# Graphing Calculators Research Support »

**A growing body of research* shows that effective graphing calculator use improves students' math skills as well as their attitudes toward math.**

Specific research studies show that effective use of graphing calculators:

» Improves student skills and achievement in high school and middle school math.
» Positively impacts student performance in algebra.
» Improves math test scores – with and without student calculator use during testing.
» Leads to significantly better student attitudes toward math.
» Promotes higher student achievement when incorporated into the curriculum.

| WHAT WE KNOW | HOW WE KNOW IT | TITLE/AUTHOR |
|---|---|---|
| » When teachers incorporated graphing calculators into their curriculum more frequently and with greater intensity, including during less frequent math topics, student achievement was higher.<br><br>» The more access students have to graphing calculators and more frequent use during instruction, the higher their end-of-course test scores.<br><br>» Increased use of graphing calculators during instruction resulted in higher test scores even when students did not use graphing calculators during testing. | A correlational study looking at the relationship between graphing calculator use and student standardized test scores in grades 9-11.<br><br>Students were instructed with varying levels of graphing calculator use, and they did not use graphing calculators during testing. | ***"Impact of Handheld Graphing Calculator Use on Student Achievement in Beginning Algebra"***[1]<br><br>January 2006<br><br>**Heller Research Associates**<br><br>Joan Heller, Deborah Curtis (San Francisco University), Rebecca Jaffe and Carol Verboncoeur (Heller Research Associates) |
| » Strong evidence showed that student use of graphing calculators increased performance in algebra. | A systematic review of rigorous scientifically-based research addressing the impact of graphing calculator use on student achievement. A meta-analysis of eight individual studies specific to graphing calculator use found a large pooled effect size (.85) that is statistically significant.<br><br>This review supports the findings of other studies regarding the impact of graphing calculator use on student achievement, such as the meta-analysis conducted by Aimee J. Ellington and reported in the November 2003 issue of Journal of Research in Mathematics Education. | ***"Effectiveness of Graphing Calculators in K-12 Mathematics Achievement"***[2]<br><br>November 2005<br><br>**Emperical Education Incorporated (EEI)**<br><br>Madhab Khoju and Gloria Miller (EEI, Palo Alto, California) and Andrea Jaciw (Stanford University) |

*For more information, visit education.ti.com/research.

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|---|---|---|
| » Students who received instruction using graphing calculators performed as well or significantly better in conceptual, problem solving and operational skill areas.<br>» Students using calculators during instruction – but not during assessment – performed as well or better in all five math skill areas. This key finding also indicates that student math skills did not suffer even without calculator use specifically during assessment.<br>» Students using calculators had better attitudes toward mathematics than their noncalculator-using counterparts. | A meta-analysis of 54 high-quality studies, 22 specifically on graphing calculators, to determine the effects of calculator use on students' performance in five skill areas: conceptual, computational, operational, problem solving and selectivity.<br>For those using calculators during instruction, performance was measured and compared between students who both did and did not use calculators during assessment.<br>Survey data was collected on students' attitudes toward mathematics and related to calculator usage. | ***"A Meta-Analysis of the Effects of Calculators on Students' Achievement and Attitude Levels in Precollege Mathematics Classes"***[3]<br>November 2003<br>**Aimee J. Ellington**<br>Peer reviewed research |
| » Student use of graphing calculators positively impacted general algebra performance, specifically showing:<br>- Significant improvement in student performance (Thompson and Senk, 2001)<br>- Higher achievement among low performing students (Harskamp, Suhre and Van Streun, 2000)<br>- Improved students' skills in creating algebraic descriptions of Cartesian graphs (Ruthven, 1990)<br>- Improved student knowledge of functions (Schwarz and Hershkowitz, 1999)<br>- Improved student understanidng of functions (Hollar and Norwood, 1999) | An analysis of five independent experimental and quasi-experimental studies on secondary level mathematics and the impact of graphing calculator use.<br>Meets the rigorous standards of scientifically-based research relating to criteria from the No Child Left Behind Act. | ***"Using Graphing Calculators in Secondary Mathematics: What Scientifically-Based Research Has to Say"***[5]<br>May 2003<br>**Prepared for Texas Instruments by Interactive Educational Systems Design, Inc.** |
| » Student access to and use of graphing calculators were among the top 10 factors related to grade 9 achievement in both applied and academic mathematics. | A correlational analysis that examined the factors relating to math performance of Ontario's grade 9 students, analyzing data from more than 600 schools. | ***"Technical Paper: Relationship Between Education Quality Indicators and Achievement, Grade 9 Assessment of Mathematics, 2001-2002"***[4]<br>Retrieved September 2004 from the Ontario EQOA Web site.<br>**Ontario Education Quality and Accountability Office (EQOA)** |

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[1] "Impact of Handheld Graphing Calculator Use on Student Achievement in Beginning Algebra." Complete study available at the Texas Instruments Web site: http://education.ti.com/sites/US/downloads/pdf/EEI_GraphingCalcReviewReport_2006.pdf.
[2] "Effectiveness of Graphing Calculators in K-12 Mathematics Achievement." Complete study available at the Texas Instruments Web site: http://education.ti.com/sites/US/downloads/pdf/Heller_GrCalcReport_2005.pdf.
[3] "A Meta-Analysis of the Effects of Calculators on Students' Achievement and Attitude Levels in Precollege Mathematics Classes." Complete study available at the NCTM Web site: http://my.nctm.org/eresources/article_summary.asp?URI=JRME2003-11 433a&from=B.
[4] "Technical paper: Relationship Between Education Quality Indicators and Achievement, Grade 9 Assessment of Mathematics, 2001-2002." Complete study available at the Ontario EQOA Web site: www.eqao.com/pdf_e/03/03P025e.pdf.
[5] "Using Graphing Calculators in Secondary Mathematics: What Scientifically-Based Research Has to Say." Complete study available at the Texas Instruments Web site: education.ti.com/research.

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