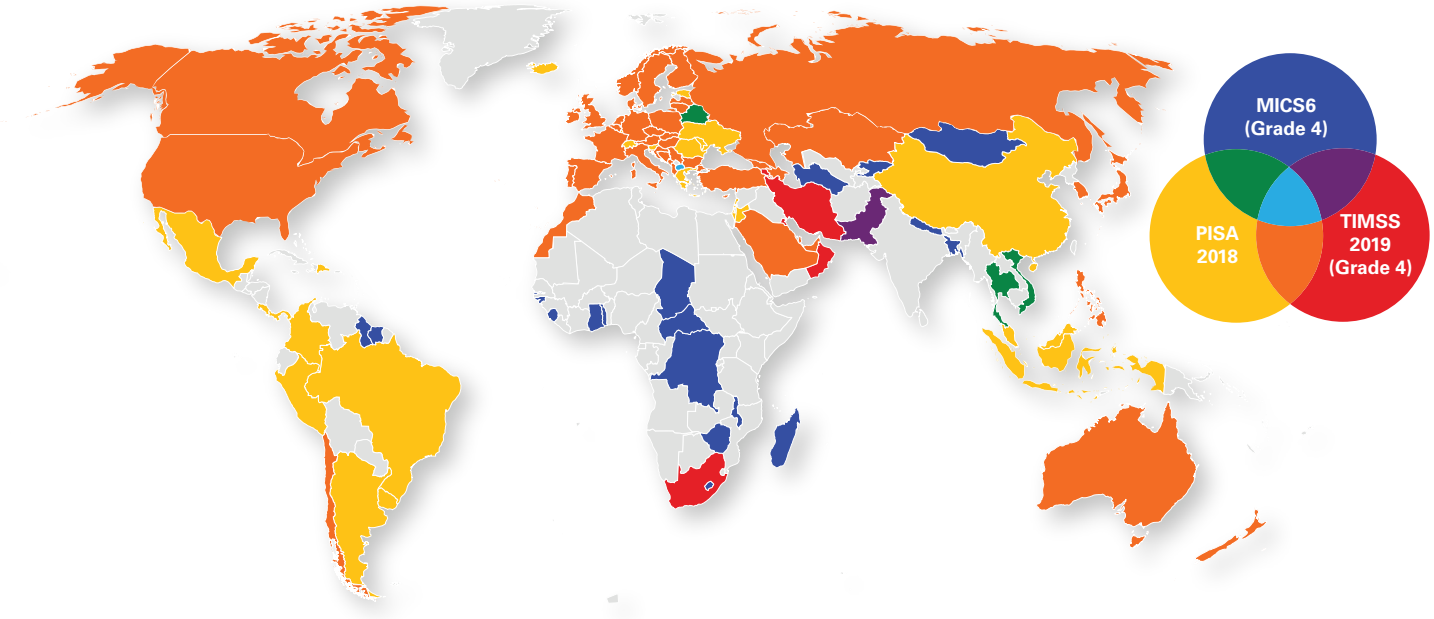
Our primary sources of data were the sixth round of the Multiple Indicator Cluster Surveys (MICS6), the Programme for International Student Assessment (PISA) 2018, and the Trends in International Mathematics and Science Survey (TIMSS) 2019. Here, the analysis of MICS Foundational Learning Skills data (which cover children aged 7 to 14 years) and TIMSS data (which cover Grades 4 and 8) – was limited to 4th graders.[7] PISA targets students aged 15 years.

These analyses cover a wide range of countries: most countries in TIMSS and PISA are high- and upper-middle-income countries while most countries in MICS are low- and lower-middle-income countries *(see Figure 1).* Therefore, any findings common to all three assessments would be quite robust. At the same time, direct comparisons across the assessments, because of differences in participating countries as well as in assessment designs, should be interpreted with caution. While we use similar variables in each analysis, some are not available or identical across datasets (e.g., differences in wording of questionnaires). Moreover, these analyses show associations, not necessarily causes.

Development of mathematics skills

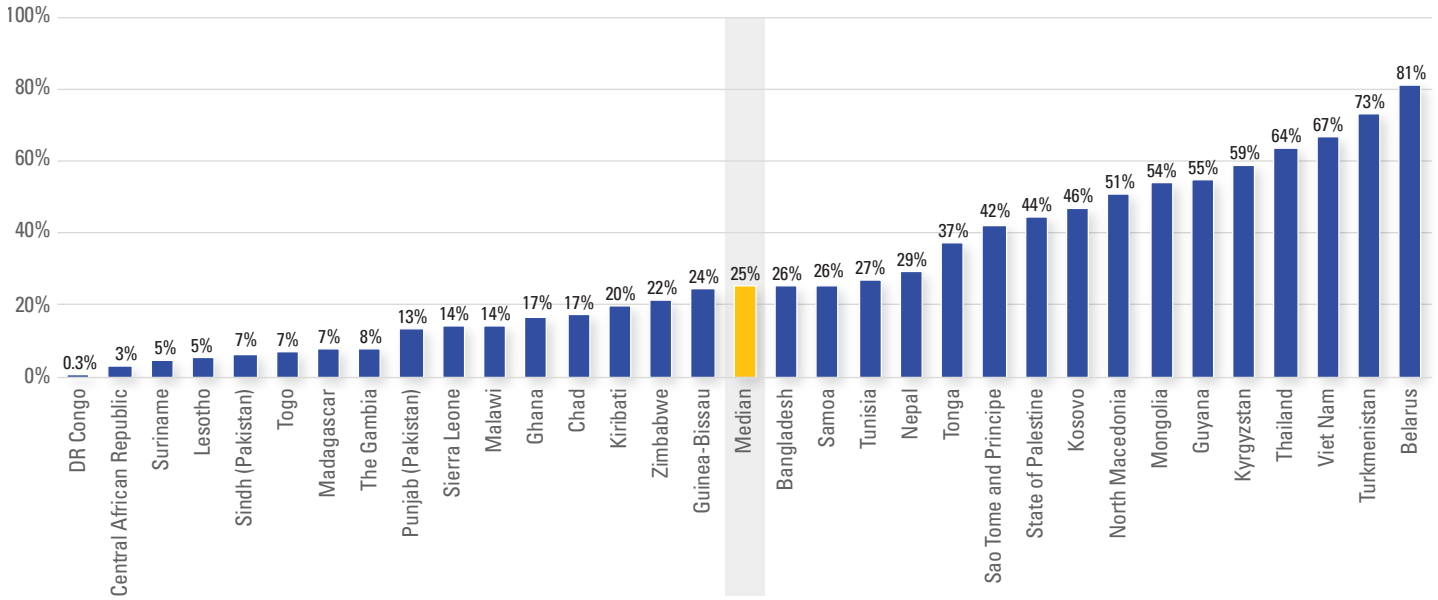
Across the three datasets, sizable proportions of students lack the expected mathematics skills. For MICS6, in 26 of the 34 low- and middle-income countries analyzed, most Grade 4 students have not achieved foundational numeracy skills, with 25

FIGURE 1. Map of country participation in MICS6, TIMSS 2019 and PISA 2018



Note: For the following countries, survey participation was confined to specific areas: MICS6 – Pakistan (Punjab, Sindh); TIMSS 2019 – Belgium (Flemish), China (Hong Kong, Taiwan Province); PISA 2018 – Azerbaijan (Baku), China (Beijing, Shanghai, Jiangsu and Zhejiang provinces, Hong Kong, Macao). This map does not include benchmarking entities participating in TIMSS 2019. This map is stylized and not to scale. It does not reflect a position by UNICEF on the legal status of any country or territory or the delimitation of any frontiers.

FIGURE 2. Few Grade 4 students have foundational numeracy skills (MICS6, 2017–2021)



Source: Multiple Indicator Cluster Surveys Round 6 (2017–2021). **Note:** Countries with fewer than 50 observations have been dropped. All references to Kosovo in this report should be understood to be in the context of United Nations Security Council Resolution 1244 (1999).

per cent as the median value of students that have acquired these skills *(see Figure 2)*.[8] In TIMSS Grade 4, which covers middle- and high-income countries, the median value for the share of students attaining minimum mathematics proficiency was higher, at 71 per cent, ranging from a low of 6 per cent in the Philippines to a high of 96 per cent in Singapore, Hong Kong, China, and Taiwan Province of China.

In PISA, the median value for the share of children attaining minimum mathematics proficiency was 70 per cent. However, there is wide variation across countries: the share of 15-year-old students with minimum mathematics proficiency ranges from a low of 9 per cent in the Dominican Republic to a high of 98 per cent in the Beijing, Shanghai, Jiangsu and Zhejiang provinces/municipalities of China.

These results reveal that across various age groups and sets of countries, large shares of children have not yet achieved mathematics proficiency. This conclusion is supported by findings from regional assessments, including the Southeast Asia Primary Learning Metrics (SEA-PLM)[9]: on average across six participating countries, about a third of students in Grade 5 – the end of primary education in some countries – still had not acquired the mathematics skills that should have been attained at Grades 2 or 3.

Gender differences in mathematics achievement

While girls tend to outperform boys in reading, boys tended to outperform girls in mathematics achievement in the assessments analyzed here.[10] After controlling for student, home, and school characteristics, MICS6 results (combining 34 countries) show that in Grade 4, boys had higher odds (1.2 times the odds) of having foundational numeracy skills, compared to girls. Similarly, in both TIMSS Grade 4 (58 countries) and PISA (79 countries), boys had 1.3 times the odds of achieving minimum mathematics proficiency. It is important to note that these analyses focus on boys and girls who are currently in school. In countries where girls are more likely to be out of school than boys, the overall disparities in mathematics proficiency will be even wider.

Why do boys tend to outperform girls in mathematics? Research on biological factors, including brain development, shows that there are no intrinsic, gender-based differences in mathematical abilities – rather, gender disparities in achievement stem from sociocultural influences.[11] These include gender stereotypes surrounding mathematics and learning, as well as social and gender norms, behaviors, attitudes and beliefs

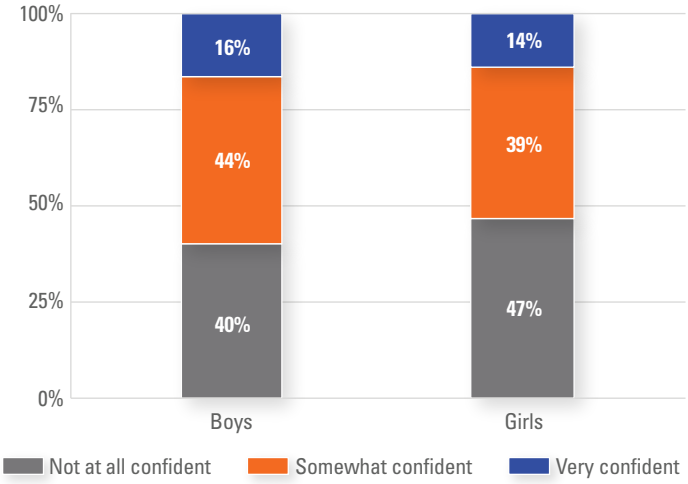
held by teachers,[12] parents, caregivers, and peers[13] regarding gender and innate abilities.

Gender norms and stereotypes can shape girls' self-confidence in their mathematical abilities. In TIMSS, students were asked how well they believed they could do mathematics. On average across countries, students who expressed being very confident in their mathematical abilities scored nearly one standard deviation (equivalent to 100 scale score points) higher than those reporting being not confident. Boys reported higher confidence in their mathematical abilities than did girls in most participating countries, including those where girls performed equal to or better than boys *(see Figure 3).*

Girls' lack of self-confidence can affect their future education and career paths. A study using TIMSS 2019 Grade 8 data found that girls and boys confident in their mathematical abilities were more likely to report interest in careers involving mathematics; however, boys were significantly more likely to do this than girls of the same achievement level.[14] Much talent could be lost in science, technology, engineering and mathematics (STEM) fields: fewer high-achieving girls may pursue further education and careers in STEM, even when they show great potential to succeed.

That girls tend to have lower self-confidence in their mathematical abilities highlight the need to break

FIGURE 3. Girls report lower levels of self-confidence in mathematical abilities than boys



Source: Authors' calculations using data from IEA TIMSS 2019 database.

gender norms and stereotypes that may contribute to learning inequalities in mathematics. However, this does not mean that boys do not need support with the development of their skills – as earlier discussed, overall mathematics achievement is poor, and more must be done to improve learning for all children. In the next section, we discuss student, home and school factors associated with the attainment of mathematics skills that provide insight into potential policy actions.

Students in the classroom of Yixing School of Zhong County in Chongqing, China.
© UNICEF/UNI336256/MA

Factors associated with the development of mathematics skills

In MICS6

Previous analysis with MICS6 data found wealth as a major determinant of attaining foundational numeracy skills among Grade 3 students.[15] In the current analysis, which focuses on students in Grade 4, wealth continues to have a considerable effect on the attainment of foundational numeracy skills *(see Figure 4)*. Compared to a child in the poorest wealth quintile, a child in the wealthiest quintile has 1.8 times the odds of having these skills. Consistent with the results for Grade 3 students, parental involvement in school (such as attending school meetings and helping with homework), having books at home and mothers' education remained important predictors for having foundational numeracy skills for students in Grade 4.

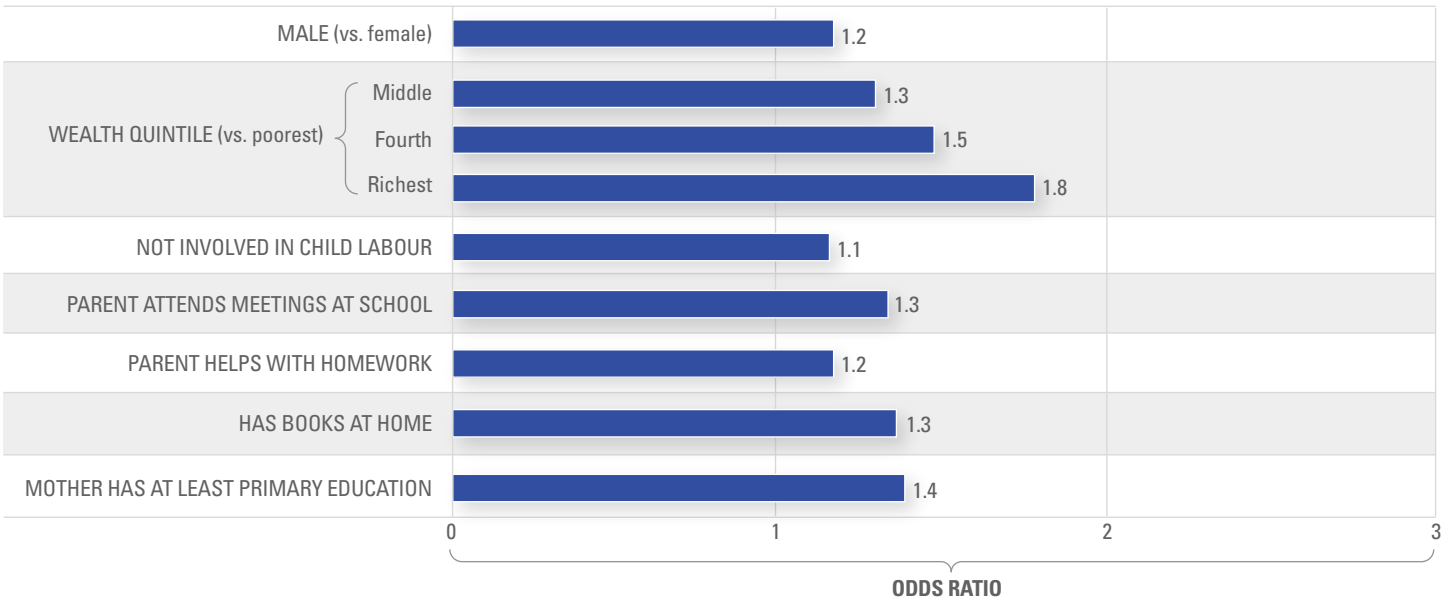
Sevane Aliyeva,10 [left] and Anakhanim Abdullayeva 10 in class in the UNICEF supported primary school in Baliqchilar settlement, Azerbaijan.

However, two differences emerged between the Grade 3 and Grade 4 results. While disability was a significant predictor in Grade 3, it was not significant in Grade 4.[16] Additionally, child labor emerged as a significant predictor of foundational numeracy skills among Grade 4 students, while it was not significant in Grade 3.[17] There is a clear and urgent need to address child labor: due to COVID-related economic shocks and school closures, as many as 9 million more children are predicted to fall into child labor at the end of 2022.[18]

In TIMSS Grade 4

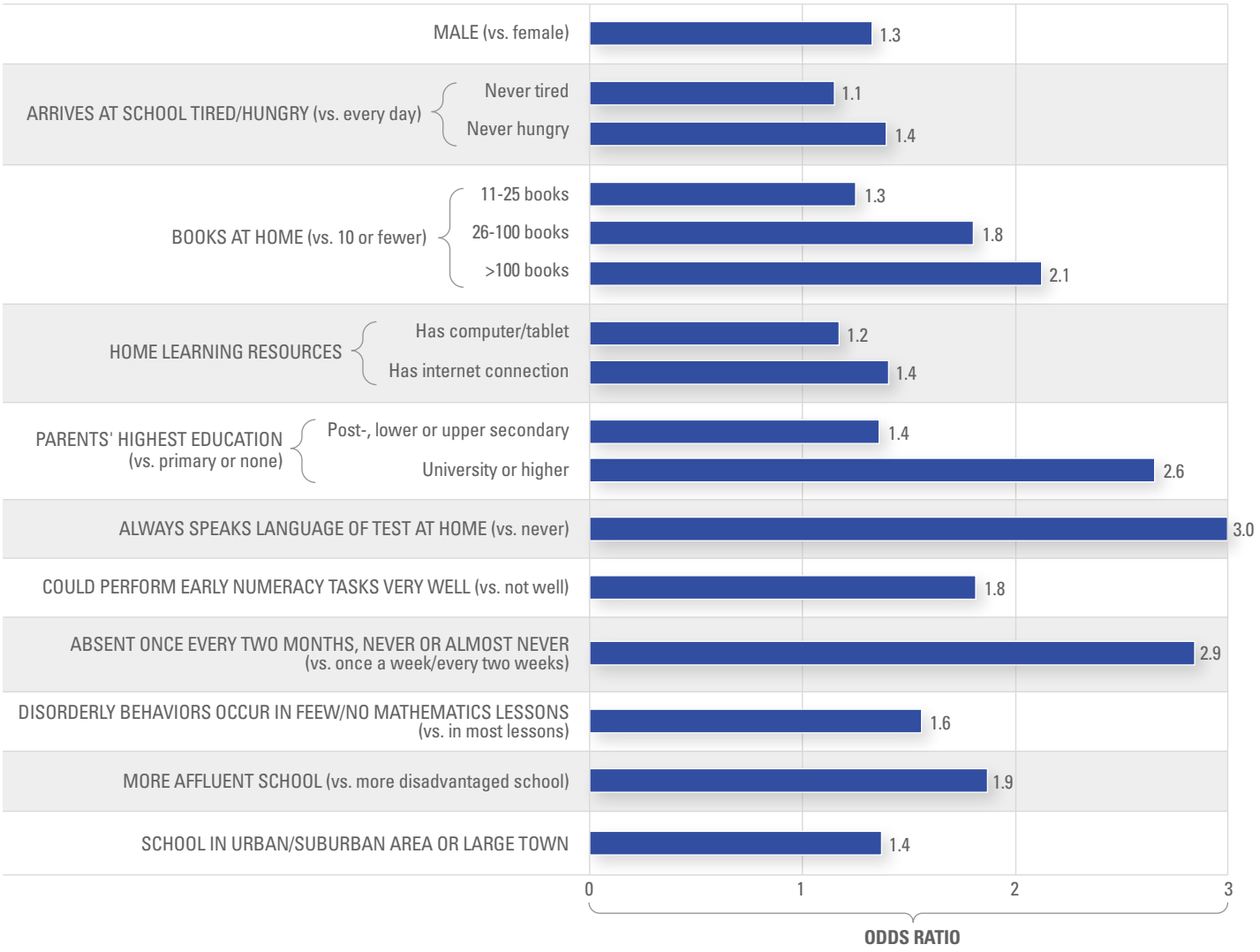
The TIMSS analysis also highlights the importance of the home environment, including student health and nutrition, books, and other learning resources at

FIGURE 4. Odds ratios of having foundational reading skills, MICS6 (Grade 4 students)



Source: Multiple Indicator Cluster Surveys Round 6 (2017–2021). **Note:** Only statistically significant results are presented.

FIGURE 5. Odds ratios of attaining minimum mathematics proficiency in TIMSS Grade



Source: Authors' calculations using data from IEA TIMSS 2019 database. **Note:** Only statistically significant results are presented.

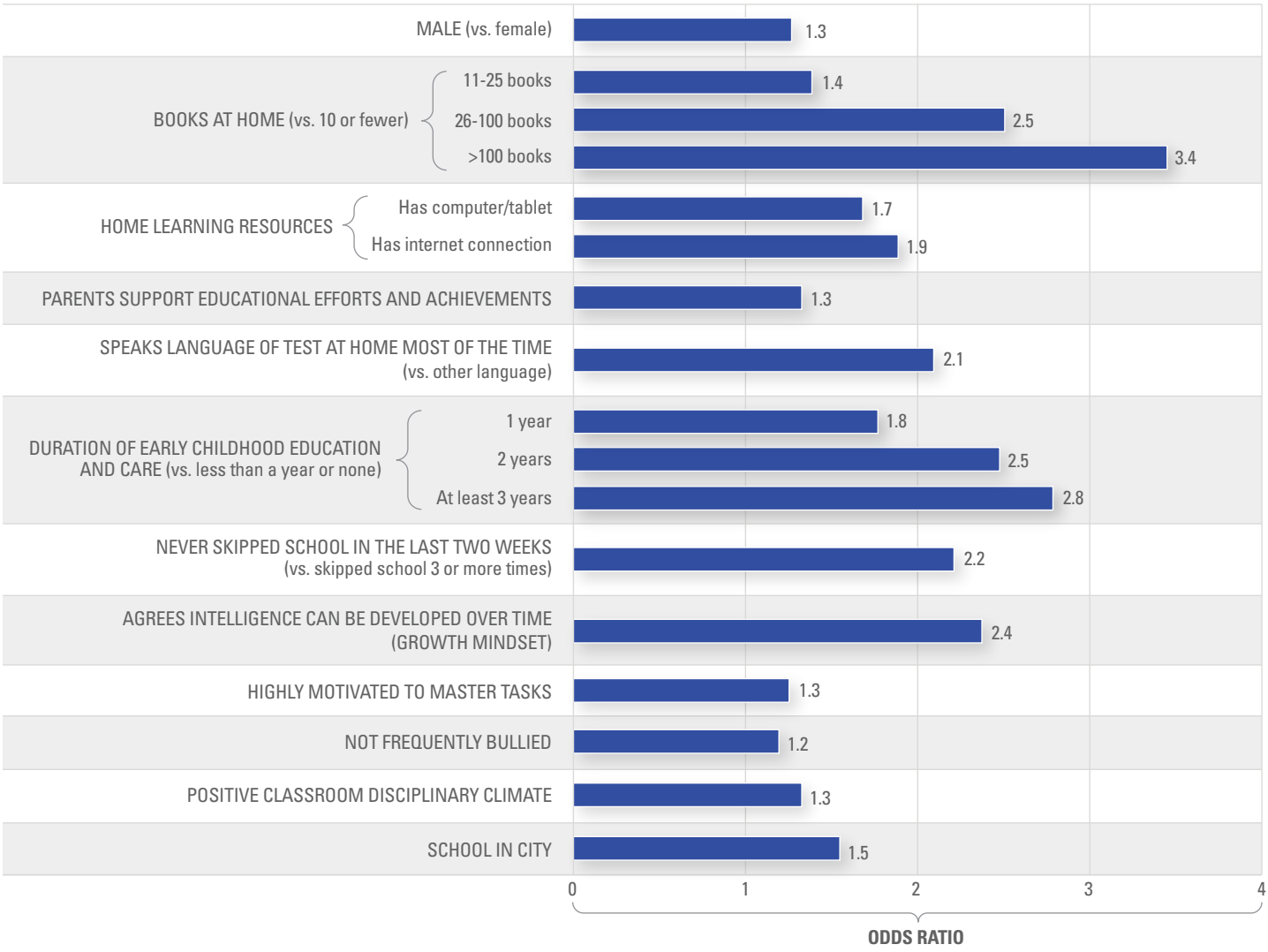
home *(see Figure 5)*. School readiness is a significant predictor, as students whose parents reported they could perform early numeracy tasks very well when they began primary school (i.e., amongst the top tercile of the TIMSS early numeracy tasks scale in their respective countries) had 1.8 times the odds of meeting minimum mathematics proficiency, compared to those whose parents reported they could not do these tasks well (i.e., amongst the bottom tercile). Additionally, results suggest the importance of a match between home and test language: compared to those who never speak the language of test at home, students who always speak the language of test at home had 3 times the odds of achieving minimum mathematics proficiency.

School factors, including classroom disciplinary climate, were also important predictors of mathematics proficiency: compared to those who reported disorderly behaviors occurred in most mathematics lessons, students who reported disorderly behaviors occurred in few or no lessons had 1.6 times the odds of attaining minimum mathematics proficiency.

In PISA

In PISA, home characteristics such as the number of books and other learning resources, parents' support for educational efforts and achievement, and language spoken at home were significant predictors of minimum mathematics proficiency

FIGURE 6. Odds ratio of attaining minimum mathematics proficiency in PISA



Source: Source: Authors' calculations using data from OECD PISA 2018 database. **Note:** Only statistically significant results are presented.

attainment *(see Figure 6)*. Early childhood development emerged as an important factor: the odds of meeting minimum mathematics proficiency at 15 years old increased with the duration of participation in early childhood education and care programmes. Student absenteeism also significantly predicted mathematics achievement: compared to those who skipped school three or more times in the last two weeks prior to the PISA test, students who never skipped school had 2.2 times the odds of attaining minimum math proficiency. Additionally, the results highlight the importance of positive attitudes towards learning, including fostering a growth mindset (i.e., the belief that intelligence can be developed) and student motivation.

Results from PISA also underscore the critical role of a conducive school and classroom environment. Compared to their peers reporting the least positive classroom disciplinary climate (i.e., amongst the bottom tercile of the PISA classroom disciplinary climate scale in their respective countries), students with highly positive classroom disciplinary climates (i.e., amongst the top tercile) had 1.3 times the odds of meeting minimum proficiency in mathematics. Safety and inclusion in school also mattered: compared to those who were frequently bullied (i.e., amongst the top quartile of the PISA exposure to bullying scale in their respective countries), students who were not frequently bullied had 1.2 times the odds of achieving mathematics proficiency.

Conclusions

The literature shows that girls perform better in mathematics in more gender-equal societies. A gender-transformative approach allows us to tackle gender inequalities not only in the education systems but beyond.

Results from the MICS6, TIMSS and PISA reveal important considerations for the design of policies and interventions to support the development of mathematics skills, especially given the urgent need to mitigate learning losses following COVID-related education disruptions. To this end, the RAPID framework for learning recovery and acceleration outlines five key actions to recover education for all children *(see Figure 7)*.[19]

Reach every child and keep them in school

As schools reopen, education systems should ensure no child is left behind in returning to school. Reaching every child and keeping them in school is critical to building their numeracy skills: MICS data show out-of-school children and youth are far less likely to develop these skills.[20]

In this report, results suggest a negative relationship between student absenteeism and academic performance. To encourage students to return to and stay in school, education systems will need to develop early-warning systems to identify the factors that may influence absenteeism and to what degree. Such factors may be within school contexts (e.g., exposure to student bullying, negative disciplinary climates) or beyond the classroom (e.g., involvement in child labor, health-related reasons, gender and social barriers, discrimination, or negative attitudes around disability). Understanding the drivers of these barriers using social and behavioral evidence-generation should be prioritized to help inform the design and implementation of effective policies and programmes towards reducing absenteeism and ensuring every child returns to and stays in school.

Assess learning levels regularly

As schools reopen, understanding students' current learning levels should guide their learning recovery process. At the system level, baseline measures of learning can help mobilize resources to where they are most needed. In the classroom, formative assessments (e.g., those showcased in the FLN Hub and the RAPID resource guide) can help educators and other education system personnel adapt their approaches to better support students' learning levels.

During school closures, children may have depended more on parental guidance with schoolwork, which could result in larger learning losses among those whose parents have low educational attainment. As highlighted in this report, parental involvement and support, as well as the availability of home learning resources, can boost student learning. At the school level, educators can focus on strengthening family-school partnerships to support learning both in the classroom and at home. Additionally, low learning levels may be due to issues related to a mismatch in the language of instruction and students' home language[21]; in such cases, there may be a need to review policies surrounding the language of instruction.

Prioritize teaching the fundamentals

Learning recovery efforts should focus on essential missed content and prioritize the most important skills and knowledge required at each grade, including foundational numeracy. To prevent exacerbating learning losses, education systems can review, adjust, and consolidate curricula within and across subjects. Teachers will also need support in improving their teaching of foundational skills to diverse groups of learners, including becoming aware of their own potential biases stemming from stereotypes and social and gender norms in their environment, which could also impact their teaching. This can be done by training teachers on learner-centered, inclusive, gender-responsive pedagogy.

FIGURE 7. The RAPID Learning Recovery Framework

Prioritizing teaching the fundamentals will be critical for learning recovery, especially given the large shares of children and youth unable to acquire basic numeracy skills. Findings in this report suggest that students who attended early childhood education and demonstrated school readiness tended to have better academic performance. Ensuring access to quality early childhood services is important for all children, but may be especially beneficial to those belonging to disadvantaged contexts where families lack home learning resources and children are at greater risk of falling behind.

Increase the efficiency of instruction, including through catch-up learning

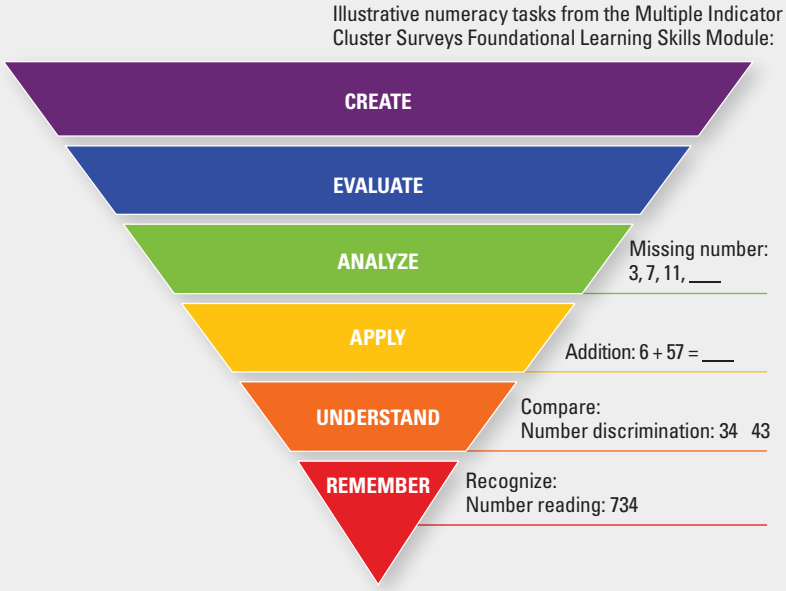
As students return to classrooms, education systems will need to adopt effective teaching practices and learner-focused strategies. Evidence-based approaches for recovering and accelerating learning include targeted instruction, structured pedagogy, tutoring, self-guided learning programmes, gender-transformative approaches, and expanded learning time, as well as an understanding of the social and behavioral environment in the classroom.

BOX 1. How teaching at the right level can help all learners go from applying **procedures** to solving **problems**

Teaching at the right level can play an important role here. Figure 8, described here from the bottom up, illustrates the importance of a solid numeracy foundation, anchored in basic concepts and the application of simple **procedures**, in order to be able to solve **problems**. Learners must **Remember** conventional representations of mathematical concepts, for instance, when they *recognize* the written representation of numbers (e.g., '7'). MICS's *Number reading* task is one such example. Learners must **Understand** simple mathematical relationships, like greater than, or >, which allows them to *compare* two numbers; e.g., in MICS's *Number discrimination* task.

Learners must be able to **Apply** procedures that include, for instance, basic arithmetic operations like addition, subtraction, multiplication, and division. An example is MICS's *Addition* task. As familiarity with basic concepts and simple procedures increases, learners must also become able to **Analyze** a situation by 'Breaking material into its constituent parts and detecting how the parts relate to one another and to an overall structure or purpose'.[22] One example is MICS's *Missing number* task, where learners recognize a pattern and then complete it by producing the missing number.[23] While the examples mentioned above come from MICS, a household survey, teachers can implement approaches in their own classrooms to ensure that all children can make this transition from applying procedures to solving problems, by relying on provenly effective Teaching at the Right Level approaches, for instance, as featured in the FLN hub.

FIGURE 8. Numeracy development: from applying procedures to solving problems



Teachers will need to be supported with professional development and a conducive working environment. In some countries, teachers will need substantial support to enhance their subject matter and pedagogical knowledge. For instance, the Programme for the Analysis of Education Systems (PASEC) 2019 report shows that one out of three teachers in participating countries have procedural knowledge of numbers and geometry, but their ability to solve problems is just emerging. From a gender perspective, male teachers outperform female teachers in mathematics subject matter knowledge in all but two PASEC countries. PASEC data also show the need for support in mathematics *teaching,* i.e., pedagogical skills.[24]

Teachers may also need practical training and guidance, for instance, on maintaining positive classroom disciplinary climates, which has been found to be positively associated with students' academic performance. Targeted professional development can include classroom management skills to help teachers maintain order, communicate and implement classroom rules, and prevent and address disruptive behaviors. Additionally, to support the efficiency of instruction, education systems and policymakers should also ensure potential barriers to maintaining positive classroom disciplinary climates, such as high pupil-teacher ratios, social and gender norms that endorse disciplinary measures, lack of self-efficacy among teachers, and shortages of educational materials, are addressed.

Given the highlighted gaps in numeracy development for girls and children with disabilities, it is crucial to support teachers in improving their pedagogy not only for learning, but also for equity. Gender-responsive and inclusive pedagogy enables teachers to do this.[25] In addition, in creating teaching and learning materials for mathematics, we should avoid reproducing harmful gender stereotypes.

Develop psychosocial health and well-being

As the COVID-19 pandemic has affected children's mental health and psychosocial well-being, it is critical that schools support whole-child development through comprehensive, tailored services that are accessible to all. Education systems must ensure children are safe, protected and able to access basic services, including those related to nutrition, mental health and psychosocial support, water, sanitation, and hygiene.

Children learn best when they are healthy and well-nourished: findings in this report show that the odds of reaching minimum mathematics proficiency increase when students do not arrive at school feeling hungry or tired. Supporting children's learning and overall well-being requires collaboration across sectors, including education, health, nutrition, and child protection. School practices and interventions can also target social and emotional skills to help students form positive attitudes and habits, fostering safe and inclusive classrooms climates, and dispelling gender-based stereotypes and social and gender norms that drive inequality in learning.

A young girl is solving a math problem on a wooden black board, while other students watch her in a village in Punjab Province, Pakistan.
© UNICEF/UNI60312/LAMA

Endnotes

1 Azevedo, Joao Pedro, et al., *Ending Learning Poverty: What will it take?*, World Bank, Washington, D.C., 2019.

2 Duncan, Greg J., et al., 'School Readiness and Later Achievement', *Developmental Psychology*, vol. 43, no. 6, November 2007, pp. 1428-1446.

3 Jenkins, Robert, Haogen Yao and Kenneth Russell, 'Failing to Read: Why global disparities in reading skills matter and what we can do about it', UNICEF Evidence for Action, 22 July 2021, <https://blogs.unicef.org/evidence-for-action/failing-to-read-why-global-disparities-in-reading-skills-matter-and-what-we-can-do-about-it/>, accessed 8 June 2022.

4 In this report, 'mathematics' covers foundational numeracy skills assessed in the sixth round of the Multiple Indicator Cluster Surveys (MICS6), mathematics (i.e., how well students have learned mathematics, based on the results of an international curriculum analysis) assessed in the Trends in International Mathematics and Science Survey (TIMSS) 2019, and the mathematical literacy domain (i.e., application of mathematics knowledge and skills to 'everyday life') assessed in the Programme for International Student Assessment (PISA) 2018. For more information, see MICS, TIMSS and PISA.

5 Lavy, Victor, and Edith Sand, 'On the Origins of Gender Gaps in Human Capital: Short-and long-term consequences of teachers' biases', *Journal of Public Economics*, vol. 167, November 2018, pp. 263-279.

6 Children with disabilities are among these vulnerable populations. For a detailed analysis, see: *Seen, Counted, Included: Using data to shed light on the well-being of children with disabilities*.

7 Even though the MICS Foundational Learning Skills module was developed in alignment with the Sustainable Development Goals Indicator 4.1.1, which assesses minimum proficiency in reading and mathematics in Grades 2/3, there are two main reasons to focus on 4th grade in this report. First, it enables a more direct comparison with TIMSS 4th grade, while bearing in mind the differences between the two assessments in terms of design and the profiles of participating countries. Second, because the proportion of 3rd grade students with 3rd grade skills in MICS was so low in some countries, focusing on 4th grade allows for richer comparisons across genders and other categories.

8 This report updates analyses of MICS6 data in the report 'Are Children Really Learning? Exploring foundational skills in the midst of a learning crisis' with two added countries (i.e., Malawi and Viet Nam) and a focus on students in Grade 4.

9 SEA-PLM is a regional assessment by the UNICEF East Asia and Pacific Regional Office and Southeast Asian Ministers of Education Association (SEAMEO). Six countries participated in the first cycle of SEA-PLM in 2019: Cambodia, the Lao People's Democratic Republic, Malaysia, Myanmar, the Philippines, and Viet Nam. For more information, see SEA-PLM.

10 Separate logistic regression analyses were conducted with each dataset to estimate odds ratios of attaining foundational numeracy skills (MICS6) or minimum mathematics proficiency (intermediate benchmark in TIMSS and Level 2 in PISA), while controlling for student, home and school characteristics. All results presented are statistically significant at $p < 0.05$ level.

11 Kersey, Alyssa J., Kelsey D. Csumitta and Jessica F. Cantlon, 'Gender Similarities in the Brain During Mathematics Development', *npj Science of Learning*, vol. 4, no. 19, 2019.

12 Lavy, Victor, and Edith Sand, 'On the Origins of Gender Gaps in Human Capital: Short-and long-term consequences of teachers' biases', *Journal of Public Economics*, vol. 167, November 2018, pp. 263-279.

13 Eble, Alex, and Feng Hu, 'Gendered Beliefs About Mathematics Ability Transmit Across Generations Through Children's Peers', *Nature Human Behaviour*, vol. 6, 2022, pp. 868–879.

14 Hencke, Juliane, et al., 'Missing Out on Half of the World's Potential: Fewer female than male top achievers in mathematics and science want a career in these fields', IEA Compass: Briefs in Education No. 17, IEA, Amsterdam, April 2022.

15 UNICEF, *Are Children Really Learning? Exploring foundational skills in the midst of a learning crisis*, UNICEF, New York, 2022.

16 For some functional difficulties, the proportion of children who stay at school drops slightly in the transition from 3rd grade to 4th grade. This may explain why this association becomes statistically not significant.

17 See also: Park, Hyunju, et al., 'Digging Deeper with Data: Child labour and learning', UNICEF Evidence for Action, 30 June 2020.

18 International Labour Organization (ILO) and UNICEF, *Child Labour: Global estimates 2020, trends and the road forward*, ILO/ UNICEF, New York, 2021.

19 World Bank, et al., *Guide for Learning Recovery and Acceleration: Using the RAPID Framework to address COVID-19 learning losses and build forward better*, World Bank, Washington, D.C., 2022.

20 UNICEF, *Are Children Really Learning? Exploring foundational skills in the midst of a learning crisis*, UNICEF, New York, 2022.

21 Analyses of the rich MICS6 dataset based on home language and medium of instruction are upcoming.

22 Krathwohl, David R., 'A Revision of Bloom's Taxonomy: An overview', *Theory Into Practice*, vol. 41, no. 4, pp. 212-218.

23 To make sure that learners are not simply recalling examples they have been drilled on, it is important to include several items in each task (five or six in MICS), with increasing degrees of difficulty. In MICS, learners were deemed proficient if they were able to correctly answer all the items presented.

24 Programme for the Analysis of Education Systems of CONFEMEN, PASEC2019: Quality of education systems in French-speaking sub-Saharan Africa – Teaching/learning performance and environment in primary education, PASEC, Dakar, 2022.

25 Education Development Trust, 'Gender-Responsive Pedagogy: Good-quality pedagogy for learning and equity', Education Development Trust, 11 October 2021, <https://www.educationdevelopmenttrust.com/our-research-and-insights/commentary/gender-responsive-pedagogy-good-quality-pedagogy-f>, accessed 12 August 2022.

unicef | for every child

Published by UNICEF
3 United Nations Plaza
New York, NY 10017

Email: education@unicef.org
Website: www.unicef.org

September 2022