

Impact of Information and Communication Technology (ICT) on Student Learning and Achievement

“[Current] graduates began their school career being taught the literacies of paper, pencil, and book technologies. Many will finish their secondary school careers familiar with the new literacies demanded by a wide variety of ICTs: wikis, blogs, avatars, podcasts, mobile technologies, and many others unimagined at the beginning of their schooling” (IRA, 2009)

General Observations

Although action research reveals that ICTs can empower teachers and learners, provide a learning environment that helps address different learning styles, and foster the development of ‘21st century skills’, current peer reviewed studies to support these beliefs are still limited.

Much of the literature dates from 2005 or earlier, which is a number of generations in ‘technology years’. At that time, data was often obtained by testing students’ computer skills, or by measuring changes in their achievement after using specific computer-assisted learning applications. Due to the short ‘shelf life’ of studies related to the impact of ICT on student achievement and engagement, this analysis examines mainly studies published in the last five years and is based on the following two caveats.

- **ICTs should not be seen as the focus of the learning process**
ICTs are generally not, and should not be considered, the focus of the teaching and learning process. Manitoba’s Literacy with ICT (LwICT) model encourages “infusion” of ICT in teachers’ instruction and in students’ learning, whereby ICTs are not the focus of learning, but rather are supportive of critical, creative, and ethical thinking. Many peer-reviewed studies focus specifically on certain types and titles of instructional software. This focus is too narrow to give a generalize-able view of the use of ICT to support and enhance learning and engagement across the curriculum.
- **Pedagogy must be put ahead of ICT**
One of the ongoing challenges of technology use in education is that, until recently, educational leaders and technology advocates thought of ICTs first and investigated the pedagogical component only later. There are still only a limited number of peer-reviewed studies which avoid this pitfall.

Over a dozen research studies and meta-analyses (see references) were reviewed in order to answer the following two guiding questions.

Guiding Questions:

1. What do we know about the impact of ICTs on student learning and achievement?
2. What do we know about the impact of ICTs on student motivation and engagement in learning?

Impact on student achievement

1. The impact of ICT use in education has been difficult to measure quantitatively

In general, and despite thousands of research studies, most of those conducted before 2005, the impact of ICT use on student achievement has remained difficult to measure. Now that ICT is used more and more in classrooms as a means to access information, support learning and communicate understanding (Literacy with ICT) rather than as a tool to be learned (ICT Literacy), research looking at student achievement seems to have become more qualitative-based.

“Measuring ICT impact against students’ attainment and improvement of their basic skills is one way of assessing impact assessment, but one which assumes a fixed education system in which school learning is primarily about mastering of a pre-determined body of knowledge, skills and understanding.” (Balanskat, 2006)

“...most reputable educational researchers today would agree that there will never be a direct link, because learning is mediated through the learning environment and ICT is only one element of that environment.” (Newhouse, 2002)

2. The impact of ICT on student achievement is more positive when linked to pedagogy

Research has described how ICTs can have positive effects on student achievement when used appropriately to complement a teacher’s existing pedagogical approaches.

“...technology interacts with many variables: student preparation and motivation, how the student or instructor uses technology, and how well the environment supports learning.... Instead of asking what impact technology has on student learning, ask how you can incorporate the best-known principles about teaching and learning, using technology as a tool for innovation.” (Spurlin, 2006)

3. Acquisition of competencies such as critical thinking and collaboration are also considered a positive impact of ICT

In Manitoba, the *Literacy with ICT Developmental Continuum* links ICT to pedagogy by focusing on Inquiry across the curriculum. ICT is infused into inquiry where critical and creative thinking is supported through the ethical and responsible use of ICT.

“Individuals, groups and societies who can identify the most important problems, locate useful information the fastest, critically evaluate information most effectively, synthesize information most appropriately to develop the best solutions and then communicate these solutions to others most clearly will succeed in the challenging times that await us.” (Leu et al, 2011)

“Technology has been shown to positively influence student learning when students explore technology-rich tasks that simultaneously require them to use higher-order thinking skills (HOTS), such as analyzing or evaluating information or creating new representations of knowledge.” (Polly, 2011)

“Most of the reviewed studies show that ICT impacts on competency development – specifically team work, independent learning and higher order thinking skills – that are not yet recognised by many education systems” (Balanskat, 2006)

4. ICT impact is dependent upon the type of pedagogies used

Transmission-type teacher-centred pedagogies are sometimes seen as more efficient than more 'constructivist' student-centred pedagogical styles, likely because their level of effectiveness may be more easily measured. Conversely, the use of ICT for teaching and learning is seen to be most effective when employed as part of a student-centred approach, which by nature is more difficult to measure.

"Factors that impede the successful implementation of ICT in teaching [include] ... teachers' poor ICT competence, low motivation and lack of confidence in using new technologies in teaching [which] are significant determinants of their levels of engagement in ICT [and reveal that such] teachers' practice is not changing much when they use ICT. What is the likely scenario when e-confident children become frustrated in e-immature schools?"
(Balanskat, 2006)

5. Disconnect between use of ICT for learning and assessment of ICT impact

The connection between the use of ICT and the achievement of students is only valid when the means of measurement is congruent with the means of teaching and learning. In some studies there is a mismatch between the methods used to assess the effects of ICT on student achievement and on how ICT is actually used in the classroom. For example, some studies have looked only for improvements in traditional teaching and learning processes, and in mastery of knowledge, instead of looking for the new processes and higher order thinking skills related to the infusion of ICTs. Students who use ICTs often and regularly in their learning, but are evaluated using traditional methods such as pen and paper, may show little to no significant improvement in their achievement because they are not able, in the testing situation, to use the ICT-infused strategies they have become comfortable and successful with.

"...current education systems hinder ICT impact and, correspondingly, impact studies and evaluations often measure against traditional systems. Are researchers looking at the wrong outcomes? And are policy-makers clear or realistic about what they expect the results of ICT investment to be?" (Balanskat, 2006)

6. ICTs have a positive impact on student achievement in blended-learning situations

Classrooms are considered face-to-face learning environments, but classroom learning can be supplemented with the use of ICTs such as web-based courses and other online technologies. This is considered a 'blended learning' situation.

"Classes with online learning, whether completely online or blended, on average produce stronger learning outcomes than learning face-to-face alone." (Underwood, 2009)
"In recent experimental and quasi-experimental studies contrasting blends of online and face-to-face instruction with conventional face-to-face classes, blended instruction has been more effective, providing a rationale for the effort required to design and implement blended approaches." (U.S. Dept. of Education, 2009)

7. Learners believe that ICTs make a positive difference in their learning

In studies that rely largely on self-reporting, most students feel that using ICTs makes them more effective learners. This may be due to the satisfaction felt by students when they use tools with which they are comfortable.

"..students see the use of relevancy-based digital tools, content and resources as a key to driving learning productivity, not just about engaging students in learning" (Speak Up, 2009)

Impact on student motivation and engagement

1. ICTs motivate both teachers and students

There appears to be some consensus that both teachers and students feel ICT use greatly contributes to student motivation for and engagement in learning.

"A very high 86% of teachers in Europe state that pupils are more motivated and attentive when computers and the Internet are used in class... ICT has a strong motivational effect and positive effects on behaviour, communication and process skills." (Balanskat, 2006)

2. Access to ICTs outside of school affects learner confidence and behaviour

Students who use ICTs at home, and for personal use, also use them in school more frequently and with more confidence than students who have no home access.

"Young people with a computer at home are less likely to play truant at ages 14 and 16 than those without computer access. For example, having access to a computer at home is associated with a 5.8 per cent reduction in the likelihood of playing truant at age 16." (Underwood, 2009)

3. The location of ICTs has an impact on both effectiveness and engagement

Placing portable technology in classrooms and allowing students to bring personal mobile devices to school for learning enables more effective use of ICTs than placing computers in separate labs where it is difficult to align time of access with the 'teachable moment'. School divisions in Manitoba are now allowing students, on a trial basis, to bring their own technology to school and to connect to the divisional network for access to the Internet. Dakota Collegiate in Louis Riel SD is reporting a high level of both teacher and student engagement by allowing students to bring their own technology to school.

4. ICTs can promote lifelong independent learning skills

Evidence exists that use of ICTs can increase learner autonomy and self-regulated learning for certain learners.

"Students assume greater responsibility for their own learning when they use ICT, working more independently and effectively... ICT offers learners assignments better suited to individual needs and makes it easier to organize their own learning, through the use of, for example, digital portfolios" (Balanskat, 2006)

"Peer-based learning has unique properties that suggest alternatives to formal instruction." Mizuko, 2008.

References

Balanskat, Anja, Roger Blamire and Stella Kefala. *The Impact Report: A Review of Studies of ICT Impact on Schools in Europe*. European Schoolnet, 11 Dec 2006.

http://ec.europa.eu/education/pdf/doc254_en.pdf

...evidence from 17 recent impact studies and surveys carried out at national, European and international level.

"The use of ICT in education and training has been a priority in most European countries during the last decade, but progress has been uneven. There are considerable differences of 'e-maturity' within and between countries, and between schools within countries. A small percentage of schools in some countries have embedded ICT into the curriculum, and demonstrate high levels of effective and appropriate ICT use to support and transform teaching and learning across a wide range of subject areas. Most schools in most countries, however, are in the early phase of ICT adoption..."

Educational Research and Innovation: Are the New Millennium Learners Making the Grade?: Technology Use and Educational Performance in PISA 2006.

http://www.oecd.org/document/57/0,3343,en_2649_35845581_45000313_1_1_1_1,00.html#1

"This report ... continues the investigation of how equitable the access is to computers across countries, how familiar students are with ICT, how often and where they use computers, for how long they have been using them, how confident they feel, for which tasks they use them and, finally, what the relation is between these characteristics and students' performance."

International Reading Association (IRA). *New Literacies and 21st-Century Technologies: A Position Statement*. 2009.

Leu, Donald J. et al. *The New Literacies of Online Reading Comprehension: Expanding the Literacy and Learning Curriculum*. *Journal of Adolescent and Adult Literacy*. 55(1), Sept 2011.

Mizuko, Ito et al. *Living and Learning with New Media: Summary of Findings from the Digital Youth Project*. MacArthur Foundation, 2008.

"The study was motivated by two primary research questions: How are new media being integrated into youth practices and agendas? How do these practices change the dynamics of youth-adult negotiations over literacy, learning, and authoritative knowledge?"

Newhouse, Paul. *The Impact of ICT on Learning and Teaching*; Literature Review. Western Australia. Dec. 2002.

<http://www.det.wa.edu.au/education/cmis/eval/downloads/pd/impactreview.pdf>

"This review set out to identify and evaluate relevant strategies in local, national and international research and initiatives related to measuring and demonstrating the impact of ICT in schools with regard to: students, learning and the learning environment; teachers and teaching strategies; organisational change; and other areas relevant to teaching and learning in Western Australia government schools."

Polly, Drew. *Developing Students' Higher-Order Thinking Skills (HOTS) through Technology-Rich Tasks: The Influence of Technological Pedagogical and Content Knowledge (TPACK)*. *Educational Technology*, v51 n4, p20-26. Jul-Aug 2011.

“This article examines the overlap between technology-rich tasks that develop HOTS and TPACK in the context of formal school settings.”

Speak Up 2009 National Findings. *Creating Our Future - Students Speak Up About Their Vision for 21st Century Learning*, by Project Tomorrow; K-12 Students and Parents. March 2010.
<http://www.tomorrow.org/speakup/pdfs/SU09NationalFindingsStudents&Parents.pdf>

Spurlin, Joni E. *Technology and Learning: Defining What You Want to Assess*. Educause Learning Initiative (ELI) Paper 1. July 2006.
<http://net.educause.edu/ir/library/pdf/ELI3005.pdf>

“Asking whether technology improves learning may seem straightforward, but the answer is not simple. The challenge begins with defining assessment and is compounded by the complexities of people, technology, and educational organizations. This paper clarifies technology assessment by exploring the definitions, methods, and realistic expectations it can address.”

Underwood, Jean. *The Impact of Digital Technology: A Review of the Evidence of Digital Technologies on Formal Education*. Coventry, UK: Becta, 2009.
<http://www.ictliteracy.info/inf/pdf/impact-digital-tech.pdf>

“There is now a growing body of national and international evidence demonstrating the positive impact of digital technologies on measurable learning outcomes. The so-called hard evidence is supplemented by softer observational evidence, which has an important role in explaining why the positive outcomes have or have not accrued. The evidence tells us that integrated use of technology enables a range of positive outcomes for children and young people.”

U.S. Department of Education, Office of Planning, Evaluation, and Policy Development. *Evaluation of Evidence-Based Practices in Online Learning: A Meta-Analysis and Review of Online Learning Studies*. Washington, D.C., 2009.
<http://www2.ed.gov/rschstat/eval/tech/evidence-based-practices/finalreport.pdf>

Meta-analysis and review of online learning studies.

“The meta-analysis found that, on average, students in online learning conditions performed better than those receiving face-to-face instruction.”