formative by newsela

More use of Formative is linked to higher math achievement for high school students

Evidence from a district serving primarily low-SES and Hispanic students

We're ready to support you. Let's talk!
newsela.com/contact

Author: Kayleigh Ryherd, PhD

Executive summary

- This study tests the impact of Formative on mathematics achievement in **1,265 9th** and **11th graders**.
- Students who completed **more numeric questions** on Formative showed **higher MAP and SAT scores**.
- In 9th grade, the average student experienced the equivalent of **34 additional days** of instruction thanks to their use of Formative.
- These results suggest that Formative can be an **effective tool for teachers** to support their students' math achievement by allowing them to more deeply probe **quantitative reasoning** through numeric questions.
- This study meets the ESSA standards for **Tier III (Promising)** evidence.

Introduction

In 2022, less than 25% of 12th-grade students achieved proficiency in mathematics, a statistic that has held generally steady since at least 2005. Students who score poorly on standardized measures of math achievement at the end of high school are less likely to go to college.[1] Without strong math skills, students may not be prepared for future college or career plans, especially those in science, technology, engineering, and mathematics (STEM). Jobs in STEM have been on the rise for the past few decades,[2] and STEM workers tend to out-earn non-STEM workers by about 30%.[3] Without the strong foundations in math built in high school, students are often unable to access the advanced mathematics coursework necessary for success in these fields.[4] For example, students who take algebra in high school tend to earn more in their future careers than students who do not.[5]

Math achievement is even lower in Hispanic students, with only 11% of students reaching proficiency.[6] This achievement gap has real consequences; Hispanic students are less likely to expect to achieve a bachelor's degree, and they are less likely to enroll in advanced math classes in early high school.[7] Difficulty in mathematics also contributes to these students' later entrance into STEM careers. Hispanic individuals are underrepresented in STEM and STEM-related careers. Recent reports show them making up only about 10% of the STEM workforce despite being nearly 20% of the workforce as a whole.[8] Supporting earlier math proficiency for Hispanic students, then, can potentially improve later career success.

To more frequently check in on their students' understanding of key mathematical concepts, many teachers utilize **formative assessments**. Decades of scholarship demonstrate the power of formative assessment in improving student learning outcomes.[9,10] For teachers, collecting formative assessment data empowers them to tailor their instruction to meet student needs,[11] document student progress towards standards mastery,[12] and provide students with developmentally appropriate corrective feedback to clear misconceptions and set them on a better instructional path.[13,14] Students also benefit directly from the formative assessment when they themselves have insight into their own performance and can set and monitor progress towards learning goals independently.[15]

Formative by Newsela (hereafter referred to as "Formative") was built to make the formative assessment process easier and more data-driven for both teachers and students. Formative allows

teachers to build lessons and assessments, receive real-time student performance data, and deliver immediate feedback to students via various modalities (written notes, voice memos, etc.). Teachers can collaborate to build activities on Formative and interpret Formative data.

Prior research has demonstrated that the more a secondary classroom uses Formative, the higher its students score on standardized math assessments.[16] The current study investigates the relationship between Formative usage and math achievement, specifically in high school (grades 9 and 11).

This study meets the Every Student Succeeds Act (ESSA) standards for Tier III (Promising) research. ESSA is America's primary education law and provides a framework for evaluating the effectiveness of educational programs. Tier III research evaluations are well-designed and well-implemented correlational studies that statistically control for selection bias.

Method

Sample

Formative partnered with J. Sterling Morton High School District 201 for this research study. This district, located in the suburbs of Chicago, serves approximately 8,000 students in grades 9 through 12.[17] The median income for families in this area is $67k[18] (below average for Illinois as a whole, but above average for their county).[19]

A total of 1,265 students from grades 9 and 11 were included in this study.[20] The majority of students in the sample were identified as Hispanic. Most students qualified for free or reduced lunch. About 40% of the sample were English learners (ELs) during the study period.

Characteristic	9th grade	11th grade	Total sample
Total students	508	757	1,265
% Hispanic	94%	92%	93%
% Female	49%	54%	52%
% Current English learners	38%	40%	39%
% Free or Reduced Lunch	90%	70%	78%

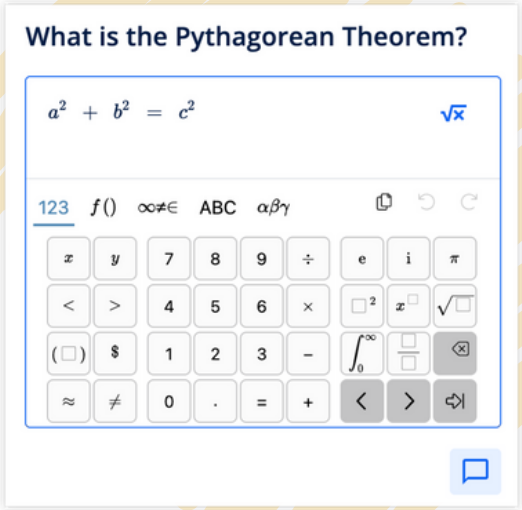
Table 1. Sample demographics

Achievement Measures

Ninth-grade students were tested in the fall and spring of the 2023–2024 school year using the NWEA MAP. The NWEA MAP® Growth™ is an online adaptive interim assessment typically taken by students at three points throughout the school year (Fall, Winter, Spring). Interim assessments like MAP Growth measure students' academic performance at these points.[21] The analyses presented here focus on the **Math** subject test, which covers operations/algebraic thinking, geometry, number systems, and statistics/probability. Prior research has also shown that MAP Growth is highly correlated with multiple summative assessments.[22,23]

Eleventh-grade students were tested using the SAT in the spring of 2024. The SAT is a standardized assessment aimed to measure students' college readiness. The SAT is split into two sections: Math and Reading/Writing. The **Math** section covers algebra, advanced math, problem-solving and data analysis, and geometry/trigonometry. PSAT scores from spring 2023 were also collected as a baseline measure. The PSAT is commonly known as a "practice" SAT; it covers the same topics but is administered earlier in a student's high school career.

Numeric Questions on Formative



On Formative, teachers can create customized assessments using a variety of question types, such as multiple choice, short answer, fill-in-the-blank, and matching. For all question types, teachers can use a math keyboard that provides additional symbols and formatting options.

Numeric questions on Formative specifically allow **students** to respond to questions using the same math keyboard.

Numeric questions allow teachers to ask mathematical short-answer questions of their students. These short answer questions probe recall memory, which is inherently more difficult than the recognition memory needed for multiple-choice questions.[24] As such, giving students numeric questions may allow them to practice the deeper mathematical processing necessary for success in STEM courses and careers.

Results

Overall use of Formative

The average student in this sample used Formative about twice a week throughout the school year, completing an average of 10-15 questions over 1-2 assessments per session. Students completed numeric questions approximately once every other week.[25]

Greater use of numeric questions on Formative is linked to higher MAP and SAT achievement

For both 9th- and 11th-grade students, students who completed more numeric questions had higher math achievement on both MAP and the SAT. This effect was significant even after controlling for many other factors, including prior math achievement (MAP: fall score; SAT: prior year's PSAT score), EL status, school, gender, race, and free/reduced lunch status.

The average student in the 9th-grade sample completed 17 numeric questions, equivalent to a 0.7 point increase in RIT score or an **extra 34 days of instruction.**[26] Results were similar for 11th graders; for each additional numeric question completed on Formative, students' SAT scores increased by 0.23 points.[27] Figure 2 illustrates the relation between Formative use and math outcomes for these students.

The results of this study demonstrate a statistically significant relationship between the use of Formative (specifically numeric questions) and high school math achievement in a district serving primarily low-SES and Hispanic students. Numeric questions allow students to respond with full mathematical notation, forcing them to recall rather than just recognize the answer and engage in deeper processing along the way. This study meets ESSA criteria for Tier III (Promising) evidence because it shows a statistically significant correlation between usage and outcomes after controlling for variables likely to affect selection bias, like race and socioeconomic status. The most important takeaway from this study, though, is the positive impact of Formative on preparing these students for rigorous STEM education in later high school and beyond.

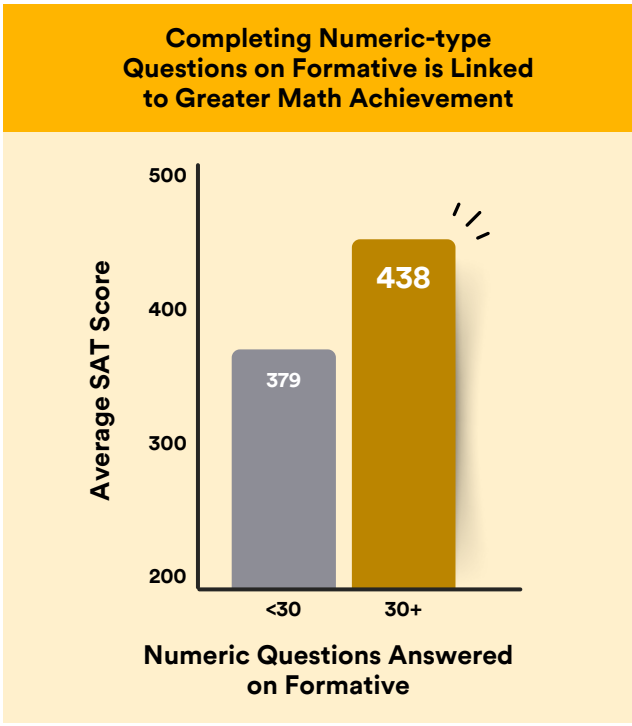


Figure 2. Average SAT math score summarized by use of numeric questions

Resources

1. Ogut, B., Bohrnstedt, G., & Broer, M. (2021). College Enrollment Benchmarks for the NAEP Grade 12 Mathematics Assessment. AIR-NAEP Working Paper 2021-04. *American Institutes for Research*.
2. Langdon, D., McKittrick, G., Beede, D., Khan, B., & Doms, M. (2011). STEM: Good Jobs Now and for the Future. ESA Issue Brief# 03-11. *US Department of Commerce*.
3. Noonan, R. (2017). STEM Jobs: 2017 Update. ESA Issue Brief# 02-17. *US Department of Commerce*.
4. Lynch, K., & Kim, J. S. (2017). Effects of a Summer Mathematics Intervention for Low-Income Children: A Randomized Experiment. *Educational Evaluation and Policy Analysis, 39*(1), 31-53. https://doi.org/10.3102/0162373716662339
5. Black, S. E., Muller, C., Spitz-Oener, A., He, Z., Hung, K., & Warren, J. R. (2021). The importance of STEM: High school knowledge, skills and occupations in an era of growing inequality. *Research policy, 50*(7), 104249. https://doi.org/10.1016/j.respol.2021.104249
6. NAEP Report Card: Mathematics
7. Kotok, S. (2017). Unfulfilled potential: High-achieving minority students and the high school achievement gap in math. *High School Journal, 100*(3), 183-202.
8. Taylor, D. & Arbeit, C. A. (2024). The STEM Labor Force: Scientists, Engineers, and Skilled Technical Workers. *National Science Foundation*. Retrieved from https://ncses.nsf.gov/pubs/nsb20245/representation-of-demographic-groups-in-stem
9. Black, P., & Wiliam, D. (1998a). Assessment and classroom learning. *Assessment in Education: Principles, Policy, & Practice, 5*(1), 7–74.
10. Kingston, N., & Nash, B. (2012). How many formative assessment angels can dance on the head of a meta-analytic pin. *Educational Measurement: Issues and Practice, 31*(4), 18-19.
11. Wiliam, D. (2011). What is assessment for learning? *Studies in Educational Evaluation, 37*, 3–14.
12. Pellegrino, J. W. (2014). Assessment as a positive influence on 21st century teaching and learning: A systems approach to progress. *Psicologia Educativa, 20*(2), 65–77.
13. Brookhart, S. M., Moss, C. M., & Long, B. A. (2010). Teacher inquiry into formative assessment practices in remedial reading classrooms. *Assessment in Education: Principles, Policy & Practice, 17*(1), 41–58.
14. Hattie, U., & Timperley, H. (2007). The power of feedback, Review of Educational Research, 77(1), 81–112.
15. Bransford, J. D., Brown, A. L., & Cocking, R. R. (2000). *How people learn: Brain, mind, experience, and school*. Washington, DC: National Academies Press.
16. Henschel, M. & Styers, M. (2021). *Formative Pilot Study Report*. Prepared by LearnPlatform.
17. From NCES District Lookup
18. ACS-Ed District Demographic Dashboard 2018-22
19. 2018-2022 ACS
20. Students in grades 10 and 12 did not have MAP scores or both PSAT and SAT scores due to the district testing schedule.
21. Northwest Evaluation Association. (2020). 2020 NWEA MAP Growth normative data.
22. Northwest Evaluation Association. (2016). Linking the PARCC Assessments to NWEA MAP Growth Tests for Illinois.
23. Northwest Evaluation Association. (2021). Linking Study Report: Predicting Performance on the Smarter Balanced Summative Assessments based on NWEA MAP Growth Scores.
24. Haist, F., Shimamura, A. P., & Squire, L. R. (1992). On the relationship between recall and recognition memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 18*(4), 691.

25. The median student used Formative on 72 unique days in 34 unique weeks. The median number of questions answered was 1,142 over 82 assessments. The median student also completed 15 numeric questions.
26. The effect of numeric questions was statistically significant (b = 0.04, $t(1040)$ = 3.23, p = 0.001). Thus, a student completing 17 numeric questions would be expected to grow by 0.68 points on MAP Growth. The average 9th grader can be expected to grow by 3.6 points from Fall to Spring.
27. b = 0.23, $t(1610)$ = 2.98, p = 0.003). The median 11th grade student in this sample completed 14 numeric questions.