Research Report
Saskatchewan School Trustees Association

Providing Professional Development to Assist Teachers with Integrating Information and Computer Technologies (ICT) into their Professional Practice

by
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The Saskatchewan School Trustees Association commissioned Dr. Warren Wessel, Professor, Faculty of Education, University of Regina to develop this paper. This work complements SSTA Research Centre Report #00-01 entitled **Diversifying Opportunities for Learning: Program Delivery in Saskatchewan** (O'Brodovich, 2000) which investigates some possibilities for expanding the delivery of programs. When alternative means of delivering program are chosen, they will include considerable use of ICT. These alternative uses of ICT will require teachers to develop additional knowledge and skills to ensure that ICT is used in pedagogically appropriate ways. This paper describes assumptions used to focus the discussion of professional development for preservice and practicing teachers. Some myths and concerns about ICT are presented followed by a discussion of professional development appropriate for assisting teachers to integrate the use of ICT in their professional practice. Suggestions for new roles of teachers in distance education are discussed. Developmental semesters for teachers to work on locally identified problems and the roles of Saskatchewan Education and the provincial universities are specified.

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Introduction

In 1997 the Saskatchewan School Trustees Association and Saskatchewan Education were asked to examine means of providing assistance for creative initiatives in program delivery in rural school divisions. Some school divisions with low student population densities are finding it increasingly difficult to meet CORE Curriculum expectations for their students. Concerns range from the delivery of senior science and mathematics classes to providing practical and applied arts classes in rural settings where facilities and/or qualified teaching personal are unavailable. Although actual problems in delivering program have similarities, the concerns of each division are unique and require individual solutions based on their needs, and the resources and personnel available to solve them.

In response to this request the SSTA established a Reference Group on Alternative Strategies for Program Delivery to examine possible solutions and assistance. The reference group produced a paper called *Diversifying Opportunities for Learning: Program Delivery in Saskatchewan* (O'Brodovich, 2000) which investigates and discusses some possibilities for expanding the means of delivering programs in Saskatchewan. One guiding principle of that paper is the availability of equitable programs for all students in the province. Every student should be able to access the courses that he/she requires for graduation from grade twelve and for entrance into his/her chosen field whether that be post-secondary education or the work force.

This paper provides a complement to *Diversifying Opportunities for Learning: Program Delivery in Saskatchewan* by exploring the implications of increased use of information and communication technologies (ICT) for effective practice in Saskatchewan schools. Increasing the use of ICT has ramifications for all teachers in the province regardless of where they are located. Delivery of curricula to rural classrooms using various forms of distance education is likely to employ extensive use of ICT. Teachers involved in this form of delivery will have professional concerns related to both the sending facility and the receiving classroom. The range of uses of ICT in all classrooms will increase over the next few years and all teachers are likely to seek some

support for ICT implementation during that time. This paper explores some issues concerning education and professional development for preservice and inservice teachers. Teacher education institutions want to ensure that their programs provide preservice teachers with sufficient opportunities to learn about and experiment with uses of ICT in a wide range of instructional applications. If practising teachers are to use ICT effectively and in ways that are pedagogically appropriate, then they need additional knowledge and skills. Conceivably new educational applications of ICT will require different specialties (majors and minors for provincial teacher certification) as more K-12 courses are delivered through different on-line media.

This paper describes a number of professional development experiences that can be provided for teachers who are already practising and for those who are enrolled in teacher education programs. Several options including short-term inservice, longer-term (with teaching relief) inservice and post-graduate courses and degrees are discussed. This paper examines means of facilitating research to develop and improve uses ICT for more effective instruction. A proposal to create an experimental facility which can be used to experiment with and develop new means of program delivery using ICT is presented. The paper raises the issue of what increased use of ICT means that we leave out of the current curricula and what things are not funded as a result of this increase.

Assumptions upon which the discussion is based

Because ICT has an enormous range of possibilities, this paper would become unmanageable if I do not establish some assumptions to limit the content. My assumptions are, of course, open to debate just as the rest of the content is. Debate about these assumptions is very important, because policies must be developed to achieve specific educational goals and aims. I want to state up-front that I am comfortable with ICT and do use many aspects of it; however, I do not believe that Saskatchewan education is currently so poor that it will collapse without an extensive infusion of ICT. On the contrary, I think we have a very strong provincial education system that can be weakened by incorporating inappropriate uses of ICT in classrooms. I taught

secondary school science for twenty-three years before completing a doctorate and joining the Faculty of Education at the University of Regina. As result of my professional background I believe that I have a reasonable understanding of the realities of classroom teaching and learning, and try to keep my discussion of professional development within what seems to be manageable by classroom teachers.

First, I assume that teachers in Saskatchewan are professionals and doing a very good job in the classroom. Generally, they are well educated and care very strongly about the children in their classrooms and their profession. No single description of a teacher is sufficient to provide more than a slight idea of the range of situations in which teachers teach in our province. They have a professional attitude toward the quality of the instruction that they provide and understand much more about the education that actually occurs in their classrooms than many of the public and most business leaders. Second, the goals and policies of education for our province are laid out in the documents of Saskatchewan Education, including CORE Curriculum Directions (Saskatchewan Education, 1984), (Saskatchewan Education, 1987), Common Essential Learnings (Saskatchewan Education, 1988) and the curriculum guides. Our provincial documentation is built on a sound philosophical foundation and is probably the best in Canada (I realize some persons in other province might disagree, but they are biased). This assumption is particularly important because uses of ICT in Saskatchewan must fit within our provincial programs and philosophy. Third, some use of ICT in Saskatchewan schools is desirable and inevitable, particularly in delivering curricula to rural/isolated schools and students. ICT, however, is surrounded by an enormous amount of hype, which while sounding wonderful, is not backed by any experience (or research) in classroom situations. Faculties and Colleges of Education, and school divisions can not plan their programs and develop policies based solely on the advertising claims of software developers and computer manufacturers.

A fourth assumption is that much more goes on in our classrooms than the explicit curriculum that is laid out in our provincial documentation. Implicit educational goals are achieved which, although not written down, are intended nonetheless. Without the development

of social, interpersonal and cooperative learning skills that occurs in classrooms, our society would be in peril. These implicit goals are of great importance and must not be unintentionally (and certainly not intentionally) eliminated through the use of ICT or any other instructional strategy. We must not lose sight of the children in our K-12 classrooms. A great deal is known about how children learn and appropriate ways of teaching them. Young students are not adult learners and adult learning principles (andragogy) should not be used in designing ICT experiences for them.

Finally, I assume that whatever funding is spent on ICT can not be spent on other programs in a school. While this point may seem obvious, the ramifications of spending large amounts of money on ICT are that some other program is discontinued, some building repair is not made, or some teacher is not hired. This funding issue needs to be addressed but does not always get the attention that it deserves in the rush to implement ICT. Franklin (1999) has argued that when technology is introduced we should remember that students matter more than computers and that planning to implement the use of technology should be aimed at minimizing disaster.

Potential uses of ICT in classrooms

One problem with using ICT in educational settings is that the potential uses appear to be so numerous. Designing education programs and professional development for inservice and preservice teachers could become unmanageable if we do not limit the discussion to the most likely classroom uses of ICT. In this section I discuss some probable uses of ICT in Saskatchewan classrooms and the roles teachers have in such use. Incorporating new and creative uses of ICT requires that teachers develop additional skills and knowledge and have opportunities to do so at times that are convenient. The range of uses suggested below should be discussed and debated, but the identification of probable uses of ICT in K-12 education is crucial to designing appropriate professional development experiences for educators. In other words, if the use is note known, how can professional development be planned appropriately?

Some uses of ICT seem very likely to occur. The most obvious application software for students to learn to use (at this time) are word processing, spreadsheet usage, data base creation and access, presentation software and multi-media software. K-12 students will increasingly use these types of software applications as tools in completing their assignments in all subjects and classes. Teachers will increasingly use these applications for their own professional needs, such as record keeping, preparation of lessons and assessments. Attendance and mark applications are in wide usage, and computers will soon be used daily in all schools to record marks, attendance and other student information. Increased administrative use of computers is guaranteed. Communication by computer between teachers and administrators, and parents will continue to increase. Some American schools are using email communication with all parents, which allows more immediate reporting and communication. Without doubt this list is not complete and will never be because of the rapid growth and develop of new communications programs with educational applications.

The Internet and the World Wide Web will increasingly be used to seek resources for students and teachers, especially if budget limitations reduce the purchase of other types of resources. As computers increase in speed, demand for access to the Internet grows because of more convenience and shortened search times. On-line communication systems are certain to be used more extensively by teachers, students, parents and administrators. New forms of communication which include visual images will be developed and will increase demand for access, and for new machines (and money) to facilitate expanded communication. The chat room facility of Web software (for example, Web CT) will be employed by students and teachers to communicate outside of class time. While face-to-face conversation will still be favored, email and chat room communications have some advantages in some types of interaction because of their asynchronous nature.

Whether with one-way or two-way student-teacher communication, more curricula will be offered at a distance. ICT is likely to be used in a variety of forms to provide alternative delivery of program, especially at the secondary level. Classroom teachers will have to learn to facilitate

learning for those students who access such instruction. Teachers involved at the sending end of distance instruction will have to learn instructional skills that are not normally taught as part of teacher education courses. The ability of students to access courses on-line also has policy and accreditation implications for division administrations and Saskatchewan Education.

Software for classroom use is being targeted at each subject area in every grade level. Teachers have to learn to evaluate this software as to its suitability for their classroom situations, and to learn how to use appropriate software in ways that are meaningful to their students. The use of appropriate software is not as straight forward as might be expected. Because of limited computer resources within individual classrooms, all students will not have access to the computer(s) at the same time. This situation has implications for teachers about the choice of instructional strategy and classroom organization. Expertise in learning centers and multiple activity classroom organization is required. While these strategies are currently used by many teachers, especially at the elementary level, others (especially at the secondary level) may require support to learn to use them effectively with ICT.

In the secondary sciences many computer applications are available for use in science laboratory activities. Such software and hardware is already in use in many science classes to collect and manipulate data. Much of this use has been developed by teachers who have a particular interest in gadgets and computers; however, in the future all science teachers will need to know how to use such applications in science laboratories. Drafting software and graphic design software are already in use in some Saskatchewan schools and will soon be adopted in many others for use in practical and applied arts courses. These types of software have extensive use in professional applications and will have to be introduced in school. Few draft persons use pencils and rulers as most of us were taught in our drafting classes. Many high school yearbooks are already being created exclusively using page maker software and scanned images. In some schools academic credit is awarded to those students compiling and editing school yearbooks.

The most important criterion for adopting any aspect of ICT is that its use be pedagogically appropriate. Teachers require inservice workshops and other experiences to assist

them in understanding the uses and limits of software and hardware. Appropriate uses are not necessarily (or even usually) those that are advertised by manufacturers. Teachers have to be helped to understand that the range of future uses is not completely known and that as professional educators they can develop new and creative uses for ICT in their classrooms. Would anyone reading this paper be prepared to state the future use of ICT in Saskatchewan classrooms in the next two, five and ten years? How much would you be willing to bet that your list is correct? Likely a little on the two-year list, probably almost nothing on the ten-year list.

Some concerns and myths about ICT

Educators have learned a lot from educational research about how students learn and what types of experiences are most appropriate for particular developmental levels. As the result of his research with his own children, Piaget (1954) described developmental stages of children based on the type (level) of knowledge with which they could think or function. For purposes of this paper, the concepts of concrete and abstract thinking are sufficient to describe an issue that, I think, has not been discussed sufficiently. Some proposed uses of ICT in classrooms are not appropriate for the developmental level of the students. Educators know that certain types of activities and instruction can not work with younger students because they do not yet think abstractly. Some proposed uses of ICT require students to learn on their own in isolation with little supervision. For example, some suggestions for ICT involve elementary students studying at home with little or no teaching supervision. They are to sit in front of a computer monitor working through computer assisted learning exercises. Although this approach may be appropriate for adult learners who work from more intrinsic motivation, it is unlikely to succeed for younger students.

Many proposed educational uses of ICT appear to be based on a view of teaching as transmission of knowledge from a teacher or computer to a student who learns through simple reception of the transmitted knowledge. Over the last couple of decades this transmission model of learning has been thoroughly discredited. Learning is now accepted as individual knowledge

construction in a social setting. Individual knowledge construction (von Glasersfeld, 1995) and social constructivism (Vygotsky, 1978) are widely extolled as excellent theoretical descriptions or students learning (see for example, Brooks and Brooks, 1993). In spite of this many applications of ICT seem based on a transmission model of learning, even though constructivist language is used in the description.

Constructivism as a learning model has received a great deal of attention during the past two decades. If student learning is viewed as individual knowledge construction in social environments then experiences that students have in classrooms should be designed as if learning occurred in this manner. As much as learning may have seemed to occur by reception of transmitted knowledge, research in learning and psychology has showed that learning happens as the result of individual cognitive activities by learners. Students individually construct knowledge to bring meaning to the many phenomena and experiences that occur in their lives. As experienced teachers know, they interact with each student individually based on his/her own learning needs, not through some programmed series of responses. Feedback is tailored for each student. This caring immediate response and interaction from teachers is an essential part of learning, especially for younger children. If, as many educators recommend, we adopt constructivism as a model of learning, then instructional strategies and classroom activities must be chosen to be consistent with that model.

The Common Essential Learnings include communication, and personal and social values and skills as two of its components. Students must work with others in order to learn how to interact with people. A significant part of the social skills and knowledge required to function in our society are developed as the result of classroom activities and interactions that occur in K-12. This role of education is not described in the foundational or learning objectives in our curriculum guides, but nonetheless this development is a crucial and important goal of education. While some aspects of communication skills can be developed through interactions using a computer, other important forms of communication can not be. In our society the ability to read non-verbal signs of communication is extremely important in understanding others; body language, facial

expressions and voice tone are not communicated using computers alone. Students and people in general would be at a considerable disadvantage in the world, if they had never experienced face-to-face communications with others.

The adoption of technology in North America has led to a downgrading of personal experience and knowledge in education (Postman, 1991; Franklin, 1999). We are tending to devalue our common sense (experiential knowledge) in making decisions about what is supposed to occur in classrooms. For example, our common sense tells us that computers and ICT can not replace teachers. In spite of this knowledge we listen to arguments that performance on standardized exams by students taught by computers is as good as those students taught by teachers and begin to wonder if teachers can be eliminated from instructional roles. This view does not make sense to us but we do not question whether the test used assessed everything that we expect students to learn in a classroom. Fleming and Pain (1996) found that parents in rural communities were very clear about the expectation that their children should be in the presence of teachers and other students. These parents were adamant that teachers must remain an integral part of their children's education. In spite of this common sense conclusion we persist in speculating about the replacement of teachers with ICT. Alternative means of delivering curriculum should be considered but not without the presence of teachers.

Another claim frequently heard from proponents of ICT is that students will be able to interact using email with the actual scientists (or writers, or other professionals) who made discoveries or wrote books. The argument goes something like this, "who better to explain the discovery than the person who made it." Sooner of later, reality will set in. First, scientists (and other professionals) will not have the time to interact with a significant number of students, any more than famous actors have time to answer all their fan mail. Second, a teacher may well be able to explain a discovery better to students in his/her classroom than the scientist who made the discovery is able to do. Scientists who work at the frontier of knowledge are not known for their ability to communicate their ideas and findings in ways that are clearly understood by adults, let alone children and adolescents. Some of the hype and dreams that pass for policy development

are just that, hype and dreams. We cannot plan our classroom use of ICT based solely on such claims and dreams. Teachers and students have to operate in actual classrooms regardless of how they are configured or where they are located. ICT will create some innovative instructional aids but without professional teachers' guidance and planning, chances of general successful educational applications are slim.

Lastly, if we look at predictions made about computers in the last decade or so, many have not come to fruition in quite the manner predicted. For example, computer communications have not eliminated paper from our lives; in fact, we are not even using less of it. Computers have a have life expectancy of three to five years, which means that they must be replaced much more frequently than ever imagined or predicted. Bill Gates argued not long ago that no one would ever need more the 640 kB of memory. The quality of computers has increased as they become faster and have greater memory capacity; however, the demands and costs of new software are constantly increasing because new versions of programs require ever more powerful machines to run them. The wonderful "486" machine of a few years ago becomes a paperweight or doorstop when a new piece of software is chosen with memory requirements that exceed those of the "486". Many organizations have had to replace all hardware simply because the latest generation of programs does not run on older machines. This cycle of perfectly planned obsolescence has important funding ramifications for school divisions.

Professional development and teacher education

I realize that the opening sections of this paper may leave readers with the impression that I am opposed to ICT use in the classroom. I am not, but I want the readers to be aware of some practical limitations that I see as inherent in the adoption of ICT. The assumptions that I made in the first part of the paper are reasonable and will require extensive professional development for practising teachers and a wider range of experiences for students in education programs. Few

educators at the elementary, secondary, post-secondary or graduate levels are currently integrating ICT into their classrooms in ways that are meaningful to students and pedagogically appropriate. We do not want to waste our ICT resources that required considerable expenditures of money. Without appropriate professional development for teachers, waste is precisely what will happen and has happened in some schools where computers sit idle (some still in boxes), or where they are used by students to "surf the net" with little direction or plan. The Internet and World Wide Web can be a very ugly and unfriendly place to explore. Without proper supervision and censorship, students (especially younger ones) are in some danger if allowed unlimited access to web sites. Extensive practical workshops and other opportunities need to be provided for teachers and administrators so that they can learn about pedagogically appropriate uses of ICT for their classrooms and schools. We want our teachers to use ICT well and have to assist them in obtaining the necessary education to do so.

In March of 1997, I chaired a symposium of educational partners at the University of Regina. The focus of the discussions was what computer literacy skills our (U of R) education students should have upon graduation. Among the recommendations were that a single stand-alone ICT course could not provide the necessary skills and experiences for our students. The participants agreed that exposure to the uses of ICT had to be provided within the context of curricula that students would eventually be teaching. This recommendation has been supported by research (ISTE, 1999). This group recommended that students be shown a variety of instructional uses of ICT in our university classes, and provided with opportunities to develop pedagogically appropriate projects for use during internship and future teaching positions. Seeing practical applications used in their classes and working with ICT in hands-on activities was viewed as a powerful way to assist in raising the level of computer literacy among our graduates. During the past two and a half years many changes at the Faculty of Education have occurred. Students now see ICT used much more frequently in their education classes and have more opportunity to use ICT on their own in their teaching preparation.

One problem our faculty has faced is reflected in the provincial educational community. How do we provide professional development for our faculty? What form should it take? When no one knows definitively where ICT development is going to end, how are we to decide what to do? These concerns are faced by the school systems in Saskatchewan. Who has the capabilities required to assist others to develop the skills and knowledge necessary for integrating ICT into provincial curriculum and classrooms? In the following section of the paper I describe some ideas for professional develop that may be useful in Saskatchewan.

Preservice and inservice teachers

These suggestions are combined as professional development for both inservice and preservice teachers; however, practising teachers require less exposure to some aspects of the professional development because of their professional experience. For example, experienced teachers can identify applications of ICT for their own classrooms in ways that can not be expected of preservice teachers.

Most advocates argue for the integration of ICT into the curricula across subject areas wherever possible. That is, the use of ICT should not be restricted to computer science and computer applications courses, or computer labs. Students should have ready access to computers in each classroom for use in all courses. This approach is recommended because it is argued that students need to learn to use ICT while performing authentic learning tasks. Projects that are limited to being part of computer science or computer applications courses are viewed as too restricted to be engaging and relevant for all students. If this position is adopted, then all teachers (inservice and preservice) will have to acquire some working knowledge of computers, and considerable knowledge of how to use them in a variety of instructional approaches in their classrooms.

Students in teacher education programs need to be provided with opportunities to incorporate the use of ICT in their studies. Thus, preservice teachers need access to a variety of software and hardware with which they can experiment. They need opportunities to develop

skills that will enable them to assess and evaluate software for use in their classes. A software package may have only a small niche into which it can fit appropriately, and these niches can be determined only through critical examination and evaluation. Classroom use of ICT should be consistent with the goals of the Saskatchewan curricula and be age/grade appropriate. Because of the enormous rate of change of software titles and limited budgets, choices must be made wisely. The skills required to assess and evaluate educational software must be developed in university curriculum and instruction courses.

Technical knowledge

Another concern is to determine the level of technical knowledge that we can reasonably expect the majority of classroom teachers to have. This question is of considerable importance because computers do not have a reputation for flawless and uninterrupted performance. How many teachers can replace the bulb in an overhead projector on the fly during a class? What can we reasonably expect a classroom teacher to be able to do if a computer system fails? Probably a very limited number of skills can be part of a teacher's repertoire, because most teachers are unlikely to master the technical side of computers. They will not normally repair computers and such technical skill development is not likely to become part of their academic program at university. Even if a classroom teacher has the necessary skills and expertise to diagnose and fix such a problem, when will the repair be made? If diagnosis and correction takes more than a couple of minutes, then repairs must be done outside class time, because teachers can not take thirty minutes (or, in many cases, much more) to make a repair during class time.

These limitations of time and skills have implications for the support personnel that need to be available whether as division employees or contracted workers. Weiss (1996) argues that planners tend to underestimate the size of ICT systems in schools and divisions; and, consequently, underestimate the amount of technical support required to keep the system functioning. Owston (1997) echoes this concern by stating the K-12 systems generally do not have enough technical support. I will not address solutions to this issue here; rather, I raise the concern to remind us that repairs and downtime are not insignificant concerns of ICT.

Instruction and ICT

Student-centred classrooms, critical and creative thinking skills, problem solving skills, and facilitation of student learning in a manner consistent with a constructivist model of learning have been advocated as reasons to adopt more ICT in classrooms (Laferriére, Breuleux & Bracewell, 1999). While all of these goals/aims are desirable, none is dependent on ICT, or even made more easily achievable by ICT. All these characteristics should be developed with or without the aid of computers; however, they are dependent on the structure of the assignments given to students, the choice of instruction, and the relationship developed between teachers and students, not on the adoption of ICT. Constructivism is a model or way of learning and knowing, but does not imply a particular style of teacher instruction (Millar, 1989).

Independent and life long learning skills are argued to be another benefit of more extensive integration of ICT into the curricula (Laferriére, Breuleux & Bracewell, 1999). Every reader of this paper and essentially every adult in Canadian society are an independent and life long learner. No one today operates with only the skills and knowledge that they acquired during their K-12 education which may have been decades ago. Essentially all of us have learned a great deal throughout our lives whether in formal education, informal reading and learning, or from professional experience. These attitudes toward learning are extremely important to foster in our children but the development is being portrayed as dependent on ICT, which it is not. As learners we have developed them, but for most of us computers had not been invented, let alone been in common use, when we attended K-12.

Good teacher education programs need to prepare their graduates with solid foundations in instruction, planning, psychology, learning theory and classroom management. These skills and knowledge are not required in less degree, if ICT is integrated into the curricula. Responsible educators are not arguing that teachers need only to be able to install and to turn on a "learn to read" program, then stand back and let the computer teach young children to read. Current teacher education programs need to incorporate skills and knowledge about ICT as appropriate to

specific grade levels and subject areas but not at the expense of other instructional skills and knowledge.

What ICT for which grade/age levels

Another issue, which must be addressed, is to decide which aspects of ICT are to be integrated at which grade levels or in which courses. Asking for integration of ICT into the curricula seems like a simple request, but the reality for classroom teachers is that they already have such an extensive range of curricular topics/units to choose from that adding anything more is impossible without leaving something out. What are the appropriate elements of ICT to be taught to students in K-3, 4-6, 7-9, or 10-12? Our provincial universities are not the appropriate bodies to decide these policy issues. The responsibility for resolution of this concern falls to Saskatchewan Education and considerable work needs to be done to resolve this issue. For example, do we postpone learning to write or read so that students can learn to "surf the net" or learn to use computers in some other manner?

Distance Education

One area requiring considerable professional development for teachers is the use of ICT for various forms of distance education. In this paper *distance education* refers to situations where students are not in the same location as the primary teacher(s). Distance education courses can be accessible on the Internet, broadcast over SCN (in Saskatchewan), provided as one of the courses available from the provincial correspondence school, or by other means as they are developed. Currently, distance education is being used in a variety of forms in rural and northern schools where traditional means of curricula delivery are limited because of resources and personnel. Although most educators think primarily about the teacher who at a distance, consideration should be directed to the role of teachers in receiving locations. This teacher will have an increasingly important role to play in distance education; however, means of assisting students who are accessing distance education has not been explored to any extent. In the future classroom teachers in the receiving area/location will become an important component of distance education.

In preparing this paper I informally interviewed two persons who had taught using televised forms of distance instruction. One taught Calculus 30 and Geometry 30 using SCN facilities to grade 12 students at remote locations in the province; the other, using SCN facilities, taught university courses to off-campus students. Their comments about their experiences provide some guidance about the kind of education that could be provided for inservice and preservice teachers who are going to be involved with some form of curriculum delivery through distance education.

Both instructors indicated that the flow of their lessons was quite different from their regular classroom experience. This characteristic was not identified as a technical problem; rather, it was the result of not being in the direct presence of their students. No immediate feedback from students was available and this lack made pacing of lessons more difficult than in regular classrooms. Students enrolled in the Geometry 30 and Calculus 30 classes were in contact by phone and fax machine, and had real-time video of the teacher as he taught his class. The instructor emphatically declared that this means of communication was not the same or as immediate as personal face-to-face contact. Both instructors stated that their lessons had to be carefully scripted because "dead air time" is a problem in this form of instruction. Even referring to ones notes or lesson plan was perceived differently in distance education than in a regular classroom. Both instructors felt that the sending teacher should be a "sending specialist" because of the skill development necessary for this form of teaching. Teacher education programs could develop courses and facilities to allow preservice teachers to develop the skills and knowledge necessary for this type of instruction. Once developed these courses and facilities can also be used to deliver professional development for classroom teachers.

The second role in distance education involves the supervising teacher (or teacher aid) in the classroom at the receiving end where the student(s) is (are) located. These students need not be left completely on their own. Very little has been written about the role of teachers at the receiving end in the learning process. Courses and workshops should be developed to provide preservice and inservice teachers with opportunities to learn how to assist students who are taking

courses through distance education. The skills and knowledge developed to assist learners in distance education will undoubtedly have application is assisting students to effectively use computer-enhanced instruction in their courses. We have not yet developed an instructional model that includes a classroom teacher or other instructional assistant in the process of using ICT in distance education. Distance education models usually assume that students work through their learning problems without assistance. Teachers and other mentors in the proximity of the students are going to be asked questions, but little has been done to examine how teacher/mentor interactions can be most effective to assist students who access distance education instruction.

On-going support for teachers implementing ICT

Richmond (1997) has written about "just-in-time" support (assistance) which is designed to be available on very short notice to teachers working with ICT. In this model expert support personnel are available to assist teachers as they plan the integration of ICT into their instruction. Richmond argues that teachers need just-in-time support because studies show that they abandon ICT usage when stymied by some aspect of its use. This abandonment is entirely understandable because teachers do not have long periods of time to solve technical and operational problems. In one model of ICT implementation teacher-librarians act as the main source of support. Having one person provide support and guidance for all teachers in a school and knowing all programs and applications used by them seems to be a very demanding if not impossible task for one person whether he/she is a teacher-librarian or other designated guru. This model is difficult to imagine in a workable implemented form that does not involve teacher-librarians burning out. A charismatic expert might achieve this kind of support but few such persons exist. ICT implementation policy should not be dependent on one person with "super-expertise

An alternative model of professional development would be for an individual teacher to become an expert on a particular (software) program and act as mentor to other teachers who wish to use that program. The expert teachers could provide advice about appropriate uses through a provincial web site maintained by Saskatchewan Education or at workshops. Developing this sort of expertise takes time; however, most teachers do not have significant

amounts of spare time to spend becoming experts on a program. Development time will have to be provided in some manner by individual school divisions or by Saskatchewan Education. Success is more likely to occur if development of skills and knowledge is achieved through some form of release time, or if teachers are paid directly to develop expertise and assist others.

Most software programs have built-in "help modules" which educators will have to make use of to answer some problems. Instruction manuals can provide much assistance for teachers. As the Internet becomes more sophisticated, on-line help will be available for many programs, especially those produced by major corporations. If ICT is to be used commonly in classrooms, teachers will have to learn other ways of overcoming problems with programs and equipment. They will have to demonstrate problem-solving skills and life-long learning. This issue will be on going because hardware and software are far from perfect, and teachers constantly must balance development time against instructional classroom payback. If the payback does not show in the classroom, teachers will not spend many hours preparing instruction using ICT. In other words three hours of preparation must produce more than thirty minutes of classroom activity.

Developmental Semesters

Each school division has unique problems and concerns in delivering CORE Curriculum. Solutions will be most suitable if they are developed locally rather than imposed from above. Saskatchewan Education will have to provide support for locally developed solutions, but should not limit them to a few standardized formats.

One form of support would be to provide funding which would allow a teacher (or teachers) chosen by a division to have a "developmental semester." During a semester (or other period of time) teachers would be freed from teaching and supervision duties, charged with exploring a local concern, and developing a plan for resolution, which would be implemented at the end of the "developmental semester". In this way local teachers who know the resources and personnel in an individual community could construct a viable resolution to the concern or problem.

The provincial universities could provide advice and support as requested. Collaborating faculty could report locally developed solutions in a more formal manner as research. The solutions should be published in a written format and, more easily accessed, on an Internet site (maintained by Sask Ed). Such publications and posted solutions would then be resources for other teachers with "development semesters". In some cases the work accomplished by the teachers might fulfill part of the requirements for postgraduate degrees. The major concern, however, is funding. How do divisions find money to relieve teachers from their regular duties when budgets are already under strain? A provincial program could be created to fund special projects much as has been done on other occasions in the past. The key feature of this proposal is that teachers in a division would be working on a problem of delivery that is related to their own schools and communities.

Implications for postgraduate students and programs

The provincial universities have different mandates than do school divisions and classroom teachers. Faculty members and graduate students are required to carry out research projects and disseminate the results to the research and education community at large. Some research projects could serve multiple purposes by assisting teachers to acquire skills, knowledge and postgraduate degrees, solving school divisions problems and producing publishable research for faculty members. Thoughtful collaboration between educational partners in the province can produce obvious benefits to all.

Many aspects of integrating ICT into the provincial curricula require research and development. I am not speaking of standardized tests to see if students learn as well as with more traditional instructional approaches. I mean research and development that lead to more effective uses of ICT in education. Many practising teachers are interested in exploring ICT and its applications to education and could enter postgraduate programs that provide facilities to explore these interests. In the next section I describe a facility that could serve undergraduate and post-graduate students, and the provincial education community.

A proposal for a research facility

Establishing an ICT facility at a university (or close to one) would facilitate research and development, and provide opportunities for professional development for inservice and preservice teachers, and administrators. The kind of facility I envision would have state of the art hardware (provided through partnerships where possible to avoid the necessity of replacing costly equipment every few years), and have access to current educational software. The facility would be designed around an ICT classroom, which could act as both a receiving classroom for distance education and as a classroom to model the use of ICT in practical applications. A sending (or transmitting) facility would be located in the same building so that feedback about instructional strategies could be provided immediately.

This facility would have uses for all educators and payback to the partners who contributed to the project. Preservice teachers would be able to use the facility to develop skills required for classroom use of ICT. They could explore various approaches to distance education at both the receiving and sending ends allowing them to experience some realities of classroom ICT use and distance education. The sending facility could be connected to classrooms in near-by schools, which would allow elementary and secondary students to be part of the developmental process. These students could point out deficiencies and strengths of a particular distance education approach more rapidly than any group of adults.

During the school year or in the summer, workshops could be held for inservice teachers and administrators. These workshops would be designed to assist participants in understanding the strengths and weaknesses of ICT and to help them design other uses appropriate to their individual situations. Graduate students could interact with all levels of educators to design research that would examine various components of projects. The partners would benefit in that they would receive feedback about the hardware and software from educators in a variety of educational roles. Such feedback would be invaluable in designing newer versions of software and hardware. The facility could also be used to develop software for educational purposes.

Closing thoughts

Public demand will ensure that some ICT is integrated into the classrooms of Saskatchewan. The most important consideration is that ICT act a resource and tool for students and teachers, and not come to drive education in the province. Student learning will always be a slow, challenging process and teacher instruction will always be a challenging and rewarding process. Learning is a cognitive process that occurs in the minds of students as the result of knowledge construction that individuals carry out to make sense of their experiences. ICT does not and will not change the way people learn. Knowledge building is an individual process and can not be handed over to computers. ICT must not be portrayed as a technological panacea for educational concerns.

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