TECHNICAL BRIEF

Technical appendix for:
Boys regain the advantage in middle school STEM skills: Post-COVID trends in gender achievement gaps

May 2025

Megan Kuhfeld, Karyn Lewis, Gus Robinson

NWEA, a division of HMH, supports students and educators worldwide by providing assessment solutions, insightful reports, professional learning offerings, and research services. Visit NWEA.org to find out how NWEA can partner with you to help all kids learn.

© 2025 NWEA. NWEA and MAP are registered trademarks, and MAP Growth is a trademark of NWEA in the US and in other countries. All rights reserved. No part of this document may be modified or further distributed without written permission from NWEA.

Suggested citation Kuhfeld, M., Lewis, K., & Robinson, G. (2025). Technical appendix for: **Boys regain the advantage in middle school STEM skills: Post-COVID trends in gender achievement gaps**.

Table of Contents

List of Tables

1. Introduction

The purpose of this technical appendix is to more fully describe the sample, methods, and results of the research brief **Boys regain the advantage in middle school STEM skills: Post-COVID trends in gender achievement gaps**. We investigated three research questions in this brief:

1) How have 8th grade gender gaps in STEM subjects changed from 2019 to 2024 on the NAEP, TIMSS, and MAP Growth assessments?

2) How have gender gaps on the MAP Growth assessment widened or narrowed among low- and high-performing students?

3) How have 8th grade Algebra 1 enrollment trends by gender changed from 2019 to 2024?

2. Data

Data Sources

NAEP. The National Assessment of Educational Progress (NAEP), or "The Nation's Report Card," is run by the Department of Education and provides biennial data on the math and reading skills of 4th and 8th grade students in the US. NAEP data support the comparison of achievement levels across states over multiple decades and provide insights into student performance disaggregated by demographic factors, school type, and other variables. For this brief, the scale score means and standard deviations from the 2019, 2022, and 2024 assessments for 8th grade boys and girls in public schools were downloaded from the NAEP Data Explorer. More details on the assessment itself and data availability can be found on NAEP's website.

TIMSS. The Trends in International Mathematics and Science Study (TIMSS), collected by the International Association for the Evaluation of Educational Achievement (IEA) since 1995, provides insights into international trends in mathematics and science achievement of students at grades 4 and 8. It allows for global comparisons of what students know and can do in these subjects. The study also gathers contextual information about how countries teach and learn these subjects, offering a broader understanding of educational outcomes. For this study, we downloaded 8th grade scale scores for boys and girls in the United States from 2005 to 2023 for math and science from the TIMSS 2023 International Results in Mathematics and Science webpage. More details on the sample and assessment used in TIMSS can be found on the TIMSS website.

***NWEA MAP Growth*.** The MAP Growth data for this study are from the NWEA anonymized longitudinal student achievement database. School districts use NWEA® MAP® Growth™ assessments[1] to monitor elementary and secondary students' reading and math achievement and gains, with assessments typically administered in the fall (usually between August and November), winter (usually December to March), and spring (late March through

[1] In the 2023-24 school year, NWEA began the phased implementation of an enhanced item-selection algorithm (EISA) for the MAP Growth assessment, which altered the test scale of the math assessment. To account for the differences in test version, we converted the MAP with EISA math test scores to be on the traditional MAP Growth scale. For more detail on the score conversion process, please see NWEA's EISA documentation.

June). The NWEA data also include demographic information, including student race/ethnicity, gender, and age at assessment.

MAP Growth Samples

For our first two research questions, we created a sample of 8th grade Math, Science, and Reading test scores from US public schools. To ensure consistency within the sample over time, we only included a school's test events for any given subject if the school administered the MAP Growth assessment for that subject to 8th grade students each spring from 2019 to 2024 (excluding spring 2020). Descriptive information for the students in each MAP Growth sample (overall and by year) is provided in Table 1. The Reading and Math samples each contain approximately 1.5 million students in total, while the Science sample has 230 thousand students. Boys make up 51% of the students across the various samples. The Reading and Math samples contain about 50% White students, 4% Asian students, 15% Black students, and 20% Hispanic students. The Science sample has similar demographics but has a higher percentage of Hispanic students than the other two subjects (24% overall).

For our third research question, the MAP Growth Math sample (described above) was further restricted to only include the subset of 1,300 schools that had math course enrollment data available in the same set of years. Schools did not have to offer 8th grade algebra to be included in the sample, but they did have to provide sufficient information in their reported course names to classify whether a course was (a) pre-Algebra, (b) Algebra, (c) Geometry, (d) General Mathematics, or (e) Not Matched (more detail on identifying course names is provided in the RQ3 section). The course enrollment sample contains about 42% White students, 5% Asian students, 18% Black students, and 25% Hispanic students. Boys make up 51% of the students in the course enrollment sample.

Descriptive information for the schools in our samples along with comparisons to the population of all U.S. public schools enrolling 8th grade students is provided in Table 2. There are approximately 2,300 schools in our Reading and Math samples, 466 schools in our Science sample, and 1,300 schools in our course enrollment sample (relative to 32 thousand total U.S. public schools serving 8th graders). Our sample reflects a diversity of schools from across various locales (urban, suburban, town, and rural). Relative to the population of U.S. schools, our subject-specific samples include schools serving a slightly higher average percentage of White students and a lower average percentage of Hispanic students. Our course enrollment sample overrepresents urban schools and schools serving a higher percentage of Black students.

3. Methods

RQ1: How have 8th grade gender gaps in STEM subjects changed from 2019 to 2024 on the NAEP, TIMSS, and NWEA assessments?

To track the trends in gender achievement gaps (i.e., the difference between the boys and girls in a given year/subject), we reported the average test score ($\overline{\mathrm{RIT}}_{tsg}$) in timepoint *t* for subject *s* and group *g* (where *g*=B for boys and G for girls). Scale score means are presented for each timepoint/subject/group for NAEP, TIMSS, and NWEA in Table 3.

Achievement gaps were calculated by computing the standardized mean difference between boys' and girls' average test scores. For example, the achievement gap in timepoint *t* and subject *s* was calculated as the effect size:

$$ES_{ts} = \frac{\overline{\mathrm{RIT}}_{tsB} - \overline{\mathrm{RIT}}_{tsG}}{SD_{19s}},$$

where $\overline{\mathrm{RIT}}_{tsB}$ is the average test score at timepoint *t* and subject *s* for boys; $\overline{\mathrm{RIT}}_{tsG}$ is the corresponding average for girls; and SD_{19s} is the national standard deviation (SD) for the first year of our study (2019). The standardized mean differences are reported in Table 3 and are displayed below the points in Figure 2 in the main brief.

RQ2: How have gender gaps on the MAP Growth assessment widened or narrowed among low- and high-performing students?

Within each year, subject, and gender group, we calculated the 10th percentile, 50th percentile (median), and 90th percentile score on the MAP Growth assessment. These estimates are reported in Table 4 and Figure 3 in the main brief.

RQ3: How have 8th grade Algebra 1 enrollment trends by gender changed between 2019 to 2024?

The third research question used course names from school roster data to identify students enrolled in Algebra in 8th grade. The school roster data were submitted to NWEA by school data administrators and include a free-text field with the names used by the school to identify courses (e.g., Santiago 8th Grade Math, Geometry - Grade 9, etc.).

For this study, we classified each student's 8th grade math course enrollment within one of five enrollment categories: (a) pre-Algebra, (b) Algebra, (c) Geometry, (d) General Mathematics, or (e) Not Matched. Students were classified as enrolled in pre-Algebra within a given year if any of their course names contained the substring *pre-alg, prealg*, or *pre alg*. Students were classified as enrolled in Algebra if any of their course names contained the substring *alg* so long as it was not part of the larger substrings *pre-alg, prealg*, or *pre alg*. Students were classified as being enrolled in Geometry if their course names contained the substring *geom* and did not contain any of the substrings associated with pre-Algebra or Algebra and were classified as enrolled in General Mathematics if their course names contained the substring *math* but did not include any of the substrings associated with pre-Algebra, Algebra, or Geometry. Students whose class names matched none of the substrings were classified as No Match.

The gender-specific 8th grade Algebra enrollment rate was calculated based on the total number of students classified as enrolled in Algebra of that gender divided by the total number of students of the gender in a given year. Results are presented in Table 5 and Figure 4 in the main brief.

Table 1. Description of the student demographics of the four MAP Growth samples

Subject	Year	N. Students	Girls	Boys	White	AIAN	Asian	Black	Hispanic	Multi-ethnic
Reading	All Years	1,651,437	48.9	51.1	50.3	1.1	4.5	15	20.1	3.8
Reading	2019	335,804	49.1	50.9	52.6	1	4.2	14.9	18	3.2
Reading	2021	314,532	49	51	51.9	0.9	4.4	14.5	19.9	3.5
Reading	2022	340,735	48.9	51.1	50	1	4.5	15.1	20.2	4.4
Reading	2023	334,491	48.9	51.1	48.6	1	4.5	15.4	21.5	3.7
Reading	2024	327,117	48.8	51.2	48.5	1.4	4.8	15.3	20.8	4
Math	All Years	1,538,005	48.9	51.1	49.9	1.1	3.7	15.6	20.7	3.8
Math	2019	318,671	49	51	52.4	1.1	3.6	15.5	18.6	3.2
Math	2021	294,298	48.9	51.1	51.3	1	3.7	15.2	20.4	3.5
Math	2022	315,696	48.8	51.2	49.5	1.1	3.7	15.7	20.9	4.4
Math	2023	310,086	48.9	51.1	48.2	1	3.7	15.9	22	3.8
Math	2024	300,436	48.9	51.1	47.9	1.3	3.9	15.8	21.6	4
Science	All Years	232,262	49	51	45.1	1.9	3.8	16.8	24	2.9
Science	2019	46,336	49.3	50.7	48.3	2.1	3.5	16.7	20.7	2.3
Science	2021	44,447	48.9	51.1	47.1	1.7	3.8	16.9	22.9	2.8
Science	2022	47,862	48.9	51.1	45.9	1.8	3.8	16.8	23.3	3.2
Science	2023	47,662	48.9	51.1	42.7	1.9	3.9	16.8	26.3	3
Science	2024	46,165	49.2	50.8	41.6	1.9	3.9	16.7	27.1	3.3
Course Enrollment	All Years	1,202,380	48.7	51.3	42.3	0.8	5.2	18.2	24.9	4.5
Course Enrollment	2019	239,550	48.9	51.1	44.8	0.9	5.2	18.6	22.2	3.7
Course Enrollment	2021	246,918	48.8	51.2	41.7	0.7	4.8	18.3	24.9	4.2
Course Enrollment	2022	243,573	48.7	51.3	42.2	0.8	5.1	18.3	24.2	5.4
Course Enrollment	2023	239,235	48.7	51.3	41.8	0.7	5.3	18	26.3	4.5
Course Enrollment	2024	235,061	48.4	51.6	41.2	0.7	5.6	17.9	26.9	4.6

Note. N=number of students. AIAN=American Indian or Alaska Native. The Reading, Math, Science samples consist of the students with 8th grade test scores in a consistent set of schools that administered that subject's MAP Growth assessment in each of the five years in the study. The Course Enrollment sample consists of 8th grade students in schools with valid math course enrollment fields in each of the five years.

Table 2. Sample school information relative to U.S. population of schools

Sample	N. Schools	% FRPL	% White	% Black	% Hispanic	% Asian	City	Suburb	Rural	Town
Reading	2,321	52.1	54.6	16.3	19.9	3.2	25.3	31.6	30.9	12.3
Math	2,315	52.1	54.9	16.2	19.7	3.2	25.0	31.1	31.7	12.2
Science	466	54.5	54.3	13.9	22.7	2.2	16.3	27.7	41.1	15.0
Course Enrollment	1,313	56.4	46.8	20.3	23.3	3.7	35.5	29.9	22.9	11.7
Population of US schools serving 8th grade	32,616	55.9	50.0	15.6	24.3	3.1	27.4	26.6	33.8	12.1

Note: % FRPL refers to school-level eligibility rates for free or reduced priced lunch. The source of the variables is the Common Core of Data (CCD) collected by the National Center for Educational Statistics. The U.S. public school population comparison was determined by limiting to the schools that were operational in 2019-20 and enrolled students in 8th grade.

.

Table 3. Boys' and girls' mean scale scores by year, subject, and assessment

Assessment Name	Subject	Year	Boys Mean	Girls Mean	Difference	Standardized Mean Difference
TIMSS	Math	1995	494.9	489.7	5.2	0.05
TIMSS	Math	1999	505.1	498.2	6.9	0.07
TIMSS	Math	2003	507.3	501.6	5.6	0.06
TIMSS	Math	2007	510.3	506.7	3.6	0.04
TIMSS	Math	2011	511.3	507.8	3.5	0.04
TIMSS	Math	2015	519.1	517.5	1.6	0.02
TIMSS	Math	2019	513.7	517.3	-3.5	-0.04
TIMSS	Math	2023	495.0	480.9	14.1	0.14
TIMSS	Science	1995	519.5	505.5	14.0	0.14
TIMSS	Science	1999	524.4	505.4	19.0	0.19
TIMSS	Science	2003	535.8	519.4	16.4	0.16
TIMSS	Science	2007	525.9	514.2	11.7	0.12
TIMSS	Science	2011	530.3	519.1	11.2	0.11
TIMSS	Science	2015	532.6	527.3	5.3	0.05
TIMSS	Science	2019	520.0	524.7	-4.7	-0.05
TIMSS	Science	2023	518.7	508.0	10.6	0.11
NWEA	Math	2019	231.4	232.2	-0.8	-0.04
NWEA	Math	2021	228.8	229.3	-0.5	-0.03
NWEA	Math	2022	227.9	227.3	0.7	0.03
NWEA	Math	2023	227.9	226.9	1.0	0.05
NWEA	Math	2024	227.7	226.5	1.2	0.06
NWEA	Reading	2019	220.0	223.9	-3.9	-0.25
NWEA	Reading	2021	218.3	222.4	-4.1	-0.26
NWEA	Reading	2022	218.3	221.9	-3.7	-0.23
NWEA	Reading	2023	218.0	221.4	-3.4	-0.21
NWEA	Reading	2024	217.6	220.9	-3.3	-0.21
NWEA	Science	2019	216.0	215.8	0.2	0.02
NWEA	Science	2021	215.3	215.3	0.0	0.00
NWEA	Science	2022	215.3	214.7	0.5	0.04
NWEA	Science	2023	215.0	214.1	0.8	0.06
NWEA	Science	2024	215.2	214.0	1.2	0.09
NAEP	Math	2019	281.9	282.1	-0.2	0.00
NAEP	Math	2022	275.4	273.1	2.3	0.06
NAEP	Math	2024	275.8	271.8	4.0	0.10
NAEP	Reading	2019	257.7	268.8	-11.1	-0.30
NAEP	Reading	2022	256.4	264.7	-8.3	-0.22
NAEP	Reading	2024	253.2	263.0	-9.7	-0.26

Note. TIMSS= Trends in International Mathematics and Science Study, NWEA=NWEA MAP Growth assessment, and NAEP = National Assessment of Educational Progress. Data from this table are referenced in Figure 1 and Figure 2 in the main brief.

Table 4. Estimated MAP Growth scores at the median and in the tails by gender, subject, and year

		Boys				Girls			
Year	Subject	N	10th Percentile	Median	90th Percentile	N	10th Percentile	Median	90th Percentile
2019	Reading	171,006	198	222	239	164,798	206	225	241
2021	Reading	160,336	194	221	239	154,196	202	224	241
2022	Reading	174,035	194	220	239	166,700	202	223	240
2023	Reading	171,083	194	220	238	163,408	201	223	240
2024	Reading	167,409	194	220	237	159,708	201	223	239
2019	Math	162,562	205	232	258	156,109	208	232	256
2021	Math	150,272	202	229	255	144,026	205	229	253
2022	Math	161,520	202	228	254	154,176	204	227	251
2023	Math	158,345	202	228	255	151,741	203	227	252
2024	Math	153,543	200	228	255	146,893	201	226	252
2019	Science	23,510	197	217	233	22,826	199	217	232
2021	Science	22,691	195	216	234	21,756	197	216	232
2022	Science	24,457	196	216	234	23,405	197	215	231
2023	Science	24,355	195	216	233	23,307	197	215	231
2024	Science	23,438	195	216	234	22,727	196	215	231

Note. Data from this table are referenced in Figure 3 in the main brief.

Table 5. Percentage of students by gender enrolled in Algebra 1 in 8th grade

		Percentage of students enrolled	
Course	Year	Boys	Girls
Algebra 1	2019	24.21%	26.39%
Algebra 1	2021	23.90%	25.49%
Algebra 1	2022	22.75%	23.52%
Algebra 1	2023	23.68%	24.14%
Algebra 1	2024	24.36%	24.49%

Note. Data from this table are referenced in Figure 4 in the main brief.