RAND American Youth Panel

Research Report

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Students Lose Interest in Math

Findings from the American Youth Panel

Students in the United States still have not recovered to pre–coronavirus disease 2019 (COVID-19) pandemic math and reading levels. For example, the average math scores of 8th graders in 2024, published by the National Assessment of Educational Progress, were eight points lower than in 2019 (The Nation's Report Card, undated). Furthermore, the lowest-performing students performed *worse* in 2024 than in 2022, after the pandemic dissipated (The Nation's Report Card, undated). Additionally, students are now absent from school at substantially higher rates than before the COVID-19 pandemic, further complicating recovery efforts (Dee, 2024).

These trends raise urgent questions about the state of student engagement in the classroom and areas in which policymakers and practitioners might be able to intervene. This report offers one possible explanation for the slow post-pandemic recovery: Students are frequently bored with math. To help inform possible solutions for math curriculum developers, school district leaders, math teachers, and math specialists, this report presents new survey data on middle school and high school students' perceptions of their math class experiences. Although students experiencing boredom is not unique to math, this core academic subject is our focus in this report and on which we present new data on student attitudes.

This report is based on data from RAND's newly established American Youth Panel (AYP). The AYP is a probability sample–based panel of youths who regularly complete surveys via email and text message about their attitudes, behaviors, experiences in school, and other issues affecting their lives. At the time of this writing, the panel is made up of 1,138 youths ages 12 to 21, and we are recruiting an additional 1,000 youths to join the panel in spring 2025.

KEY FINDINGS

- About one-half of middle and high school students reported losing interest during their math lessons about half or more of the time.
- The students who are the most likely to maintain interest in math are the same ones who comprehend math, feel supported in math, are confident in their ability to do well in math, enjoy math, believe in the need to learn math, and see themselves as a math person.
- The students who are the most prone to disengage in math lessons want fewer online activities and more real-world applications in their math classes.

When youths first enrolled in the panel, they filled out a baseline empanelment survey in which they provided demographic and contact information and answered a battery of questions about their interest, confidence, comprehension, supports, and enjoyment in math (in summer or fall 2024).[1] Following their empanelment, the youths were invited to take their first full survey in fall 2024. In total, 724 AYP members completed the fall 2024 survey. We weighted these 724 youths to make them representative of the national population of youths ages 12 to 21 with respect to their sex, race or ethnicity, and nativity status.

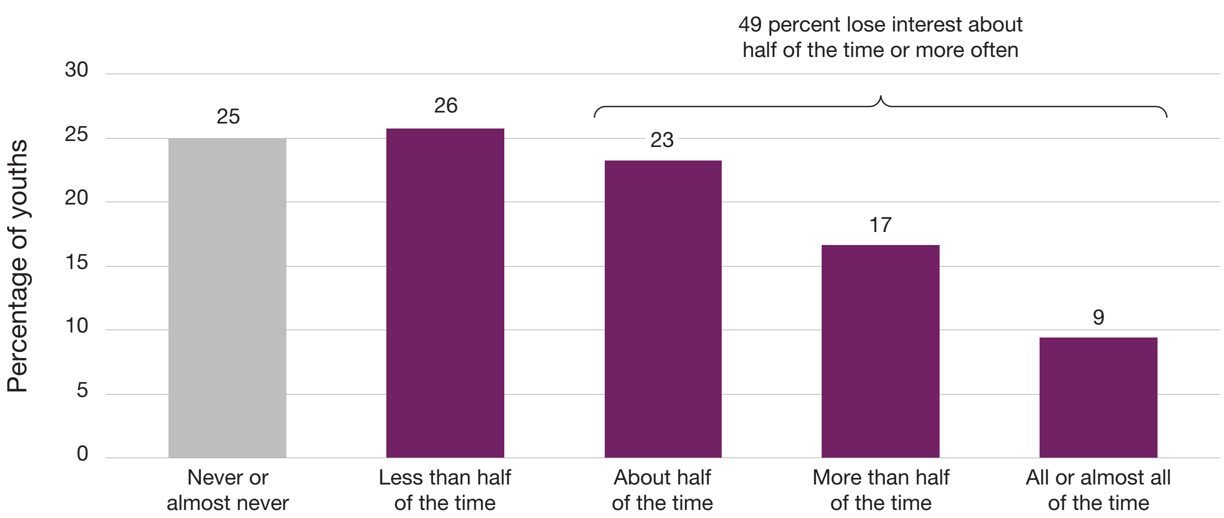
The data we present in this report are based on responses from 434 youths in grades 5 through 12 who responded to questions about their math experiences.[2] These youths were asked about their perceptions of themselves as "a math person" and what they would like to see changed about their math class activities and assignments. Our analysis is based on data from the baseline empanelment surveys and the fall 2024 survey; we intended to produce actionable information for math curriculum developers, school district leaders, math teachers, and math specialists in state education agencies. For more details about the design of the AYP and our weighting approach for this analysis, see Appendix A.

Students Frequently Lose Interest During Math Lessons

In the 2024 survey, we asked middle and high school students how often they lost interest during math lessons.[3] As shown by the sum of the three bars at the right in Figure 1, 49 percent of students in middle and high school grades reported losing interest for about half or more of the time, and 75 percent of youths reported losing interest for at least some class time. Of particular concern, about one in ten students reported losing interest during math lessons all or almost all of the time. Although it is not a perfect comparison, these estimates are higher than estimates from prior research on boredom in academic classes generally (Larson and Richards, 1991).

Figure 2 shows that students in middle and high school grades, boys and girls, and students of different races and ethnicities are equally likely to report losing interest during their math lessons about half or more the time.

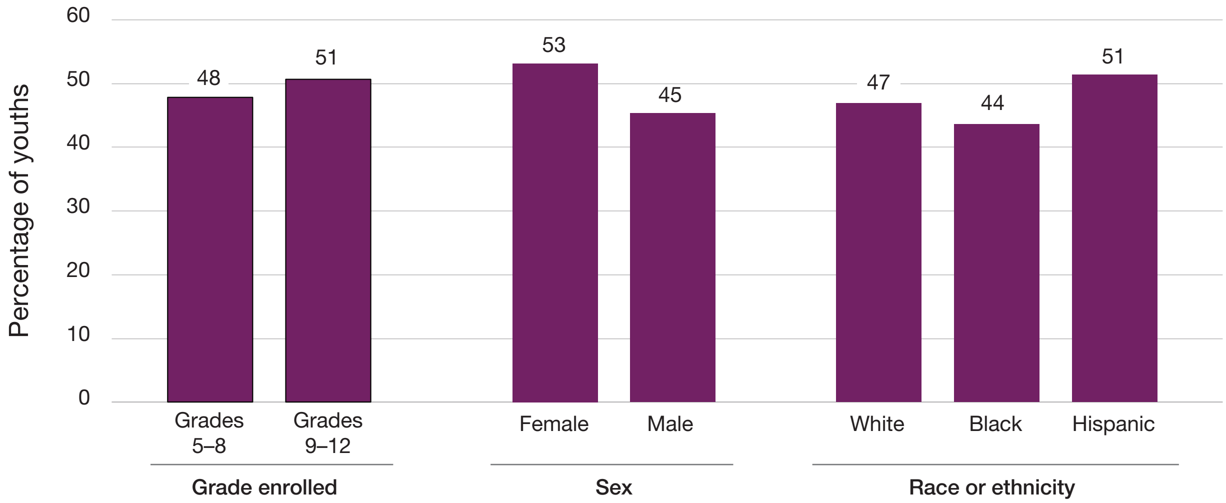
FIGURE 1
Percentage of Youths Who Lose Interest During Math Lessons, by Frequency



NOTE: This figure depicts response data from the following survey question administered to youths at the time of their AYP empanelment: "How often did you do each of the following in math class in [time period]? I lost interest during math lessons" (*n* = 434). Youths were asked to select from five responses: "Never or almost never," "Less than half of the time," "About half of the time," "More than half of the time," and "All or almost all of the time." The period asked about depended on the youth's age and when, specifically, they completed the empanelment baseline survey. Youths ages 12 to 17 who were empaneled during summer 2024 were asked about their interest in math as of spring 2024 (*n* = 337); youths ages 18 to 21 who were empaneled during summer 2024 were asked about their interest in math during the 2023–2024 school year (*n* = 9); and all youths who were empaneled in fall 2024 were asked about their interest in math in fall 2024 (*n* = 88).

FIGURE 2

Percentage of Youths Who Lose Interest During Their Math Lessons About Half of the Time or More, by Subgroup



NOTE: This figure depicts response data from the following survey question administered to youths at the time of their AYP empanelment: "How often did you do each of the following in math class in [time period]? I lost interest during math lessons" (*n* = 434). The figure displays the percentage of youths who selected one of the following three responses: "About half of the time," "More than half of the time," and "All or almost all of the time." *Grade enrolled* refers to the grade in which the youths were enrolled at the time they completed their baseline empanelment survey and were asked about their interest in math lessons.

What Could Prevent Loss of Interest During Math Lessons?

To develop actionable findings for math curriculum developers, school district leaders, math teachers, and math specialists regarding ways to cultivate and retain student interest in math, we examined the relationship between students' levels of interest in math and attitudes toward math. First, we created the following four scaled measures on the basis of a series of questions we posed to gauge students' attitudes toward math:

- scaled measure 1: **comprehends** math (alpha = 0.71)
- scaled measure 2: feels **supported** in math class (alpha = 0.76)
- scaled measure 3: **confident** can do well in math (alpha = 0.86)
- scaled measure 4: **enjoys** math (alpha = 0.93).

Each of these four scales is the numeric average of students' answers to a set of survey items. Response options to these survey items ranged from a low of 1 to a high of 4: Higher values indicate more-favorable attitudes toward math. Appendix B presents a list of the individual survey items that make up each scale. For each of these four scales, we estimated a series of logistic regression models that predict the likelihood of students maintaining interest in math about half or more of the time as a function of the six different measures of math attitudes included in the model in a stepwise fashion.

Next, we added to these four scales a fifth and sixth measure that are each based on responses to a single question rather than the average of responses to a set of questions:

- single-item measure 5: belief in the **need** to learn math
- single-item measure 6: identifies as a **math person.**

The fifth measure refers to students' level of agreement with the following statement: "Kids don't need to learn math because computers can do it for them." The sixth measure refers to students' answers to the question, "Have you ever considered yourself a math person?"

Abbreviations

ALP	American Life Panel
AYP	American Youth Panel
COVID-19	coronavirus disease 2019
MSG	Marketing Systems Group
USPS	U.S. Postal Service

With these six measures, we plotted the likelihood of students maintaining interest in math about half or more of the time across different levels of the math attitude scales (see Figure 3).

Rather than present any kind of causal explanation for students' boredom in math class, we present these six measures that prior research has shown to be related to students' success in math as a multidimensional profile of math learners with respect to their attitudes toward math. This is the first-ever survey fielded to members of the AYP, and there are plans to measure these attitudes annually to track trends over time. We recognize that these six measures are just a few among many potential factors that could explain the frequency with which students lose interest in math. For example, students' past grades in math, the level of their current math course, their relationships with their math teacher and classmates, the resources available at the students' school, and the type and frequency of math assessments can also contribute to students' math attitudes.[4] We intend to assess several of these measures in future surveys of youths (in addition to the six we summarize here) but acknowledge that we will not assess a comprehensive set of all measures that influence students' interest in math within a single ten-minute survey.

Math Attitudes Closely Correspond with Interest During Math Lessons

All six of these measures are positively associated with students' level of interest during math lessons. Students who strongly agree that they enjoy math are *much* more likely to sustain interest during math lessons than students who strongly disagree. By the same token, students who agree that they comprehend math are *much* more likely to sustain interest during math lessons than students who strongly disagree that they comprehend math. Those who strongly disagreed with the statement, "Kids don't need to learn math because computers can do it for them," were much more likely to indicate staying interested during about half or more of their math lessons. And those students who ever identified as a math person (even if they no longer do) were more likely to stay interested during about half or more of their math lessons.

Looking across all six measures of math attitudes, we find that enjoying math and comprehending math are the two attitudes most strongly correlated with retaining interest during math lessons. We find that youths' belief in the need to learn math (measure 5) has the weakest correlation with students' interest in math (although the correlation is still positive, as shown in Figure 3).

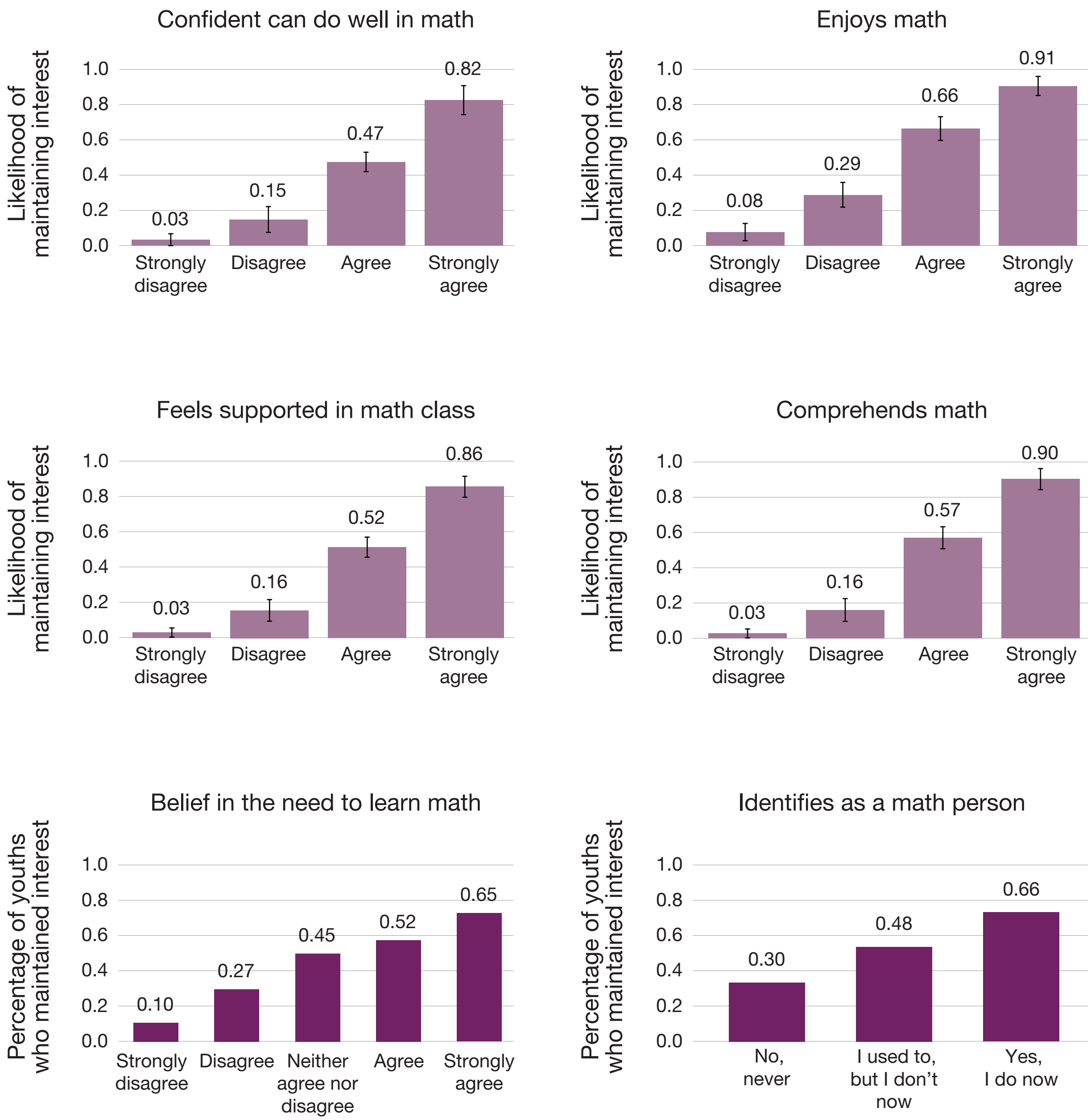
Almost One-Third of Youths Have Never Identified as a Math Person; Those Who Tend to Identify as a Math Person Develop This View During Elementary School

Thirty percent of students in middle school and high school grades indicated that they have never considered themselves a math person. This includes 26 percent of middle school grade youths and 32 percent of high school grade youths. Meanwhile, 45 percent of all youths indicated that they currently identify as a math person, and the remaining 25 percent indicated that they used to identify as a math person but do not now (results not shown).

In a follow-up question, we asked youths who either currently or formerly saw themselves as a math person to report the grade in which they first considered themselves a math person. We focus here on high school grade students, because these are the students who have progressed sufficiently far enough to reflect fully on their K–12 education. As shown in Figure 4, most high school grade youths who said they saw themselves as a math person identified as such in or before grade 5, which often coincides with the end of elementary school. Interestingly, this timing coincides with the advent of tracking of students into advanced or regular math classes that typically begin in middle school. Another

FIGURE 3

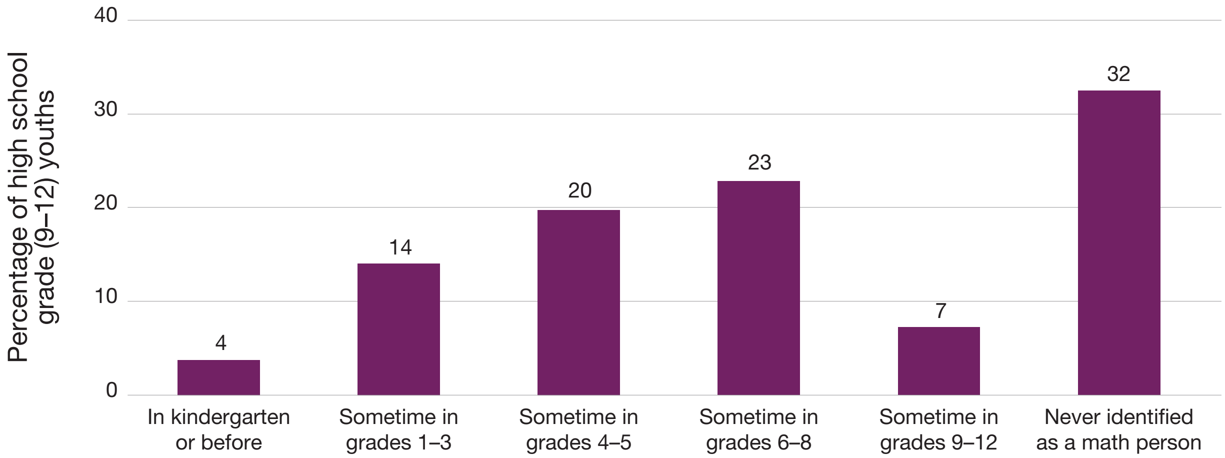
Likelihood of Keeping Interest During Math Lessons, by Math Attitudes



NOTE: The graphs in the first two rows plot the likelihood of youths *maintaining interest in math*—defined as losing interest less than about half of the time—as a function of their scores on our four math attitude scales. The plots are postestimations from a logistic regression model that predicts the likelihood of students maintaining interest in math as a function of math attitudes. The math attitudes scales range from 1 to 4, in which 1 corresponds with "Strongly disagree" and 4 corresponds with "Strongly agree." Youths were asked about their math attitudes at the time of their AYP empanelment. Youths ages 12 to 17 who were empaneled during summer 2024 were asked about their math attitudes as of spring 2024; youths from ages 18–21 who were empaneled during summer 2024 were asked about their math attitudes during the 2023–2024 school year; and all youths who were empaneled in fall 2024 were asked about their math attitudes in fall 2024. The bottom left graph depicts response data from the following survey question asked of all youths in fall 2024: "How much do you agree or disagree with the following statement? Kids don't need to learn math because computers can do it for them." We reverse coded this item for ease of interpretation. The bottom right panel depicts response data from the following survey question asked of youth in fall 2024: "Have you ever considered yourself a math person?" (n = 434).

FIGURE 4

Percentage of High School Grade (9–12) Youths Who Identify as a Math Person, by When They First Began to Identify as Such



NOTE: This figure depicts response data from the following survey question asked of youths in fall 2024: "At what age did you first consider yourself a math person?" (*n* = 325). Only students who told us they considered themselves a math person now or in the past received this question. Includes only youths currently enrolled in high school grades.

23 percent of high school grade youths said they saw themselves as a math person beginning sometime in grades 6 through 8, which roughly corresponds with middle school. Very few high school students who self-identified as a math person made this determination about themselves as late as high school. Taken together, this means that virtually all youths who identify as a math person identified themselves as such by the end of middle school, if not sooner.

Those Youths Who Lose Interest Frequently Want Fewer Online Math Activities and More Real-World Math Problems

To maintain interest in math, instructors and curriculum developers need to understand what instructional practices might be most effective at engaging students who are prone to losing interest. To this end, we asked students to think about their math activities and assignments throughout the school year and answer whether they wanted more or less online math activities and real-world math problems. Because of substantial variation in classroom assignments and instructional practices, our questions about online activities and real-world math problems can refer to a potentially disparate variety of activities. Responses to these questions should be evaluated with caution given that they are subject to student interpretation.

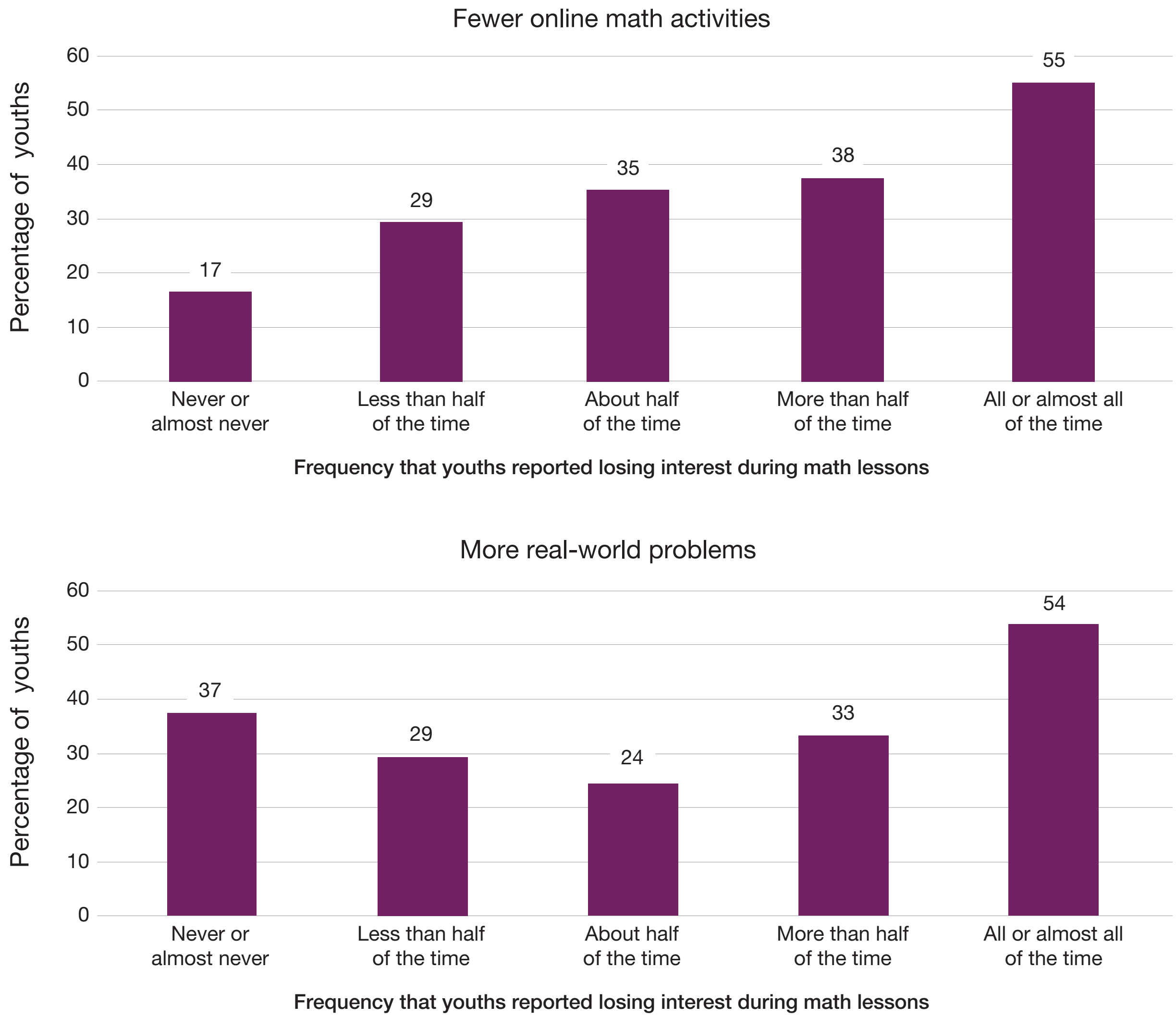
In Figure 5, we show the responses to these questions about students' desire for online math activities and real-world math programs by the degree to which students lose interest in math. The main finding is that the majority of students who lost interest in math about half or more of the time reported that they want *fewer* online activities and *more* real-world problems.[5] For example, 55 percent of the least engaged students want fewer online activities compared with 17 percent of the most engaged students. Regarding real-world math problems, 54 percent of the least engaged students want more real-world math problems compared with 37 percent of the most engaged students.

Discussion and Implications

Building and sustaining student interest in math is a longstanding challenge for educators. In light of the concerning national setbacks in math achievement since the COVID-19 pandemic, we fielded a nationally representative survey of middle school and high school students about their math engagement. Our analyses of these data yield three key findings. We

FIGURE 5

Percentage of Youths Who Want Different Math Class Activities and Assignments, by How Frequently They Lose Interest in Their Math Lessons



NOTE: This figure depicts response data from the following survey question asked of youths in fall 2024: "Please think about your math class activities and assignments this year. Do you want more or less of the following math activities?" (*n* = 434).

discuss each finding, along with our own subjective interpretations, their implications, and evidence-based practices.

First, we find that about one-half of middle school and high school students reported losing interest during their math lessons about half or more of the time. This held true for middle school and high school students; for boys and girls; and for Black, Hispanic, and White students alike.

In some sense, losing interest in math is to be expected. Boredom is a hallmark of adolescence, and self-reported rates of boredom have only increased since 2008 (Weybright, Schulenberg, and Caldwell, 2020). In a prior study of U.S. middle school students, about one-third described classwork time as boring (Larson and Richards, 1991).

Even though boredom is common, routine boredom in math class remains a problem. Prior research has shown boredom to be a predictor of lower school performance, reduced motivation, reduced effort, and increased rates of dropping out of school (Bozick and Dempsey, 2010; Camacho-Morles et al., 2019;

Camancho-Morles et al., 2021; Tze, Daniels, and Klassen, 2016). On their own, these findings are troubling. In the context of learning loss following the COVID-19 pandemic with few signs of recovery, these findings sound an alarm for a renewed policy focus on student engagement.

Second, we find that students' attitudes toward math are strongly associated with their engagement in math. In particular, we find that students who maintain their interest in math are also students who typically report that they comprehend math, feel supported in math, are confident in their ability to do well in math, enjoy math, believe in the need to learn math, and see themselves as a math person. Just as student attitudes could partially explain boredom, so too could boredom explain attitudes.

These student attitudes are just a few of the many potential reasons for students' level of engagement in math. Such societal or structural trends as greater disengagement from school during and since the COVID-19 pandemic (for a variety of reasons), a general decline in the attention spans of young people, and the way schools structure math course offerings are just a few of the many potential explanations for the high rates of boredom in math that we observed in this survey of students. Ideally, the solutions for increasing engagement should derive from clearly established, causally proven reasons for students' low engagement. Such solutions might include changes in teaching practices, as we outline in the next paragraph. Beyond teaching practices, additional important structural changes regarding increasing student engagement and success that merit further study include changes in the slate of math courses that schools offer, how schools assign (or track) students to those courses, the duration and scheduling of math classes, the preparation that math teachers receive in teacher-preparation programs, and the kinds of math assessments and instructional materials school systems procure.

> Online math activities might be less motivating than face-to-face instruction, during which a teacher can respond and adapt to a greater variety of cues than a computer can.

Third, students who are frequently disengaged in math want fewer online math activities and more real-world content. In one sense, the fewer online activities finding is surprising, because technology that mirrors social media and online gaming—to the degree that online math activities do mirror those activities—could give students a similar feeling of pleasure and sustain their motivation. However, it could be that online math activities are primarily not gamified or, even if they are, may not give the same dopamine rush as scrolling or playing games if students are struggling with their problem sets.

We hypothesize that students who are frequently disengaged in math want fewer online math activities because those activities are often done individually and require a sustained solo effort that causes fatigue and frustration, especially when students are over-challenged. Online math activities might be less motivating than face-to-face instruction, during which a teacher can respond and adapt to a greater variety of cues than a computer can. It could also be that the use of technology directly triggers a craving for social media and gaming, which might engender boredom with the task at hand. Whatever the reason, we emphasize in our list of research-recommended, engaging math activities below a combination of face-to-face teacher-student interactions and a mix of offline and online activities to provide engaging, individualized, high-quality math instruction.

Frequently disengaged students wished for fewer online math activities and wanted more real-world content instead. This complements research on career and technical education, which finds that occupationally focused courses with real-world applications help engage disadvantaged students because the material is directly relevant to their future (Plasman, Gottfried, and Klasik, 2021). As we indicated above, real-world applications are also engaging because conveying the intrinsic value of math activities can combat boredom.

Fourth, nearly one-third of middle school and high school students noted that they have never identified as a math person. Those who did said they identified as such by middle school, if not earlier. This is the point at which many schools begin to track students into regular, remedial, or advanced math courses. Given the early timing of students' self-identification as a math person, it is especially important for elementary grade math teachers to cultivate positive math attitudes in students regardless of the track to which they are assigned. Students' self-perceived math competence and perceived value of math declines as they advance from elementary school to high school (Jacobs et al., 2002). Math comprehension, confidence, and subsequent enjoyment in middle school and high school are typically rooted in early formative experiences in the classroom and reflect a cumulative process of academic engagement that unfolds as students progress through school (Alexander, Entwisle, and Horsey, 1997). Most of the engaging math practices for teachers that we detailed above apply across elementary to secondary grade levels, with modifications to make the practices age appropriate.

Finally, research points to many things that math teachers and curriculum developers can do to increase student engagement. Although our survey results do not identify causes for students' disengagement, we offer a set of evidence-based strategies that math teachers can use to heighten student engagement. We note that pedagogy and the content of math lessons are likely only parts of the solution to boredom; the slate of math classes in schools and the way students are assigned to those classes are likely also important but in ways that research has not yet defined. The following is our list of teacher- and curriculum-centric ideas:

- Provide "just right" math content to students. Under- and over-challenging content leads to boredom (Goetz et al., 2023; Vygotsky, 1978). Adaptive instruction and testing provide students with new content on the basis of their prior responses, which can reduce the gap between their performance level and the task at hand. Formative assessment to understand student comprehension followed by differentiated instruction can help pitch math content at "just right" levels for subgroups of students. Likewise, online instructional materials, tutoring, and assessments are improving in quality. In concert with face-to-face interactions with teachers, the combination of teacher and online materials can deliver high-quality individualized instruction to students.
- Use active learning strategies, such as problem-based learning, educational games, group discussion, and structured group activities to increase students' involvement in their learning (Shernoff et al., 2016; Vygotsky, 1978).
- Provide students a choice in how to do math assignments, such as the order in which they answer problems or a choice in which variants of math problems to answer. Or, allow alternative formats for some projects so that students can explore aspects that interest them. This can increase students' sense of control and autonomy (Cheon and Reeve, 2015; Tze, Daniels, and Klassen, 2016; Wang et al., 2017).
- Teach students strategies to reframe a boring situation, such as by students reminding themselves of the value of the task (e.g., how it helps them achieve a downstream, real-world goal) or finding interest within it (e.g., a chance to compete against their prior personal best) (Nett, Goetz, and Daniels, 2010). Likewise, teachers can teach students to challenge assumptions, such as math being inherently boring (Tze et al., 2024).
- Model enjoyment of math to transmit the emotion to students (Frenzel et al., 2018; Keller et al., 2014; Morrish et al., 2018; Quoidbach, Mikolajczak, and Gross, 2015). Teachers who enjoy the material are more likely to explain why it is interesting, which helps students value the material (Cui, Yao, and Zhang, 2017).
- Remind students of the purpose of math at the outset by framing how it relates to real-world problems, daily decisionmaking, or a science, technology, engineering, or math career (Wang et al., 2017).

In closing, as policymakers and educators grapple with the academic fall-out observed in schools following the COVID-19 pandemic, our survey of middle school and high school students suggests the need to focus on disengagement. We find that a substantial proportion of middle school and high school students are frequently losing interest in math. Although our data are not equipped to pinpoint the reasons students are bored in math, they do point to possible solutions worth exploring. In particular, educators should support students in math, convey the importance of learning math, pair face-to-face instruction with online activities, and use more real-world applications in the classroom.

Limitations

The findings from this study should be considered in light of its limitations. First, the AYP is still under construction at the time of the writing of this report, so the sample size of youths who completed the survey is on the smaller side ($N = 434$). Even though we used probability sampling to recruit panelists and applied survey weights to the analyses, the results reported here are not as precise as they will be when the panel reaches its full size ($N = {\sim}2{,}000$). Second, our analyses in no way establish causality (e.g., we cannot state that boredom is *caused* by a lack of confidence in math or vice versa). Instead, we are only examining correlations to establish, in essence, a multidimensional profile of math learners who report frequent disengagement with math. Third, our survey asked about only a limited set of dimensions in a profile of math learners. We will add some important dimensions in future surveys, such as students' grades in math and the level of their math course(s), but our surveys are and will be limited in the number of dimensions we can examine. In particular, students' math course grades (which we did not ask about on this first survey) are likely an important filter for interpreting students' responses. Finally, our analysis is based on a cross-sectional portrait of youths in fall 2024. We lack comparable data on the state of student engagement prior to COVID-19, so we cannot ascertain if the patterns we observed here have improved or worsened over time.

Educators should support students in math, convey the importance of learning math, pair face-to-face instruction with online activities, and use more real-world applications in the classroom.

APPENDIX A

RAND American Youth Panel Methodology

This report is based on data from a self-administered, English-only web survey completed by 724 members of RAND's AYP. The AYP includes a nationally representative sample of non-institutionalized English-speaking youth in the United States between the ages of 12 and 21 who are asked to take periodic surveys about social, economic, and policy issues. The data in this report come from a survey that was fielded between June and November 2024. Participants in the survey gave informed consent, and ethical approval was granted by RAND's Human Subjects Protection Committee. For those participants under the age of 18, parental consent was also obtained. A total of 724 youths completed the survey. The full set of survey results can be viewed and user-friendly charts can be created in Bento, a free data visualization tool. To learn more about Bento, go to www.getbento.info/about or email bento@mgt.us.

Sample Design and Recruitment

The AYP was launched in 2024 to augment RAND's American Life Panel (ALP). Developed by RAND researchers in 2006, the ALP is a probability sample–based panel of approximately 5,000 regularly interviewed adults in the United States ages 18 and older. The AYP, funded by the Gates Foundation, was developed to extend the age range of the ALP so that it can collect timely data on issues related to contemporary youths and their transition to adulthood. The ALP was constructed by combining existing probability samples developed for other purposes along with periodic recruitment drives to refresh the panel as members age and attrit. Currently, the ALP is made up of panelists recruited from random-digit dialing of sampling frames of landlines and cell phones and push-to-web recruitment from address-based samples from the U.S. Postal Service's (USPS) Computerized Delivery Sequence File. For more information about the history and design of the ALP, see Pollard and Baird (2017). In spring 2024, 346 ALP members were identified as having a child between the ages of 12 and 17 living in their household.

In addition to inviting current members of the ALP, we launched a recruitment drive in spring 2024 using a disproportionately stratified sample design by means of auxiliary data sources on the potential ages of household members. The goal of this recruitment drive was to recruit parents of children between the ages of 12 and 17 and young adults between the ages of 18 and 21. Although sampling with an equal probability of selection is the gold standard for population-based surveys, the costs associated with recruiting a large number of households without an age-eligible resident (e.g. youths between the ages of 12 and 21) were prohibitive. Instead, we sought to construct a sampling frame that would include housing units with a high probability of an age-eligible resident as identified via auxiliary data sources. This sampling frame was provided by Marketing Systems Group (MSG), which developed an address-based sample frame derived from the latest generation of the USPS's Computerized Delivery Sequence File. MSG enhanced this file by geocoding each address to a specific latitude and longitude. This bridging step enabled MSG to append a long list of ancillary data from both commercial and federal databases. These data are sourced from various datasets, including public records, phone directories, U.S. Census data, consumer surveys, and other proprietary sources. A housing unit was considered to have a known or inferred age-eligible resident if indicated by at least two sources. The final sampling frame provided by MSG includes only the housing units where an age-eligible resident is believed to reside.

Unlike the original ALP, which was designed to provide nationally representative point estimates, the AYP is intended to provide national representation and state-level representation in four key states of interest to the Gates Foundation: California, Florida, New York, and Texas. To achieve this goal, the sampling frame provided by MSG was used to create five equal size strata: one for each of the four key states of interest and one for the rest of the country. With this stratified file, we drew a random sample of 13,000 housing units within each of the five strata for a total sample of 65,000 housing units.

To each of these 65,000 housing units, we initiated a push-to-web enrollment process by sending them a brochure about the ALP and a letter inviting one adult in the household to join. This letter contained a unique enrollment code to access the survey platform via the ALP website. The mailing also contained a $2 bill as incentive, which was visible through a window in the envelope. Once a prospective panelist logged onto the ALP website with the unique enrollment code, they were asked to provide participation consent and to fill out demographic information about themselves and members of their household. Of the 65,000 invited, 5,014 adults (or 7.7 percent) went online and joined the panel. Of these 5,014 adults, 463 were between the ages of 18 and 21 and directly enrolled in the AYP. Of the adults over the age of 21 who joined, 1,382 reported that they had a child between the ages of 12 and 17 living with them.

To enroll the children of existing ALP members and the children of newly recruited parents in the panel, we sent a web survey to the parents that collected information about their children's home environment and experiences with math. At the end of the survey, parents were invited to enroll their children in the panel by providing us with their children's email addresses and cell phone numbers (if they have one). Parents were given two options for how they could consent to their children receiving the surveys: (1) blanket permission for RAND to directly email or text the child with the survey link or (2) a survey-by-survey permission process, in which RAND first sends an email to the parent describing the content of the survey and then the parent provides active consent before the survey is sent to the child. Analogous to a traffic light, the former is considered our green light group, and the latter is considered our yellow light group. Those parents who declined to enroll their children are considered our red light group. We then sent an email invitation to the children of all parents who provided consent and invited them to join the panel and to fill out a baseline survey. Of the 1,026 children invited, 631 agreed to join the panel.

Weighting Approach

The analysis in this report was conducted using weights. The weighting approach for this survey was designed to ensure that respondents to the survey reflect the population of youths ages 12 to 21 in terms of gender, race or ethnicity, and nativity while allowing for analysis of key grade-level subgroups on the basis of school enrollment. Raking was used to match respondents in one of three school enrollment clusters to the population on the basis of the characteristics in Table A.1: (1) enrolled in grades 5–8 (middle school), (2) enrolled in grades 9–12 (high school), (3) enrolled in postsecondary school, or (4) not enrolled. Trimming at the 95th percentile was used to reduce the outliers, and the trimmed weights were reallocated for the population totals to remain the same after trimming. Population distribution benchmarks for the weighting are from the 2023 American Community Survey. Post-trimming, the design effect for the survey is 1.26.

TABLE A.1

Calibration Variables Used for Weighting

Characteristic	Unweighted Sample Size	Unweighted Percentage	Weighted Percentage	Population Percentage
Gender				
Male	306	42.3	50.6	51.3
Female	418	57.7	49.4	48.7
Race or ethnicity				
Non-Hispanic, White	413	57.0	51.6	50.6
Non-Hispanic, Black	69	9.5	11.5	13.4
Hispanic	184	25.4	26.3	24.5
Non-Hispanic, other	58	8.0	10.6	11.5
Born in the United States				
Yes	687	94.9	95.2	92.6
No	37	5.1	4.8	7.4

SOURCE: Adapts information from U.S. Census Bureau, "2023 Data Release Schedule," webpage, updated September 12, 2024.

NOTE: This table presents counts of panelists who responded to the survey and information from the population totals on the proportion of the population with each characteristic, as measured by the 2023 American Community Survey.

APPENDIX B

Construction of Math Attitudes Scales

To support our analysis, we constructed six math attitude scales from survey items administered to youths. Table B.1 identifies the six math attitude scales and the underlying survey items used to construct the scales. The survey items we analyzed in this report were asked to youths either when they completed their empanelment at some point during summer or fall 2024 or as part of a fall survey administered to youths who had already joined the AYP. (Some youths who empaneled into the AYP in fall 2024 took the empanelment survey items and the fall survey items together.)

For the items administered as part of the AYP empanelment process, the period asked about in the question differed depending on when the youths completed their empanelment. Youths ages 12 to 17 who were empaneled during summer 2024 were asked about their math attitudes as of spring 2024 (*n* = 337); youths ages 18 to 21 who were empaneled during summer 2024 were asked about their math attitudes during the 2023–2024 school year (*n* = 9); and all youth who were empaneled in fall 2024 were asked about their math attitudes in fall 2024 (*n* = 88).

As shown in Table B.1, most survey items were asked on a four-point scale ranging from 1 = strongly disagree to 4 = strongly agree. The math attitude scale is equal to the average of respondents' answers across the items that make up that scale. We confirmed our construction of math attitude scales by conducting a factor analysis. Alphas are shown in Table B.1.

TABLE B.1

Construction of Composite Measures of Math Attitudes from Survey Items

Math Attitude	Survey Item	When Asked?	Alpha
Comprehends math	To what extent do you agree or disagree with the following statements about your math performance in [time period]? Four-point scale: strongly disagree, disagree, agree, strongly agree. *I understand the math I have studied.*	Time of empanelment	0.71
	To what extent do you agree or disagree with the following statements about your math performance in [time period]? Four-point scale: strongly disagree, disagree, agree, strongly agree. *Doing math is easy for me.*	Time of empanelment	
	To what extent do you disagree or agree with the following statements about the math teacher you have in [time period]? Four-point scale: strongly disagree, disagree, agree, strongly agree. *My math teacher explains things clearly, so that I can understand the material.*	Time of empanelment	
Feels supported in math class	To what extent do you disagree or agree with the following statements about the math teacher you have in [time period]? Four-point scale: strongly disagree, disagree, agree, strongly agree. *My math teacher is someone I can count on to help me.*	Time of empanelment	0.76
	To what extent do you disagree or agree with the following statements about the math teacher you have in [time period]? Four-point scale: strongly disagree, disagree, agree, strongly agree. *My math teacher cares about me as a person.*	Time of empanelment	
	To what extent do you agree or disagree with the following statements about your interest in math in [time period]? Four-point scale: strongly disagree, disagree, agree, strongly agree. *When I'm in math class, I feel like I belong.*	Time of empanelment	

Table B.1—Continued

Math Attitude	Survey Item	When Asked?	Alpha
Confident can do well in math	To what extent do you agree or disagree with the following statements about your math performance in [time period]? Four-point scale: strongly disagree, disagree, agree, strongly agree. *I feel confident that I can understand math in school.*	Time of empanelment	0.86
	To what extent do you agree or disagree with the following statements about your math performance in [time period]? Four-point scale: strongly disagree, disagree, agree, strongly agree. *I can overcome setbacks in math.*	Time of empanelment	
	To what extent do you agree or disagree with the following statements about your math performance in [time period]? Four-point scale: strongly disagree, disagree, agree, strongly agree. *I can get good grades in math.*	Time of empanelment	
Enjoys math	To what extent do you agree or disagree with the following statements about your interest in math in [time period]? Four-point scale: strongly disagree, disagree, agree, strongly agree. *I enjoy learning math.*	Time of empanelment	0.93
	To what extent do you agree or disagree with the following statements about your interest in math in [time period]? Four-point scale: strongly disagree, disagree, agree, strongly agree. *Math is interesting.*	Time of empanelment	
	To what extent do you agree or disagree with the following statements about your interest in math in [time period]? Four-point scale: strongly disagree, disagree, agree, strongly agree. *I look forward to taking math.*	Time of empanelment	
Belief in the need to learn math	How much do you agree or disagree with the following statement? Five-point scale: strongly disagree, disagree, neither agree nor disagree, agree, strongly agree. *Kids don't need to learn math, because computers can do it for them.*	Fall 2024	N/A
Identifies as a math person	Have you ever considered yourself a math person? Response options: No, never; I used to, but I don't now; Yes, I do now	Fall 2024	N/A

NOTE: N/A = not applicable

Notes

[1] The first recruitment period for the AYP took place in summer 2024 and the second took place in fall 2024. Most youths (78 percent) completed their empanelment during the initial summer period. Therefore, most youths completed the initial battery of survey items about their math interest and experiences during the summer 2024 period, when these items asked youths to refer to the spring 2023–2024 school year.

[2] Of the 724 youths who completed the fall 2024 survey, 63 percent were enrolled in grades 5 through 12. Twenty-four percent of youths ages 12 to 21 were enrolled in grades 5 through 8 (roughly corresponding with middle school), 38 percent were enrolled in grades 9 through 12 (roughly corresponding with high school), 21 percent were enrolled in postsecondary education, and 17 percent were not enrolled in school. Among those who were enrolled in grades 5 through 12, 80 percent were enrolled in public schools at the time they completed their AYP baseline empanelment survey, 8 percent were enrolled in private schools, and 9 percent were homeschooled. We excluded responses for 25 youths who were not enrolled in K–12 schools throughout the entire period observed.

[3] We defined grades 5 through 12 as middle or high school grades. Grade 5 is the youngest grade in which an AYP youth is enrolled in school. Because our sample is too small to report on youths in grade 5 separately, we combined grade 5 with other common middle school grades.

[4] Sun (2018) finds that tests that focus on performance goals (getting things right) can convey fixed-mindset messages. In this way, even "gamified" online activities are unlikely to promote growth mindsets or positive math identities if the activities reinforce the idea that math is a subject in which things are right or wrong and that *being good at math* means getting the most things right in a fixed amount of time.

[5] We did not define *online math activities* or *real-world math problems* for respondents, and, therefore, we acknowledge that there may be some ambiguity in how youths interpreted this language.

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About This Report

In summer and fall 2024, we surveyed 994 youths to track several timely topics in K–12 education today, including math and the use of artificial intelligence for school: 586 of those youths were surveyed in both summer and fall. Our series of short reports is intended to provide brief analyses of survey results of immediate interest to policymakers, practitioners, and researchers. Appendix A of this report provides more information on survey recruitment, administration, and sample weighting.

The youths we surveyed are members of the American Youth Panel (AYP). The AYP is one of a series of RAND survey panels, including nationally representative samples of teachers, school leaders, and districts across the country. The panels are a proud member of the American Association for Public Opinion Research's Transparency Initiative. For more information, visit https://www.rand.org/surveypanels.

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