



The Positive Impact of eLearning

Studies indicate that ICT-enhanced learning can benefit students, teachers, families, societies, and economies.



EXECUTIVE SUMMARY

Effective eLearning comes from using information and communication technologies (ICT) to broaden educational opportunity and help students develop the skills they—and their countries—need to thrive in the 21st century. While conclusive, longitudinal studies remain to be done, an emerging body of evidence suggests that eLearning can deliver substantial positive effects:

- **Students** are more engaged and able to develop 21st century skills.
- **Teachers** have a more positive attitude toward their work and are able to provide more personalized learning.
- **Family interaction** and parental involvement may increase.
- **Communities** benefit from bridging the digital divide. Economically disadvantaged students and children with disabilities benefit particularly.
- **Economic progress** can result from direct job creation in the technology industry as well as from developing a better educated workforce.

This paper summarizes some key research findings, to help educational leaders identify relevant eLearning benefits and make judicious decisions as they develop their eLearning strategies. To further aid in planning, we share findings relating to the challenges of eLearning implementation, and provide a bibliography for additional reading.

Waxman's meta-analysis of 42 peer-reviewed papers showed a positive impact on student performance, and concluded that "overall effects of technology on student outcomes may be greater than previously thought."

SKILLS FOR THE 21ST CENTURY
Tomorrow's citizens and workers deserve an education that prepares them—and their nation's economy—to thrive in a world of rapid change and widespread globalization. The International Society for Technology in Education (ISTE) has identified a range of skills that will help students work and live in the 21st century. These skills include the ability to conduct independent research, think critically and solve problems, use technology to communicate and collaborate, and understand societal issues related to digital citizenship!

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eLearning Overview

Each year more of the world's people become connected to the network, its bandwidth increases, and its use becomes more integrated into all that we do. Connectivity to this network, and the ability to master it once on, has become an essential part of life in the 21st century, and a key to opportunity, success, and fulfillment for the people of the world.

The technology that has so dramatically changed the world outside our schools is now changing the learning and teaching environment within them. Some of the common ways of integrating technology into education include:

- **Teacher PC programs** provide teachers with ubiquitous access to tools such as tablets, interactive whiteboards, and document cameras. A critical component of teacher focused programs is the provision of professional development that supports teachers as they shift their pedagogical repertoires to take advantage of the wide range of rich digital resources they can bring to their classrooms.
- **PC labs** are frequently used to offer technology access when resources are severely constrained. While PC labs provide some exposure to technology, they limit teachers' ability to incorporate technology into the curriculum, and often are used only to teach computer literacy.

- **Classroom eLearning** brings PCs into the classroom, typically via systems stationed at the back of the classroom or computers on wheels (COWs) that are shared by different classrooms. Students have a dedicated device for part of the school day, with the focus on using PCs to enhance learning across the curriculum and not simply to develop technology skills.

- **One-to-one (1:1) eLearning** provides each teacher and student with a dedicated laptop for use at school and, in many cases, at home. Laptops serve as personal learning and teaching tools that are used throughout the day for many educational tasks and subjects. In a 1:1 environment, students get the maximum learning opportunity from access to PCs, Internet connectivity, and their integration into the education environment.

Research Overview

A variety of studies have evaluated the impact of eLearning and concluded that—supported by holistic approaches that include appropriate policies, infrastructure, professional development, and curricula—eLearning can help produce positive outcomes. However, despite a large body of research evidence, there are no longitudinal, randomized trials conclusively linking eLearning with positive learner outcomes. Reasons may

More than 80 percent of teachers surveyed said that students were more engaged and more actively involved in their learning and produced higher quality work.

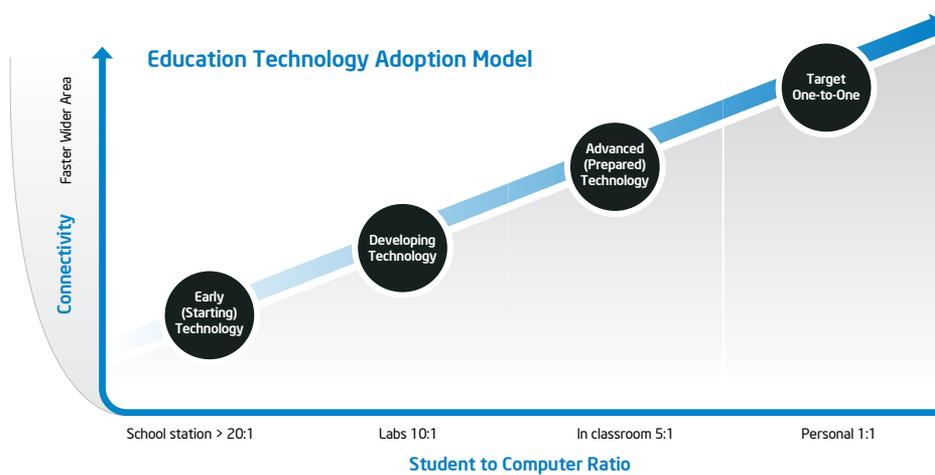


Figure 1. Movement toward the aspirational model of 1:1. For many school systems, the model of ubiquitous computing is an evolution over time. The x-axis represents the student to PC ration in the school system; decreasing from left to right. The y-axis represents the need for increased bandwidth as more student devices enter the school system; increasing bottom to top. At the upper right corner, overall access to ICT is optimized. The net impact is that richer educational computing experiences can be delivered; enabling a significant shift in how students learn—a profound opportunity to shift the paradigm from an instructor centric to a student centric model.

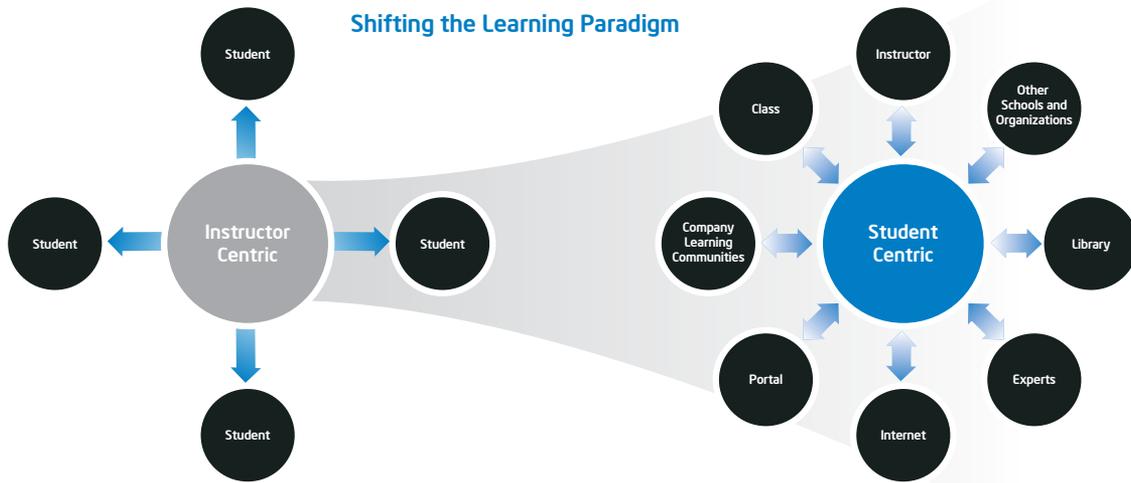


Figure 2. 1:1 computing is a paradigm shift from an instructor-centric learning experience (lecture-driven, knowledge acquisition) to one which is student-centric. In an instructor-centric paradigm, the student is dependent on the instructor for information, direction, and guidance (student-directed, knowledge creation). In the student-centric paradigm, students increasingly become independent, self-directed learners who master higher-level critical thinking, problem-solving, and collaborative skills. Students learn at their own pace, repeating material to reinforce learning, or delving into additional material to enrich it. ICT makes this type of learning possible.

Other key attributes of 1:1 computing can include the following: Computing is ubiquitous and mobile—anytime, anywhere, anyway learning as opposed to stationary PC labs. Computing integrated into the curriculum—computing is a tool for learning as opposed to a subject in itself. Learning is collaborative and connected—students more easily work with peers, teachers, and community experts; teachers more easily work with peers and parents. Computing becomes more personalized with the shift to one-to-one.

range from economics to ethics—if you have a limited budget for educational interventions, do you spend the money on the students or evaluations? So, while it’s important not to overstate what the research shows, an emerging body of evidence strongly suggests that effective eLearning can produce promising effects. Research also seems to indicate that a more technology-rich environment delivers greater impacts.

In reviewing the research, we’ve organized the findings around five major areas of benefit: student learning, teaching and administration, family and home, social and community, and economic development. The studies we cite represent examples rather than an exhaustive list. Detailed references may be found in the bibliography at end of this white paper.

Student Learning

Studies show that eLearning can help increase student engagement, motivation, and attendance—key requisites for learning. Effective eLearning can also improve performance on core subjects and foster the development of 21st century skills, whether in mature or emerging countries.

Engagement, Motivation, and Attendance

- The US state of Maine created 1:1 eLearning environments in schools reaching over 42,000 middle school students and 5,000 teachers. More than 80 percent of teachers surveyed said that students were more engaged and more actively involved in their learning and produced higher quality work. Principals and teachers reported “considerable anecdotal evidence” that eLearning increased student motivation and class participation, and improved behavior. (Silvernail, USA)
- In a 1:1 eLearning program at 10 primary and secondary schools in Malaysia, 85 percent of teachers, many of whom were initially skeptical, reported that the program helped them create an innovative and collaborative eLearning environment within their classrooms. (Malaysia Ministry of Education and Intel Malaysia, Malaysia)
- At a large rural high school, attendance rose from 91 percent to 98 percent after the 1:1 eLearning program began. (Mitchell Institute, USA)

For a deeper look at key functional areas to address when moving toward a one-to-one initiative, to include details on the movement along the adoption curve, and tips on progressing from one stage to the next, please see www.K12BluePrint.com (Mobilizing tehmillenials).

As schools migrate from traditional learning environments to more modern technology rich learning environments, it is not merely a change in physical environment (e.g., the need for increased connectivity as seen in Fig. 1), there is a fantastic opportunity to significantly enhance the learning experience, as captured in Fig. 2. As outlined in the ISTE NETs Standards (www.iste.org), the shift reflects a move from teacher-centered instruction to student-centered learning:

- Single-sense stimulation vs. Multi-sensory stimulation
- Single-path progression vs. Multi-path progression
- Single media vs. Multimedia
- Isolated work vs. Collaborative work
- Information delivery vs. Information exchange
- Passive learning vs. Active/exploratory/inquiry-based learning
- Factual, knowledge-based vs. Critical thinking and informed decision-making
- Reactive response vs. Proactive/planned action

GREATER TECHNOLOGY INTEGRATION, GREATER BENEFITS

The effects of 1:1 eLearning appear to increase as technology is more deeply integrated into the educational experience and students and teachers have technology access throughout the day.

- Trucano's review of papers dealing with ICT's benefit for education in developing nations showed that placing PCs in classrooms rather than separate labs enables much greater use of technology for higher order skills. (Trucano, Global)
- In West Virginia, one of the poorest US states, students who experienced classroom eLearning had higher gains in overall scores and in math than those who had technology access only in computer labs. The authors compared classroom eLearning against other policy interventions of similar cost (such as smaller class size, additional instructional time, and cross-age tutoring) and found that technology can be one of the most efficient ways to boost outcomes. (Mann et al, USA)
- In a study comparing COWs and 1:1 eLearning environments for fifth, sixth, and seventh graders at a small-town school district in the American Midwest, researchers found that students in the 1:1 environment gained significant advantages on writing performance, including ideas/content, organization, style, and conventions. In addition, math, science, and social studies achievement scores were higher on average for students in the 1:1 environment compared to those using COWs. (Ross et al, USA)

Performance

- A meta-analysis of 42 peer-reviewed papers published between 1996 and 2003 found a positive significant correlation of .448 with cognitive outcomes, indicating that average students who used technology would be at the 66th percentile while average students without technology would be at the 50th percentile. The authors observed that "the overall effects of technology on student outcomes may be greater than previously thought." (Waxman et al, Global)
- In South Africa, a three-year randomized controlled study of the large-scale Khanya project showed math scores were significantly higher for students who participated in a technology program. Khanya is an award-winning project to provide a technology-rich environment and professional development activities to students and teachers throughout the Western Cape region. (Wagner et al, South Africa)
- Penuel et al performed a research synthesis of 19 programs in Europe, the Middle East, Africa, and the US that used technology to link home and school. They found that technology-supported programs produced positive effects on reading achievement (+0.08 to +0.10), writing (+0.20 to +0.34), and math achievement (+0.18 to +0.23), as measured by traditional methods and standards. (Penuel et al, Global)
- A meta-analysis of over 500 studies indicated that students receiving computer-based instruction tend to learn more in less time. (Chinien, Global)
- In a 1:1 class in Puebla, Mexico, teachers observed an improvement in second to fourth grade students' skills at searching information and ability to write—both important 21st century skills. The eLearning environment gave students the opportunity to conduct Internet research and evaluate the quality of information found. (Escorza and Rodriguez, Mexico)

Although numerous studies report positive outcomes, there are also indications that improper use can lead to negative student behaviors, from playing games to tampering with security measures. (Keri et al, USA) However, solutions such as classroom management software and technology usage policies are well documented and effective at overcoming such obstacles. The potential for negative outcomes underscores the importance of holistic planning, with attention to access, policies, connectivity, professional development, and curriculum, in order to achieve desired benefits.

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Teaching and Administrative Outcomes

Researchers have reported that issuing laptops to teachers, or helping them purchase laptops, can empower them to teach better, increase lesson planning and preparation productivity, gain a more positive attitude about their work, and improve efficiency of management and administration tasks.

Student-Centered Teaching and Preparation

- Using technology, teachers can access tools that enable them to deliver customized assessments and gain immediate feedback on individual and class progress. (Kerr et al, USA)

- With this feedback, teachers can provide personalized learning opportunities, using remediation and enrichment to deliver more differentiated instruction that better meets each child's needs. (Warschauer et al, USA)
- In Maine's state-wide eLearning deployment, teachers with personal PC access said that technology helped them locate and develop better instructional materials and conduct research related to their teaching assignments. Teachers gained access to better quality curricula and learning materials, especially when schools created eLearning portals where teachers could share resources they found or developed. (Silvernail, USA)
- In a Turkish study of primary school teachers and students, 87 percent of teachers surveyed said eLearning improved their ability to conduct project-based learning. They also stated that eLearning supported the shift from teacher-centered to student-centered teaching, and enabled them to act as facilitators more than lecturers. (Aydin, Turkey)

Attitudes and Productivity

- Personal PC access has been shown to increase teacher productivity. UK agency Becta cites a 2005 study by PricewaterhouseCoopers indicating that teachers creating a lesson plan from scratch using digital resources saved an average of 26 minutes compared to those who did not. (Becta 2007, UK) When 400 teachers were surveyed on how they used time saved on lesson planning and other tasks, 31 percent said they performed additional preparation, planning and other core tasks, while 47 percent performed new tasks or performed existing tasks to a higher standard. (PricewaterhouseCoopers, UK)
- A review of 17 recent European studies reported that teachers' roles can be more rewarding in an effective eLearning environment. Teachers who perceive a highly positive impact from ICT tend to use technology in project-oriented, collaborative, and experimental ways. Teachers function as advisors, dialogue partners and facilitators for specific subject domains. (Balanskat et al, Europe)

- In evaluating the Notebooks for Teachers and Principals Program implemented by the Victoria Department of Education and Training, researchers found that teachers felt more valued as professionals as a result of having their own laptops. They also felt that parents viewed them more respectfully, and that they were recognized as important by the government. Some 70 percent of teachers said the program had increased their professional competence in areas such as teaching practices and assessing and reporting student learning. (Gough et al, Australia)

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Students and teachers are not the only people who benefit from eLearning. When a rural Pennsylvania school district equipped all students in grades 3-12 with a laptop and home Internet access, principals said they could provide more effective instructional leadership because they had better visibility into students' progress and work products.

Management and Administration

- Students and teachers are not the only people who benefit from eLearning. When a rural Pennsylvania school district equipped all students in grades 3-12 with a laptop and home Internet access, principals said they could provide more effective instructional leadership because they had better visibility into students' progress and work products. Principals said the enhanced connectivity also improved their capacity to communicate with parents, faculty, and district leaders, and enabled them to perform their responsibilities more efficiently. (Kerr et al, USA)
- There is growing evidence that eLearning supports school improvement efforts. A recent study surveyed the head teachers of 181 British schools that had improved enough to be removed from a "Special Measures and Notice to Improve" list, and found that 82 percent of head teachers indicated technology had played a key role in their school's achievement. Effective approaches ranged from adopting systems for monitoring and analyzing student progress, to using technology to engage underachieving students. (Hollingsworth, cited in Becta 2008, UK)

A less positive aspect of eLearning environments is that they can expand teacher workloads by increasing clerical expectations or creating a need to adapt curriculum materials. To a certain extent, this can be addressed with professional development, supportive leadership, and improved policies.

Dual Investment Strategy for Optimal eLearning

Research indicates that eLearning is most effective in a 1:1 eLearning environment where:

- Technology tools and connectivity are deeply integrated into the classroom and used across the curriculum.
- Teachers are skilled and comfortable using digital resources to enhance teaching and learning.

To achieve this integration and skill, governments and educators must invest in professional development and curriculum resources as well as in PCs and networks. These two areas of investment reinforce each other and increase the return on either type of investment: professional development

and curriculum resources help teachers actually use technology to transform teaching and learning, and adequate technology access enables teachers to apply what they learn in professional development activities.

Research supports these conclusions. The Organization for Economic Co-operation and Development (OECD) states that to reap educational benefits from ICT, countries and educational systems must reach a threshold of investments in ICT and in the skills and educational organization to use them. (OECD, Global)

Backing this up, a survey of 11 international eLearning deployments found that teachers are more likely to integrate technology into their pedagogy when they have technology in the classroom. The average implementation rate for teachers who had

lab access only was 71.7 percent, increasing to 87.2 percent when teachers had one PC in their classrooms and reaching 94.8 percent when teachers had access to two to six classroom computers. (Martin, et al, Global)

A second global survey highlights the importance of effective teacher professional development and support. It found that teachers who are most likely to use technology effectively to improve education are those who have completed professional development programs, work in a school with ample support, and have technology in the classroom rather than in a PC lab. (Light and Martin, Global)



Family and Home Effects

Parental involvement and other home effects are often secondary, if not peripheral, to the goals of eLearning deployment. Nevertheless, eLearning does seem to produce some positive effects in the home.

- Evidence suggests a relationship between frequency of home PC use and academic achievement. Reviewing data from the 1996 National Assessment of Educational Progress in mathematics, one study reported that students using home computers more often had higher levels of achievement in mathematics. (Wenglinsky, USA) This seems to echo findings from previous studies, describing incremental impacts when technology is more mobile, personalized, and integrated throughout the day and across the curriculum.
- Another impact noted by researchers is increased family interaction. Many school systems establish an eLearning portal that parents can access to track homework assignments and communicate with teachers and staff, providing opportunities for increased awareness and discussion of homework assignments, student progress, and so forth. In addition, when students bring their laptops home, they are free to study in the kitchen with family rather than in a more isolated room. This gives parents greater visibility of schoolwork and opens new avenues for discussion. (Mitchell Institute, USA)

- Results are mixed when it comes to eLearning's impact on parental involvement. In Michigan's statewide Freedom to Learn Initiative, 66 percent of teachers said parents were more involved with their children's schooling. Over 90 percent of parents are excited about the program, which provided over 20,000 laptops to students in 195 schools, and 80 percent believe it will make their children better students. (Lowther, USA) On the other hand, some studies see a neutral impact on parental involvement. (Penuel, USA)

Social and Community Effects

By issuing a laptop to each student, schools aim to meet the educational needs of students who ordinarily could not afford a PC and thereby improve the performance of all students. Research shows that this strategy is working.

- At-risk and low-achieving students, and students whose parents do not have a bachelor's degree, experience greater positive impact than other groups when 1:1 eLearning is deployed. For example, the Texas Technology Immersion Pilot showed that economically disadvantaged students reached proficiency levels matching the skills of advantaged control students. (Texas Center for Educational Research, USA)
- A qualitative study focused on two US schools with high percentages of immigrant and/or impoverished students. It analyzed the use of 1:1 eLearning to help English language learners develop academic literacy. At an elementary school, Latino fourth-grade students used laptops for pre- and post-reading. At a middle

school, immigrant and refugee students used laptops in community projects that required independent reading and research. At both schools, students achieved reading test scores that were higher than their state averages, and the middle school students' writing scores were above average as well. (Warschauer, USA)

- In studies of students with disabilities, researchers have observed improved student self-esteem, increased motivation and ability to work independently, and other academic achievements such as improved quality and quantity of student writing. (Harris, USA)

Economically disadvantaged students reached proficiency levels matching the skills of advantaged control students.

A number of studies suggest that, from a long-term perspective, a wide array of social and community benefits are associated with improved education. These benefits include reduced criminal activity, reduced reliance on welfare and other social programs, increased charitable giving and volunteer activity—even attainment of desired family size and improved health for the individual and his or her family. (Riddell, Global) Knowing the many ways in which eLearning can improve education, it's intriguing to consider that eLearning may indirectly enhance these areas as well.

Economic Development

So far, we've discussed research showing how eLearning improves educational achievement. Now we turn to studies that examine how improved achievement can affect a nation's economic prospects. For many countries, economic development is the driving reason behind eLearning investments.

Recent examples indicate that eLearning investments can improve economic development in two ways: by direct job creation as governments procure the PCs, networks, software, and services to support the eLearning deployment; and indirectly, by developing a better educated workforce.

Direct Economic Impact: Portugal

In July 2008, Portuguese Prime Minister Jose Socrates announced Project Magellan, an investment by the Government of Portugal to provide locally-built classmate PCs to all Portuguese students aged 6-10. Classmate PCs would be supplied by local technology company JP Sá Couto, Linux* software provider Caixa Magica, and other local ICT companies. JP Sá Couto plans to manufacture and export 4 million classmate PCs in addition to 500,000 units intended for use within Portugal.

With Project Magellan, the Government is making a two-fold investment in the nation's knowledge economy: Portugal's children will be equipped with the skills to compete for high paying jobs in the future, and Portuguese workers will gain access to high-quality, high-value-added jobs in

the near term. According to analysis by Vital Wave Consulting, Project Magellan will generate a total of 1,470 jobs and produce a total economic impact of EUR 2.26 (USD 3.131) billion (Table 1). (Coppock, Portugal)

Indirect Impact: Economic Benefits of a Better-Educated Workforce

Although no research clearly addresses the indirect impact of eLearning on the economy, it certainly seems reasonable to think that, by increasing educational achievement, eLearning may be able to ultimately enhance economic attainment.

International comparisons show that education plays a pivotal role in fostering labor productivity and economic growth. For example, Harvard economist Robert Barro's analysis of education and economic growth concludes that an increase of one standard deviation in test scores would raise the growth rate of real per capita GDP by 1 percent per year. (Barro, Global)

A World Bank study further underscores these findings: it reports that raising test scores on the OECD Program for International Student Assessment (PISA) test by 47 points (the equivalent of one country-level standard deviation) will drive approximately a 1 percent increase in gross domestic product (GDP). The World Bank report also references US research suggesting that an increase of one standard deviation in math performance at the end of high school translates to 12 percent higher annual earnings. (Hanushek and Wossmann, Global)

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Table 1. Economic Impact of Portugal's Project Magellan

	DIRECT IMPACT*	INDIRECT IMPACT	TOTAL
Jobs	350	1,120	1,470
Economic activity (based on sales of five million units through 2010)	EUR 1 billion (USD 1.386 billion)	EUR 1.26 billion (USD 1.746 billion)	EUR 2.26 billion (USD 3.131 billion)

+ Result of manufacturing expansion.

Source: Vital Wave Consulting.



Teachers who are most likely to use technology effectively to improve education are those who have completed professional development programs, work in a school with ample support, and have technology in the classroom rather than a PC lab.

Looking Forward

Increasing educational quality is a critical challenge for government and education leaders the world over. While conclusive, randomized, longitudinal studies on eLearning's benefits do not yet exist, a critical mass of evidence indicates that investments in eLearning can deliver substantial positive effects.

Contact your Intel representative or visit us on the Web at www.k12blueprint.com.

References

- Aydin, Cengiz Hakan and Unal, Figen. Research Report: *The 1:1 eLearning POC Project Pilot Implementation in Turkey*. Ankara, 2008.
- Balanskat, Anja, Blamire, Roger and Kefala, Stella. *The ICT Impact Report: A Review of Studies of ICT Impact on Schools in Europe*. European Schoolnet, December 2006.
- Barro, Robert J. *Education and Economic Growth*. Harvard University, 2000.
- Becta. *Harnessing Technology Review 2007: The Role of Technology and Its Impact on Education, Summary Report*. November 2007.
- Becta. *Harnessing Technology Review 2008: The Role of Technology and Its Impact on Education, Summary Report*. November 2008.
- Chinien, Chris. *The Use of ICTs in Technical and Vocational Education and Training*. UNESCO Institute for Information Technologies in Education. 2003.
- Coppock, Karen, Smith, Brendan, and Howell, Karina. *Conceptual Mapping of Education Ecosystem: Final Report*. Vital Wave Consulting, May 2009.
- Escorza, Yolanda Heredia and Rodriguez, Armando Lozano. *The Use of Classmate PC Computers in an Elementary School in the State of Puebla: A Descriptive Study*. Tecnológico de Monterrey, 2008.
- Gough, Annette, Marshall, Alan, and Taylor, Joan. *Notebooks for Teachers and Principals Initiative Research Project*. Deakin University, 2003.
- Hanushek, Eric A. and Wossmann, Ludger. *Education Quality and Economic Growth*. World Bank, 2007.
- Harris, Walter J. *Laptop Use by Seventh Grade Students with Disabilities: Perceptions of Special Education Teachers*. Maine Learning Technology Initiative, 2004.
- Hill, Janette R. et al. *The Impact of Portable Technologies on Teaching and Learning: Year One Report and Year Two Report*, Dept. of IT at the University of Georgia (U.S.), for Athens Academy.
- Hollingworth, Sumi. et al, *Technology and School Improvement: Reducing Racial Inequity with Technology?* Report to Becta. Institute for Policy Studies in Education, April 2008.
- Kerr, Kerri A, Pane, John F. and Barney, Heather. *Quaker Valley Digital School District: Early Effects and Plans for Future Evaluation*. Technical Report. RAND Education, 2003.
- Kulik, James A. *Effects of Using Instructional Technology in Elementary and Secondary Schools: What Controlled Evaluation Studies Say*. Final Report. SRI International, May 2003.
- Light, Daniel and Martin, Wendy. *Evaluation Summary: Intel Teach and Intel Learn*. SRI International, June 6, 2007.
- Lowther, Deborah et al. *Freedom to Learn Initiative: Michigan 2005-2006 Evaluation Report*, University of Memphis Center for Research in Educational Policy.
- Mann, Dale et al. *West Virginia Story: Achievement Gains from a Statewide Comprehensive Instructional Technology Program*. Milken Family Foundation, 1999.
- Malaysia Ministry of Education and Intel Malaysia. *MOE-Intel School Adoption Project Phase One Project Report*, May 2008.
- Martin, Wendy, et al. Research Report Summary: *Intel Teach to the Future International Evaluation: Year End Report*. Center for Children & Technology. 2005.
- Mitchell Institute. *One-to-One Laptops in a High School Environment: Piscataquis Community High School Study, Final Report*. February 2004.
- Organization for Economic Co-operation and Development. *Education Today: The OECD Perspective*. OECD, 2009.
- Penuel, William R. et al. *Using Technology to Enhance Connections between Home and School: A Research Synthesis*. SRI International, April 2002.
- PricewaterhouseCoopers. *Using ICT in Schools: Addressing Teacher Workload Issues*, DfES. Research Series. London, 2004.
- Riddell, W. Craig. *The Impact of Education on Economic and Social Outcomes: An Overview of Recent Advances in Economics*. February 2006.
- Ross, Steven M. et al. *Anytime, Anywhere Learning: Final Evaluation Report of the Laptop Program: Year 3*. University of Memphis, 2003.
- Silvernail, David L and Lane, Dawn M. *The Impact of Maine's One-to-One Laptop Program on Middle School Teachers and Students*, Research Report 1. Maine Education Policy Research Institute, University of Southern Maine, February 2004.
- Texas Center for Educational Research. eTxTiP: *Evaluation of the Texas Technology Immersion Project: Final Outcomes for a Four-Year Study (2004-05 to 2007-08)*, January 2009.
- Trucano, Michael. *Knowledge Maps: ICT in Education*. Washington, DC: InfoDev, 2005.
- Wagner, Daniel A. et al. *Monitoring and Evaluation of ICT in Education Projects: A Handbook for Developing Countries*. Washington, DC: InfoDev, 2005.
- Warschauer, Mark, et al. *Promoting Academic Literacy with Technology: Successful Laptop Programs in K-12 Schools*. Elsevier, 2004.
- Waxman, Hersch C., Lin, Meng-fen, and Michko, Georgette M. *A Meta-Analysis of the Effectiveness of Teaching and Learning with Technology on Student Outcomes*. Learning Point Associates, 2003.
- Wenglinsky, Harold. *Does It Compute? The Relationship between Educational Technology and Student Achievement in Mathematics*. ETS Policy Information Report, September 1998.

¹ <http://www.iste.org/AM/Template.cfm?Section=NETS>.

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