



Kawartha Pine Ridge District School Board



Instructional Technology Plan

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1. Context for the Plan

The Instructional Technology Plan is a response to a system demand for a clear framework, direction and support model to guide the expanding use of technology in our schools. Through this technology plan, we will address the growing need to equip our students with the technological tools to develop the 21st century skills necessary in our modern society. The plan also provides guidance to assist the system in addressing the constantly changing scope of educational technology, in leveraging existing technology, and in directing the selection and implementation of new and emergent technology.

“equip our students with the technological tools to develop the 21st century skills necessary in our modern society”

The Instructional technology plan was developed first to support our students in their learning and our teachers in their teaching. The plan was developed with the overarching purpose of enhancing student success in alignment with the goals of the Ministry of Education (raise levels and decrease gaps in student achievement), the Kawartha Pine Ridge District School Board (Student Achievement in the Areas of Emphasis, sections 1.2 and all six sections of 1.5) and schools in the board (individual school improvement plan goals.)

The Instructional Technology Committee was formed in the fall of 2008 with the mandate to “Develop and implement a coordinated plan for the use of advanced classroom technology to support instruction.” The purpose of this mandate as aligned with the Areas of Emphasis was to “assist school staff in engaging with

“enhance the learning of our students through its potential as a teaching tool.”

technology as an instructional tool.” The committee was comprised of a wide range of stakeholders and worked to provide a vision and a framework for a plan that would guide the provision of and training related to technology in Kawartha Pine Ridge for the three year period beginning in September 2010. Throughout the working life of the

committee, one focus remained constant; that **technology's role in our education system was one of a tool to enhance the learning of our students through its potential as a teaching tool.** The scope and recommendations in this plan reflect that guiding principle.

The plan is presented in a format that addresses the training, infrastructure, technology components, and support requirements necessary for its implementation. The plan is presented as a three phase implementation which may extend beyond the initial three

year window envisioned for the committee. The implementation costing by phase is outlined in Appendix A while the ongoing annual cost is outlined in Appendix B. The

... a three phase implementation which may extend beyond the initial three year window envisioned for the committee.

world of technology is an ever changing one, and the plan will need to be responsive to that pace of change and sensitive to a variety of factors which will have an impact upon it; factors such as Ministry supports and directions, financial constraints and budgetary priorities as well as the rapid pace of change of the technology itself.

The plan presented here for the committee and the Board to discuss therefore reflects an overall direction and philosophy for technology in our classrooms; a direction that is designed to be implemented in phases as conditions will permit. The plan is a conceptual framework for where we wish to take our classrooms in the immediate future. As such, it does not necessarily represent the ideal future for Kawartha Pine Ridge classrooms, but a beginning movement towards a future that will evolve as the needs for technology in the broader world our students inhabit also evolve. The implementation of the plan will be subject to the varied influences indicated here, and will proceed at a pace that will be determined by these influences once the conceptual direction has been agreed upon by the board.

2. Instructional Technology Plan Outline

The instructional technology plan outlines:

- a vision for instructional technology;
- Technology tools and resources.
- The support infrastructure and human resources to provide Professional Development and sustain operability of technology.
- The plan implementation phases.
- Ongoing committee work related to the plan.
- Specific 21st century technology learning goals for teachers and students
- An outline of the proposed budget (presented as costs by implementation phase and ongoing budget implications)
- A Research Summary

The plan is supported by a guide document which is intended to assist staff of the Kawartha Pine Ridge District School Board in the detailed implementation of the plan.

The plan is intended to guide the Kawartha Pine Ridge District School Board towards the realization of its vision by the enhancement of the teaching and learning environment through a variety of technology elements including:

- **improved school networks including wireless networking that is available throughout (pervasive) the school building.**
- **improved student access to computers**
- **improved teacher access to technology**
- **enhanced video streaming and video conferencing technology**
- **improved access to student email and web 2.0 (interactive internet (web) based collaborative document) tools**

- **enhancements to the software and assistive devices** needed by many of our students.

In addition to such technological and infrastructure enhancements, the plan also calls for ongoing **professional development** and **enhanced technological support**.

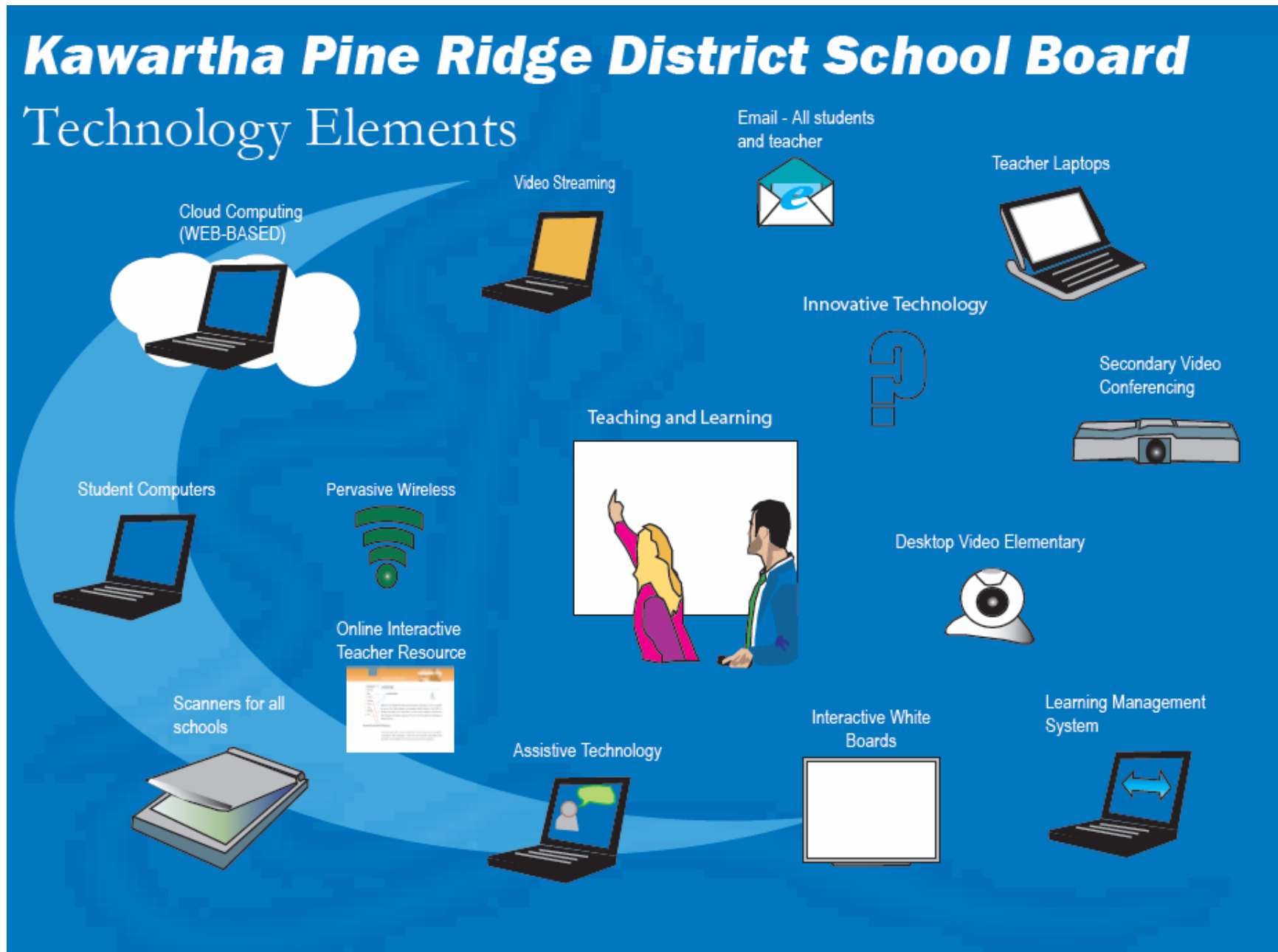
3. Instructional Technology Vision

Statement

The vision statement was created by the members of the Instructional Technology Committee to provide a clear vision of the future for the Kawartha Pine Ridge District School Board with respect to the connections between quality instruction and instructional technology. The vision statement addresses the role, nature and support for technology as a teaching and learning tool.

The Kawartha Pine Ridge District School Board provides accessible, sustainable and equitable learning environments that engage learners and enhance student success through the integration of evolving instructional technologies. Relevant learning experiences and partnerships within these environments actively promote responsibility, global awareness, lifelong learning and ethical digital citizenship.

4. Plan Elements a. Proposed Technology Elements



b. Infrastructure Considerations

The plan considers which changes will be required by our system in order to support the both new and existing technologies. These are summarized below:

- 1) The establishment of open and pervasive wireless networks in all schools
- 2) Installation of hardware elements such as SMART boards, video conferencing units, net books with carts etc.
- 3) Modification of the technology refresh cycle and sustainability plan to reflect the rich resources provided to schools under the Instructional Technology Plan
- 4) Changes in infrastructure, as required, to enable implementation of new technologies recommended through the Technology Committee.

c. Support Considerations

i. Human Resources

The plan will require a consideration of new support roles within the organization. These roles may incorporate existing roles and expand or create others. These roles are outlined below:

1. Technology Consulting –to facilitate staff learning to embed technology in Professional Development board wide. This will serve to actively engage staff in the development and provision of ongoing support for teachers to promote the integration of technology as a support for student learning. This will also allow for professional development supporting progression towards the attainment of the learning goals for teachers and students.
2. ITC Project Coordination – the purpose will be to oversee IT related projects, and direct ongoing committee work. This coordination will be conducted in collaboration with Teaching and Learning.
3. Provision of appropriate support staff centrally and in schools

ii. Professional Development and Innovation

The training plan for technology includes the following features:

1. Intentional training focus for teachers and staff as technology is introduced and an integration of technology into existing academic professional development.
2. Training for central support staff to ensure each individual can support the technology infrastructure, operation and implementation of technology tools in schools. It is important that training be provided to keep all support staff current and able to incorporate emerging technologies smoothly and efficiently.
3. Creation of a collaborative electronic space, where teachers will find Electronic Training resources and Educational Resource sharing.
4. The provision of an annual innovation fund to support school and teacher created projects.

The purpose of funding innovative projects is to provide insight into how technology integration can support student learning. These projects will also provide data to the KPR system that inform future directions in technology use.

The following graphic outlines the focus, methodology and characteristics of the professional development plan. Annual and semi annual plans will be developed.

Kawartha Pine Ridge District School Board

ITC PD Plan

Delivery Methods

- Small Group
- Job Embedded
- Risk Free Environment
- Multiple Session
- Cost Saving
- Environmentally Sound
- Modelling of Technology Use in PD
- Hands On
- Team Taught with a Variety of Staff (IT, Teaching & Learning, School)
- Utilize Existing PD Avenues
- Can Occur Online
- Flexible With Respect to Site, Time and Environment (Group Meeting vs Training Lab vs Online)

Areas of Focus

- Technology and DI
- Technology and Assessment
- Connections to Expectations
- New Technology
- Successful Practice
- System Identified Emerging Needs
- Training for All Staff Involved With Assistive Technology
- Support for Ministry Initiatives
- Technology and Specific Curriculum Areas (Subjects, Panels, Grades)
- Using Specific Technology Tools
- Embedding Technology in Teaching
- Extending Practice: Differentiated sessions based on level of expertise

Characteristics

- Well supported
- Assessed for Effectiveness by Participants
- Ready to Embed in Current Practice
- Differentiated for Participants
- Related Resources Available in Multiple Formats
- Reflective of Successful Practice in Schools
- Reflective of the KPR Standards for Technology
- Focus is on Technology as a Support for Instruction
- PD is Organized Through an Annual Plan
- Reflects a Need to Support Existing Needs of Staff
- Supports Current Technology
- Utilizes Technology for Training

d. Technology Learning Goals

Technology learning goals for our students provide a framework against which teachers and students can compare student progress in the effective use of technology. As student success is our central function, these goals are a means by which we can also assess our success in making technology a part of our student's skill sets and classroom experience.

Kawartha Pine Ridge District School Board Technology Learning Goals for Students

1. Creativity and Innovation

Students demonstrate creative thinking, make connections and develop innovative assignments and processes using technology.

Students:

- a. apply existing knowledge to generate new ideas, products, or processes;
- b. create original works individually or as a group;
- c. use models and simulations to explore complex systems and issues and
- d. identify trends and forecast possibilities.

2. Communication and Collaboration

Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.

Students:

- a. interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media;
- b. communicate information and ideas effectively to multiple audiences using a variety of media and formats;
- c. develop cultural understanding and global awareness by engaging through technology with learners of other cultures and
- d. contribute to project teams to produce original works or solve problems.

3. Research and Information Fluency

Students apply digital tools to gather, evaluate, and use information.

Students:

- a. plan strategies to guide inquiry;
- b. locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media;
- c. evaluate and select information sources and digital tools based on the appropriateness to specific tasks and
- d. process data and report results.

4. Critical Thinking, Problem Solving, and Decision Making

Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

Students:

- a. identify and define real world problems and significant questions for investigation;
- b. plan and implement steps necessary to develop a solution or complete a project;
- c. collect and analyze data to identify solutions and/or make informed decisions and
- d. use multiple approaches and diverse perspectives to explore and communicate alternative solutions.

5. Digital Citizenship

Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.

Students:

- a. advocate and practice safe, legal, and responsible use of information and technology;
- b. use technology to support collaboration, learning, and productivity;
- c. demonstrate personal responsibility for lifelong learning and
- d. exhibit leadership and responsibility in a digital community.

6. Technology Operations and Concepts

Students demonstrate a sound understanding of technology concepts, systems, and operations.

Students:

- a. understand and use technology systems;
- b. select and use applications effectively and productively;
- c. appropriately troubleshoot systems and applications and
- d. transfer current knowledge to learning of new technologies.

The Technology Learning Goals are adopted from the 2007 International Society for Technology in Education standards.

Kawartha Pine Ridge District School Board Technology Learning Goals for Staff

Technology proficiency is becoming increasingly important for educators in Ontario. Our staff need guidance and support in expanding their skills and knowledge so that they may help our students attain their technology learning goals. “*What If: Technology in the 21st Century Classroom*”, a discussion paper from the Ontario Public School Boards’ Association advocates for an educational system that shows “students taking charge of their learning in the ‘connected’ classroom and strengthening, every day, their command of this sophisticated set of transferable skills.” (5)

The Standards of Professional Practice from the Ontario College of Teachers includes standards which call for teaching practice that incorporates technology and addresses current needs, which in modern Ontario society includes technology as an integral component of the daily lives of people both within and beyond our schools. Examples from the standards are quoted below (Italics are added and illustrate connections to the use of technology as a teaching and learning tool):

Professional Knowledge

Members strive to be *current in their professional knowledge* and recognize its relationship to practice. They understand and reflect on student development theory, pedagogy, curriculum, ethics, *educational research*, learning professional knowledge and legislation to inform professional judgment in practice.

Professional Practice

Members apply professional knowledge and experience to promote student learning. They use *appropriate pedagogy, assessment and evaluation, resources and technology in planning for and responding to the needs of individual students* and learning communities. Members refine their professional practice *through ongoing inquiry, dialogue and reflection*.

Alignment with the Provincial Framework

Areas where technology is referenced or could be applied and for which the learning goals can assist teachers, are in bold text.

Commitment to Pupils and Pupil Learning

- Teachers are dedicated in their efforts to teach and support **pupil learning and achievement**.
- Teachers provide an **environment for learning that encourages pupils to be problem solvers, decision makers, lifelong learners, and contributing members of a changing society**.

Professional Knowledge

- Teachers know a variety of **effective teaching and assessment practices**.
- Teachers know a variety of **effective classroom management strategies**.
- Teachers **know how pupils learn and factors that influence pupil learning and achievement**.

Professional Practice

- Teachers use their professional knowledge and understanding of pupils, curriculum, legislation, **teaching practices**, and classroom management strategies to promote the learning and achievement of their pupils.
- Teachers **communicate effectively** with pupils, parents, and colleagues.
- Teachers **adapt and refine their teaching practices through continuous learning** and reflection, using a **variety of sources and resources**.
- **Teachers use appropriate technology in their teaching practices and related professional responsibilities**.

Leadership in Learning Communities

- Teachers **collaborate with other teachers and school colleagues** to create and sustain learning communities in their classrooms and in their schools.
- Teachers work with other professionals, parents, and members of the community to **enhance pupil learning, pupil achievement, and school programs**.

Ongoing Professional Learning

- Teachers **engage in ongoing professional learning** and apply it to improve their teaching practices.

Technology in the Curriculum

In addition to the samples provided above that reflect the linkages between technology and both teaching and learning, technology is embedded throughout the Ontario Curriculum, beyond the technology subjects, and is further supported by educational research as a tool for the engagement of students in their learning and in connecting students to the world around them. The Kawartha Pine Ridge District School Board Technology Learning Goals represent ideals towards which staff and students should strive.

Alignment with Student Learning

Technology use and implementation as a teaching and learning tool is embedded in many school improvement plans. It is embedded in the teaching and learning critical pathway which is focused on meeting student needs. It is a curriculum component that crosses grades, panels and subjects and is truly embedded in the classroom pedagogy from Kindergarten to graduation.

The learning goals for staff and students are intended as guidelines for staff and students against which they may measure themselves in their attainment of technology skills, knowledge and application. The goals are based in part on the technology standards developed by the International Society for Technology in Education (I.S.T.E.) and reflect the use of technology as a tool to improve teaching and learning. They are intended as a framework against which staff may guide their practice.

Kawartha Pine Ridge District School Board Technology Learning Goals for Staff

Effective staff model and apply the Technology Learning Goals for Students as they design, implement, and assess learning experiences to engage students and improve learning; enrich professional practice; and provide positive models for students, colleagues, and the community. Staff provides equitable and accessible access to those with disabilities. All staff should aspire to attain the following goals.

Staff:

1. Facilitate and Inspire Student Learning and Creativity

KPR Staff use their knowledge of subject matter, teaching and learning, and technology to facilitate experiences that advance student learning, creativity, and innovation in both face-to-face and virtual environments and provide equitable and accessible access to those with disabilities.

KPR Staff:

- a. promote, support, and model creative and innovative thinking and inventiveness;
- b. engage students in exploring real-world issues and solving authentic problems using digital tools and fully accessible resources;
- c. promote student reflection using collaborative tools to reveal and clarify student and conceptual understanding and thinking, planning, and creative processes;
- d. model collaborative learning by engaging with students, colleagues, and others in face-to-face and virtual environments.

2. Design and Develop 21st Century Learning Experiences and Assessments

KPR Staff utilize technology to design, develop, and evaluate authentic, fully accessible learning experiences and assessments.

KPR Staff:

- a. design or adapt relevant learning experiences that incorporate technology to promote student learning and creativity;
- b. develop technology-enriched learning environments that enable all students to pursue their individual interests and become active participants in setting their own educational goals, assessing their own progress;
- c. customize and personalize learning activities to address students' diverse learning styles, special needs, working strategies, and abilities using technology and
- d. provide students with multiple, varied and fully accessible formative and summative assessments aligned with instructional practices, curriculum, Individual Education Plan and technology expectations to inform learning and teaching.

3. Model 21st Century Skills

KPR Staff model knowledge, skills, and professional innovation necessary for a global and digital society.

KPR Staff:

- a. demonstrate proficiency with technology and the application of current knowledge to new technologies and situations;
- b. collaborate with students, peers, parents, and community members using technology and resources to support student success and innovation;
- c. communicate relevant information and ideas effectively to students, parents, and peers using a variety of technology and
- d. model and facilitate effective use of current and emerging technology to locate, analyze, evaluate, and use information resources.

4. Promote and Model Digital Citizenship and Responsibility

KPR Staff demonstrate an awareness of local and global societal issues and responsibilities in an evolving digital culture and exhibit legal and ethical behavior in their professional practices.

KPR Staff:

- a. advocate, model, and teach safe, legal, and ethical use of digital information and technology, including respect for copyright, intellectual property, and the appropriate documentation of sources;
- b. address the diverse needs of all learners by using learner-centered strategies and providing equitable access to appropriate technology and accessible resources;
- c. promote and model digital etiquette and responsible social interactions related to the use of technology and information;
- d. model global awareness through collaboration with colleagues and students of other cultures using technology communication and collaboration tools and
- e. will safe guard private information.

5. Engage in Professional Growth and Leadership

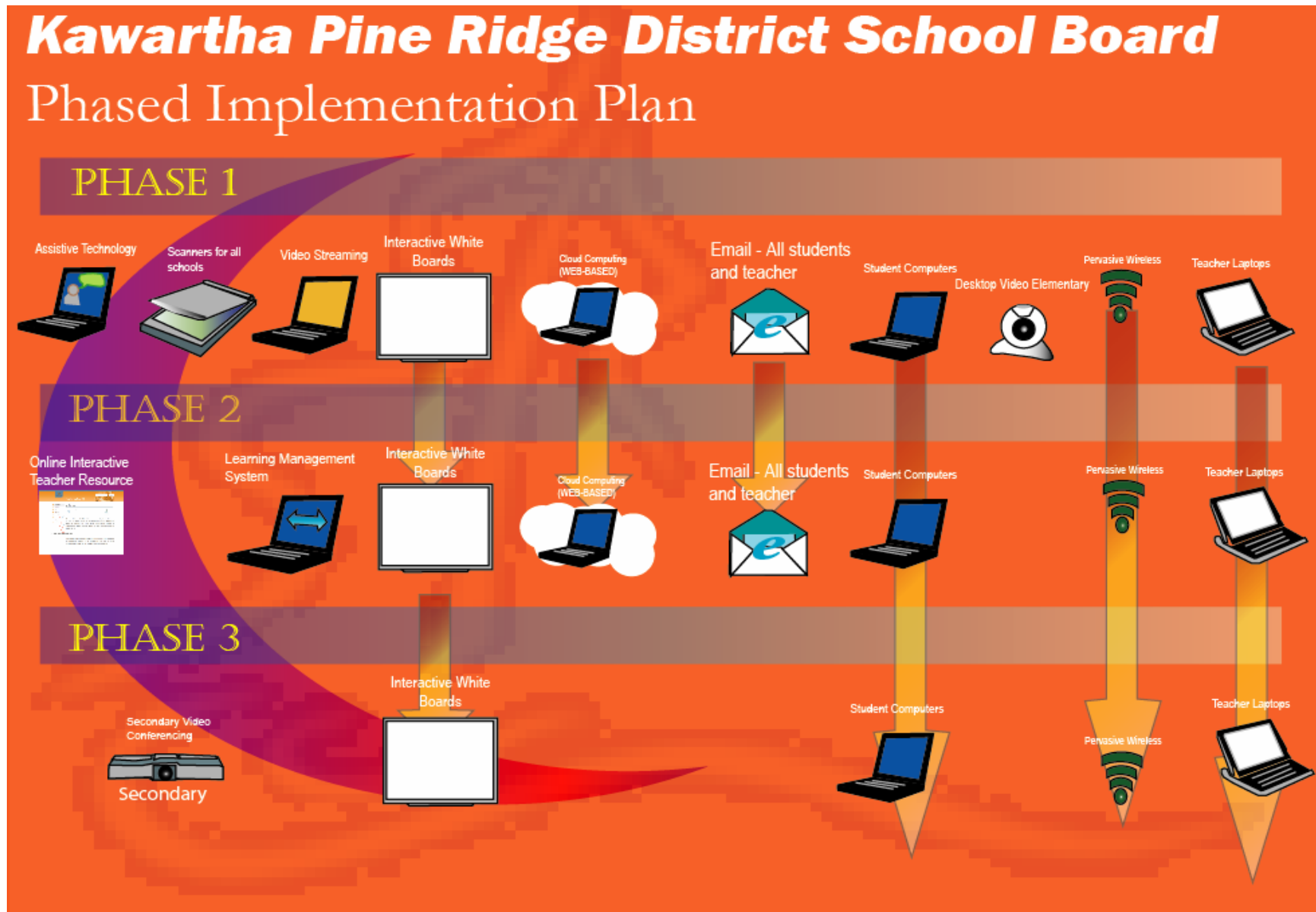
KPR Staff continuously improve their professional practice, model lifelong learning, and exhibit leadership in their school and professional community by promoting and demonstrating the effective use of technology and resources that meet the needs of all learners.

KPR Staff:

- a. participate in local and global learning communities to explore creative applications of technology to improve student learning;
- b. exhibit leadership in shared participating in shared decision making and community building, and developing the leadership and technology skills of others;
- c. evaluate and reflect on current research and professional practice on a regular basis to make effective use of existing and technology in support of student learning and
- d. contribute to the effectiveness, growth and self-renewal of the teaching profession and of their school and community.

5. Three Phase Implementation Plan

The graphic below displays a plan for implementation of the various technology components of the plan.



6. Technology Committee

The Instructional Technology Plan will require ongoing committee functions. Committee creation, mandate membership and duration will be determined by system needs with respect to technology. The existing Information Technology Advisory Committee (ITAC) will serve as the committee to which technology related issues will be brought for consideration. ITAC will assess issues and direct their further consideration to appropriate committee members for consultation, further approval and related action, which may include the creation of short or longer term committees to more fully address technology issues. In this manner, many instructional technology issues may be appropriately addressed, including but not exclusive to the list provided below:

- Technology integration into curriculum and instruction and ways in which successful practices can be shared to inform and support successful classroom practice.
- Applications to a technology innovation fund,
- Decisions and report on outcomes of innovation pilots.
- Technology use and issues in the system
- Coordination of technology support, planning and development from a systemic perspective.
- Research and technology development in the wider context of educational and non-educational communities
- Recommendations about emergent technology that could be integrated into instructional practice in KPR classrooms.
- Assess the current state of the technology plan, identify strengths, weaknesses and make recommendation about changes, refinements, planned abandonment and new technology integration related to the plan.

APPENDIX A: IMPLEMENTATION COST BY PHASE

Instructional Technology	Total Cost
Phase 1	
<i>Implementation of Wireless Access in all Secondary Schools</i>	\$823,935.97
<i>Implementation of Wireless Access in all Elementary Schools</i>	\$1,383,020.16
<i>Implementing Video Streaming in all Schools</i>	\$83,296.00
<i>Increasing use of Smartboards</i>	\$882,323.84
<i>Implement Video Conferencing in all Elementary Schools</i>	\$130,961.04
<i>Implement E-Mail for all Students</i>	\$265,582.13
<i>Introduce cloud computing</i>	\$166,811.20
<i>Increased Classroom Scanners</i>	\$168,260.43
<i>Increased Instructional Software - WordQ & Premier <small>French Engines</small></i>	\$242,404.80
<i>Instructional Technology focused PD</i>	\$674,850.00
<i>Project Implementation Management</i>	\$200,000.00
Total	\$5,021,445.57
Phase 2	
<i>Improving student access to Technology - Elementary netbooks</i>	\$2,223,586.91
<i>Improving student access to Technology - Secondary Netbooks</i>	\$398,755.84
<i>Improved Teacher Access - Laptops for Teachers</i>	\$2,673,894.76
<i>Implement Learning Management System for all Teachers & Students</i>	\$106,828.02
<i>Increase Web access to Curriculum Software</i>	\$197,280.00
<i>Implement Online PD and Support Portal</i>	\$230,160.00
<i>Instructional Technology focused PD</i>	\$674,850.00
<i>Project Implementation Management</i>	\$200,000.00
Total	\$6,705,355.53
Phase 3	
<i>Increase Video Conferencing to all Secondary Schools</i>	\$87,241.60
<i>Implement Instructional Technology Training Centres</i>	\$124,489.92
<i>Instructional Technology focused PD</i>	\$674,850.00
<i>Project Implementation Management</i>	\$200,000.00
Total	\$1,086,581.52

APPENDIX B: ANNUAL BUDGET IMPLICATIONS

Instructional Technology	Capital Costs	Hardware-Software Maintenance	Technical Support	Total Annual
Improving School Networks				
Wireless Access - Secondary (Pervasive)	\$126,733	\$32,960	\$32,016	\$191,708
Wireless Access - Elementary (Pervasive)	\$215,053	\$48,635	\$32,016	\$295,703
Improving Student Access				
Secondary Netbooks & Cart	\$132,919		\$64,031	\$196,950
Elementary Netbooks Cart	\$555,897		\$180,000	\$735,897
Improving Teacher Access				
Teacher Laptops - all	\$630,451		\$509,172	\$1,139,623
Video Streaming		\$16,659		\$16,659
Smartboards - 50:1 ratio	\$93,514			\$93,514
Video Conferencing - Secondary	\$12,463	\$4,954		\$17,417
Video Conferencing - Elementary	\$29,611		\$64,031	\$93,642
Students E-Mail and access to Web 2.0 tools				
E-Mail - all Students	\$46,090	\$37,543	\$64,031	\$147,664
Learning Management System	\$17,805	\$19,240		\$37,044
Web 2.0 tools (private cloud computing)	\$26,669	\$76,800	\$11,200	\$114,669
Web access to Curriculum Software	\$37,447			\$37,447
Technology Resources				
Innovation Fund		\$54,800		\$54,800
Classroom Scanners	\$28,043			\$28,043
Instructional Software				
WordQ & Premier French Engines	\$40,401			\$40,401
Supports				
Online PD and Support Portal	\$39,273	\$43,840		\$83,113
Training Centres	\$28,918			\$28,918
Total	\$2,061,285	\$335,431	\$956,496	\$3,353,212

Appendix C: Supporting Research Summary

Kawartha Pine Ridge District School Board
Instructional Technology Literature Review

Final Review
January, 2010

Purpose of the Literature Review

The purpose of this literature review is to examine research related to the instructional technologies and technology supports identified in the Kawartha Pine Ridge District School Board Instructional Technology (IT) Plan. The review is organized in sections as defined by the elements included in the IT plan and the description of each study examined for this review includes context, methods and findings. The academic literature on instructional strategies and cost effectiveness were also briefly examined in order to situate findings in the larger setting of instruction and student achievement in an Ontario School Board.

A comprehensive review of the literature in this area is necessary and must be ongoing to determine whether the claims of research studies are warranted and if the proposed direction outlined in the Instructional Technology plan is of benefit to KPR stakeholders. Boote and Beile (2005, p. 3) state that, “A substantive, thorough, sophisticated literature review is a pre-condition for doing substantive, thorough, sophisticated research.” They argue that writing a literature review is a particularly difficult task in education due to the disparity in topical background knowledge levels, and methodological beliefs of a diverse audience. This is certain the case in the realm of instructional technology.

Organization of the Literature Review

For accountability purposes, an explanation of the organization of the literature review is included, along with a description of the search strategy. Following the description of the search procedures, the literature review is organized into three sections. These three areas represent broad categories of information uncovered during the course of the literature review and are ordered in the following sequence:

- Pervasive wireless
- Email – all students and teachers
- Teacher notebooks
- Cloud computing – web based
- Video streaming
- Computer ratio of 4:1
- SMART Board ratio 50:1
- Desktop video elementary
- Secondary video conferencing
- Scanners for all schools

- Assistive technology
- Learning Management System.

2. Support

- Technology Consultant
- ITC Project Coordinator
- Increased support staff centrally and in schools.

3. Training

- One day of training per teacher per year
- A collaborative electronic space

Search Procedures

As suggested by Fraenkel and Wallen (2003), three types of sources were used for this review. These included general websearching, investigating research published in peer reviewed journals and examining local knowledge and resources related to the KPR Instructional Technology Plan.

The review began with a general internet search by accessing publicly available websites and then expanded to a more rigorous search by accessing several educational indexes and databases online through the KPR electronic library (ESBCO Host) and through the OISE / UT library system (Education Resources Information Centre, ProQuest, Scholars Portal, WilsonWeb, JSTOR). Search terms were formulated and refined, including useful words and phrases found in the IT plan. A few examples of key descriptors, often used in combination, include *instruction, technology, computers, student, learning, teacher, instruction, improvement* and *student achievement*.

A Primer on Research Methods

Research can be broadly classified into two categories, qualitative and quantitative. A brief description of each category is included in Table 1 below. This description is limited but is intended as an initial resource to those wishing to further their understanding of the research methods that underpin educational and technological inquiry.

Table 1. A brief overview of educational research methodologies

	Role of the Researcher	Common Data Collection Methods	Benefits	Challenges
Qualitative (e.g. words, descriptions, action research)	find meaning	-interviews -observations -focus groups	Provides a deep understanding of an issue in specific circumstances	Can be difficult to generalize results (e.g. what happened in this class may not happen in that class)
Quantitative (e.g. numbers, measurements, statistics)	find evidence	-surveys -test scores -assessments	Provides insight into the effects of an issue in general or in specific circumstances	Can be difficult to understand statistical results

Infrastructure

- Pervasive wireless

The search for research studies on the topic of wireless networks and pervasive wireless communications in peer reviewed academic literature yielded no results for stand-alone investigations. That is to say that the effect of the installation of wireless networks on student achievement has not been studied. However, research on the use of laptops and mobile computing equipment, which are dependent on wireless networks, was explored and will be reported on below in the subsection on computer to student ratio.

- Email – all students and teachers

There are many research studies examining teacher email for administrative use, collaboration and professional development networking (Kabilana and Embib, 2006; Hu et al., 2009). In a study of Singapore's 350 government schools Hu et al., 2009 reported that 65% of all teachers (grades 1-12) used email at least once a week. Teacher email use was dominated by communication with colleagues for administrative purposes.

Fewer studies, however, investigate the use of email for communicating with students. The same authors found that grade 11 and 12 teachers reported the most use of email to communicate with students (26% of these teachers reported emailing students at least once a week as compared to 15% of grade 1-6 teachers communicating with students once a week via email).

- Teacher notebooks

The effect of teacher laptops on student achievement has not been well documented in the peer reviewed literature. The few examples that could be found detailed the implementation of teacher laptops in conjunction with students receiving laptops in a 1:1 computing environment. For example, Barone and Wright (2009) use a qualitative methodology to tell the story of the implementation of 1:1 computing in a junior level classroom. This story includes some detail on how the teacher was supported as Apple Educator of the Year, and how he felt his instructional practice shifted with the access to technology, but no numerical evidence is presented.

Warschauer (2007) examined information literacy using data obtained from ten K-12 schools with one-to-one notebook computer programs in California and Maine. Results showed wide variation across schools in the focus on assessing information, analyzing information for the purpose of knowledge production, and understanding social issues surrounding information, suggesting that the laptops were not used in the same way by all teachers at all schools.

Successful implementation of teacher laptops has been better documented in independent and private schools with a relatively small number of staff (e.g. <50) but the initiative, again, is linked to a simultaneous implementation of student laptops (e.g. Lemelin et al., 2009).

The fact that teachers are among the few groups of professionals who work in an environment where they usually do not have a computer at their desk is well documented on corporate and public websites and is frequently discussed in teacher / educational blogs. Debate goes both ways, with some believing that lack of ready access to the internet reduces the chance of teachers being interrupted by incoming email messages or distracted by web surfing throughout the working day and others believing that the lack of ready access to the digital world hinders teacher performance.

There are several educational jurisdictions that support teacher laptop initiatives described on various website including the Calgary Board of Education (<http://www.innovativelearning.ca/sec-research/research-projects3.asp>), Detroit Public Schools (<http://www.detroit.k12.mi.us/resources/tti/faq/>), an initiative in Victoria, Australia (<http://www.education.vic.gov.au>), and a laptop program in South Africa (<http://www.education.gov.za/dynamic/dynamic.aspx?pageid=310&id=8553>). These sites describe various types of implementation (e.g. system purchased; shared purchased; supported purchase).

- Cloud computing – web based

A search for the impact of cloud computing on student achievement resulted in no citations in the peer reviewed academic literature search. Definitions for cloud computing were found on public / opensource webpages (e.g. wikipedia; infoworld.com) and on proprietary corporate websites (e.g. Sun Microsystems at sun.com; salesforce.com) but information was neither dated nor verifiable.

- Video streaming

Boster et al. (2006) conducted a series of experiments designed to examine the effects of video streaming on student achievement in two American school districts. Third and eighth grade students either did or did not receive exposure to video streaming (unitedstreaming) in either their science or social studies classes. Results indicated that the video streaming resulted in higher mean examination performance in both subjects in the third grade and in 8th grade social studies.

- Computer ratio of 4:1

Clariana (2009) conducted a quasi-experimental investigation of mathematics software use on wireless laptops (1:1 ratio) in three grade 6 math classrooms compared to non-laptop classrooms (5:1 ratio) in seven other schools in a US state district. Proprietary software from CompassLearning was delivered via the internet and designed to align to state curriculum and intended to replace print-based textbooks. In the laptop classrooms, the teacher's role shifted to one-to-one interaction as students moved through the online text at their own pace. In the non-laptop classes, students shared computers in the class or the lab to access the online text. Student results for in school tests were significantly better in the laptop classes (effect sizes ranged from 0.47 to 0.90) but no difference was observed on the state examination.

Tearle (2005) conducted a case study of one secondary school in the United Kingdom where almost all staff are used ICT to enhance and extend learning in their subject areas. A multi-method approach obtained a rich picture of ICT implementation, including work with individual staff members, departments and the whole school through interviews, questionnaires, document analysis and observation. The author reported that an onsite ICT coordinator and network manager were key to the ongoing operations of technology (computer to student ratio of 10:1) and that over a period of several years, the school staff (80 teachers) worked collaboratively to ensure ICT was integrated into all subjects (details of 'integration' and / or changes in teaching methods were not given).

- SMART Board ratio 50:1

An interactive white board is a presentation device that is connected to a computer. It allows user to display and manipulate computer images through a digital projector. Note that SMART board is a proprietary brand name for this type of technology. In a study of interactive white board (IWB) use in the Turkish education system, Somyurek et al. (2009) found that despite a substantial investment in IWBs (ratio not mentioned), 65% of teachers reported that they had not used an interactive white board at all, even through there was at least one in their school. Three main reasons were stated for lack of use: (1) Don't know how to use it (51%); (2) Don't know how to integrate it into class activities; (3) No school plan for the use of IWB (31%). Students surveyed reported disruption to lesson flow while teachers were trying to turn on the IWB or trying to 'make it work'.

In a qualitative study of interactive white board use in England, Wall et al. (2005) invited 1,568 students to comment on the use of IWBs in their classrooms. Fifty-six (56%) reported that IWB use was a positive addition to their classroom, 32% were neutral and 12% viewed the IWB as a negative addition to their class. Students reported that the benefits of whiteboard technology included the

ability to visualize concepts to support their learning, and the use of games to motivate and engage them in thinking. These benefits were largely reported in reference to the mathematics and science curricula. Frustrations included ongoing need for recalibration during lessons, teacher control, and class time wasted for technical problems.

In a literature review of research pertaining to IWBs, Higgins et al. (2007) reported a widespread recognition of the potential to enhance pedagogy through improved visuals; more effective demonstrations and high levels of student motivation. The same review discussed three models of teacher use of IWBs including: (a) supporting pedagogy, where the interactive whiteboard (IWB) is used to enhance traditional teaching using a central visual (e.g. chalkboard); (b) interactivity, where the teacher recognizes some additional benefit of technology and endeavours to stimulate interactivity by questioning and involving pupils; and (c) enhanced interactivity where teacher moves from the instructional to the involvement role and uses the technology to stimulate interactive learning.

The empirical evidence about the impact of IWBs shows small effects on student performance, and effects are not necessarily enhanced classrooms with teachers who are fully conversant with the IWB technology. However, industry sponsored studies have found positive effects on student learning and motivation within classrooms, particularly in mathematics achievement.

- Desktop video elementary / Secondary video conferencing

A search for the impact of video conferencing on student achievement resulted in no citations in the peer reviewed academic literature search.

In 2008-09, the Kawartha Pine Ridge DSB participated in a research project with Parks Canada to evaluate the efficacy of Parks Canada using video conferencing technology as an outreach mechanism to inform students about National Parks and National Historic Sites. This program was also connected to the Grade 10 Science curriculum and the Grade 8 History curriculum. Preliminary data from the Parks Canada study shows that student engagement in video conferencing is high and that students enjoy learning using the technology. Student identified a few distractors from the experience, including technological problems and having to sit for a long time during conferences. Results on student achievement outcomes are less clear, as students reported increased learning in some outcomes (e.g. understanding the reasons for the existence of a National Historic Site) but misunderstanding on other outcomes (e.g. identifying specific statements pertinent to the significance of a National Historic Site).

- Scanners for all schools

No independent / unique evidence for scanners for all schools was found in the peer reviewed academic literature. That is to say that the impact of adding one scanner to a school has not been investigated.

- Assistive technology

While the benefits of assistive technology (AT) are well documented for individual cases, there is no evidence of a systematic, standard implementation of AT across a school or school system. This area is best considered in terms of individual student needs.

- Learning Management System

Learning management systems (LMS) are web-based systems that allow instructors and students to share materials, submit and return assignments and communicate online. In a multi-year study of faculty and students at a large American Midwestern University, Lonn and Teasley (2009) found that faculty identified communication with students (45%) as the most valuable benefit of a learning management system while student identified efficiency (39%) as the most valuable benefit of an LMS. Very few students (7%) felt that improved teaching was a benefit of the system and very few instructors (8%) reported improved student learning as a benefit of the LMS. This suggests that the system was most valued for the way it improved ability to push out information to students rather than for the way it supported teaching and learning.

Hornik, Johnson & Wu (2007) also identified a gap between instructors pedagogical practices and students learning through LMS technologies. In their study of faculty and students at a large American University only 45% of students felt that the LMS technology supported the way they learned best, while the remaining 55% felt that the LMS did not meet their individual learning needs. When students fail to see the relevance of interactive tools for deeper learning, or instructors fail to see the benefits for improved teaching, they are likely to continue to view ICT as merely a quick and accessible means to retrieve course documents and announcements.

Support

- Technology Consultant

The benefits of an ICT champion are well documented in research literature. In a study of school Principals in New Zealand, Stuart et al. (2009) found that educational leaders can support (champion) ICT without having significant ICT project experience. In fact Principals who used technology only routinely (e.g. email; web searching) and who were not involved in the managing or teaching with technology at their schools still expressed support for the use of technology for student learning.

- ITC Project Coordinator

See page 5 reference to Tearle (2005).

- Increased support staff centrally and in schools.

Technology can make a difference with a minimal amount of teacher training. Ross and Bruce (2009) reported that relatively little teacher training time (~60 min) was used to introduce teachers to CLIPS online math resources. However, technological limitations were also reported as a barrier by teachers in the mixed methods study. Hardware and software issues included: slow network speed; lack of equipment within classrooms meant that students accessed the web based resources outside of their class and were therefore unsupervised (e.g at home) or monitored for behaviour only (e.g. if students appeared to be working, no teacher intervention was given). Once the technological issues were resolved, grade 7-10 students showed significant gains on a math pre-test, post-test design.

Training

One day of training per teacher per year

There is much evidence, within and beyond the boundaries of technology literature, that suggests teacher knowledge and expertise is integral to improved student achievement (Spillane, J.P. (2000); Darling Hammond, L. (2000)). Teachers do make a difference and a highly skilled instructional leader can elicit improvement in the most challenging of students. The introduction of technology does not necessarily make a difference to teacher results.

In a meta-analysis of 248 quantitative studies on Computer Based Instruction (CBI), Kulik and Kulik (1991) reported that controlling for instructor effects is an important aspect for technology studies. That is to say that the effects reported in technology studies declined when researchers controlled for the teaching variable (ES = .39 for studies that didn't control for instructor and ES = .25 for studies that did control for instructor). That is to say that strong, positive effects of technology may in fact be effects of strong, positive teachers if the study does not account for teacher differences.

Core practices of good teaching include teacher ability to identify the conceptual origins of student difficulty, to predict and address student misconceptions / errors and to relate current to future curriculum topics through content expertise. Generalist teachers in elementary schools and

secondary school staff teaching courses outside of their specialization might not have the opportunity to develop conceptual foundations and practices needed to promote deep understanding of curriculum expectations. Ross and Bruce (2009) demonstrate that online technology resources (CLIPS) can provide direct assistance to students through sequencing and scaffolding of mathematical learning materials in an online video format, independent of teacher content knowledge. Students in grades 7-10 accessed five set of web-based learning objects and showed improvements in student achievement over a pre-post design (ES = .53). They conclude that a research-based set of learning objects can be an effective remediation tool with a minimum of teacher training (60 minutes of instruction on how to access CLIPS, the structure of the CLIPS and the projected benefits for students).

Lemelin et al. (2009) found that teachers did not use technology until they had a reason to. Their qualitative study of an independent school with high access to technology (e.g. student and teacher laptops for all) documents the development of a professional community of practice for teachers to dialogue and share ideas about teaching with technology. The teacher group reported the motivational effects of the teacher community of practice about technology (e.g. sharing resources, learning software). Student effects were unreported.

In a case study of one secondary school in the United Kingdom, Tearle (2003) reported that planning for ICT implementation resulted in effective informal computer training for staff within each department. Formal professional development was not offered to staff, rather colleagues worked together to plan for the implementation of ICT in class lessons.

- A collaborative electronic space

No independent / unique evidence for a collaborative electronic space for teachers was found in the peer reviewed academic literature. That is to say that the impact of a collaborative learning space is not reported without a connection to a stated, intended purpose for a collaborative electronic space. However, the impact of electronic teacher communication / sharing with each other and with students is reported as integrated with the student email section. Results for teacher communication of electronic learning materials to students are reported in the learning management system section.

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