Question

1. What does the research say about the effectiveness of one-to-one computing in K–12 schools in relation to student achievement?

Background

REL Midwest received a request for information on one-to-one computing and student achievement.

Following an established REL Midwest research protocol, we conducted a search for research reports as well as descriptive and policy-oriented briefs and articles on one-to-one computing and student achievement. We focused on identifying resources that specifically address this topic. The sources include additional research institutions, several educational research databases, and sites we found in a general Internet search using Google. It should be noted that the devices/technology options and pedagogy used in earlier studies may not be similar to devices and pedagogy in use now.

We also searched for appropriate organizations that could be resources on this issue. We have not done an evaluation of these organizations or the resources themselves but offer this list for your information only.

1. What does the research say about the effectiveness of one-to-one computing in K–12 schools in relation to student achievement?


From the abstract: “Despite the growing interest in 1:1 computing initiatives, relatively little empirical research has focused on the outcomes of these investments. The current special edition of the Journal of Technology and Assessment presents four empirical studies of K-12 1:1 computing programs and one review of key themes in the conversation about 1:1 computing among advocates and critics. In this introduction to our 1:1 special edition, we synthesize across the studies and discuss the emergent themes. Looking specifically across these studies, we summarize evidence that participation in the 1:1 programs was associated with increased student and teacher technology use, increased student engagement and interest level, and modest increases in student achievement.”

*From the abstract:* “This paper examines the educational impacts of the Berkshire Wireless Learning Initiative (BWLI), a pilot program that provided 1:1 technology access to all students and teachers across five public and private middle schools in western Massachusetts. Using a pre/post comparative study design, the current study explores a wide range of program impacts over the three years of the project’s implementation. Specifically, the current document provides an overview of the project background, implementation, research design and methodology, and a summary of the quantitative results. The study details how teaching and learning practices changed when students and teachers were provided with laptops, wireless learning environments, and additional technology resources. The results found that both the implementation and outcomes of the program were varied across the five 1:1 settings and over the three years of the student laptop implementation. Despite these differences, there was evidence that the types of educational access and opportunities afforded by 1:1 computing through the pilot program led to measurable changes in teacher practices, student achievement, student engagement, and students’ research skills.”


*From the abstract:* “After 10 years of No Child Left Behind standards-focused education, mathematics scores have improved only marginally for elementary-aged students. Students who developed a solid conceptual mathematics foundation at the elementary level succeeded later in higher-level mathematics courses; thus, educators have sought ways to increase mathematics achievement, especially among elementary school students. Educators have utilized advances in technology with game-based learning applications and wireless Internet access to create exciting interactive learning opportunities for students that may translate into student achievement. The purpose of this quantitative, quasi-experimental study was to examine the effects of iPad use as a 1-to-1 (1:1) computing device on 5th-grade students’ mathematics achievement in two rural Virginia elementary schools. A nonequivalent group’s pretest and posttest design was used with 104 fifth-grade students. For one academic quarter of nine weeks, the experimental group used iPads as 1:1 computing devices daily during mathematics class while the control group members did not. A pretest was administered before the iPad intervention and a posttest was administered after the iPad intervention. The change from pretest to posttest was not significantly different between the two groups as measured by a one-way repeated measures analysis of variance. Recommendations for future study include increasing the intervention duration, using additional participants, collecting qualitative data, and providing students with continuous 24-hour, seven-day-a-week iPad access.”

*From the abstract:* “Researchers and evaluators have been attempting to document the impact of ubiquitous or 1:1 computing on students, teachers, schools, and communities. However, the most recent reviews of research on 1:1 computing initiatives reflect a dearth of rigorous studies and emphasize the need for well-designed, scientifically based research to measure the impact of 1:1 learning on student achievement. This study investigates the effect of 1:1 laptop to student ratios on math and science achievement in at-risk middle school students. The researchers used a pretest–posttest control-group design. The findings are based on between-groups analysis of covariance (ANCOVA) of longitudinal data comparing standardized achievement test scores. The researchers compared the test scores of students randomly assigned to 1:1 laptop classrooms with the test scores of students in classrooms without 1:1 laptops in the same middle school. Students were exposed to the treatment for two years and the authors used the students as the unit of analysis. Pre-existing achievement scores for each student were included as a covariate to statistically equate groups previous to analysis. Results showed significant post-intervention program effects for science achievement. Furthermore, there was a gender effect in science achievement, with boys significantly outperforming girls in the same 1:1 laptop classroom. In contrast, no significant program effects for math achievement were obtained. The results suggest that 1:1 laptop instruction can increase student achievement under certain conditions. This study has implications for policymakers, instructional designers, and educators who are currently implementing a 1:1 laptop program or considering such an implementation. The authors suggest the need for further research to help determine the efficacy of 1:1 laptop instruction and the implementation conditions necessary for increased student achievement in this context.”

*Note:* REL Midwest tries to provide publicly available resources whenever possible. Although we were unable to locate a link to the full-text version of this article, we determined that it might be of interest to you. The resource may be available through university or public library systems.


*Summary:* “This article examines the implementation of a one-to-one laptop program in three diverse schools in California. The program was carried out in one largely Hispanic low socio-economic junior high, one largely Asian Asian-American high-SES K–8 school, and in the gifted program in a medium-SES elementary school. Interviews, observations, surveys, and analysis of student work indicated that the program helped facilitate writing-intensive, information-rich, multimodal, and student-centered instruction. Analysis of test scores in English and mathematics indicate that laptop students failed to keep up with non-laptop students in the first year of implementation but made strong gains in the second year of implementation. Explanations for these outcomes are discussed.”

*From the abstract:* “Educators have seen the excitement and focus that students show when using digital devices. In hopes of increasing attendance, reducing dropout rates, and improving learning overall, more and more superintendents are driving their districts toward a 1-to-1 environment in which students take control of their own learning. The question is no longer whether districts should move to digital learning, but how they can do it well, what they should focus on to help students learn, and when they should adopt it. To help schools answer these questions, in 2010 Project Red conducted a survey of technology programs in 1,000 US schools. The survey was the first and only national research focusing on academic results and financial implications of education technology. The research shows that, if effectively implemented, 1-to-1 technology programs can lead to improved student achievement and significant return on investment. Based on those findings, Project RED has created a replicable design for school districts to make the best possible use of technology in a learning environment to help improve student achievement and offer significant return on investment. The Project RED research reveals that in most schools, planning is less comprehensive than it should be.”

Note: REL Midwest tries to provide publically available resources whenever possible. Although we were unable to locate a link to the full-text version of this article, we determined that it might be of interest to you. The resource may be available through university or public library systems.


*From the abstract:* “There are now a large number of initiatives designed to make laptops with wireless connectivity available to all students in schools. This paper synthesizes findings from research and evaluation studies that analyzed implementation and effects of one-to-one initiatives from a range of countries. Factors related to successful implementation reported in the research include extensive teacher professional development, access to technical support, and positive teacher attitudes toward student technology use. Outcome studies with rigorous designs are few, but those studies that did measure outcomes consistently reported positive effects on technology use, technology literacy, and writing skills.”

From the abstract: “This study provides a comprehensive look at a constructivist one-to-one computing program’s effects on teaching and learning practices as well as student learning achievements. The study participants were 476 fourth and fifth grade students and their teachers from four elementary schools from a school district in the Dallas, Texas, area. Findings indicated consistent and highly positive findings of the efficacy of a constructivist one-to-one computing program in terms of student math and reading achievement, differentiation in teaching and learning, higher student attendance, and decreased disciplinary actions, suggesting a range of possible educational benefits that can be achieved through a comprehensive one-to-one computing educational environment.”


From the abstract: “This multi-site case study examined literacy practices in 10 U.S. schools with one-to-one computing programs where all students had access to laptop computers throughout the school day. Important changes noted in the processes, sources, and products of literacy were along the lines often touted by educational reformers but seldom realized in schools. For example, reading instruction featured more scaffolding and epistemic engagement, whereas student writing became more iterative; more public, visible, and collaborative; more purposeful and authentic; and more diverse in genre. Students also gained important technology-related literacies such as those that involve analysing information or producing multimedia. However, laptop programs were not found to improve test scores or erase academic achievement gaps between students with low and high socioeconomic status. Both the benefits and limitations of laptop programs are discussed in this article.”

Note: REL Midwest tries to provide publically available resources whenever possible. Although we were unable to locate a link to the full-text version of this article, we determined that it might be of interest to you. The resource may be available through university or public library systems.

Additional Resources


From the abstract: “Advocates of ubiquitous computing have long been documenting classroom benefits of one-to-one ratios of students to handheld or laptop computers. The recent sophisticated capabilities of the iPod Touch, iPhone, and iPad have encouraged further speculation on exactly how K–12 teaching and learning might be energized by such devices. This paper summarizes the research-to-date on mobile learning for K–12 students, and then delineates specific features and applications available on the iPod Touch that might impact student learning across the curricula. Finally, caveats are offered regarding the introduction and assimilation of these handheld computers into K–12 schools.”
Note: REL Midwest tries to provide publically available resources whenever possible. Although we were unable to locate a link to the full-text version of this article, we determined that it might be of interest to you. The resource may be available through university or public library systems.


Summary: “Such initiatives as one-to-one computing, laptop learning, and technology immersion are gaining momentum in middle level and high schools, but the key to their success is more than cutting-edge technology. Henrico County Public Schools, a pioneer in educational technology in Virginia, launched a one-to-one computing initiative in 2001. The professional development approach that supported the initiative was driven more by the products than by instructional needs, and as a result, the district did not achieve all the results it wanted for teachers or students. This article describes the positive effects of the district’s efforts to reshape professional development for the one-to-one computing initiative by switching to a new computer platform and implementing Dell notebook computers in all its high schools in the 2004–2005 school year. Increased use of technology has helped ignite excitement in teaching and learning while building students’ critical-thinking and problem-solving skills.”

Note: REL Midwest tries to provide publically available resources whenever possible. Although we were unable to locate a link to the full-text version of this article, we determined that it might be of interest to you. The resource may be available through university or public library systems.


From the abstract: “This study investigates students’ use of one-to-one laptops for various activities and the impact of one-to-one computing on student learning and school culture. Based on data collected from surveys and interviews of teachers, students, and parents in a Midwestern middle school over one academic year, this study answers the following major questions: (1) How did students use their laptops? (2) What impact did the one-to-one laptop program have on student learning and school culture? (3) What were the perceptions of and concerns over one-to-one computing? A sound understanding of these issues is increasingly important as more and more schools are joining in this one-to-one computing initiative and more money is being invested. Results revealed that students used their laptops for various tasks related to learning, communication, expression, and exploration. Students gained significantly in their technology proficiency. The one-to-one laptops have provided great opportunities and resources for teaching and learning, but also raised issues such as student discipline problems, concerns on digital literacy, and fear of over-dependency on information technology.”

Note: REL Midwest tries to provide publically available resources whenever possible. Although we were unable to locate a link to the full-text version of this article, we
determined that it might be of interest to you. The resource may be available through university or public library systems.


*From the abstract:* “This article presents findings from an investigation of the overall effectiveness of Michigan’s Freedom to Learn (FTL) One-to-One initiative. The major goal of the FTL initiative was to help students to gain 21st century knowledge and skills while increasing their learning and achievement through the integration of over 20,000 laptop computers with comprehensive teacher professional development. This study used a mixed-methods descriptive and quasi-experimental design. Data were collected with validated observation and survey instruments. The findings reveal greater use of research-based best practices in FTL classrooms and greater teacher confidence to integrate technology as compared to normative data. FTL students performed as well as control students yet demonstrated greater 21st century knowledge and skills.”

*Note:* REL Midwest tries to provide publically available resources whenever possible. Although we were unable to locate a link to the full-text version of this article, we determined that it might be of interest to you. The resource may be available through university or public library systems.


*From the abstract:* “This two-year, mixed methods study with surveys, observations, and interviews, documented student technology use and skill before and after the implementation of a new one-to-one tablet computing program at a private middle school in the United States. After one year with tablets, several differences in students’ technology use and skill were documented, including: higher satisfaction with school technology, greater frequency of technology use in specific subjects such as math and science, greater frequency of certain classroom activities such as two-way communicating, and greater technology skills on competencies such as editing collaborative wikis. New modes of student collaboration were evident after implementing the tablet program, including sharing notes and co-editing wikis. Differences were inconsistent across grade levels and subjects, suggesting teachers are adopting the tablet innovation differentially. In general, technology use increased most in math, science, and social studies classrooms, with smaller increases in language arts and foreign language classrooms.”

*Note:* REL Midwest tries to provide publically available resources whenever possible. Although we were unable to locate a link to the full-text version of this article, we determined that it might be of interest to you. The resource may be available through university or public library systems.
From the abstract: “The Forest Hills Local Schools board in Ohio had always been supportive of a 1-to-1 program, but it simply did not have the resources to buy every student a computer. The district had some laptops available, but only enough for about one out of every five students. So, when a teacher wanted to integrate technology into a lesson, the machines had to be reserved, rolled into the classroom, and set up for the kids; or media center access had to be scheduled and the class moved there for the session. This article describes the launching of the district’s seventh-grade bring-your-own-laptop (BYOL) pilot and how a BYOL program may eventually put a device into the hands of every student in the district—and technology into every one of its classrooms.”


From the abstract: “The impact of a one-to-one computing initiative at a Midwestern urban middle school was examined through phenomenological research techniques focusing on the voices of eighth grade students and their teachers. Analysis of transcripts from pre- and post-implementation interviews of 47 students and eight teachers yielded patterns of responses to illuminate how one-to-one computing changed students’ learning experiences and teachers’ instructional practices. Key themes that emerged were changes in teacher pedagogy, effect on student learning experiences, impact on classroom behavior and management, potential for improved communications, and suggestions to address professional development needs. The students demonstrated their learning in varied and creative ways through the use of computer-based lessons. However, the altered format presented new demands on teachers as a delivery model. Although some students were distracted by gaming and chatting opportunities, learning benefits were reported for students of varied ability levels. This study builds on the theoretical framework supporting the role and use of technology to foster learning and to prepare students for a global economy. The focus on student and teacher voices provided the opportunity to explore a new perspective and engage middle school students, teachers, and administrators in school change efforts.”

Additional Organizations to Consult

- **Edutopia**

Edutopia is an online resource from the George Lucas Educational Foundation focused on the mission of transforming kindergarten through 12th-grade (K–12) education so all students can thrive in their studies, careers, and adult lives. Edutopia is focused on practices and programs that help students acquire and effectively apply the knowledge, attitudes, skills, and beliefs to achieve their full potential.
• **Innovations in Learning**  

  The Innovations in Learning Center is operated by Temple University Institute for Schools and Academic Development Institute. The center’s mission is to increase the capacity of state education agencies to stimulate, select, implement, and scale up learning innovations in districts and schools to improve learning outcomes for all students.

• **International Society for Technology in Education**  

  The International Society for Technology in Education is an association of educators, leaders and experts who are committed to expanding the horizons of education technology. Home to the ISTE Conference & Expo and the ISTE Standards for learning, teaching and leading in the digital age, the association represents more than 100,000 professionals worldwide.

• **National Center for Research & Development Center on Instructional Technology: Center for Advanced Technology in Schools**  

  *From the website:* “The mission of the Center for Advanced Technology in Schools (CATS) is to conduct high-quality research, development, assessment, and evaluation of games and other advanced technologies intended to improve learning. Through knowledge dissemination and addressing key issues in the development and measurement of learning technologies, CATS will significantly contribute to setting the national research and development (R&D) agenda in learning games and simulation, and other advanced technology platforms to support future learning.”

• **One-to-One Institute**  
  [http://www.one-to-oneinstitute.org](http://www.one-to-oneinstitute.org)

  The mission of One-to-One Institute is to transform education by personalizing learning through universal access to technology. OTO offers a One-to-One Implementation Protocol designed to help guide the planning and implementation process, as well as the development of leadership and instructional practices that will lead to a successful and sustainable 1:1 program.

---

**Keywords and Search Strings Used in the Search**

- One-to-one computing AND student achievement
- One-to-one computing
- Bring your own device AND student achievement
- Bring your own device
Search of Databases and Websites

**Institute of Education Sciences sources:** Institute of Education Sciences (IES), National Center for Education Research (NCER), National Center for Education Statistics (NCES), National Center for Special Education Research (NCSER), National Center for Education Evaluation and Regional Assistance (NCEE), Regional Educational Laboratory (REL) Program, What Works Clearinghouse (WWC)

**Additional data resources:** ERIC, EBSCO databases, Google Scholar

**Criteria for Inclusion**

When Reference Desk researchers review resources, we consider—among other things—four factors:

- **Date of the publication:** We include the most current information, except in the case of nationally known seminal resources.

- **Source and funder of the report/study/brief/article:** We give priority to IES, nationally funded, and certain other vetted sources known for strict attention to research protocols.

- **Methodology:** Randomized controlled trial studies, surveys, self-assessments, literature reviews, policy briefs. We generally give priority for inclusion to randomized controlled trial study findings, but the reader should note at least the following factors when basing decisions on these resources: numbers of participants (just a few? thousands?); selection (Did the participants volunteer for the study, or were they chosen?); representation (Were findings generalized from a homogeneous or a diverse pool of participants? Was the study sample representative of the population as a whole?).

- **Existing knowledge base:** Although we strive to include vetted resources, there are times when the research base is slim or nonexistent. In these cases, presented the best resources we could find, which may include, for example, newspaper articles, interviews with content specialists, and organization websites.

The Regional Educational Laboratory (REL) Reference Desk is a service provided by a collaborative of the REL Program, funded by the U.S. Department of Education’s Institute of Education Sciences (IES). This response was prepared under contract ED-IES-12-C-0004 with IES, by REL Midwest, administered by American Institutes for Research. The content of the response does not necessarily reflect the views or policies of IES or the U.S. Department of Education, nor does mention of trade names, commercial products, or organizations imply endorsement by the U.S. government.