Evaluating technologies for team learning in health sector workers: a review and synthesis of the literature and recommendations for future research

Prepared for the Office of Learning Technologies (OLT), CANARIE Inc., and Health Canada

Table of contents

Executive Summary

This report is a result of a systematic review of the literature pertaining to technology support of team learning in health care. It was conducted with the intention of identifying gaps in the literature and making recommendations that focus future research on these gaps. Although many theoretical papers and reports of pilot studies were reviewed, few made recommendations on the establishment of technology-supported programs of team learning in health care.

Models for future directions in health care education stress the integration of practice and learning and the benefits that flow from professionals working in communities of practice. The continuum of professional education, including undergraduate, postgraduate, residency and continuing education is largely perceived as a single process. It is recognized that patterns of learning and practice acquired in undergraduate education are reflected in future professional activity where the need to adapt to change, generate new knowledge, and continuously improve performance identifies lifelong learners. Thus, pedagogies that encourage a combination of practice and learning, such as problem based learning and multidisciplinary team learning, provide a vision of the future.

Technology is often cited as a means of facilitating styles of learning throughout the continuum. This is most apparent at the professional level, when time and geography often preclude opportunity for face-to-face meetings and professional learning. Additionally, technology permits access to information sources at the point of care in a just-in-time manner. This facilitates a different kind of learning, which is largely patient centered, and which responds to the immediate unmet information needs of practitioners. Educators seek to use this kind of information seeking as a basis for community and group learning within professional practice and patient care multidisciplinary teams.

Few studies demonstrate how organizational changes can be facilitated by information and communications technologies. Indeed, the literature provides little guidance on how to move pilot projects into permanently funded programs. While many studies of ICT supporting team learning among physicians and nurses were found in the literature; few described learning among teams consisting of nursing aids, technicians, health records officers and catering and maintenance workers in health institutions. Team learning provides opportunities for these workers, who have been traditionally viewed as support staff, to participate as equal partners in learning with physicians and nurses and be empowered to strengthen their identity as team members.

The development of inter-operable technological tools to support established programs of team learning is also not well documented. Although parts of technologies exist that address specific issues, products that specifically support information seeking and knowledge building are lacking. Additionally, models for evaluating both systemic implementations and the educational and health outcomes of technology mediated practice-based learning are lacking.

The report recommends that future researchers focus on the gaps found in the literature. The greatest return on investment at this point would most likely be related to research into the evaluation of ICT mediated team learning. If models for evaluating point of care and group learning were developed and universally adopted, organizational change resulting from practice-based learning would in effect be promoted and lifelong learning supported. Once this is done, models should be developed for the evolution of multidisciplinary health care teams involved both in just-in-time negotiation of patient problems, and in intentional learning. As well, models for communities of learning with practice groups should be developed. Such models would support organizational and policy changes needed to systemically deploy lifelong learning in the context of current health care practice.

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Structure of the report

This report synthesizes, critiques and identifies gaps in the literature pertaining to the uses of information and communication technologies (ICT) to support and enhance multidisciplinary team learning and practice performance in the health sector. A systematic search of the literature on studies in the following four areas was undertaken:

- Multidisciplinary teams and communities of practice;
- Application of ICT to support learning;
- Workplace learning in health-related fields; and,
- Knowledge building and its application to practice.

The searches identified articles that pertain to ICT support for multidisciplinary and interprofessional team learning and its relationship to practice and performance enhancement in the four areas of study. A classification of the ICT reported in the literature is provided in appendix 1. The search strategies and annotated bibliographies pertaining to the four areas of study are shown in appendices 2 - 5.

Expected Benefits

This report makes recommendations on the direction that research into ICT support of multidisciplinary and interprofessional team learning in health sector workers should take. Its main goals are to assist researchers to focus their studies on health workers and areas of practice with the greatest need for technology mediated learning; and to ensure that future research will generate useful information for funding agencies and policy makers. A secondary result is that the recommendations will encourage industry to develop ICT applications that assist health sector workers to continuously update their skills and maintain a high quality of health care for Canadians.

Definitions and assumptions

Multi-disciplinary, inter-professional teams will deliver healthcare in the 21st century

There are compelling forces for health care to be delivered by teams of professionals working in group practices, institutions and academic centers. Most will work in service-delivery networks thus overcoming the isolation and secondary role played by community based services in traditional care delivery models. (Frankford et al, 2000) Increasingly, teams are becoming *multidisciplinary*, in the sense that doctors, nurses, and dietitians, for instance, form the diabetes care delivery team. As well as delivering care of the highest quality, teams provide opportunities for workers, such as nursing aids and technicians who have been traditionally viewed as support staff to participate as equal partners in collaborative learning and be empowered to strengthen their identity as team members.

Health care teams are also becoming *interprofessional* in the sense that professionals that are not traditionally seen as health sector workers, such as basic scientists, librarians and information specialists are also being integrated into care delivery teams. Governments have shown an interest in testing models based on this vision, as evidenced recently by the announcement by Jane Stewart, Minister of Human Resources Development Canada (HRDC) of a human resources sector study to examine existing and emerging models of health care delivery.

The adoption of interprofessional and patient centered care is in part driven by an aging demographic that has repositioned complex continuing care and rehabilitation medicine at the forefront of health care in Canada. Patients from these health sectors typically have complex clinical presentations and are treated by a variety of health care professionals, establishing a need for professionals from diverse backgrounds to collaborate for purpose of learning and practice. Operationalizing interprofessional and patient centered care models in daily practice, however, remains a challenge.

Practice-based learning will replace traditional modes of health professional education

The vision of a new working style for care providers is occurring at a time of dramatic changes in the education of professionals and in the information and communication technologies that support their learning activities.

In the changing environment in which the health care system operates, training of health sector workers must go beyond the acquisition of knowledge, skills and attitudes needed for traditional practice. Professional education must produce lifelong learners, defined as individuals who have the ability to adapt to change, generate new knowledge, and continuously improve performance. (Davidoff, 1996) To achieve this lofty goal, students and trainees must be provided with opportunities to construct their own learning using problem solving experiences. So doing they must engage in reflection and, by interacting with peers and practitioners, recognise and respect differences in perspectives.

It follows that providing a work environment that encourages practice reflection and information sharing enhances the learning and practice behaviors of health professionals and trainees. (Barr, 2000) Many are already working in multidisciplinary teams and communities of practice, a term used by Wenger (1998) to describe *working groups of people who place high value on the integration of learning and practice.* In communities of practice, the teaching traditions of undergraduate, postgraduate and continuing education are blurred as students and trainees naturally work and learn alongside practitioners. The term *service learning* is used by Cauley et al (2001) to indicate "*a method under which students learn and develop through active participation in ... organized service experiences.*. ". Students also learn and acquire professional identity from informal interactions with practitioners in the community. Nurses belonging to a team, for instance, lunch together with student nurses and exchange practical tips gleaned from the reconstruction of practice experiences. This type of information, referred to as tacit knowledge, is as important as specialized knowledge in patient centered care delivery systems. (Brigley et al, 1997)

The vision for the future requires continuing education and learning, to be repositioned from its traditional role of being a developmental tool for the self-motivated individual to a strategic tool to enhance team performance and health outcomes. In-service training has traditionally been a process undertaken by the individual and best done at a location that is free from the distractions of the workplace. Health care workers, faced with the increasing pace of change, can no longer depend on intermittent attendance at refresher courses to keep up to date. To qualify as lifelong learners, practitioners will continually interact with other members of the team as they revisit assumptions, revise previously learned concepts and implement new practices. Research is required to prove the hypothesis that ***team learning*** of this intensity translates into enhanced practice performance and improved outcomes for patients.

Knowledge management is integral to team learning in practice

The field of knowledge management (KM) provides a framework for a number of activities that support practice based learning. First, it pro-actively captures both the experiential knowledge that is intrinsic to practice, and the empirical knowledge derived from the outcomes of practice; and second, it operationalises healthcare knowledge to serve as a decision-making resource, providing, for instance, trend-predicting insights, workflow analysis, and procedural guidelines. (Abidi, 2001) ICT applications that support KM may not be perceived as tools to enhance learning in the traditional sense. However, they provide the knowledge and direction that ensures that learning is relevant and shared among team members. ICT supported KM creates the organizational learning and the "corporate memory" that is essential for the team to learn from adverse events and failures as well as successes. Equally important, KM, by demonstrating the impact of learning on team performance and practice outcomes, provides evidence of return on investment in team learning, which greatly contributes to the sustainability of projects after the pilot or implementation phase.

Information literacy is integral to decision making and learning in practice

Information literacy refers to the ability to collect, store, collate, retrieve and use information to solve complex problems. It is central to the development of the knowledge base and wisdom that distinguish high-level performers. According to Limberg (2000), the interaction between information seeking and learning primarily concerns the use of the information. The need to provide decision support for health professionals at the point of care has focused research in this field. Many projects have studied the incorporation of technology as a support for quick and familiar access to databases of medical information. Also, data systems that offer peer suggestions can provide front line error recognition, although the key to enabling technology to enhance patient safety includes the integration of the decision support systems into medical devices and practice in a seamless manner. ICT that support decision making by health professionals should be perceived as e-learning tools since this kind of information seeking is the basis for learning within multidisciplinary teams. It makes sense for organizations to take into account the "digital divide" and make efforts to address the inequitable distribution of ICT resources and learning opportunities that presently exists within and between professions. Researchers should be encouraged to study the role of ICT not only in enhancing the learning of individuals, but also in enhancing organizational and team learning and its translation into improved and safer delivery of health care.

Measuring return on investment is an important outcome for technology mediated learning in practice

Exploring options for a return on investment is essential to moving programs of technology mediated team learning beyond the research and pilot phases. Health care funders need evidence of how investment in ICT enhanced team learning can bring tangible returns for their institutions. The outcomes of studies of ICT supported team learning should include listings of specific incidents where changes in practice resulting in enhanced patient safety are instituted as a consequence of ICT support, for instance, in reviews of critical incidents and adverse events in care delivery. Information of this nature will emphasize the potential gain for institutions that continue the funding of ICT after the research and implementation phases. There are other measurable outcomes that may be viewed as return on investment in ICT support for team learning. Building trust and identity and relieving professional isolation, for instance, are benefits that promote retention of staff. Tying community activities to tangible outcomes is important because healthcare funders might make the

mistake of dismissing communities of practitioners as "soft" structures. Articulating the value of communities in terms of their tangible effects on performance provides them with the legitimacy they need to ensure continued funding.

The choice of technology also impacts on the sustainability of projects beyond the pilot phase. For instance, ICT applications supporting team learning in practice must be fully interoperable. Although the technical systems, support networks and information databases may operate from different platforms, they must present a seamless integrated system to users. The capacity for the integration of upgrades and new technologies over years is essential for health care funders to realize a return on investment in ICT applications in the workplace.

Principles

Adult learning principles rather than technological innovation must guide the integration of ICT into workplace learning.

A great deal of effort has been put into integrating various technologies at all levels of the continuum of health professional education: from e-learning at the undergraduate level, to providing online courses for practitioners. In many cases however, technology is used to perpetuate traditional ways of presenting new information, such as through lectures from experts. Yet current ICT applications are powerful tools for self-directed, interactive learning, which is more likely to result in improved practices and health outcomes than traditional continuing education methods. We contend that both the pedagogy and technology must be directed at supporting intentional learning for deep understanding, continuous problem solving, synthesis and innovation.

ICT should facilitate transformational learning

Traditional education largely focuses on acquiring competence (knowledge, skills, and attitudes) and enhancing performance. In today's complex world, we must educate not merely for enhancement of competence and performance in the traditional sense of applying what one has learned but for the enhancement of *capability*. Fraser & Greenhalgh (2001) define capability as the ability to adapt to change, generate new knowledge, and continuously improve performance. Capability is enhanced through activities such as feedback on performance, the challenge of unfamiliar contexts and problem based learning – all of which are provided when students, trainees and practitioners learn and practice together, which is the basis of transformational learning. We contend that capability as well as competence of team members and the team or organization should be an important outcome measure in studies of ICT support for team learning in practice. Similarly, Scardamalia & Bereiter (1993) distinguish between first and second order learning technologies, the former supporting knowledge reproduction (copy, delete, etc.) while the latter supports knowledge creation (innovation and transformational learning). Learning technologies to support teamwork should support higher order cognitive processes such as deep understanding and knowledge advancement.

Lessons learned from a review of the literature

A classification of ICT supporting team learning is shown in appendix 1. The annotated bibliography supporting the report is found in appendices 2-5. The published literature on ICT support of team learning in health care is mostly comprised of studies that use ICT applications that are at least 5 years old. However, most ICT that specifically focus on team learning activities, such as knowledge sharing, knowledge creation and facilitation of collaboration are less than 3 years old. Most reports in the bibliography relate to studies on ICT that are presently in beta-testing or pilot stages. Studies on their effectiveness to enhance learning have not yet been done. This is not surprising, as reports on the effectiveness of multidisciplinary teams in the delivery of care are still relatively few. However, several publications were found in which the authors use case scenarios and observations from pilot projects to describe the potential for ICT to support team functions including team learning in health care delivery.

Gaps in the research

Gaps in the types of health care workers studied

That significant gaps were found in the literature should not come as a surprise, given the state of infancy of this research. Most studies involved medical and nursing students and practitioners. The scarcity of studies of ICT support for learning among other groups such as nursing aids, health records officers, catering and maintenance workers, suggests that these groups of workers are in the category of under served learners. Few studies were found that involved patients or clients as part of the health care team.

Gaps in the types of ICT used to enhance learning

Most studies focus on the evaluation of traditional e-learning tools for individual learners, which are described as learnware in the classification shown in appendix 1. Few studies explore, and none were found that evaluate, models for systemic development of technology-linked multidisciplinary teams. As mentioned above, teams provide fertile ground for informal and intentional learning and could be greatly facilitated by technology-mediated communications.

Gaps in the choice of outcomes selected for study

The outcomes in many studies of *e*-learning by individuals consisted of levels of user satisfaction, while a few provided pre- and post test data as evidence of learning. Similarly, most reports on research in team learning use learner satisfaction as the outcome. Few were found that identify specific outcome measures based on the activities of successful teams.

Gaps in the research and evaluation methodologies

Most published studies utilize the traditional medical model whereby the ICT is evaluated as an intervention. There is a need to explore methods of evaluation beyond this traditional model.

Recommendations

The review of the literature and identification of gaps in the research has led to the following recommendations:

The research community should focus its energies on implementation studies that give under served health care workers opportunities to participate in technology-enhanced learning.

The scarcity of published studies of ICT support for learning among, for instance, nursing aids, technicians, health records officers and catering and maintenance workers in health institutions, suggests that these workers have fewer learning opportunities than physicians and nurses. Team learning provides opportunities for these workers who have been traditionally viewed as support staff to participate as equal partners in learning with physicians and nurses and be empowered to strengthen their identity as team members. On the other hand, there are members of the front-line professions, including medicine, nursing and allied professions, that are normally well served with learning opportunities, who also fall into the category of under served learners. In times of shortages of nurses and physicians, the reasons for their failure to take advantage of learning opportunities normally available to these professions need to be studied. The possibility that ICT may facilitate learning among these health care workers should be explored.

Studies should focus on implementation models for the systematic development of technology linked multidisciplinary teams.

Teams provide fertile ground for informal and intentional learning and could be greatly facilitated by technology-mediated communications. Although organizational and geographic barriers present challenges to the development of teams of health workers, such teams provide a solution to the delivery of high quality care, especially in rural, remote and northern regions of the country.

Research studies should use a wide variety of outcomes in the cost-benefit analyses of ICT support for team and organizational learning.

ICT support for learning may have its greatest impact on behaviors and outcomes that are not traditionally considered in health research studies, yet may ultimately affect clinical and cost outcomes and client satisfaction. For instance, working in teams may enhance provider satisfaction and the retention of professionals as well as its primary goal to enhance interdisciplinary team learning. Such evidence of a return on the investment will likely impact on the sustainability of a project after the implementation phase. Similarly, research studies that explore the ability of ICT to create a team culture of learning from inquiry and learning from situations of uncertainty should be encouraged. The processes involved in team learning, including knowledge sharing and collaboration between team members need to be measured using valid and reliable tools of measurement. These gaps in the research were also highlighted in the Report on Telelearning in the Health Sector (OLT, 2001) The inter and intra organizational changes facilitated by the use of ICT could spread beyond the realm of health care delivery. Technology has been documented to initiate cultural changes in organizations and corporations (Berge & Smith, 2000), and often these are not easily evaluated or documented, especially in the short term.

Projects with strategies to promote sustainability beyond the implementation phase should be given the highest priority.

For instance**,** interoperability is a characteristic of ICT that instills confidence in the minds of health care funders. ICT applications supporting team learning in practice must be fully compatible with existing equipment. The capacity for the integration of upgrades and new technologies over years is essential for health care funders to realize a return on investment.

Studies that utilize research methodologies beyond the traditional (intervention) medical model should be encouraged.

The following innovative evaluation methods deserve consideration.

- The potential for ICT applications may best be identified and measured by studies that utilize action evaluation or design experiment methodologies. Action evaluation focuses on defining, monitoring, and assessing success. Rather than waiting until a project concludes, action evaluation supports project leaders, funders, and participants as they collaboratively define and redefine success until it is achieved. Because it is integrated into each step of a program it is purported to significantly enhance program design, effectiveness and outcome.

- Similarly, design experiment methodologies (Brown, 1992; Collins, 1999) embed continual evaluation and redesign into the methodology and argue in favor of the researcher playing an active equal role to participants in the project or collaborative enterprise. Collins (1999) notes 7 hallmark differences between traditional experimental design (medical model) and design experiment methodology including: 1) laboratory settings versus messy situations; 2) a single dependent variable versus multiple dependent variables; 3) controlling variables versus characterizing the situation; 4) fixed procedures versus flexible design revision; 5) social isolation versus social interaction; 6) testing hypotheses versus developing a profile; and, 7) experimenter versus co-participant design and analysis.

- Wilde and Swatman (1999) introduce the concept of ICT enhanced communities in which the evaluation of the technologies focuses on how the community takes advantage of the ICT rather than how the ICT impacts on the team. In this approach applications would be judged by the rate of adoption of the ICT.

- The business world seeks to determine return on investment (ROI) for ICT applications as its traditional form of evaluation. ROI, in the context described above, is probably a better predictor of sustainability and more likely to command the attention of funders and policy makers than traditional outcome measures.

- Cheuk (2000) reports on information literacy research that seeks to determine how people naturally seek, and use, information from a user-centered perspective. Evaluation, termed sense making, is based on the assumption that ICT in support of team learning should focus more on bringing out people's natural information seeking and learning behaviors. It provides an innovative alternative to the traditional approach of imposing experts' standards on what "effective' information seekers and users should do.

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Limberg, L. (2000). Is there a relationship between information seeking and learning outcomes? in C. Bruce and P. Candy (Ed.) *Information Literacy around the world. Advances in programs and research* (pp.193-207), published by Charles Sturt University.

Fraser, S. & Greenhalgh, T. (2001) Complexity science: Coping with complexity: educating for capability *British Medical Journal,* 323: 799-803.

Berge, Z. L, & Smith, D. L. (2000). Implementing corporate distance training using change management, strategic planning and project management. In L. Lau (Ed.), *Distance learning technologies: Issues, trends and opportunities* (pp.39-51). London: Idea Group Publishing.

Wilde D.W. & Swatman P.A. (1999) A preliminary theory of telecommunications enhanced communities.

Cheuk, B.W. (2000). Exploring information literacy in the workplace: a process approach. in C Bruce and P Candy (Ed.) *Information Literacy around the world. Advances in programs and research* **(**pp.177-191), *published by Charles Sturt University.*

Scardamalia, M., & Bereiter, C. (1993). Technologies for knowledge-building discourse. *Communications of the ACM,* 36(3), 37-41.

Appendices

1. A classification of ICT supporting multidisciplinary team learning
2. Annotated bibliography pertaining to multidisciplinary teams and communities of practice
3. Annotated bibliography pertaining to the application of ICT to support learning
4. Annotated bibliography pertaining to workplace learning in health-related fields
5. Annotated bibliography pertaining to knowledge building and its application to practice.

Appendix 1

A classification of ICT supporting multidisciplinary team learning

Practice support systems
Technology applications that can assist practitioners to integrate learning with practice

- **The electronic medical record:** This is an essential component of knowledge management systems designed to assist health care workers to enable the identification of learning opportunities in practice and support an information system that collects, codes and shares tacit knowledge derived from adverse events and critical incidents.
- **Electronic prescription systems**: These function as front line detection for medical errors, dosing errors and drug interactions. Each detected error is an educational opportunity using the model of Morbidity and Mortality reviews, where care providers have traditionally openly discussed specific medical errors and ways of avoiding them in the future.
- **Electronic learning portfolios and learning diaries**: These tools assist health professionals to record and codify learning items derived from practice. They assist professionals to reflect on the interface between new information, its relevance to their expertise, and its potential to impact on their practice or professional activities.
- **Personal Digital Assistants**: These are increasingly used at point of care both as an information source, and decision support system, and as a means of coordinating patient care with the rest of the health care team. As well, PDAs can be linked to network resources to facilitate team communication and just-in-time learning.
- **Error-detection in medical devices:** These are systems functioning within existing devices that provide front line warnings about potential errors. They can alert practitioners to changes in patient condition, potential drug interactions, etc. These can be part of the learning process as well, if the errors averted through their use become part of the information delivered to the community of learning.
- **Expert Systems:** These are intelligent computer systems that provide interactive decision models for a variety of purposes. These include diagnostic and treatment software used by physicians; decision models that present clinical practice guidelines to physicians; and, software for recommending insulin regimes for diabetics. Expert systems facilitate team and consumer learning at the point of care.

Health information systems
Searchable databases of medical information that practitioners may use at the point of care

- **Network-based databases**: These are readily accessible to the health care team at the bedside and community clinics. Such databases, especially when wedded with portal access that facilitates powerful searching and retrieving capabilities and

geared towards medical practitioner use, are poised to transform just-in-time learning at the point of care.

- **Medical libraries and online knowledge services:** Medline, Osler and Stanford Skolar MD are examples of information services with search capabilities of varying sophistication.

Communication facilitation technology

Technologies that support and enhance communication between team members

- **E-mail and listservs:** These remain the commonest methods of creating and sharing knowledge by multidisciplinary teams in hospitals and community clinics. They are familiar to most health care workers and are economic to install and maintain.
- **Network based and online collective learning sessions:** Distance education sessions that utilize multimedia technologies enable practitioners to participate in regional, national and international learning activities. ICT enabled telementoring, a process whereby learners can receive supervision from a mentor, is increasingly used by health professionals intent on learning a specific skill at a center located at some distance from their place of work.

Learnware: Software developed for intentional learning

Software designed for the individual learner who is intent on acquiring a specific skill set

- A variety of learnware packages have been developed and adopted in various situations. WebCT, TopClass, Centra Symposium, and Lotus LearningSpace are examples. Such packages inevitably contain a pedagogical basis that colors how learning occurs within the context of the types of communication the software supports. For instance, Centra Symposium attempts to mimic face-to-face lecture situations on-line. It supports a very hierarchical style of real-time communication. Students must virtually raise their hands and be acknowledged before they can speak. Control of the class is by design, very strictly regulated by this type of courseware. Software developed for a very formal type of instruction will not favor the development of the types of learning transactions within multidisciplinary teams that have been shown to be optimal.

Knowledge-Building Environments

Technologies that support knowledge building as well as knowledge management in teams

- Knowledge-building environments, of which Knowledge Forum is a prime example, require participants not just to learn but also to construct new knowledge collaboratively. Software functions and features of Knowledge Forum support advanced knowledge-building processes such as reflection, complex problem solving, synthesis, and innovation.

Appendix 2

Annotated bibliography pertaining to multidisciplinary teams and communities of practice

produced by
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The following data bases were systematically searched for publications that pertain to ICT support for multidisciplinary and interprofessional team learning and its relationship to practice and performance enhancement in the four areas of study

Databases searched	Limits	Search Terms Used
CBCA fulltext, Medline Plus, EI Compendex,Current Contents, Inspec, Biological Abstracts/RRM, Compendex*Plus, Canadian Research Index	1996 -	Communities of practice Interdisciplinary teams Multidisciplinary teams Patient care team Delivery of Health Care Integrated organization and administration Computerized organization and administration Hospital information systems – organization and administration Information Technology AND #1 - #6
MEDLINE/PubMed, OLDMEDLINE, LOCATORplus, MEDLINEplus, DIRLINE, AIDS Meetings, Health Services Research Meetings, Space Life Sciences Meetings, and HSRProj.	1996-	Interdisciplinary teams AND Information Technology Interdisciplinary teams AND Communication AND Hospital information systems Multidisciplinary teams AND Information technology Multidisciplinary teams AND Communication Communities of practice
EDRS	Feb, 1997 -	Communites of practice Interdisciplinary teams Information technolgy AND team* Communication AND team* Communication AND Communities of Practice
Stanford Skolar M.D.	2000 -	Interdisciplinary team AND Information technology Interdisciplinary team AND Communication Multidisciplinary team AND Information technology Multidisciplinary team AND Information technology Communities of practice AND Communication Communities of practice and Information technology

Searches on the World Wide Web using similar search terms produced relevant information from many sites, including:

www.ewenger.com The website of Etienne Wenger produced several articles on ICT support of communities of practice. One of the authors (JP) attended an online course provided by Dr Wenger in the Spring of 2001 on the topic of Communities of Practice. A number of the citations below were obtained from this course.

http://books.nap.edu/books/030906399X/html/R1.html#pagetop Being Fluent with Information Technology. Committee on Information Technology Literacy, Computer Science and Telecommunications Board, Commission on Physical Sciences, Mathematics, and Applications National Research Council.

http://www.aepro.org The Action Evaluation research Institute

http://www.york.ac.uk/inst/crd/welcome.htm The NHS Centre for Reviews and Dissemination (CRD), University of York

http://www.parc.xerox .com/ops/members/brown/papers/orglearning.html Organizational learning and communities-of-practice: Toward a unified view of working, learning, and innovation

http://www.learn.motion.com/lim/kf/KF0.html Knowledge Forum (see appendix 3)

Reference	**Frankford, D.M, Patterson, M.A, and Konrad, R.T. (2000) Transforming Practice Organizations to Foster Lifelong Learning and Commitment to Medical Professionalism. *Academic Medicine*, 175 (7) July, 708-717.**
Area of application	Implications of delivery of healthcare by multidisciplinary teams
Setting	Health care setting
Objectives	To provide new perspectives on the integration of learning and practice in the delivery of health care
Methodology	Vision paper
ICT	The potential for application of ICT is implicit
Results & conclusions	The authors propose that a new vision of lifelong learning can be realized if new or reformed practice organizations combine education and service delivery and institutionalize processes of individual and collective reflection. The resulting ‘‘institutions of reflective practice’’ would be ones of collegial, experiential, reflective lifelong learning concerning the technical and normative aspects of medical work. They would extend recent methods of medical education such as problem-based learning into the practice setting and draw on existing methods used in complex organizations to maximize the advantages and minimize the disadvantages that practice organizations typically present for adult learning.
Limitations	N/A
Suggestions & future directions	Technology’s potential is far greater than we are able to profit from and this raises a pertinent question: are we jumping too fast to technology solutions without an adequate understanding of the processes of learning and practice and how they will interplay in the health care systems of the future? There is a need to thoroughly understand how teams will work and learn. This article provides insights into how ICTs could be introduced to assist health care teams to capture and utilize learning in practice.

One of the authors (JP) attended a three week online course provided by Etienne Wenger in the Spring of 2001 on the topic of Communities of Practice. A number of the citations below were obtained from the cyber library that supported the course.

Reference	Wenger E, (2001) Communities of practice a general introduction to practical and theoretical uses of the concept. *Paper presented at The Winter 2001 Communities of Practice workshop by Wenger E.*
Area of application	Communities of practice
Setting	Non-medical organizations
Objectives	To assist the reader to better understand the concepts behind communities of practice.
Methodology	Description of observations and experiences
ICT	Shows potential for ICTS in communities of practice.
Results & conclusions	Description of COPs
Limitations	N/A
Suggestions & future directions	Shows the opportunities to apply COPs principles to team delivery of health care.

Reference	**Wenger E. (1996) How to optimize organizational learning.** ***Healthcare Forum Journal,*** **July/Aug 1996 p.22&23**
Area of application	Organizational learning
Setting	
Objectives	14 guidelines to help you work with rather than against the inner logic of organizational learning:
Methodology	Review article based on observations of the author
ICT	None, but shows the potential for ICT support of learning in practice
Results & conclusions	Provides the guidelines
Limitations	N/A
Suggestions & future directions	Provides a useful description of the working relationships between learning and practice in the business world

Reference	**Wenger E, (2001)** Communities of practice in organizations: stewarding knowledge. *Paper presented at The Winter 2001 Communities of Practice workshop by Wenger E.*
Area of application	Knowledge management in communities of practice
Setting	Non-medical organizations
Objectives	To assist the reader to view knowledge as a currency of exchange among members of communities of practice
Methodology	Descriptive paper
ICT	Shows potential for ICTs to assist in knowledge management in COPs.
Results & conclusions	Excellent review of knowledge in COPs
Limitations	N/A
Suggestions & future directions	Provides a vision of knowledge that extends beyond the traditional views upheld by professional educators

Area of application	Wenger E. (2001) Managing knowledge, learning, and innovation - may technology creatively enhance this dynamic trio? *Paper presented for discussion at The Winter 2001 Communities of Practice workshop by Wenger E.*
Setting	A discussion group at a workshop.
Objectives	To stimulate innovative ideas among workshop participants
Methodology	Review paper
ICT	Provides insights into how ICTs could assist with integrating learning, practice
Results & conclusions	This paper identifies three different levels of operation in an organization or team at which ICT applications may enhance knowledge management: mechanistic, organic and dynamic. In the mechanistic environment, information flows top down through predetermined channels and competencies are well defined. Management is acting authoritatively and the focus is on stability. The organic environment focuses on continuous and controlled development, the flow of information is interactive and employees are seen as c-operating individuals. The dynamic environment is the least structured environment and is characterized by constant changes, chaos and open and unpredictable relations. Management empowers employees to make choices and innovation is usually initiated here.
Limitations	N/A
Suggestions & future directions	Provides insights into how ICTs could be introduced to assist health care teams to capture and utilize learning in practice. Technology's potential is far greater than we are able to profit from and this raises a pertinent question: are we jumping too fast to technology solutions without an adequate understanding of the processes that are being affected by this change?

Reference	**Brown, J.S & Duguid, P. Organizational learning and communities-of-practice: Toward a unified view of working, learning, and innovation** http://www.parc.xerox.com/ops/members/brown/papers/orglearning.html
Area of application	Workplace learning
Setting	Major (non-medical) organizations
Objectives	To study the relationships between work, learning and the natural evolving communities of practice.
Methodology	Observational study
ICT	None
Results & conclusions	By reassessing work, learning, and innovation in the context of actual communities and actual practices, the authors suggest that the connections between these three become apparent. With a unified view of working, learning, and innovating, it should be possible to reconceive of and redesign organizations to improve all three.
Limitations	N/A
Suggestions & future directions	These studies clearly demonstrate the need for study of health care teams with a view to revising our thoughts of training, professional education and the environment in which these are carried out. At the same time we can seek opportunities for ICT applications that enhance learning and practice

Reference	McDermott, R. (2001) Designing Living Communities. *Paper presented at The Winter 2001 Communities of Practice workshop by Wenger E*.
Area of application	Communities of practice
Setting	Business (non-medical) organizations
Objectives	To assist readers to understand the concepts behind communities of practice
Methodology	Description of observations and experiences
ICT	Show potential for ICTs to enhance learning in practice
Results & conclusions	A good description of the concepts behind communities of practice
Limitations	N/A
Suggestions & future directions	Provides glimpses into how health professional education could benefit from studying relationships between learning, competencies and practice.

Reference	**Wenger E (2001).** Supporting communities of practice a survey of community-oriented technologies. *Paper presented at The Winter 2001 Communities of Practice workshop by Wenger E.*
Area of application	ICT designed to support communities of practice
Setting	Non-medical organizations
Objectives	How assist the reader to make sense of this emerging market and understand the potential of technology and set up a community platform
Methodology	Survey
ICT	Several hundred ICTs listed
Results & conclusions	This report is intended as a guide for selecting and assembling a technological platform to support communities of practice across a large organization.
Limitations	Descriptive paper based on survey data
Suggestions & future directions	This report provides insight into the facilities and functions of a community of practice that could be enhanced by the application of ICT.

Reference	**Shneier L (2001) Communities of practice at the World Bank . *Presented at an online course on Communities of Practice held by E Wenger in February 2001***
Area of application	Creating communities of practice within large organizations
Setting	The World Bank was created after WW 11 to assist in the recovery of war torn Europe. Knowledge and advice has always been included in our loans, which are for education, health, agriculture, etc. Since mid-1996, however, sharing knowledge for development has become the strategic thrust
Objectives	To describe how CoPs have formed naturally and contribute to the new thrust of the World Bank to become the Knowledge Bank: "We would make all our knowledge about development accessible and available to anyone, from anywhere; and, not just our knowledge, but that of our partners and clients, too". Said the President.
Methodology	This paper describes the development of CoPs . It mentions the use of ICT but only in passing. The paper emphasizes the value of face to face communications
ICT	Email; telephone/fax; and the web. No details of online use
Results & conclusions	Paper describes the enthusiasm that the staff has for CoPs. Return on investment is described in terms of success stories. "in an organization that is once more going through a trying time with budget cuts and redundancies, the TGs *(CoPs)* are performing a supportive role to their members".
Limitations	Paper does not provide details of ICTs used to support CoPs. Like most papers in CoPs, the emphasis is on the behaviors of members rather than the ICT used.
Suggestions & future diections	The paper provides a suggestion that funding agencies may consider. Funding agencies traditionally provide funds for researchers. Like the World Bank, Canadian funding agencies have the opportunity to position themselves as the knowledge managers for ICT support for teams in the health sector. They facilitate the research that creates new knowledge, determines the need for focused research and shares information on ICTs support for teams with health care funders and decision makers.

Reference	Jarrett P.G (2000). Logistics In Health Care. *Action Learning Outcomes*, vol. 1, no. 1, pp. 1-20 http://www.ingenta.com/
Area of application	Just in Time systems in health organizations
Setting	National Director of Logistical, Financial, and Administrative Systems, Kaiser Permanente
Objectives	The primary purpose of this study was to undertake a diagnostic investigation of the international health care logistical environment and determine if regulatory policies or industry procedures have hindered the implementation of Just-In-Time systems and then recommend operational improvements to be achieved by implementing Just-In-Time Systems.
Methodology	The analysis was conducted in a systematic manner and compared the anticipated benefits with those validated in other industries from the implementation of Just-In-Time systems.
ICT	JIT systems as they apply to the health care system
Results & conclusions	The research findings suggest that the health care industry would benefit from implementing Just-In-Time systems and re- engineering the supply chain could result in cost reductions without adversely affecting the quality of patient care
Limitations	N/A
Suggestions & future directions	This study applies the experiences of business and industry to the health care system and finds many similarities.

Reference	**Wenger E (2001) Supporting communities of practice: a survey of community-oriented technologies. How to make sense of this emerging market understand the potential of technology and set up a community platform.** ***Presented at an online course on Communities of Practice held by E Wenger in February 2001***
Area of application	Creating communities of practice within large organizations
Setting	This report is intended as a guide for selecting and assembling a technological platform to support communities of practice across a large organization.
Objectives	The paper answers the following questions 1. What are the characteristics of communities of practice that lend themselves to support by technology? 2. . What makes communities of practice different from garden-variety online communities? 3. What categories of community-oriented products exist and what are they trying to accomplish? *4.* How to use the answer to these questions to develop a strategy for building a platform for communities of practice?
Methodology	No explicit characteristics of how the survey was undertaken. The paper describes typical facilities and technological platforms that may be useful to a community of practice. A template is suggested for assessing software which includes description, functions, pricing advantages and disadvantages
ICT	While no one software has everything for communities of practice, many products have something. In order to understand the market and its future, Wenger suggests that it is useful to cast a wide net and consider the potential of a variety of community- and knowledge-oriented technologies.
Results & conclusions	The results are shown in the form of a graphic representation of the current market of community-oriented technologies in relation to the needs of communities of practice. The chart shows eight categories of related products that have relevance in considering technologies for communities of practice.
Limitations	Paper represents the direction that researchers into ICT support of team learning should take. It is not, and is not meant to be, a scientific evaluation of ICT support for team learning.
Suggestions & future diections	All of the product categories in the report represent activities that are important dimensions of a community-based knowledge strategy. They could be used to classify research projects and funding competitions

Reference	**Zwarenstein M, Reeves S, Barr H, HammickM, KoppelI, Atkins J. (2001) Interprofessional Education: effects on professional practice and health care outcomes. Cochrane Database Systematic Review. 1:CD002213**
Area of application	Interprofessional education
Setting	This is a review of studies on the impact of interprofessional education professional practice and health care outcome
Objectives	Using rigorous inclusion criteria, to review studies of the impact of interprofessional education on practice and health outcomes
Methodology	Randomized trials, controlled before and after studies and interpreted time series studies of IPE interventions designed to improve collaborative practice between practitioners and and the well being of patients
ICT	Non discussed
Results & conclusions	Total yield from search strategy was 1042, of which 89 were retained for further study. None met the inclusion criteria. Despite finding a large body of literature on the evaluation of IPE, these studies lacked the methodological rigour needed to begin to

	convincingly understand the impact of IPE on professional practice and/or health care outcomes.
Limitations	No information on the use of ICT
Suggestions & future diections	The review is important as it indicates the lack of evidence that traditional teaching methods have little impact in multidisciplinary team learning. How does ICT supported team learning differ and will it prove to have a better outcome.

Reference	Chan DS. (2001) Combining qualitative and quantitative methods in assessing hospital learning environments. *Int J Nurs Stud 2001 Aug;38(4):447-459*
Area of application	Assessing hospital learning environments.
Setting	The clinical learning environment created for nurses in training
Objectives	To develop and test an evaluation tool to assess the clinical learning environment of nurses in training
Methodology	Based on a theoretical framework of learning environment studies, a combined quantitative and qualitative approach was used to develop the evaluation tool.
ICT	No mention of ICT support
Results & conclusions	A valid and reliable tool was developed which can be used in future ICT research to determine the impact of ICT on the clinical learning environment of multidisciplinary teams of health care workers
Limitations	The paper does not assess the impact of ICT
Suggestions & future diections	A valid and reliable tool was developed which can be used in future ICT research to determine the impact of ICT on the clinical learning environment of multidisciplinary teams of health care workers. Knowledge of the existence of this assessment tool can be shared with researchers.

Reference	**Coiera E, Tombs V (1998). Communication behaviours in a hospital setting: an observational study *BMJ 1998;316:673-676 (28 February)***
Area of application	Potential for ICTs to enhance communication behaviors
Setting	British district general hospital.
Objectives	An exploratory study to identify patterns of communication behaviour among hospital based healthcare workers.
Methodology	Non.participatory, qualitative observational study
ICT	Not studied. Seeking opportunities for ICT to assist in communication and collaboration
Results & conclusions	Communication behaviours resulted in an interruptive workplace, which seemed to contribute to inefficiency in work practice. Medical staff generated twice as many interruptions via telephone and paging systems as they received. Hypothesised causes for this level of interruption include a bias by staff to interruptive communication methods, a tendency to seek information from colleagues in preference to printed materials, and poor provision of information in support of contacting individuals in specific roles.
Limitations	The paper does not assess the impact of ICT
Suggestions & future diections	This paper suggest that specific technologies (1998 vintage) such as Voicemail and email with acknowledgment, mobile communication, improved support for role based contact, and message screening may be beneficial in the hospital environment.

Reference	**Keen J, Wyatt J. (2000) Information in practice. Back to basics on NHS networking *BMJ 2000;321:875-878 (7 October)***
Area of application	ICT to support teams of health care providers
Setting	Large scale nation-wide networking
Objectives	To present data on NHSnet, the UK NHS e-network and contrast it with the internet.
Methodology	Estimates of costs and workload were obtained from surveys and data collection
ICT	NHSnet covers access to Internet, email, EMR, knowledge managemnt
Results & conclusions	Authors identify five criteria: cost-effectiveness, security, reliability, open membership, and sustainability that can be thought of as a general statement of user requirements for networking technology.
Limitations	The paper evaluates a national network, not e-networking for local teams
Suggestions & future diections	This paper identifies the criteria for networks and emphasizes the need for the training in order for staff to move from ”information islands of varying quality to a congruent linked community where data can move freely and be used to create helpful knowledge for clinicians beyond the capabilities of any paper record”. Comments on sustainability are important: “A sustainable networking strategy is one that allows individuals and organisations to change their own working practices, and the ways in which they use a network, and yet be able to continue to use the network without serious impediment. In effect this means that the economics of the solution, as well as the technology itself, must continue to make sense. In the case of information technologies, exposure to dynamic markets may lead to both cost reductions and innovations, which suggests that the NHS should use systems and software that are "open" and have many suppliers”.

Reference	**Kushniruk AW, Patel C, Patel VL, Cimino JJ.. (2001): 'Televaluation' of clinical information systems: an integrative approach to assessing Web-based systems. *Int J Med Inf 2001 Apr;61(1):45-70***
Area of application	Evaluating web networks in heath care
Setting	The development of innovative methods for assessing the effectiveness and usability of Web based information health systems
Objectives	To describe the distance evaluation (i.e. 'televaluation') of emerging Web-based information technologies.
Methodology	Estimates of costs and workload were obtained from surveys and data collection
ICT	Internet. Information systems, Email, discussion groups.
Results & conclusions	A framework is presented for conducting evaluations of health-care information technologies that integrates a number of methods, ranging from deployment of on-line questionnaires (and Web-based forms) to remote video-based usability testing of user interactions with clinical information systems.
Limitations	Descriptive paper using pilot work on small numbers
Suggestions & future diections	Issues in designing, prototyping and iteratively refining evaluation components are discussed, along with description of a 'virtual' usability laboratory.

Reference	**Patel VL, Cytryn KN, Shortliffe EH, Safran C (2000). The collaborative health care team: the role of individual and group expertise. Teach Learn Med 2000;12(3):117-132**
Area of application	Coallaborative activities in health care teams
Setting	Primary care unit
Objectives	To characterize the qualitative nature of team interaction and its relation to training health professionals, drawing on theoretical and analytical frameworks from the sociocognitive sciences.
Methodology	Activities in a primary care unit were monitored using observational field notes, hospital documents, and audio recordings of interviews and clinical interactions.
ICT	Not studied.
Results & conclusions	Distributed responsibilities allow the team to process massive amounts of patient information, reducing the cognitive load on individuals.
Limitations	ICTs not studied
Suggestions & future diections	The uniqueness of individual professional expertise as it contributes to the accomplishment of team goals is highlighted, suggesting emphasis on conceptual competence in the development of individual professional education programs.

Reference	McKeown K, Jordan D, Feiner S, Shaw J, Chen E, Ahmad S, Kushniruk A, Patel V. (2000) A study of communication in the Cardiac Surgery Intensive Care Unit and its implications for automated briefing. *Proc AMIA Symp* 2000;:570-574
Area of application	ICT facilitation of communication
Setting	Intensive care units
Objectives	To compare human-generated and machine-generated briefings study to evaluate a system, MAGIC, that developed for automated generation of briefings
Methodology	Experimental design
ICT	Customised ICT
Results & conclusions	MAGIC's current level of performance is useful. Moreover, MAGIC could help improve information flow in the CTICU by providing a consistent set of information earlier than in current practice. The separate standards are also consistent in suggesting specific modifications that may be necessary for iterative design and further system development.
Limitations	-
Suggestions & future diections	MAGIC is designed for communicating practice information, although the potential to capture learning and "corporate memory" of advers events and tacit knowledge is significant.

Reference	**Kushniruk AW, Patel VL, Cimino JJ (2000) Evaluation of Web-based patient information resources: application in the assessment of a patient clinical information system.** ***Proc AMIA Symp 2000;:443-447***
Area of application	Knowledge management in health care
Setting	Patient and care giver information
Objectives	An ongoing evaluation of a system known as PatCIS, designed to be accessed by patients from home for obtaining health information, and for management of chronic diseases.
Methodology	Employs a multi-method approach that involves collection of a rich data set, including Web-based questionnaires, automatic logging of user activity and e-mail communication with users
ICT	Custom ICT
Results & conclusions	This paper describes a framework for the distance evaluation of web-based information technologies.
Limitations	
Suggestions & future diections	This work in evaluation design is influenced from research in the areas of cognitive science and the field of usability engineering which aims to characterize the interaction of users with information technologies.

Reference	**Safran C, Jones PC, Rind D, Bush B, Cytryn KN, Patel VL (1998) Electronic communication and collaboration in a health care practice. Artif Intell Med 1998 Feb;12(2):137-151**
Area of application	Facilitation of collaboration
Setting	Health care delivery
Objectives	this study examines the effects of an electronic patient record and electronic mail on the interactions of health care providers.
Methodology	Uses cognitive evaluation techniques to evaluate communication and collaboration
ICT	Telephone, email,
Results & conclusions	the least structured communication methods are also the most heavily used: face-to-face, telephone, and electronic mail. Positive benefits of electronically-mediated interactions include improving communication, collaboration, and access to information to support decision-making. Negative factors include the potential for overloading clinicians with unwanted or unnecessary communications.
Limitations	
Suggestions & future diections	The least structured communication methods (email, telephone) are also the most heavily used:

Reference	**Carletta J, Anderson AH, McEwan R 1: The effects of multimedia communication technology on non-collocated teams: a case study. Ergonomics 2000 Aug;43(8):1237-1251**
Area of application	ICT support of teams
Setting	Two automotive supply chain teams
Objectives	To determine what support non-collocated teams need and the potential effects of introducing technologies on their group processes.
Methodology	Teams were observed while they were experimenting with multimedia conferencing. The observations included meeting recordings and other sources that show the organizational factors affecting teams
ICT	Two way video-conferencing
Results & conclusions	Communication technology can help teams if it is used to foster close and relatively informal person-to-person interaction. Organizational constraints on how the technology is introduced favour high-technology, special-purpose installations, but teams can best be supported using relatively modest equipment with desktop access.
Limitations	Case study
Suggestions & future diections	Confirms that qualitative methods can be used to provide data on which to base decisions

Reference	Syed Sibte Raza Abidi (2001) Knowledge management in healthcare: towards 'knowledge-driven' decision-support services International Journal of Medical Informatics 63 5–18
Area of application	ICT support for health care teams
Setting	Knowledge management systems for healthcare delivery teams
Objectives	1) Present a reference Knowledge Management environment—a Healthcare Enterprise Memory—with the functionality to acquire, share and operationalise the various modalities of healthcare knowledge. 2) Present the specification of a Strategic Healthcare Decision-Support Services Info-structure, which effectuates a synergy between knowledge procurement (vis-a ` -vis Data Mining) and knowledge operationalisation (vis-a ` -vis Knowledge Management) techniques to generate a suite of strategic knowledge-driven decision-support services.
Methodology	Descriptive paper with some pilot project data
ICT	IT to support data collection, knowledge creation and decisionmaking
Results & conclusions	The authors argue that the proposed Healthcare Enterprise Memory is an attempt to rethink the possible sources of leverage to improve healthcare delivery, hereby providing a valuable strategic planning and management resource to healthcare policy makers.
Limitations	
Suggestions & future diections	IT support of this nature is going to provide solutions to questions such as: how does the team get its curriculum for learning?; How is tacit knowledge captured and stored in the corporate memory? Etc. This paper provides insight into the limitations of the traditional use of the term "enhanced learning" rather than adopting the new terminology of KM.

Reference	**Cheuk, BW (2000). Exploring information literacy in the workplace: a process approach. Chapter 14 in Information Literacy around the world. Advances in programs and research. Edited by C Bruce and P Candy, published by Charles Sturt University,**
Area of application	Information literacy
Setting	Evaluating research into information literacy (IL)
Objectives	To describe a novel approach to research in IL called sense-making methodology
Methodology	Descriptive, giving examples, for instance from studies of how auditors seek and use information in their workplace
ICT	No specific ICT, but refers to the behaviors engendered by information systems in the workplace
Results & conclusions	Makes the case for the use of sense making assumptions and methodologies in researching information literacy in the workplace
Limitations	
Suggestions & future diections	This paper focuses research on bringing out peoples awareness of their natural information seeking and use behaviors, than on imposing expert standards on what "effective" information seekers and users should do. It shows relationships between learning and information literacy.

Reference	**Sonnenwald DH, Livonen M. (1999) An integrated Human Information Behavior Research Framework for Information Studies Library and Information Science Research, Vol 21, (4), 429 – 457.**
Area of application	Human information behavior in multidisciplinary teams
Setting	Design teams
Objectives	To explore different types of research methods and data collection in studies of human information behavior
Methodology	Description of case studies – content analysis, event sequence analysis and social network analysis
ICT	Information systems
Results & conclusions	The study developed a taxonomy of roles that facilitate collaboration in multidisciplinary teams
Limitations	None
Suggestions & future diections	When evaluating information behaviors in teams, research studies should consider the following facets: personality-refers to the actors or participants and their social network; matter- refers to the target of the action, including information resources and includes technology that provides access to information; energy- refers to the action itself and includes participant's tasks, processes and goals; space- is the environment of the action; and time – is considered an episode, interval or eon. ,

Reference	**Proust M. (2001) Action Evaluation Research .** http://www.aepro.org
Area of application	Evaluation methodology
Setting	Implementation projects
Objectives	To provide an evaluation technique that meets the needs of ICT projects.
Methodology	Action evaluation research
ICT	None
Results & conclusions	Action Evaluation is a new method of evaluation, one that focuses on defining, monitoring, and assessing success. Rather than waiting until a project concludes, Action Evaluation supports project leaders, funders, and participants as they collaboratively define and redefine success until it is achieved.
Limitations	
Suggestions & future diections	Action evaluation is more likely to meet the needs of implementation projects and provide useful information regarding challenges and successess. Of such projects

Reference	**Sonnenwald DH and Pierce L. (2000) Information Behavior in dynamic group work contexts: Interwoven situational awareness, dense social networks and contested collaboration in command and control. Information processing and management. 36; 461-479**
Area of application	Information needs for teams
Setting	Military
Objectives	To identify the types of information needs of multidisciplinary teams
Methodology	Description of case studies
ICT	None
Results & conclusions	**Understanding the complexity and texture of information-intensive and dynamic organizations and situations - Sonnenwald D and Pierce L (1999)** **In our analysis three themes or characteristics of human information behavior emerged as determinants of success. They are:** **1. Interwoven situational awareness appears to facilitate task completion (*Continuous extraction of environmental information, integration of this information with precious knowledge to form a coherent mental picture in directing further perception and anticipating future events*) . There also must be shared situational awareness among group members and a shared working understanding of the goals, identity and challenges among group members** **2. Dense social networks – what social structure network best maintains information flow between group members. Three types of Information – dynamic work goal and situation; Information about the work process; and information from specialized domains** **3. Contested collaboration – when team members have their own goals and priorities**
Limitations	None
Suggestions & future diections	This paper provides a classification of the information needs of a multidisciplinary team which may be used to determine how ICT can support information behaviors of group members.

Appendix 3
Annotated bibliography pertaining to the application of ICT to support learning

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Search Strategy

The databases listed below were systematically searched for abstracts that pertain to the application of ICT to support learning.

Databases Searched	Limits	Search Terms Used
Medline, HealthSTAR, and CINAHL (medical information databases)	1999-present	1. lifelong learning and technology and health 2. distance and technology and health 3. reflective practice and health 4. communities of learning and health
ERIC (education database)	1999-present	1. lifelong learning and technology and health 2. distance and technology and health 3. reflective practice and health 4. communities of learning and health
ABI Inform Global and Business Index ASAP (management databases)	1999-present	1. reflective practice and health 2. organizational change and technology and health 3. communities of learning and technology and health 4. learning and technology and health

Search results were critiqued by content and topic initially. Those abstracts that described pilot projects of technology-mediated teaching in the context of undergraduate education, and had a systemic or lifelong learning perspective, were chosen. As well, abstracts that had a focus on practice combined with undergraduate education and problem-based pedagogies, along with papers that addressed practice-oriented pedagogies, were selected. Similarly, technology mediated CME abstracts were extracted on the basis of systemic applications or combining practice with learning.

Once abstracts were selected, the complete articles were retrieved, read, critiqued and summarized. Finally, handsearches were performed on the retrieved articles and a number of additional references were accessed, critiqued and summarized.

List of References and Summaries

Reference	**Armstrong, M. L., Gessner, B. A., & Cooper, S. S. (2000). POTS, PANS, and PEARLs: The nursing profession's rich history with distance education for a new century of nursing.** ***The Journal of Continuing Education in Nursing, 31(2), 63-70***
Area of application	Technology mediated professional development
Setting	Nursing education has been involved in distance delivery for over a century. Resent developments in computer technology have enabled a more comprehensive approach and better penetration.
Objectives	To describe the history of nursing's involvement with distance education, and to contexualize current technologically mediated continuing medical education delivery.
Methodology	This paper is an historical overview. It follows the style of a meta-analysis
ICT	Various technologies are mentioned. Networking technologies are presented as a part of a technical continuum , and as a step in a natural progression from devices such as the telephone.
Results & conclusions	The paper predicts that since distance education is embedded in nursing practice as a means of maintaining professional currency, it will likely thrive and expand with the greater use of network technologies. A focus on pedagogy, rather than technology is recommended.
Limitations	The paper does not explore specific technologies, and their effects on pedagogical processes.
Suggestions & future directions	The paper is historical, and ends by encouraging and predicting future uses of ICT for continuing professional education.

Reference	**Ashton, D. (1998). Geography Lessens. *People Management March 19, 1998: 46-49.***
Area of Application	This article focuses on "virtual leaning communities" and how they can contribute to organisational learning.
Setting	Organisational learning is important because it adds value to the whole businesses through the sharing of experiences. Virtual learning communities enable learners to interact through technology regardless of time and space and use facilitators to guide their learning.
Objectives	The article presents the findings from a pilot study on virtual management learning for Cable and Wireless (a telecommunications company) in the Caribbean, Hong Kong and United States.
Methodology	Groups of managers acted as temporary members of learning communities – they shared their problems, experiences and practices. Each community was made up of 8 managers who had at least one major interest in common. The groups used Lotus Notes groupware to analyse critical issues (other platforms such as "chat rooms" would work as well). Each group had a facilitator who gave leadership and support. Facilitators had the ability to contact each other internationally for the purpose of forming a further learning community to share regional differences or common problems.
ICT	The ICTs mentioned in this article include Lotus Notes groupware (collaborative working software), Internet chat rooms, email, software
Results and Conclusions	The learning communities had the potential to improve performance. The work done by the learning community at the local level can be accessed and reviewed quickly. This means that proposals based on these local discussions can be made at an international level. Internationally, the communities created a foundation for new core competencies to be developed.
Limitations	The methodology and the explanation for how results were obtained were not explicitly outlined. Greater clarification as to how results were obtained (ie. Did they complete a survey or questionnaire) would be helpful.
Suggestions and Future Directions	The author suggests that an organisational culture needs to be developed in which individuals possess skills in sharing and are comfortable sharing. If the organisation is international in nature, then sharing can be supported and improved by using communications technology.

Reference	**Barone, C. A. (2001). Conditions for transformation: infrastructure is not the issue.** ***Educause 2001 May/June: 41-47.***
Area of Application	Technological infrastructure in post-secondary institutions.
Setting	This article is intended to provide a framework for universities to follow to successfully integrate technology into the institution.
Objectives	To describe the 12 campus conditions for transformation.
Methodology	The author outlines the 12 conditions: choices, commitment, courage, communication, cooperation, community, curriculum, consistency, capacity/competency, complexity/confusion, culture/context and creativity.
ICT	No specific ICT is mentioned, but the use of technology is discussed.
Results and Conclusions	The message of the twelve conditions is that technology must be employed within a socio-technological system. Policy and practice regarding the role of technology needs to fit the culture, values and style of operation of the institution.
Limitations	The 12 conditions may not all be useful for every university, as well there may be other possible alternatives to successfully integrate technology into higher education.
Suggestions and Future Directions	The changes needed in universities cannot be made by the leadership alone, the entire institution needs to participate in, and own the transition enabled by technology (through the 12 Campus Conditions).

Reference	**Bates, A. W. (1995).** ***Technology, open learning and distance education.*** **London: Routledge.**
Area of application	Technology mediated education.
Setting	Various technologies have been used either to augment or to replace face-to-face meetings for educational purposes. The true costs and benefits of these have not been systematically reviewed.
Objectives	To review various technological media for delivering educational content from the point of view of full costs, and full benefits.
Methodology	Various technological media are examined for both overt and hidden costs and benefits, including pedagogical benefits.
ICT	Radio, audio cassette, television, video cassettes, multimedia, audio conferencing, video conferencing, computer mediated communication.
Results & conclusions	There are advantages and disadvantages to using various media. Guidelines are set out in the book for decision makers pondering the addition of technology to learning. Guidelines about organizational and pedagogical changes are also provided.
Limitations	The book does not specifically deal with professional workplace education or with just-in-time educational needs.
Suggestions & future directions	The need for solidification of infrastructure and organizational change to accommodate the cultural and pedagogical changes inherent in new technology adoption are noted.

Reference	**Berge, Z. L, & Smith, D. L. (2000). Implementing corporate distance training using change management, strategic planning and project management. In L. Lau (Ed.), *Distance learning technologies: Issues, trends and opportunities* (pp.39-51). London: Idea Group Publishing.**
Area of application	Web-based learning in corporate settings.
Setting	Theories of change, and the concepts of strategic planning and project management have long been used in corporate management. However, they have not traditionally been used to plan for the delivery of production enhancing learning materials through distance learning technologies. Most of the theoretical work surrounding the implementation of distance learning using technology has originated in the realm of higher education.
Objectives	To apply corporate planning strategies to the deployment of web-based corporate learning.
Methodology	Theoretical paper.
ICT	Web-based materials and delivery.
Results & conclusions	In a corporate setting, where productivity and efficiency are the goals, and education the byproduct, applying standard change management theories, strategic planning procedures and project management principles to the delivery of web-based distance education as an alternative to face-to-face learning is expected to produce optimal results: the greatest change in employee behaviour, with the least financial input.
Limitations	This is a theoretical paper, and the assertions need to be empirically tested.
Suggestions & future directions	It is imperative that distance educations in a corporate setting arise out of a genuine need to improve information management and access. Planning should be carried out utilizing corporate planning principles and theories.

Reference	**Bergeron, B. P. (1998). Technology-enabled education. Editorial. *Postgraduate Medicine.* 103(5). http://www.postgradmed.com/issues/1998/05_98/dd_may98.htm. Accessed July 26, 2001.**
Area of application	Continuing medical education for physicians using ICT.
Setting	Increasingly physicians are choosing between face to face and distance delivered ICT mediated continuing education.
Objectives	To consider choices faced by physicians choosing continuing education options.
Methodology	This paper represents an informal discussion of one physician's observations.
ICT	Sound, animation, medical simulations delivered via network and CD-based technologies.
Results & conclusions	ICT has provided not only options for time-saving and efficient learning to physicians, it has also provided the opportunity for acquiring knowledge during and as a part of daily practice.
Limitations	The paper is an informal consideration, not a research paper.
Suggestions & future directions	Licensing rules and credit for continuing education delivered via ICT are concerns expressed in this paper. The use of ICT is seen as positive, but a system for officially recognizing just-in-time learning is urged.

Reference	**Bleanger, F., Jordan, D. H. (2000). *Evaluation and implemntation of distance learning: Technologies, tools and techniques.* London: Idea Group Publishing.**
Area of application	Distance learning using technology.
Setting	Systemic implementations of technology-mediated teaching often occur without consideration of learner need and the costs to the system.
Objectives	To provide a framework of considerations that should be applied when considering developing technology-mediated distance education.
Methodology	Theoretical consideration, followed by case studies.
ICT	Computer and software, web-based training, video conferencing, videotape, audio conferencing.
Results & conclusions	This book provides a framework for a comprehensive cost-benefit analysis of large scale deployments of distance learning technologies and products. As well, it provides a framework for evaluating such deployments and a comparison of some existing products that support web-based learning.
Limitations	More large scale studies using these techniques are needed.
Suggestions & future	The authors suggest three areas for future work: lowering the

directions	training cost per learner, considering technology insertion into the traditional classroom, and integrating plans for technology mediated learning into existing institutional and training plans.

Reference	**Brookfield, S. D. (1986). *Understanding and Facilitating Adult Learning.* San Francisco: Jossey-Bass Publishers.**
Area of application	Continuing professional education.
Setting	The relationship of learning and professional activity is discussed.
Objectives	To explore changed in attitudes and delivery of continuing education for professional adults.
Methodology	This book explores the subject in depth.
ICT	Some mention of e-mail is made, but the principles mentioned are applicable in ICT environments.
Results & conclusions	Adult learning is fundamentally self-directed. Adult educators need to define success as a decrease in learner reliance on institutions and educators. Facilitating self-directed adult learning is the primary role of faculty. Motivation and peer support are predictors of success. Informal education networks support adult education as much as formal institutional programs do. Evaluations of such programs should include not only knowledge or skills gained, but the applications of these skills in practice
Limitations	Specific ICTs are not mentioned or explored.
Suggestions & future directions	Wedding evaluation with practice, as education and practice are being wedded is suggested.

Reference	**Clement, D., & Wan, T. (1997). Mastering health care executive education: Creating transformational competence. *The Journal O f Health Administration Education,* 15(4), 265-274.**
Area of application	Continuing executive health care education and ICT.
Setting	Executive continuing medical education has traditionally been conducted through face to face sessions.
Objectives	To describe changes to continuing executive health care education precipitated through the advent of ICTs as delivery options.
Methodology	The paper reviews a number of programs and describes changes to the programs facilitated by the use of ICTs.
ICT	CD-Rom based software, video-taped lectures, multimedia, network technologies.
Results & conclusions	Health care executives and administrators are well-served by on-line educational programs geared at maintaining currency in knowledge and skills related to the technological and behavioral changes in health care delivery. On-line programs integrated into professional practice reflect the changes in the medical services delivery system – towards seamlessness and efficiency.
Limitations	The paper does not address particular applications of ICT and their effects.
Suggestions & future directions	The paper suggest that the use of innovative technologies coupled with non-traditional teaching modes will assist transformational learning, which will change organizations to include continual learning .

Reference	**Collett, D. (1999). *Learning technologies in distance education.* Report to the Office of Learning Technologies, Human Resources Development Canada. (http://olt-bta.hrdc-drhc.gc.ca/publicat/reports_e.html#l). Accessed July 26, 2001.**
Area of application	Distance education and ICTs.
Setting	OLT sponsored projects are discussed in this report.
Objectives	To discuss computer and web-based instruction and assist in the process of transition from traditional to web-based delivery of learning materials and experiences.
Methodology	A number of projects are reviewed and discussed, and inferences made.
ICT	Networked computers and software to support on-line education.
Results & conclusions	Results of an extensive research project were compiled into this report. It identifies the skills needed by instructors to conduct successful on-line teaching, and the administrative qualities needed to support computer-based education systemically. It also includes a formal presentation of the strengths and weaknesses on computer or web-based instruction and identifies typical issues faced by educational programs in transition from traditional to computer-based delivery modes.
Limitations	
Suggestions & future directions	Working on transforming the pedagogical background of delivery to reflect the advantages of on-line education.

Reference	**Cote, D. J. (1998). *Web-based technology to support medical education.* Unpublished master's thesis, University of Calgary, Calgary, Alberta, Canada.**
Area of application	Undergraduate medical education and ICTs.
Setting	The University of Calgary has been adding on-line components to its curricula for some time.
Objectives	To examine student attitudes towards computer-based components of the undergraduate medical curriculum.
Methodology	Surveys were conducted at workstations. Statistical analysis shows significant differences among groups.
ICT	Computer-based programs, some available over networks.
Results & conclusions	The University of Calgary's medical program is problem-based and includes computer-based components. This study examines student attitudes towards and preparation for computer-based medical education, based on their experiences in the University of Calgary undergraduate medical program.
Limitations	Study is very narrow in scope.
Suggestions & future directions	Further study of larger groups and wider applications of computer-based learning materials.

Reference	**Crompton, P., Booth, S. and Timms, D. (2000). Telematics and distance education – a review of current approaches.** ***The quarterly review of distance education 2000 1(3): 195-203.***
Area of Application	The educational and technological approaches used in open and distance learning.
Setting	A wide variety of new educational experiences are being created by developments in the design of computer hardware and software.
Objectives	This paper focuses on the how practitioners of open and distance learning (ODL) are using communication and information technologies to deliver and support learning.
Methodology	The review is based on a survey using an e-mail questionnaire. The questionnaire was distributed to a sample of individuals involved in delivering telematics-based ODL. The survey covered the individuals' approaches, experiences and attitudes toward ODL related to pedagogy, organization and technology. The survey was conducted in Europe, the U.S. and Australia.
ICT	The ICTs mentioned in the article include Internet, email, CD-ROM, videoconferencing, various software packages (e.g. Web CT, TopClass, Lotus Notes).
Results and Conclusions	In general, course developers used two computer-based technologies (Internet and e-mail) and one other delivery method (e.g. handouts). The technology related activities in the courses were domain content, Web pages, graphics, experience, self-study, email and scheduled contributions. On-line work in the courses accounted for 19% of the student workload. Students were capable of communicating

	electronically with fellow students and tutors. The Web was used as a convenient delivery tool. WebCT, TopClass and Learning Space were found to be the most popular software packages. There is a gap between theory and practice for telematics ODL. Most interactions were one-way and learning networks were sparse and single-stranded. This is very different from the dense, multistranded forms of interaction that underlie the notion of the learning community.
Limitations	This paper examines ODL in higher education institutions and the private sector. The paper does not specifically address ODL related to the health care sector.
Suggestions and Future Directions	In order to produce a rich learning environment, the authors suggest providing video and audio conferencing to students. Crompton, Booth and Timms suggest that new models of learning may be required in order to realize the full potential of the new electronic learning environment.

Reference	**Devitt, P. and Palmer, E. (1999). Computer-aided learning: an overvalued educational resource?** ***Medical Education 1999 33:136-139.***
Area of Application	Use of computer-aided learning (educational software program)
Setting	Undergraduate medical curriculum (second year medical students at the University of Adelaide).
Objectives	To measure the impact of computer-aided learning (CAL) in a section of the anatomy and physiology component of an undergraduate medical course.
Methodology	The study used MEDICI, a program which contains material on clinical topics. The program was re-written in 3 different ways: standard problem solving approach, free text and a didactic version. Second year medical students were pre-tested, given 2 weeks of study with the CAL and post-tested with the same questions. (Control group was not given access to CAL)
ICT	MEDICI – computer program for CAL
Results and Conclusions	All showed significant improvement in knowledge. The students with the didactic material performed significantly better than the control group and the problem solving group. At a certain level of learning, providing interactive computer-based multimedia may not confer any advantage and might be considered a waste of resources. What the students get out of the CAL resource will depend on how material is presented, how it is related to the particular course and what type of assessment is made.
Limitations	Limitations of the study were that students were asked to use the computer material as individuals and did not have the opportunity to interact in a group. As well, the tool used to assess the students measured recall of knowledge and not necessarily understanding or retention.
Suggestions and	It is suggested that similar work be carried out using senior students

Future Directions	who may be more familiar with problem-based learning. These studies would look at understanding and long-term retention.

Reference	**Dickmann, C., Habermeyer, E., & Spitzer, K. (2000). WWW-Based continuing medical education: How do general practitioners use it? *Studies in Health Technology and Informatics*, 77, 588-592.**
Area of application	ICT mediated continuing medical education.
Setting	Germany is developing web sites to support physicians, and is offering not only information, but the opportunity to partake in virtual learning and support communities.
Objectives	To examine the use of available ICT learning opportunities among a group of German physicians.
Methodology	Network use reports are used to infer information about web-site use. A survey clarifies the information and preferences of German physicians.
ICT	E-mail, web-sites.
Results & conclusions	Use reports from a German CME portal and web-site and a survey suggest that GPs are accessing just-in-time information, and not partaking in virtual community building or sophisticated interactivity.
Limitations	The study group is small.
Suggestions & future directions	Although physicians used the resources, the study suggests that further investigation into whether on-line resources improve patient outcomes is needed.

Reference	**Dickmann, C., Baaren, J. van der, and Spitzer, K. (1999). *Post-Doc: Satisfying the Information Needs of General Practitioners in Continuing Medical Education and Daily Practice.* Medical Informatics Europe '99. Kokol et al (Eds.). IOS Press.**
Area of Application	Satisfying the Information Needs of General Practitioners (GPs) in Continuing Medical Education and Daily Practice
Setting	In the home home and at location of practice for GPs in Euroregion Maastricht-Liege Hasselt-Aachen
Objectives	To investigate structural and content requirements and the feasibility of an Internet-based CME service for GPs
Methodology	Regional core user groups of 5-10 GPs stated requirements (elicited by group discussions, brainstorming, questionnaires and workshops) that formed the basis for the construction of the prototype website. A web-based "Post-Doc" environment (focused on the needs of GPs) was created by collaboration of users and designers.
ICT	Use of "Post-Doc" environment (websites with GP relevant info and CME).
Results and Conclusions	Four regional website prototypes in native languages were set up based on the needs of GPs. The evaluation of the prototype showed that the classification of functions by types of information was different from the GPs way of thinking. GPs categorize based on actions, organ systems and medical topics. GPs stressed the need to quickly find info by keyword search, well-organized content structure and to get news presented on the starting page. Organizational aspects of the CME service have to be clarified.
Limitations	The study was done regionally and because of this the GPs had different needs and different responses to the project
Suggestions and Future Directions	The future work will focus on refining the delivery of the service, a thorough evaluation and setting up management and quality assurance structures. It is suggested that the integration of links to computer-based patient records, secure communications and patient –GP or GP-hospital collaboration be investigated further in the future.

Reference	**Eisenberg, J.M. (2000). Continuing education meets the learning organization: the challenge of a systems approach to patient safety. *The journal of continuing education in the health professions (2000) 20: 197-207.***
Area of Application	The use of continuing medical education to improve patient safety.

Setting	The media and the public are now concerned with medical errors and patient safety. This presents the medical profession with a great learning opportunity and an opportunity to improve patient safety.
Objectives	The paper examines the error as a learning opportunity and how to redesign systems and organizations systematically to limit the potential for errors.
Methodology	The author presents suggestions on how reduce error and improve patient safety.
ICT	ICT's mentioned include: decision support systems, computerized physician order entry systems, bar-code markings, computerized protocols, Internet, electronic health records, wireless computers (PDAs)
Results and Conclusions	The author believes that the response to errors should be to put corrective systems in place methodically and throughout the system. This will help to prevent mistakes and to detect mistakes early. Also, when addressing patient safety ways of improving delivery of CME need to be addressed. The author lists eight points on how to improve CME: Informatics for Information, guidelines as learning tools, learning from opinion leaders, learning with the patient, decision support systems, team learning, learning organizations and just-in-time and point of care delivery.
Limitations	
Suggestions and Future Directions	The 8 above mentioned points suggest megatrends in health care that will have implications for the future of CME.

Reference	**Faughnan, J.G. and Elson, R. (1998). Information Technology and the Clinical Curriculum: Some Predictions and Their Implications for the Class of 2003.** ***Academic Medicine1998 July 73(7): 766-769*****.**
Area of Application	Information Technology and the Clinical Curriculum
Setting	Medical School Curriculum.
Objectives	To make some predictions on how information technology will be integrated into Clinical Curriculum.
Methodology	The authors write the article using academic studies and their own clinical and industry experiences.

ICT	ICT applications discussed are Internet Technologies
Results and Conclusions	It is predicted that by 2003 clinicians will work with data that has been processed (the right information, the right form and quantity at the right time) and is delivered directly to the point of care. It is believed that physicians and patients will rely upon trusted authorities to provide a "seal of approval" for knowledge resources. Emerging topics in clinical information technology such as confidentiality, systems thinking and resource evaluation are discussed.
Limitations	The limitation of this paper is that it is not definitive, the paper is based on the predictions of the authors using academic studies and their own personal experiences.
Suggestions and Future Directions	It is predicted that in the future in the clinical setting computers will become increasingly invisible, ubiquitous and simple. As well, "power tools" will be needed to manage information and reduce medical error.

Reference	**France, R. (2000). WHO views on perspectives in health informatics.** ***International Journal of Medical Informatics, 58-59, 11-19***.
Area of application	Health informatics in a global context.
Setting	WHO is in the process of setting visionary goals and practical guidelines for the inclusion of health telematics in the delivery of education and clinical services.
Objectives	To anticipate and prepare for the deployment of health telematics on a global scale.
Methodology	This is a visionary paper.
ICT	Various network technologies.
Results & conclusions	The WHO –European Region has set far-reaching and idealistic policy goals for health telematics for the next few years and specific principles that must be maintained during deployment. The organization anticipates that health telematics will play a central role in a number of policy goal areas, including education and research.
Limitations	The paper is visionary and has not specific applications described.
Suggestions & future directions	Applications of health telematics within the targets and guidelines and goals of the WHO for global health

Reference	**Friedman, C. P. (2000). The marvelous medical education machine or how medical education can be unstuck in time.** ***Academic Medicine, 75(10), S137-S142.***
Area of application	Simulation in medical education using ICT.
Setting	Speculation based on existing simulation technologies.
Objectives	To explore the changes in organizational structure and teaching practices associated with the use of simulation technologies in medical education.
Methodology	This is a visionary paper that refers to a number of existing applications.
ICT	Virtual reality, simulation technologies, interactive software.
Results & conclusions	Medical education, especially undergraduate education, functions in a very traditional manner in terms of content and delivery, favouring a fixed, lecture-based curriculum. Friedman sees sophisticated simulation devices as the future answer to growing needs for just-in-time medical education. Although the article does not deal explicitly with continuing education, it does mention the generalizability of the theory, and the potential for applying it in this area.
Limitations	The paper does not study any current application in depth.
Suggestions & future directions	The paper speculates that in the future, medical simulation with be an important component of medical education, both intentional and just-in-time.

Reference	**Graves, W. H. (2001). Virtual Operations: Challenges for traditional higher education.** ***Educause Review 2001 March/April.***
Area of Application	Use of E-Learning in post secondary and continuing professional education.
Setting	E-learning will be used by post secondary institutions to increase

	learning outcomes and to increase the convenience of instruction in any place and time.
Objectives	This paper discusses how universities can increase effectiveness of instruction, convenience and access to education through the use of E-Learning. The Internet's capacity to improve communication and resource sharing provides opportunities for intra and inter-institutional and institutional-commercial partnerships that can address resource issues.
Methodology	The authors examine the relevant literature and the current state of E-learning in universities. The authors make suggestions and predictions about the direction universities need to go in order to provide effective, accessible virtual education.
ICT	Use of the Internet, use of "learningware" (a software application that provides structured opportunities for active learning).
Results and Conclusions	1) To help achieve educational goals efficiently and cost-effectively selected ICT related operations should be outsourced by institutions. 2) The knowledge economy's emphasis on life-long learning is driving a vigorous market economy of learning services for adults that is learner-centric and employer-centric. 3) "Learningware" provides effective learning in a self-study environment. 4) E-learning represents an opportunity to redirect the focus on the role of the instructor onto the learning outcomes of the instruction. (The best instruction becomes a learning-centric activity that uses the learner-centric convenience of virtual (anyplace-anytime) instruction 5) Traditional campuses may use virtual technologies to deliver virtual curricula or to strengthen "on-ground" classroom programs or to do both.
Limitations	
Suggestions and Future Directions	Traditional institutions need to decide to what extent they will offer virtual academic programs, how to use anyplace-anytime technologies and how to make traditional programs more convenient for learners and instructors and how instructors can use the technologies to improve learning outcomes.

Reference	**Greenhalgh, T. (2001). Computer assisted learning in undergraduate medical education.** ***BMJ, 322, 40-44.***
Area of application	ICTs in undergraduate medical education.
Setting	The paper is a meta-analysis of research in ICT mediated undergraduate medical education.
Objectives	To suggest strategies for successful deployments of ICT mediated undergraduate medical education.
Methodology	Papers are reviewed and discussed.
ICT	Network-based technologies (web sites, teaching software).
Results & conclusions	Many pilot studies have been done on the application of computer technology to undergraduate and specialist medical education. This meta-analysis points out that very few are randomized and controlled, and results, at best, are ambivalent. Guidelines for successful transfers of content and pedagogy are provided and discussed. The paper suggests strategies for on-line teaching associated with progressive and inclusive pedagogies.
Limitations	
Suggestions & future directions	To offset the costs of producing quality content, the authors suggest inter-university collaboration.

Reference	**Haag, M., Maylein, L., Leven, F., Tonshoff, B., & Haurx, R. (1998). Web-Based training: A new paradigm in computer-assisted instruction in medicine.** ***International Journal of Medical Informatics, 53(1), 79-90.***
Area of application	ICT in medical education.
Setting	Traditional on-line training programs provide frameworks for traditional delivery of materials.
Objectives	To describe new technical architectures that support interactive pedagogies.
Methodology	A review of current architectures leads the authors to suggest alternative architectures which take advantage of the interactive nature of the World Wide Web.
ICT	On-line, hypertext based teaching software.
Results & conclusions	Historically, computer-assisted instruction has been used sporadically in medical education and professional development for more than 30 years. Web-based versions of CAI ideally include the pedagogical tools developed during that time. Recognizing these pedagogical imperatives helps developers choose appropriate technologies for their pedagogical goals.
Limitations	No research results are presented.
Suggestions & future	The paper suggests that conventional software will give way to

directions	new software that promotes interactive learning.

Reference	**Hersh, W.R., and Hickman, D.H. (1998). How well do physicians use electronic retrieval systems? A framework for investigation and systematic review.** ***JAMA 1998 280 (15): 1347-1352*****.**
Area of Application	The clinical setting.
Setting	To determine the effectiveness of electronic information retrieval (IR) systems used by physicians.
Objectives	The effectiveness of electronic information retrieval (IR) has not been well assessed, despite its proliferation. The purpose of the review is to provide a conceptual framework and apply the results of previous studies to this framework.
Methodology	The authors searched MEDLINE, LISA, RR Bowker, New Providence and NJ databases from January 1998 back to 1966. A framework for evaluation was developed by starting with previously described theoretical models. The framework was then modified on the basis for classification of articles retrieved for the study.
ICT	Electronic information retrieval (using the Internet).
Results and Conclusions	Current IR systems have limited use in patient care settings. They are used to meet only a small portion of the information needs of a clinician. This means that developers need to create systems that are easier to use and that have more clinically relevant information. Also, there is a time problem with current approaches to bibliographic searches – it takes an average of 30 minutes to search for articles, find them and appraise the content. Therefore, using the IR system is impractical for most clinical questions, especially at the point of care.

Limitations	IR systems are commercially successful widely distributed, however, the magnitude of their impact still needs to be quantified.
Suggestions and Future Directions	Need further research investigating the content and delivery methods of IR systems. Also, continued assessment of use and performance of IR are needed.

Reference	**Hersh, W. (1999). "A world of knowledge at your fingertips": The promise, reality and future directions of on-line information retrieval.** ***Academic Medicine, 74(3), 240-243.***
Area of application	On-line medical information sources.
Setting	On-line information sources have promised to provide seamless, immediate access to information for practicing physicians.
Objectives	To discuss the limitations of current medical informatics.
Methodology	A review of currently available resources.
ICT	Web-accessible databases.
Results & conclusions	Physicians have many daily information needs, yet currently, only a fraction of theses are being met. A recent survey points out that the average clinician has unmet information needs in two out of every three patient encounters. Despite the availability of well-organized on-line databases, such as those offered through The National Library of Medicine, Medline, The Centers for Disease Control and Prevention, etc., unmet information needs persist. The author explores the reasons for this, and suggests modifications to the current modes of delivery of information to clinicians, such as linking on-line information to patient medical records.
Limitations	This is an informal review.
Suggestions & future directions	Developing interactivity among on-line information sources.

Reference	**Holtum, E., & Zollo, S. (1998). The Healthnet project: Extending online information resources to end users in rural hospitals.** ***Bulletin of the Medical Libraries Association. 86(4), 569-575.***
Area of application	ICTs in support of just-in-time workplace learning
Setting	Biomedical databases and information have not been traditionally easy to access outside of an academic setting.
Objectives	To test the efficacy of a relatively large deployment of access to biomedical database at medical workplaces.
Methodology	System use was monitored and compiled, and user satisfaction surveys were conducted and statistically analyzed.
ICT	Cross-linked online databases with web access at enabled stations.
Results & conclusions	Providing library resources (through telehealth links with university-based medical databases), equivalent to those in major academic centers, to rural practitioners in Iowa proved to be a successful project. Usage statistics and user surveys indicate that practitioners are very happy to have access to the latest information on a just-in-time basis. Training was identified as a necessary component of the deployment.
Limitations	The project ended in 1997 and was funded for only 3 years.
Suggestions & future directions	Enabling wider access to academic biomedical information at medical workplaces.

Reference	**Holm, H.A. (1998). Quality issues in continuing medical education.** ***BMJ, 316, 621-624.***
Area of application	Continuous medical education.
Setting	Continuous learning is desirable for physicians. The author, a member of the Norwegian Medical Association, evaluates trends in medical learning and identifies progressive and efficient alternatives.
Objectives	To review current European practices and policies, and recommend future areas for development.
Methodology	This is a theoretical discussion paper.
ICT	Computerized diary.
Results & conclusions	This article provides a survey of various European and North American national policies regarding Continuing Medical Education. The division of medical education into components of a continuum is regarded as misguided; the author prefers to think of medical education as a continuous process. The author identifies the need for medical colleges to develop and administer continuing education programs. The need for physicians to pursue self-directed learning is identified, and the use of mandatory CME credits is questioned.
Limitations	Not much information is discussed about ICT.
Suggestions & future directions	The system of CME credits and classes needs to be re-evaluated and a more seamless system devised.

Reference	**Hunt, D. L., Haynes, B., Hanna, S., and Smith, K. (1998). Effects of computer-based clinical decision support systems on physician performance and patient outcomes.** ***JAMA 1998 280(15): 1339-1346.***
Area of Application	Computer-based clinical decision support systems and the effects on physician performance and patient outcomes

Setting	The claim has been made by software developers and vendors that their systems can improve clinical decision making. These claims need to be based on trials that assess the computer system's effects on clinical performance and patient outcomes.
Objectives	To review controlled clinical trials assessing the effects of computer-based clinical decision support systems (CDSS) on patient outcomes and physician performance.
Methodology	The authors searched MEDLINE, EMBASE, INSPEC, SCISEARCH and the Cochrane Library and asked authors of relevant studies for any additional references for materials related to CDSS. Once the articles were compiled, 2 authors assessed selected studies for methodological quality. The studies were placed into 4 groups: drug dosing, diagnosis, preventive care, and other aspects of medical care. Measures of the process of care and clinical outcomes were characterized for each study according to whether a statistically significant effect was reported.
ICT	CDSS was defined as any software designed to aid in clinical decision-making in which characteristics of individual patients are matched to a computerized knowledge base for the purpose of generating patient specific assessments or recommendations that are then presented to clinicians for consideration.
Results and Conclusions	Published studies of CDSS are increasing in number and improving in quality. CDSS can enhance clinical performance for preventive care, drug dosing and other aspects of medical care, but not convincingly for diagnosis.
Limitations	
Suggestions and Future Directions	The effects of CDSS on patient outcomes have not been studied sufficiently. CDSS have the potential to improve the effectiveness and efficiency of clinical care.

Reference	**Knebel, E. and Kolodner, J. (2001). Tuberculosis case management training. *Tech Trends 2001 45(2): 20-21.***
Area of Application	Health care training and clinical practice for international health care providers.
Setting	There was a great need to reach isolated health providers with important information regarding tuberculosis case management. The Quality Assurance Project and other international health institutions developed the Tuberculosis Case Management CD-ROM (TB CD ROM).
Objectives	To develop a computer-based course that could deliver information to international health care providers in an accessible and cost-

	effective fashion.
Methodology	The authors describe the need for providing international health workers with information on TB case management. The development of the CD ROM is explained and so are the characteristics of the program.
ICT	CD-ROM, Internet (the CD-ROM has links to key TB websites)
Results and Conclusions	The program that was developed consists of lessons, review questions, and examinations on TB case management. The TB CD ROM has a reference library and links to TB websites. The program uses audio, video and graphics. During the product development it was found that the audience needed a simpler program and modifications were made.
Limitations	This paper outlines the need for the CD-ROM course, how the course was developed and by whom, and how the CD-ROM works. However, there is no mention of the actual "real life" use of the program and/or satisfaction with the program by the users (it only says the product has been "received warmly by the international health community". As well, there is no mention of how the program might have improved patient outcomes.
Suggestions and Future Directions	The author views the TB CD ROM as a pioneering computerized training course for international health care workers.

Reference	**Lanser, E. G. (2001). Fulfilling the promise: Technology's role in improving patient safety.** ***Healthcare Executive 2001 16(5): 6-11.***
Area of Application	Clinical application (use of ICTs to improve patient safety).
Setting	This paper discusses some of the different ICTs that have been used to reduce medical error and improve patient safety.
Objectives	The objective is to provide a description of some of the successful ICT tools that improve patient safety in the areas of risk management, clinical alerting systems, medication administration and Computer Physician Order Entry (CPOE) system. The author briefly discusses instituting ICT into the health organization.
Methodology	The author provides specific examples from different organizations that act as testimonials to the successful use of ICTs in the clinical

	setting.
ICT	Synthesis of databases, Clinical Alerting Systems, Medication administration systems (bedside terminals and handheld devices), Computer Physician Order Entry (including handheld devices).
Results and Conclusions	1) Risk management programs allow providers to record and analyze adverse events. The University Community Hospital in Florida used a risk management application and decreased the number of falls by almost 50% and eliminated the cost associated with these falls. 2) Clinical Alerting systems warn clinicians of potential problems. Using this system providers can proactively manage patient care. 3) Medication administration systems use bedside terminals or handheld devices to check the barcode on a patient's wristband to verify and enter information regarding medication. 4) CPOE delivers point-of-care information (in real-time) to the clinician. In a cost-benefit analysis Promina Health System in Atlanta found that CPOE reduced lengths of stay and created efficiencies that made 80 additional beds available.
Limitations	The limitation of this article is that it only presents one perspective - that the use of ICTs in the clinical setting improves patient safety.
Suggestions and Future Directions	In order to incorporate ICTs into the health organization patience and planning are essential. Four suggested implementation strategies are to: 1) Focus on short-term gains 2) Recognize IT is one piece of the puzzle 3) Get leadership support 4) Collaborate.

Reference	**Lewis, M.J., Davies, R., Jenkins, D., Tait, M. (2001). A review of evaluative studies of computer-based learning in nursing education.** ***Nurse Education Today 2001 21: 26-37.***
Area of Application	Use of computer-based learning (CBL) in nursing education.
Setting	There is a general feeling that CBL should be beneficial to the education of nurses however, there is a lack of empirical evidence to prove this. Results of evaluation studies of CBL packages have been equivocal (some authors claim CBL to be beneficial and others claim no apparent benefits).
Objectives	The authors objectives were to investigate the methods used in the evaluation of CBL packages, assess whether meaningful conclusions could be drawn from these studies, and consider whether results of individual CBL evaluation studies could be used to make general claims about all CBL packages.
Methodology	The authors performed an electronic literature search using CINAHL, BNI, RCN, ENB Health Care Database, Medline, HMIC, ERIC, PsychLit, BIDS and ASSIA. Publications had to meet the following criteria: describe a qualitative or quantitative investigation of CBL in nursing, compare the efficacy of CBL to some other form

	of teaching and use a sample population of student nurses. The articles were then evaluated.
ICT	The ICTs mentioned include computers, Internet, and videostreaming
Results and Conclusions	Many of the publications were qualitative and anecdotal. There were only a few well executed quantitative studies. Very few nursing studies have investigated the efficacy of knowledge transfer and knowledge retention through CBL. Most studies had significant design flaws so the conclusions of the studies were not always valid.
Limitations	As mentioned in the article, it is nearly impossible to derive substantive evidence from the review of CBL studies presented.
Suggestions and Future Directions	Future evaluation studies of nursing CBL packages need to be improved in terms of design. More work is required to produce high-quality guidelines for CBL evaluation.

Reference	**Lucas, M. S. (2001). Speaking of Efficiency. *Health Management Technology 2001 22(7): 42-47.***
Area of Application	The use of voice recognition technology in medical practice.
Setting	This article describes the advances that have been made in voice recognition technology that have made the product more user friendly and better integrated with clinical work flow.
Objectives	The article compares old voice recognition (VR) products and the new "next generation" VR. The problems of the old and the merits of the new VR are described as well as the possible benefits to the clinician.
Methodology	The author describes the old products, the new products and provides a specific example of the technology in use.
ICT	VR technology, electronic medical records (EMR), databases
Results and Conclusions	Some of the new VR systems can interface and share data with legacy billing and EMR. Dictations can be automatically faxed or emailed to a referring physician. Historical patient data can be linked and brought forward into new dictations. The systems are extremely flexible and can be located at the point of care. Creating the voice model now only takes 15 minutes and accuracy over 95% can be achieved in a few weeks. If implemented correctly, voice recognition can improve the efficiency and profitability of a medical practice.
Limitations	This paper only gives positive feedback on the new VR, a complete evaluation of the new VR is needed (including a cost-benefit

	analysis).
Suggestions and Future Directions	When choosing VR, one needs to ensure that the application selected is designed specifically for health care and that the supplier can support the VR.

Reference	**Mooney, G., & Bligh J. (1997). Computer-based learning materials for medical education: A model production.** ***Medical Education. 31, 187-201.***
Area of application	Undergraduate computer-based medical education.
Setting	A variety of medical applications for computer-based delivery have been produced and pilot tested. Few encourage the type of learning their creators intended.
Objectives	To promote the use of progressive pedagogies in computer based medical learning.
Methodology	Theoretical paper.
ICT	Network-based technologies, CD-Roms, Virtual Reality.
Results & conclusions	The University of Liverpool's Medical Education Unit has compiled functional production guides for the development of computer-based learning materials for all levels of medical education. They have identified the basic problems in existing materials as stemming from a lack of applied progressive pedagogical principles. The model provided suggests a multidisciplinary environment for producing pedagogically sound materials.
Limitations	A theoretical paper.
Suggestions & future directions	Only sound technologies will promote better learning in medicine using advanced technologies. The author recommends a three pronged approach, including computer science, medical content, and medical education within a sound educational structure.

Reference	**Mooney, G., & Bligh, J. (1997) . Information technology in medical education: Current and future applications.** ***Postgraduate Medical Journal 73(865), 701-704.***
Area of application	Computer-based undergraduate medical education.
Setting	The authors identify a lack of educational focus as a problem in the development of quality on-line medical learning applications.
Objectives	To develop pedagogically sound frameworks for delivering on-line medical education.
Methodology	Software developed using the proposed model was evaluated using user-satisfaction surveys. The results were presented descriptively.
ICT	Courseware and network technologies
Results & conclusions	A 1995 survey of 19-year old medical students in Liverpool indicates that 92% use computers daily. Potential applications of computer and network technology are discussed in a broad context. The authors suggest a courseware development model to ensure quality learning materials for medical education.
Limitations	No statistical analysis was done to ensure significant differences between users of courseware developed traditionally, and using the proposed model.
Suggestions & future directions	

Reference	**Morphew, V. N., (2000). Web-Based learning and instruction: A constructivist approach. In L. Lau (Ed.),** ***Distance learning technologies: Issues, trends and opportunities*** **(pp. 1-15). London: Idea Group Publishing.**
Area of application	Web-based education
Setting	Constructivism, a favoured educational theory is often described, but seldom applied to web-based educational efforts.
Objectives	To describe constructivism and suggest best practices for applying it to web-based education.
Methodology	This is a theoretical paper.
ICT	Web-based instructional software and network technologies.
Results & conclusions	Although the benefits of constructivist pedagogies are widely known, it is still rarely applied to web-based instruction. The use of specific classroom-based techniques like journaling, diagramming, and portfolio construction are discussed in terms of applying them to a web-based context.
Limitations	No statistical information supports the author's assertions about the primacy of constructivist teaching. It is described as simply the most popular theory and most widely accepted at this time.
Suggestions & future	The paper suggests that web educators accept and apply

directions	constructivist principles.

Reference	**Roine, R., Ohinmaa, A. and Hailey, D. (2001). Assessing telemedicine: a systematic review of the literature.** ***CMAJ 2001 165(6): 765-771.***
Area of Application	Telemedicine (Health care sector).
Setting	Telemedicine systems require assessment before they can be used routinely on a large scale. As well, the assessment of telemedicine applications is necessary to help make decisions regarding purchasing and planning and to monitor and change and technology once it is in place.
Objectives	The objective of the authors is to provide decision-makers with information regarding the effectiveness and cost-effectiveness of telemedicine.
Methodology	The authors performed a search of MEDLINE, HEALTHSTAR, EMBASE, CINALH, HSTAT, DARE, NHS, and Cochrane using the term "telemedicine". As well, the authors read reference lists in published articles and consulted experts in the field. Articles were included if they considered the outcomes of telemedicine in terms of administrative change, patient outcomes or economic assessment in a scientifically valid manner. Also, the studies were required to include a comparison of the telemedicine application with a conventional alternative.
ICT	Video-conferencing, websites, teleradiology
Results and Conclusions	There is not much data on the effectiveness and cost-effectiveness of telemedicine. As well, very few studies that make a controlled

	comparison of telemedicine applications with conventional methods are in existence. Teleradiology, teleneurosurgery, telepsychiatry, transmission of echocardiographs, and the use of electronic referrals that enable email consultations and video conferencing all have convincing published evidence regarding their effectiveness. There are few cost-effectiveness studies. Further assessment studies are needed in telemedicine.
Limitations	
Suggestions and Future Directions	The assessment literature needs to focus on routine use of telemedicine applications, longer term impact on health status, costs and organization. Also, sustainability of telemedicine, decisions surrounding equipment and telecommunications, impact on the overall use and outcome measurement are all areas for future study.

Reference	**Salmon, G. (2000).** ***E-moderating: The key to teaching and learning on-line.*** **London: Kogan Page.**
Area of application	On-line education.
Setting	As alternative pedagogies are adopted into computer mediated instruction, the need for people trained in the unique skills necessary to lead and on-line learning experience has become evident.
Objectives	To explain modes of producing and delivering successful network mediated learning experiences.
Methodology	A number of case studies are discussed, and online learning sessions are evaluated for type and content of participant input. Inferences about best teaching practices are drawn from this information.
ICT	Networked mediated communication: web-based, videoconferencing, web-based educational programs.
Results & conclusions	The skills necessary to moderate network mediated learning are discussed and explained. Evaluations, development guidelines and effective timelines are also suggested.
Limitations	More statistically valid information would have supported the author's assertions more strongly.
Suggestions & future directions	The future of education is informed partly by technological developments and adoption. Future changes in administrative and policy structures governing formal education are speculatively addressed.

Reference	**Sangster, A., Maclaran, P. and Marshall, S. (2000). Translating theory into practice: facilitating work-based learning through IT.** ***Innovations in education and training international 2000 37(1): 50-58.***
Area of Application	Facilitating work-based learning through IT.
Setting	This paper investigates how IT can support the learner in the workplace and how theory can be translated into practice.
Objectives	The authors explore work-based learning, examine the application of IT to work-based learning and speculate on how integrating IT into work-based learning may enhance the quality of the learning experience.
Methodology	The paper describes the concept and characteristics of work-based learning. The authors explore the power of IT to facilitate work-based learning.
ICT	The IT applications that are discussed in the article include: discussion lists, computer conferencing, qualitative and quantitative data analysis packages, cognitive mapping programs, self-assessment packages, email, online seminars, Internet, CD ROM
Results and Conclusions	Integration of IT (in the areas of communication, support, instruction, assessment and information) into work-based learning leads to potentially better developed lifelong learners. Workers who become proficient in the use of communications and information technology enhance their own learning and enhance their company. An important point made by the authors is that learning to use IT is essential for learning supported by electronic media and training may be required by workers.
Limitations	This paper presents possibilities and suggestions for the application of IT to work-based learning. The paper addresses work-based learning in general and no specific reference is made to its application in the health sector.
Suggestions and Future Directions	The authors believe that there is a lot of potential for research and development in this area. More studies need to be undertaken to examine how work-based learning students are able to use IT to assist their learning.

Reference	**Shaughnessy, A. F., & Slawson, D. C. (1999). Changing the doctor-patient relationship: Are we providing doctors with the training and tools for lifelong learning? BMJ, 319, 1280-1288.**
Area of application	Lifelong medical learning using interactive networked information sources.
Setting	Although on-line databases and educational opportunities have been available for some time, they have not been sufficiently integrated into the medical workplace to make them a ubiquitous option for just-in-time education.
Objectives	To suggest technological development that would promote lifelong medical learning.
Methodology	Theoretical paper.
ICT	On-line databases, e-mail, portals.
Results & conclusions	The benefits of on-line databases and educational opportunities that address the just-in-time needs of physicians are undeniable. More attention however, must be paid to how evidence-based evidence is provided to the point of care. Portals, with filtering software and e-mail bulletins are suggested as starting points for the development of a viable system.
Limitations	No experimental background to support the speculations.
Suggestions & future directions	A filtering device is suggested to enable the incorporation of databases and interactive technologies into workplace just-in-time and intentional CME.

Reference	**Silberg, W. M., Lundberg, G. D., & Musacchio, R. A. (1997). Assessing, controlling and assuring the quality of medical information on the internet. *JAMA. 277, 1244-1245.***
Area of application	Continuing medical education using on-line information sources and methods of evaluation them.
Setting	While the number of medical web-sites grows, there is no systematic way of evaluating their content.
Objectives	To review schemes for evaluating the content of medical information web-sites and information sources.
Methodology	Comparison and review of existing means of evaluating on-line medical information.
ICT	Network-based technologies and Internet accessible databases.
Results & conclusions	While the growth of medical sites on the Internet is lauded by the authors, content is identified as the main concern. Various schemes by professional associations, in the US and elsewhere, to rate medical information on line are mentioned.
Limitations	No systematic review is reported.
Suggestions & future directions	A standard for evaluating medical information on-line should be established.

Reference	**Smith, R. P. (1997). The Internet for continuing education. *M.D. Computing: Computers in Medical Practice 1997November- December; 14(6): 414-16, 418, 420.***
Area of	Continuing education, education, and clinical reference

Application	
Setting	Use of Internet for clinical reference, for educating students, residents and graduate physicians.
Objectives	To provide an update on Internet references for clinical use, education and continuing education
Methodology	The authors provide an appendix (from Smith and Edwards) to show examples of sites to access various medical databases and to other educational material
ICT	Internet
Results and Conclusions	There are many sites on the web that provide useful clinical, education and continuing education references
Limitations	The paper gives an update of websites that can be used by physicians. The websites are briefly described, but no information is given regarding evaluation of the website (i.e., usefulness, ease of use, etc.)
Suggestions and Future Directions	Article suggests that the Internet is growing in its role in providing education and continuing education to students and physicians

Reference	**Smith, T. L., & Ransbottom, S., (2000). Digital video in education. In L. Lau (Ed.),** ***Distance learning technologies: Issues, trends, and opportunities*** **(pp. 124-142). London: Idea Group Publishing.**
Area of application	Undergraduate distance education.
Setting	
Objectives	To design and test the use of digital video to enhance interactive pedagogies in course delivery.
Methodology	Case studies with small groups of students.
ICT	Analog and digital video (standard and streamed).
Results & conclusions	A discussion of basic learning theories and video transmission modes leads to the application of both in a learning environment. The results show now significant difference between traditional and video enhanced distance courses.
Limitations	The small size of test groups precluded finding statistically significant results.
Suggestions & future directions	Technology and pedagogy should be intricately related to provide optimal learning experiences.

Reference	**Trow, M. (1999). Lifelong Learning through the new information technologies. *Higher Education Policy 1999 12(2): 201-17.***
Area of Application	Role of IT in lifelong learning (Universities and continuing education).
Setting	Need to be researching the role of IT in lifelong learning because of its impact on higher education and the world, and because the effects of these new forms of instruction are not known.
Objectives	To discuss the difficulty for decision makers to make good public policy in the area of using IT in continuing education. Two factors create difficulty: speed of technological change and our lack of knowledge about how different forms of instruction over communication vehicles will affect learning.
Methodology	The author discusses the obstacles that policy makers need to overcome and presents current examples of institutions that are providing life-long learning.
ICT	Internet, on-line courses.
Results and Conclusions	The speed of change makes it extremely difficult to create policy surrounding lifelong learning and IT. The author suggests that policy is viewed as a series of experiments, policy needs to change and develop in parallel with new technologies. The author describes examples of on-line lifelong learning providers that he views as experiments in policy. The author points out that inherent in the concept of experimentation is the possibility of failure.
Limitations	
Suggestions and	The author presents the challenge of doing research on the changing

Future Directions	role of IT in lifelong learning. Research questions include where and how new programs for adult education at a distance are being designed, what they look like in the field, and what effects they have on those who continue their education and on social institutions.

Reference	**Walker, J., Thompson, A., & Smith, P. (1998). Maximizing the world wide web for high quality educational and clinical support to health and medical professionals in rural areas.** ***International Journal of Medical Informatics, 50(1-3), 287-291.***
Area of application	Computer assisted undergraduate medical education.
Setting	Medical professionals in Tasmania often work in remote areas without support from peers and without access to CME.
Objectives	To pilot a project for providing undergraduate medical students with a on-line communications tools to promote lifelong learning.
Methodology	A pilot project is observed and discussed by the authors.
ICT	Laptops with access to e-mail.
Results & conclusions	Medical students in Tasmania use on-line communication during rural clinical placements to participate in peer learning and discussions. The purpose of the project is to develop lifelong learning skills and to establish a framework for on-line research and learning communities involving practicing professionals as well as students.
Limitations	The project is quite small and does not provide statistically significant results.
Suggestions & future directions	To expand the project and to follow students to see if the desired effects are achieved.

Reference	**Wallace, G. (2001). Information technology and telemedicine.** ***CMAJ 2001 165(6): 777-779.***
Area of Application	Telemedicine (health care sector).
Setting	Information technology is discussed in reference to telemedicine.
Objectives	The author provides a short review of current trends in telemedicine.
Methodology	Wallace describes trends from the current literature and discusses this in terms of the challenges facing telemedicine
ICT	Email, Internet, videoconferencing, teleradiology, transmission of echocardiogrphs, EMR, laptops, handheld computers (portable and wireless), high speed conncections (CA*NET3 and Internet 2).
Results and Conclusions	Wallace briefly describes informatics in practice, on-line journals, resources on the Internet for patients, on-line and distance education and technological advances. The high cost of telemedicine is an obstacle to its adoption and integration. Sustained maintenance funding is needed for telemedicine initiatives. Issues surrounding patient confidentiality, security, medicolegal and copyright need to be addressed.
Limitations	The article is mainly descriptive and it presents a very positive examination of telemedicine (more discussion of negative impacts might add something to the article).
Suggestions and Future Directions	The author suggests that the greatest challenge for telemedicine is to change the "culture of an institution" so that the institution embraces telemedicine applications that can meet their needs. Telemedicine can succeed if medical or educational need is the starting point and then determine if a technology might help best meet that need.

Reference	**White, C. (2000). An OLT Study on Web-based delivery of health and human service programs: action research on the advantages and effectiveness.** ***Office of Learning Technologies June 2000.***
Area of Application	Distance education – assessing the effectiveness of web-based courses compared to print based courses.
Setting	Course delivery through the Web has potential to respond to the changes that are occurring in learning (for students and instructors).
Objectives	The four main objectives of the project were to understand how technology-medicated courses can be used more effectively; identify the approaches that best serve the needs and preferences of students; create knowledge and awareness necessary to assist faculty to gain competencies; establish a process to share, promote and collaborate with other educators using Web-based initiatives.
Methodology	A literature review was conducted on student/ instructor competencies and support, Web-based course design and delivery, interactivity and cost. Three distinct courses were targeted for the study. A survey was given to students who completed the print or Web-based course. Students in the on-line course were also given phone interviews. Instructors were interviewed at the end of the course.
ICT	Internet, email, Topclass and WebCT software.
Results and Conclusions	Findings suggest that the variety of communication options for both print and online course delivery needs to be examined to enhance both. Faculty development needs to include training related to ICT use, and communication and record-keeping in an online environment. In terms of content, quality courses need to be developed that have minimal barriers to accessing the course. Technical support tools and problem solving at a distance are essential for on-line courses.
Limitations	
Suggestions and Future Directions	According to the author, collaborative online course development shows great promise to create courses that make pedagogically appropriate use of course delivery programs. The collaborative model creates an environment of continuing instructor development focused on creating quality online courses.

Reference	**Wyatt, J. C. (2000). Keeping up: Continuing education or lifelong learning?** ***Journal of the Royal society of Medicine, 98, 369-372.***
Area of application	Lifelong medical education
Setting	Traditional undergraduate medical programs produce learners that are not as skilled at seeking out continuous medical education opportunities as are learners leaving problem based learning programs.
Objectives	To explain and identify the motivation, qualities and circumstances for lifelong medical learning to improve currency of knowledge among practicing physicians.
Methodology	Follow-up surveys of medical students leaving traditional and problem based programs are examined, and a theoretical framework built to explain and promote the motivation for lifelong learning.
ICT	Videoconferencing, electronic libraries.
Results & conclusions	Problem based learning establishes a habit of lifelong learning. Graduates of problem-based learning tend to stay more current with developments in medical research than do those that graduate from traditional programs. Telemedical links, using videoconferencing, offer the opportunity for the development of problem based continuing medical education among practicing clinicians. Technology supports a pedagogy based on continual learning, not just for immediate help, but also for long-term educational goals.
Limitations	This paper lacks a detailed description of the sources and methodology for collecting statistical information.
Suggestions & future directions	Programs of problem based learning should be wedded with electronic information sources to promote and support lifelong learning among medical practitioners.

Reference	**Zollo, S., Kienzle, M., Henshaw, Z., Crist,l., & Wakefield, D. (1999). Tele-Education in a telemedicine environment: Implication for rural health care and academic medical centers. *Journal of Medical Systems, 23(2), 107-122*.**
Area of application	Network-based education for health professionals.
Setting	Continuing Medical Education is traditionally delivered in a face-to-face context. Physicians were asked about their preferences, and to consider remote delivery options.
Objectives	To alleviate professional and educational isolation of rural medical practitioners by providing them with educational and peer contact opportunities using network technologies.
Methodology	A survey of preferred methods of CME delivery is used as well as a cost/benefits framework.
ICT	Web-based and videoconference based educational programs.
Results & conclusions	The National Library of Medicine provided funding for this study, based in Iowa, of CME delivered to rural practitioners primarily through video-conferencing. The development of research consortia and on-line learning networks among peers is stressed as a means of alleviating professional and educational isolation encountered by rural physicians. A survey of providers and users of CME is briefly reported.
Limitations	Pedagogical considerations are not mentioned.
Suggestions & future directions	Only some content areas are suitable for network-based delivery. There are impediments to non-traditional learning which should be overcome if it is to be an acceptable alternative for rural and remote practitioners.

Appendix 4
Annotated bibliography pertaining to workplace learning in health-related fields

Produced by

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Search Strategy

The literature search strategy include the clinical and health informatics literature for abstracts, articles and conference proceedings encompassing all aspects of workplace learning and e-learning in the health sector It include the following databases, over the following time periods.

Databases searched	Limits	Search Terms Used
HealthSTAR (medical information database)	1999-December 2000	1. Workplace and learning and health and sector 2. Learning and health and sector 3. Health care and skills 4. Staff development 5. Professional competence.
MEDLINE (medical information database)	1996-present	1. Workplace and learning and health and sector 2. Learning and health and sector 3. Health care and skills 4. Staff development 5. Lifelong learning and health sector
CINAHL (medical information database)	1991-present	1. Workplace and learning and health and sector 2. Learning and health and sector 3. Health care and skills 4. Staff development 5. Lifelong learning and health sector
ERIC (education database) Emerald Journals TIE	1999-present	1. Workplace and learning and health and sector 2. Learning and health and sector 3. Health care and skills 4. Staff development 5. Lifelong learning and health sector
EMBASE	1990-present	1. Workplace and learning and health and sector 2. Learning and health and sector 3. Health care and skills 4. Staff development 5. Lifelong learning and health sector

List of References and Summaries

Reference	**Flanagan J, Baldwin S, Clarke D. (2000) Work-based learning as a means of developing and assessing nursing competence. *Journal of Clinical Nursing* May;9(3):360-8.**
Area of application	Work-based learning (WBL) and assessment of nursing competence
Setting	Professional development of the nurses in the workplace
Objectives	To study notions of competence and outcome as they relate to a Work-Based Learning model.
Methodology	Description of examples of nursing programmes and review article based on WBL
ICT	None
Results & conclusions	Work-Based Learning is the bringing together of self-knowledge, expertise at work and formal knowledge. It takes a structured and learner-managed approach to maximising opportunities for learning and professional development in the workplace. The development and assessment of nursing competence can be facilitated through Work-Based Learning, although this may require pedagogic and structural changes within nurse education.
Limitations	There are a number of conditions which must accompany effective participative learning : the learner must desire to learn in the workplace, the learning expected must be within the learner's capabilities and the work environment must be prepared to support WBL
Suggestions & future directions	This method of learning and assessment has potential to bridge the gap between theory and practice, and as such it can only be achieved through commitment and partnership between the individual practitioner, clinical services and universities. Work-Based Learning can be vital element in such progressive and co-operative relationships, which are crucial to the development of the healthcare professions.

Reference	**Carkhuff MH. (1996) Reflective learning: work groups as learning groups. *The Journal of Continuing Education in Nursing.* Sep-Oct;27(5):209-14.**
Area of application	Reflective learning in the workplace for healthcare professional
Setting	Learning strategies for professional nurses
Objectives	To identify the use of reflective learning in the workplace
Methodology	Literature review and report outcomes from the implementation of the reflection-on-action technique.
ICT	None
Results & conclusions	Staff development educators are challenged to develop additional learning strategies to meet the demands of the professional nurse in the changing healthcare environment today. Methodology for workplace learning is being developed to meet the critical thinking skills necessary for the professional nurse of the future. The implications for staff development educators are reviewed for the concept of work groups as learning groups. The role of the staff development educator in reflective learning in work groups is varied. The education specialist has an important role to model the skills of forming work groups to solve real work problem. He can assist nurses to become aware of their existing knowledge and take greater responsibility for their own learning. He can provide a structure for reflection after each work group. The educator can provide a framework of questions to guide reflective journal writing for learners after completion of the work group.
Limitations	
Suggestions & future directions	The reflection-on-action technique will provide the basis for learners to test their assumptions, investigate meaning schemes, and change approach or understanding regarding a decision that signifies change, or in essence, learning. Reflective learning in the workplace can become the catalyst for professional development and system integration. Learning how to learn is the challenge for nursing staff. So, it is important to take all available avenues to assist and develop nursing staff to be critically reflective in the workplace.

Reference	**Galvin JR, D'Alessandro MP, Erkonen WE, Knutson TA, Lacey DL. (1994) The virtual hospital: a new paradigm for lifelong learning in radiology. *Radiographics* 1994 Jul;14(4):875-9.**
Area of application	Medical training in radiology
Setting	Residency programs in radiology
Objectives	To describe a solution that resides with a combination of multimedia computers, wide area networks, and information developed by academic radiology departments.
Methodology	This paper describe a distance learning and information support system that uses a multimedia data base transmitted across a wide area network as The Virtual Hospital.
ICT	Multimedia medical library distributed
Results & conclusions	Medical training in radiology should be viewed as a continuum that begins in medical school and proceeds throughout the years in practice. Unfortunately, there are significant barriers to providing continuing medical education. One key barrier is the physical separation between the information source and the workplace. A multimedia medical library distributed via wide area networks has been developed that provides needed information at the point of use.
Limitations	
Suggestions & future directions	Training should be viewed as a continuum that starts in medical school and persists throughout the years in practice. The Virtual Hospital will allow radiologists in private practice and within university environments to continue their education supported by familiar data base that provides CME materials and helps with decision-making at the view box.

Reference	**Burke LM, Wilson AM.(1997) Mental models, metaphors and their use in the education of nurses.** ***Journal of Nursing Management.*** **Nov;5(6):351-7.**
Area of application	Use of information technology within workplace
Setting	Field of nursing and health care
Objectives	To explore the use of mental models and metaphors for the technological education of nurses.
Methodology	Theorical paper.
ICT	Different applications of IT / No specified
Results & conclusions	A great deal of nurses' confidence in the use of information technology (IT) depends both on the way computers are introduced to students in the college and how such education is continued and applied when they are practitioners. It is therefore vital that teachers of IT assist nurses to discover ways of learning to utilise and apply computers within their workplace with whatever methods are available. One method which has been introduced with success in other fields is the use of mental models and metaphors. Mental models and metaphors enable individuals to learn by building on past learning. Concepts and ideas which have already been internalised from past experience can be transferred and adapted for usage in a new learning situation with computers and technology.
Limitations	
Suggestions & future directions	The need for nurses to develop skills and knowledge about the application of IT to many areas of their practice is increasing. It is essential therefore that nurse teachers continue to explore new ways of introducing and improving computer proficiency and expertise for students and experiences practitioners, particularly ones which have been evaluated so well in related fields of practice.

Reference	**Lowis A, Ellington H.(1991) Innovations in occupational health nursing education, including a distance learning approach. *AAOHN Journal* July;39(7):316-8.**
Area of application	Occupational health nurses in the United Kingdom
Setting	Distance learning option
Objectives	To describe a distance learning approach and modular structure like as an alternative mode of study
Methodology	Description of experience
ICT	Non specified
Results & conclusions	The results of a survey in the United Kingdom in the late 1980s indicated that many occupational health nurses were not being sent for formal training because of the length of time nurses needed to be away from their employment and the difficulty employers had in finding nurse replacements during training. To meet the needs of occupational health nurses and their employers, the Robert Gordon Institute of Technology (RGIT) instituted a modular training course that offers full time attendance or distance learning options. RGIT's course consists of six modules over a 1 to 3 year period, which students can take in any order after completing a short Return to Study course.
Limitations	
Suggestions & future directions	Using the innovative distance learning option, occupational health nurses can earn a Diploma in Occupational Health Nursing while completing most of their courses at the workplace, thus avoiding conflicts between training and work schedules.

Reference	**Wellman N. (1994) Management development. The MESOL (Management Education Scheme by Open learning) experience. *Health Manpower Management* 20(1):10-2.**
Area of application	Competence-based learning program
Setting	Managing Health Services
Objectives	Explores and attempts to reconcile some of the differences between traditional professional and academic management qualifications and those based on the National Vocational Qualifications (NVQ) competence model.
Methodology	Description of experience
ICT	None
Results & conclusions	Based on the experience of Universities and Higher Education institutions delivering open learning Management Education Scheme by Open Learning (MESOL) materials to the UK health and social care sector, focuses on the different assessment methodologies used by each. Concludes that it is necessary to differentiate clearly between the traditional input/knowledge-based model and the competence-based approach of the NVQ. This will allow candidates to contextualize and consolidate learning in the workplace prior to revisiting their performance at a later date.
Limitations	
Suggestions & future directions	The portfolio method competence assessment helps candidates to contextualized and embed their learning into the workplace. The need to generate evidence forces candidates to audit their strengths and weaknesses, then plan and organize how they will fill the gaps.

Reference	**Oeffinger JC, Hiebeler L, Sherman T, Gaskill M, Portante T, Polasek J, Litterer K. (1992) Innovative desktop learning tools. Implications for rural hospitals and physicians. *Annals New York Academy of Sciences*. Dec 17;670:76-90.**
Area of application	Health care professional
Setting	Rural hospitals
Objectives	To describe an emerging model: computer-related assisted distance learning enhancement (CRADLE)
Methodology	This paper relate a CRADLE case study in The Cancer Learning Center
ICT	Integrated learning tools: material about structure education, peer collaborations and access to organizational memory.
Results & conclusions	The Texas Hospital Education and Research Foundation has recently been involved in two programs that tested new approaches to worker education using distance-learning strategies. The projects--resource sharing among rural directors of nursing and training for cancer tumor registrars--used computer-conferencing technology. A new model using existing satellite, audio-conferencing, and computer-based instruction augmented by computer conferencing is proposed. The Computer-Related Assisted Distance Learning Enhancement (CRADLE) model integrates existing technologies to provide education to health care workers at their desktop. The Cancer Learning Center (CLC) tested peer collaboration, the primary component of the model. The ultimate goal is to have the system available to all tumor registrars in Texas, and to secure funding to implement rural nursing and rural high-school health occupations education projects.
Limitations	
Suggestions & future directions	Innovative methods of providing workplace education for health care professionals may be a key to the survival of rural hospitals in America. Such methods must overcome time, distance, cost and organisational constraints, and take into account the structure of the learning experience.

Reference	**Peterson R, Hakendorf M, Guscott T. (1999) Improving aged care education for Australian rural nurses using problem-based learning.** ***Journal of Continuing Education in Nursing*** **May-Jun;30(3):120-7.**
Area of application	Problem-based learning
Setting	Rural nurses
Objectives	To evaluate problem-based approach in continuing nurse education
Methodology	Both quantitative and qualitative approaches were used to evaluate the program, and data collected through observation of the participants when working on case scenarios, journal writing, and pre-questionnaires and post-questionnaires were included. Fifteen nurses participated in the program.
ICT	None
Results & conclusions	A continuing education program in aged care was developed using the principles of problem-based learning (PBL) to improve the participating nurses' understanding of current government guidelines on aged care, to develop their ability to apply this information to their workplace situations, and to give them the confidence and strategies to initiate change in their workplaces. The use of a guided introduction to PBL and the use of journals were important components in the design of this program. Participants developed a holistic approach to aged care, reflected on their practice in the journals, developed an understanding of the current aged care guidelines, and acquired the skills, strategies, and motivation to make changes in their workplaces. PBL enabled the nurses to link theory with practice, not only through the case scenarios considered in the program, but also when reflecting on their work practices in their journals. The use of journals by participants and the guided introduction to the PBL approach were important factors in the Aged Care Program's success.
Limitations	
Suggestions & future directions	PBL approach provided a viable and effective approach for introducing nurses to guidelines on care and for developing their skills in applying this information in contextual and holistic situation. It is important to organize a workshop focusing on group shills development is an important facet in implementing the PBL approach and assist the change process when participants worked in their health units.

Reference	**Ward C, McCormack B.(2000) Creating an adult learning culture through practice development. N*urse Education Today* May;20(4):259-66.n**
Area of application	Development of a learning culture, lifelong learning strategies
Setting	Nursing development
Objectives	To describe the context of the development strategy, the facilitation processes adopted including the theoretical underpinnings and some 'tentative' outcomes achieve, and to focus on ways in which nurses in a particular hospital setting developed personally and professionally when the appropriate conditions of learning were provided.
Methodology	Longitudinal study in the hospitals and combination of action research methodology, the application of adult learning theory and the principles of evaluation in determining personal and organisational outcomes.
ICT	None
Results & conclusions	The development of a learning culture is becoming a dominant theme in the strategic plans of health care organisations. This is arising through a drive to improve standards of practice, bridge the perceived theory-practice gap and create means of integrating learning with practice. There have been many initiatives to create such a change, including continuous professional development, reflective practice, clinical supervision and work-based learning. The paper presents an account of a practice development strategy that aimed to create a learning culture as a sub-element of the overall programme of work. Working with individual project leaders, the intention was to shift the emphasis away from classroom based education, to learning at and from work. Given the application of rigorous action research process and the monitoring of clear personal process and organisational outcomes, the acceptance of an innovative approach to the personal development of individuals is more likely. The value of this approach is grounded in the eventual benefits the organisation achieves in the long term. These include a flexible workforce, improved communications, and clear problem solving strategies; all key components of current approaches to life-long learning strategies and the development of learning cultures.
Limitations	
Suggestions & future directions	The paper highlight the integration of adult learning theory within a practice development strategy as a means of systematically creating a learning culture.

Reference	**Evans AW. (2001) Assessing competence in surgical dentistry. *British Dental Journal* Apr 14;190(7):343-6.**
Area of application	Assessment of the surgical dentists' skills
Setting	Workplace learning in surgical dentistry
Objectives	To discuss some of the issues that will need to be considered as assessment of surgical dentist's skills
Methodology	Descriptive paper and discussion of the author
ICT	None
Results & conclusions	The growing demand for assessment in all aspects of surgical competencies will inevitably embrace the whole of dental surgery. The paper reviews what is meant by competence and how we assess it, with particular emphasis on practical and technical skills. Specific methodologies for assessing competence are described including, as illustrations, two means of assessing the removal of lower wisdom teeth. The evaluation of competence in the workplace is discussed together with the difficulty in assessing important attributes such as attitude. It concludes that the assessment of competence is a valuable tool in its own right and a means of demonstrating to the public the continuing commitment of the profession to the highest possible standards. However assessment will be very time consuming and to be worth while we must ensure that it is done in a way that produces clear and unambiguous benefits and solves real problems.
Limitations	
Suggestions & future directions	Teaching system in undergraduate, vocational and postgraduate specialties must provide curricula with core competencies and a means of achieving objective competency based assessment. In order to measure judgement, attitude and ability to cope with a contingency assessments should take place in workplace. It is important to encourage trainees to take control of their learning process and to assist with continuation of learning and self-evaluation throughout life.

Reference	**Rogerson EC, Harden RM. (1999) Seven years on: distance learning courses for first level registered nurses and midwives. *Nurse Education Today* May;19(4):286-94.**
Area of application	Work-based Learning and Problem-based Learning into distance learning courses
Setting	Post-registration course provision for first level registered nurses and midwives
Objectives	To describe the experiences gained with distance learning, for nurses and midwives, over a 7-years period. And to highlight the benefits of distance learning and the course features deemed essential for implementation of quality distance learning.
Methodology	Description of observation and experience
ICT	No specified
Results & conclusions	There is a recognised need to increase the accessibility and flexibility of post-registration course provision for first level registered nurses and midwives. Distance learning courses were developed and implemented at the University of Dundee in response to this need. The courses provide a range of learning opportunities from single module certificate courses to Bachelor, Honours and Masters level studies. The courses are well received by nurses and midwives and experience, over the last 7 years, has highlighted important aspects for distance learning education for both professional groups. Different educational strategies such as Work-based Learning and Problem-based Learning are incorporated into distance learning course design to facilitate the integration of theory and practice and develop cognitive and meta-cognitive skills. The relationship between course assessment and clinical environment is also a key feature of course design, with assessment methods built around work-based learning opportunities in clinical practice. Experience has shown that students require support throughout the learning process. This is achieved through text-based study guides and a range of other support strategies. It is concluded that distance learning can be individualised to meet the professional and personal needs of students and provide quality, flexible learning opportunities for nurses and midwives, facilitating practice development and benefiting patient care.
Limitations	
Suggestions & future directions	High quality distance learning in association with work-based learning and other educational strategies such as problem-based learning , should play an increasing role in the provision of post-registration education and training for nurses and midwive

Reference	**Liaw ST, Marty JJ. (2001) Learning to consult with computers. *Medical Education* Jul;35(7):645-51.**
Area of application	Medical education
Setting	An overview lecture plus a workshop before and a workshop after practice placements, during the 10-week general practice (GP) term in the 5th year of the University of Melbourne medical course
Objectives	To develop and evaluate a strategy to teach skills and issues associated with computers in the consultation.
Methodology	Pre- and post-intervention study using a mix of qualitative and quantitative methods within a strategic evaluation framework. Self-reported attitudes and skills with clinical applications before, during and after the intervention.
ICT	Clinical computer systems
Results & conclusions	Most students had significant general computer experience but little in the medical area. They found the workshops relevant, interesting and easy to follow. The role-play approach facilitated students' learning of relevant communication and consulting skills and an appreciation of issues associated with using the information technology tools in simulated clinical situations to augment and complement their consulting skills. The workshops and exposure to GP systems were associated with an increase in the use of clinical software, more realistic expectations of existing clinical and medical record software and an understanding of the barriers to the use of computers in the consultation.
Limitations	
Suggestions & future directions	The educational intervention assisted students to develop and express an understanding of the importance of consulting and communication skills in teaching and learning about medical informatics tools, hardware and software design, workplace issues and the impact of clinical computer systems on the consultation and patient care.

Reference	**Eraut M. (2000) Non-formal learning and tacit knowledge in professional work. *British Journal of Educucational Psychology* Mar;70 (Pt 1):113-36.**
Area of application	Learning in professional work
Setting	Professional workplace
Objectives	To clarify the multiple meanings accorded to terms such as 'non-formal learning', 'implicit learning' and 'tacit knowledge', their theoretical assumptions and the range of phenomena to which they refer. 2. To discuss their implications for professional practice.
Methodology	A largely theoretical analysis of issues and phenomena arising from empirical investigations.
ICT	None
Results & conclusions	The paper explore the conceptual and methodological problems arising from several empirical investigations of professional education and learning in the workplace The author's typology of non-formal learning distinguishes between implicit learning, reactive on-the-spot learning and deliberative learning. The significance of the last is commonly overemphasised. The problematic nature of tacit knowledge is discussed with respect to both detecting it and representing it. Three types of tacit knowledge are discussed: tacit understanding of people and situations, routinized actions and the tacit rules that underpin intuitive decision-making. They come together when professional performance involves sequences of routinized action punctuated by rapid intuitive decisions based on tacit understanding of the situation. Four types of process are involved--reading the situation, making decisions, overt activity and metacognition--and three modes of cognition--intuitive, analytic and deliberative. The balance between these modes depends on time, experience and complexity. Where rapid action dominates, periods of deliberation are needed to maintain critical control.
Limitations	
Suggestions & future directions	The role of both formal and informal social knowledge is argued that situated learning often leads not to local conformity but to greater individual variation as people's careers take them through a series of different contexts.

Reference	**Yuen F. (1991) Case study of learning milieux: the modifying effect of the workplace. *Journal of Advanced Nursing* Nov;16(11):1290-5.**
Area of application	Nursing Workplace learning
Setting	Hospitals within the Illawarra Area Health Service, New South Wales
Objectives	To examine the hospital learning milieux for complementary or other influences following the first-year graduation of the college nursing programme.
Methodology	Exploratory research: four case studies
ICT	None
Results & conclusions	Several themes emerge in the case studies. These themes appear to indicate the significance of the role of the nurse unit manager in ongoing education. These includes 1) the staff development strategies and learning activities, 2) the staff relationships and 3) the attitude competency of the nurse unit manager. 1) There is evidence that if nursing education activities are to be successful in the clinical areas, all staff must be involved in planning these development strategies. The nurse unit manager must have a deep commitment to and skill in the involvement of staff in the organizational and educational process. 2) There were clear indications that the 'better' clinical areas were distinguished by certain kinds of work relationships among nurses. In brief, staff were seen to engage in four 'critical practices' in their work with one another. First, there was frequent and continuous discussion about nursing practice. Second, mutual observation among the staff provided a basis for useful evaluation, staff provided each other with shared referents, Third, there were opportunities for planning and implementing joint nursing activities, staff shared the considerable burden of ward operating and made reasonable standards of performance. Fourth, staff supported each other in their practice, all taking at one time or another the role of team leader. 3) The nurse unit managers must not feel threatened but rather predisposed toward continuing education, be self-confident and feel supported. They should be able to determine nurses' learning needs and to involve them from that point. It is essential that any planning of nursing education should include the nurse unit manager and emphasize the importance of her involvement in development of the learning environment and the corporation of other health professionals.
Limitations	
Suggestions & future directions	It is important to have a well-planned learning program, the learning environment in the clinical area must also be supportive if professional nurses are to develop the concept of learning as a lifelong activity. Senior nurses must serve as role models and assume responsibility for their own continuous self-

	improvement, and must integrate the concept of continuing education into various aspects of the nursing activities.

Reference	**Spouse J. (2001) Bridging theory and practice in the supervisory relationship: a sociocultural perspective. *Journal of Advanced Nursing* Feb;33(4):512-22.**
Area of application	Mentorship in the workplace
Setting	Nursing education: Students' mentor experiences
Objectives	To propose alternative theoretical frameworks for conceptualising supervisory relationships in clinical settings where professional development is the key activity.
Methodology	Longitudinal study using a constructivist/naturalistic paradigm was designed to investigate factors influencing the professional development eight pre-registration nursing students' during their practice experiences. A multi-method approach to data collection was used. An extensive literature review of nurse education texts was conducted.
ICT	None
Results & conclusions	In discussing findings from the research, paradigm examples of students' mentor experiences will be used to illustrate socio-cultural theories of learning and their relevance to professional education in clinical settings. The concept of a theory-practice gap dominates approaches to preparing professionals for their future role. With increasing emphasis on work-based learning one of the many strategies designed to support students and professionals is supervision. This strategy has had mixed success. In many instances this is because of insufficient numbers of suitably experienced and prepared staff. Another factor is how supervision has been conceptualised. In professional education the term mentorship is often used synonymously with preceptorship and supervision. These terms are all concerned with activities intended to foster professional and educational development, and in many instances the learner is a novice working in an unfamiliar setting over a predefined period of time. The most significant influence was found to be effective mentorship. Characteristics of successful mentorship are best explained using frameworks derived from socio-cultural theories. Concepts of sponsorship, legitimate peripheral participation, scaffolding and zone of proximal development (ZPD) offer a more effective means to understand and implement an educational partnership for work-place learning. The ability to scaffold knowledge-in-waiting to knowledge-in-use depends upon available resources and the social environments in which students work and learn.
Limitations	
Suggestions & future directions	These research examples illustrate how students were able to move beyond the one-to-one relationship with their mentor and engage with other members of the clinical team in an

	independent manner that was constructive and beneficial. By undertaking parallel activities of continuous performance evaluation, collaborative planning and practice, students are coached through educational experiences that benefit all concerned. Such activities need to be supplemented by opportunities to practice their skills under distant supervision, but with the confidence that senior colleagues are available to provide help and advice.

Reference	**Penney NE, Gibbons B, Bushy A. (1996) Partners in distance learning. Project outreach. *Journal of Nursing Administration* Jul-Aug;26(7-8):27-36.**
Area of application	Distance learning
Setting	Institutions of higher education and healthcare organisations
Objectives	To describe one such partnership and the common issues confronted by both the academic and service institutions in implementing an outreach education program.
Methodology	Description of observation and experience of the author, decribe the project Outreach from Bassett Healthcare System
ICT	Many technologies
Results & conclusions	Distance learning refers to any educational experience in which the instructor (teacher) is separated from the student (learner) by geographic distance. Partnerships are being established between institutions of higher education and healthcare organisations to achieve a mutual goal, that of educating employees to work in a rapidly changing workplace environment. The authors propose that these partnerships can be effective in implementing distance learning programs that meet the ongoing educational needs of nurses living and working in rural and underserved environments.
Limitations	
Suggestions & future directions	The partnership between institutions of higher education, a healthcare organization, and the community is an effective strategy to address the ongoing information needs of nurses living and working in rural and underserved environments.

Reference	**Smith P. (2000) Introducing competence-based management development: a case study of a university-hospital partnership *Journal of Workplace Learning* (UK), Vol 12 No 6: 245-251.**
Area of application	Competence-based approach to management development
Setting	Partnership between a hospital trust (a combined acute, community and mental health hospital in the north of England) and a new university in which a competence-based approach to management development - the implementation of management standards at National Vocational Qualification (NVQ) level 4 (first-line managers) - was established.
Objectives	To offer a detailed description of the case study partnership, looking at the background to the programme, how the NVQ 4 award was designed, and programme delivery and outcomes.
Methodology	Depth case study. Discusses the changes in management that have taken place within the UK National Health Service and, very briefly, reviews the literature on industry-education partnerships.
ICT	None
Results & conclusions	Four main conclusions drawn from the analysis and suggests some general lessons to be learned from the case study that might give guidance to other providers of this type of management development in the future. 1) the recruitment and selection process for candidates need to be clearly defined; 2) perceptions of the NVQ process have to be set At the correct level; 3) organisational contexts must be taken into account; 4) the evidencing process should be challenging for candidates.
Limitations	
Suggestions & future directions	Argues that commentators and critics must move from simply criticising the competence-based approach, to developing case studies of good practice and conducting further research in organisations in order to influence the future development of the management standards. For most providers of management education the competence-based approach is an important part of their strategy and is here to stay.

Reference	**Slotnick H.B. (1999) How doctors learn: Physicians' self-directed learning episodes Academic *Medicine* 74:10 (1106-1117).**
Area of application	Self-directed learning activities of physicians
Setting	Continuing Medical Education (CME) of Physicians and Surgeons of Canada
Objectives	To improve our understanding of the continuum of physicians' learning activities through formal, organized credit-bearing CME. To paint a more accurate picture of CME's role in doctors' continuing professional development. To pursue further the ways in which undergraduate and residency curricula prepare doctors to be self-directed learners.
Methodology	To qualitatively examine the self-directed learning activities of physicians in light of several lines of research on how doctors learn. The study was conducted under the auspices of the Royal College of Physicians and Surgeons of Canada, the author elicited from physicians narratives about past learning experiences. He analysed the narratives (1) seeking themes among the doctors' approaches and (2) examining those themes in light of the existing literature
ICT	
Results & conclusions	The 32 physicians interviewed described learning experiences, confirming earlier research that two varieties of problems (specific and general) precipitate learning and that learning episodes follow definite stages: scanning for problems, deciding whether to pursue the learning task, acquiring new knowledge and skill, and gaining experience with what has been learned. The latter three stages have been described previously and are expanded upon here. The author presents a four-stage Model as theory of physicians' self-directed learning episodes, by problem type.
Limitations	There are a variety of issues raised but not addressed by this study. Three aspects are indicated by the author.
Suggestions & future directions	This study produced an integrated and elaborated theory of learning in clinical practice with implications for both the education of physicians in training and physicians' continuing professional development. In particular, the theory points to problem areas in teaching medical students and residents to learn in clinical practice, and in matching the learning needs of physicians to organised continuing medical education activities. One of the eight implications cited by author is interesting: Continuing professional development activities should offer participants different learning formats depending on the nature of the participants' learning needs associated with the stages they have reached in the learning episodes.

Reference	**Parkin V.(2000) A comprehensive learning approach for central venous catheter care skill... A peek at the past -- a look at the future: the 2000 CINA conference -- October 18-20, 2000. *Journal of the Canadian Intravenous Nurses Association*, 16:62-5.**
Area of application	Workplace learning
Setting	At The Riverdale Hospital, preparing nurses to be skilled in caring for patients with central venous catheters (CVCs)
Objectives	To describe a comprehensive learning approach
Methodology	Description of observation and experience
ICT	None
Results & conclusions	Since technical care needs like basic IV therapy within the hospital were infrequently practiced by nurses in the past, it was appreciated that nurses were on a significant teaming curve to acquire competency in caring for patients with CVCs. The teaming approach established was based on adult teaming principles that would promote safe integration of central venous catheters (CVC) skills for patient care. This teaming approach involved: review of basic IV therapy; self- and peer-directed teaming opportunities with demonstration equipment; teaming guides and workshop formats; as well as ensuring continued supervised practice of the CVC skill sets towards achieving final skill acquisition.. There were a number of challenges in the implementation. One was achieving final skill acquisition for a critical number of nurses in a timely manner. Another was maintaining cost-effective ways to roll out the education such as keeping staff replacement costs as well as educational supply costs down. In addition, as individuals, learners needed varying amounts of teaming time. The following will outline the teaming approach taken to prepare registered nurses in this setting to achieve and maintain skill acquisition in CVC care.
Limitations	
Suggestions & future directions	It is important to base the learning approach on adult learning principles.

Reference	**Burks B. Tilson ER. (2000) Teaching techniques. Adult learning: classroom to workplace. *Radiologic Technology*, 71(4):390-2, Mar-Apr.**
Area of application	Teaching techniques for adult learning
Setting	Health professionals
Objectives	To describe principal adult learning principles.
Methodology	Theorical paper
ICT	None
Results & conclusions	This can be a challenge for educator who must take into consideration the psychosocial, behavioral and learning differences of adult learners. If approached correctly, this can be a powerful experience for both learners and educators. About this, the author describes theorical concepts as attitudes (like as motivation), cognitive processes (4 particular learning styles) and behavioral patterns (difference of older and younger adult learners). Educators and adult learners need to be engaged at every stage in the classroom and workplace, promoting skills to survive they will face in a global, high-tech competitive society with an increasingly diverse population.
Limitations	
Suggestions & future directions	Learning how to learn is vital for adult learners; it allows their self-esteem and confidence to increase and grow. When learners learn how to learn, it allows them to cope with new technology and change in the classroom and workplace.

Reference	**White JP. Armstrong H. Armstrong P. Bourgeault I. Choiniere J. Mykhalovskiy E. (2000) The impact of managed care on nurses' workplace learning and teaching. *Nursing Inquiry,* 7(2):74-80.**
Area of application	Workplace learning
Setting	This paper examines the impact of managed care on the informal learning process for nurses in a major US-based health organization.
Objectives	To report the nurses' view of the effect recent changes have had on the nurse/patient/care relationship.
Methodology	Analysis of focus group data. The author report the analysis of the data collected at group interviews involving nurses working in both hospital and community settings of a leading US-based HMO. All interviews took place during September of 1997 at various sites in California. This study is part of a larger Social Science Research Council of Canada funded investigation into managed care in the US and Canada.
ICT	None
Results & conclusions	Managed care, this research indicates, has transformed the learning milieus for nurses with two effects. First, nurses have seen their need for informal learning increase while the time and context for that learning has diminished. Second, the process of teaching patients and families has also been adversely affected even as managed care creates the need for more patient education.
Limitations	
Suggestions & future directions	The interaction between nurses and doctors and among nurses themselves has been jeopardized with respect to knowledge transfer in the new managed care settings. The care-givers themselves feel that their inter- and intra-professional teaching and learning has, to an extent, been undermined through separation, lack of time, multitasking and new technologies. This study indicates that it is important to address these core issues of informal learning and teaching in the managed care hospitals.

Reference	**Youseffi F. Caldwell R. Hadnot P. Blake BJ. (2000) Recall Rummy: learning can be fun... a card game to reinforce proper skill techniques. *Journal of Continuing Education in Nursing*, 31(4):161-2.**
Area of application	Teaching strategies
Setting	Nursing skills
Objectives	To propose another learning strategy
Methodology	Description of experience
ICT	Used television game
Results & conclusions	Nurse educators are continuously seeking creative methods to teach nursing skills. Continuing education programs have adapted and used television game show themes as effective teaching strategies. The traditional card game of rummy has been modified into a creative learning technique for entertaining and reinforcing skill techniques for nurses practicing in a clinical setting. Recall Rummy is presented as a creative approach to teaching nursing skills.
Limitations	
Suggestions & future directions	Imagination and creativity are important assets for planning and teaching skills that relate to the practice of nursing. The nurses educators and the learner both can benefits from creative instructional startegies.

Reference	**Hart G. Clinton M. Edwards H. Evans K. Lunney P. Posner N. Tooth B. Weir D. Ryan Y. (2000) Accelerated professional development and peer consultation: two strategies for continuing professional education for nurses. *Journal of Continuing Education in Nursing*, 31(1):28-37, 2000 Jan-Feb.**
Area of application	Continuing professional education for nurses, specifically reflective practice and peer consultation
Setting	Members of the Centre for Mental Health Nursing Research
Objectives	To evaluate a program of accelerated professional development for RNs working in mental health settings.
Methodology	The effectiveness of the program was evaluated using a quasi-experimental pretest, post-test design.
ICT	
Results & conclusions	The development of skills in reflective practice and peer consultation was fostered by encouraging nurses to explore critical incidents from their practice experience within a small group environment. The aim of the program was to improve the knowledge and skills of the participants, enhance the work environment and improve work performance. The participants demonstrated improvements in their empathic responses to patients, their sense of hope, and some aspects of their work performance and perceptions of the work environment.
Limitations	
Suggestions & future directions	The findings have important implications for nurse administrators and clinical educators. They suggest that

	empathic nursing practice and a sense of hopefulness may be fostered by the introduction of forums where staff or students have the opportunity to raise issues of concern related to professional practice and experience empathic understanding from colleagues. The value of forums as a practical alternative to traditional one-on-one clinical supervision warrants consideration. The opportunity for peer consultation in both programs encouraged supportive and trusting relationships between colleagues and the focus on practice incidents ensured an orientation to patient care and personal development.

Reference	**Lepine S. Ahola-Sidaway J. (2000) The environment-skills-delivery model: a heuristic tool for planning staff development in the new millennium. *Journal of Continuing Education in Nursing*, 31(1):18-27, 46-7, Jan-Feb.**
Area of application	Workplace learning
Setting	Environment-Skills-Delivery Planning Tool for nurse educators
Objectives	To identify trends in hospital nursing and to consider the impact of these trends on onsite staff development needs and initiatives and to explore this issue through the perspectives of individuals who directly oversee onsite nursing staff development, namely nurse educators and staff development coordinators.
Methodology	Qualitative exploratory study. Eight experienced nurse educators who work in a hospital setting were interviewed using a semi-structured interview approach. Themes and sub themes that emerged from the interviews were determined and refined. The nursing literature related to the findings was reviewed to consider possible links between the findings and the literature.
ICT	
Results & conclusions	Three interrelated themes were identified: organizational demands and constraints helping shape nurses' daily lives and their education needs; the range of educational skills needed by nurses to perform their jobs; and the kinds of onsite educational strategies evolved in response to both and constraints. The subsequent analysis of the findings led to the development of the Environment-Skills-Delivery Planning Tool for nurse educators.
Limitations	
Suggestions & future directions	The programs need to be helpful to nurses and manageable within the context of 'real' nursing environment. The findings of this study also speak to the importance of providing the necessary support and resources to build effective staff development programs for nurses and to provide educational support for nurse educators. Regarding staff development support for nurse educators and educational administrators, the findings of this study suggest it would be beneficial for hospitals and professional organizations to find ways to invest in effective and ongoing staff development opportunities for

	these educational leaders. Nurse educators and educational administrators should be considered important knowledge brokers between the world of practice and the world of research and theories.

Reference	**Dowd SB. (1999) Change and professional development: an adult education approach. *Seminars for Nurse Managers*, 7(2):78-80.**
Area of application	Adult education approach
Setting	Health care organization
Objectives	To show and to explain the staff development approach as a means of enhancing the nurse manager's professional growth as well as the growth of employees.
Methodology	A basic overview of the staff development model is presented, followed by a brief description of its theoretical model, the basic principles of adult education.
ICT	None
Results & conclusions	Staff development is growth-oriented, provides opportunity for self-direction, and integrates the needs of the learner and the facility while focusing on long-term goals. The author discusses integrating the goals of the adult learner and those of the health care organization as a means of meeting the needs of the institution and the individual employee.
Limitations	
Suggestions & future directions	Staff development approach – using accepted precepts of adult education and a view of integrating the needs of individuals and institutions – constitutes to use a perhaps overused phrase, a 'win-win' approach to personal development.

Reference	**Thomas D. (1999) Promoting learning in the clinical area. *Assignment*, 5(3):3-11.**
Area of application	Reflective practice
Setting	Nursing clinical area
Objectives	To understand who create a learning environment
Methodology	Theoretical paper
ICT	None
Results & conclusions	Promoting learning in the clinical area is an important part of the writer's work in her role as a qualified nurse. Although the writer has been involved in teaching for many years at ward level she has received little guidance during this time for developing the skill. The primary reason for undertaking this module in 'Promoting Learning in the Clinical Area' was to gain a deeper understanding of the rationale that underpins teaching so that the writer can apply this theory to future practice. As a result of this application the author hoped to become more proficient and expert in her teaching role. This paper consists of four subsections exploring assessment, planning, implementation and evaluation. Various aspects of the teaching process are discussed beginning with the process of teaching and learning and related theories.
Limitations	
Suggestions & future directions	This is followed by a look at structured teaching and its use in the clinical area by the author through to assessing the effectiveness of her own clinical teaching session through reflective practice. At the end the author offers a conclusion relating to the information she has gained as a result of this module and in the light of her findings considers a number of ways in which she could improve the promotion of learning and her teaching practice in her clinical area in the future.

Reference	**de la Cruz LAD. Bickerton M. (1996) The 12 1/2 minute learning session: some examples and analysis of impact. *Journal of Continuing Education in Nursing*, 27(2):85-8, 1996 Mar-Apr.**
Area of application	Workplace learning
Setting	Psychiatric nursing staff
Objectives	To share an innovative approach for in-service programs that was designed to capture readiness and attention of staff nurses despite their constraints.
Methodology	Description of experience
ICT	None
Results & conclusions	Staff nurses experience time demands that frequently prevent them from attending in-service offerings. The 12 1/2 minute learning session is an innovative approach designed to meet the learning needs of the psychiatric nursing staff in spite of time constraints. The guiding principles for these sessions are: 1) "We learn what we care about," 2) preparation for sessions conveys commitment, and 3) accountability for learning is the individual's responsibility but opportunities for learning are shared. Identified outcomes of these groups are the "earthquake effect" or the shifting of one's footing; opportunity for effective debunking or uncovering of habitual patterns; and "bushfire effect" or contiguousness of enthusiasm.
Limitations	
Suggestions & future directions	The 12 ‑minute learning session is innovative, effective and fun and different from the traditional delivery of staff development offerings because the learners construct their own knowledge. It is an example of constructivist view of learning.

Appendix 5a&b
5a. Annotated bibliography pertaining to the application of knowledge building and Knowledge Forum® to support interprofessional team learning at the workplace

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List of References and Summaries

Appendix 5a reviews research in progress about how knowledge building pedagogy and technology support interprofessional learning, teamwork and continuous professional development at the workplace. Knowledge building is a theory of expert learning (Bereiter & Scardamalia, 1993). Knowledge Forum® is a second-generation computer supported intentional learning environment (CSILE). Software functions and features support advanced knowledge building processes such as reflection, complex problem solving, progressive inquiry, synthesis, and innovation. Knowledge Forum® is the most thoroughly researched on-line learning environment that is commercially available. This communal database technology may be accessed using a web browser (e.g., Internet Explorer, Netscape Navigator) or using the Knowledge Forum® Client (Windows or Macintosh). The Server runs on Linux, Windows and Macintosh OSes. (http://www.learn.motion.com/lim/kf/KF0.html).

Over the past two decades the Knowledge Building/Knowledge Forum® research program at the Ontario Institute for Studies in Education/University of Toronto has been dedicated to promoting intentional learning for deep understanding, or expert learning, with children and adults in educational settings. Over the past three years, the research agenda has evolved to include learning communities across sectors, including education, health care and business. Published research on use of knowledge building pedagogy and technology in K to 12 may be found at http://kf.oise.utoronto.ca

Method of review

Appendix 5a reports only unpublished research in progress from workplace and health care settings. All principal investigators were contacted by telephone, e-mail or interviewed in person (August to September, 2001). All research sites use knowledge building pedagogy and technology to support knowledge building with adults. All projects used the Analytic Toolkit (Burtis, 2001), an online assessment tool designed to measure knowledge building indicators. Research themes addressed by research in progress concerned: creation and sustainability of knowledge building communities; telementorship; team work and computer supported collaborative learning (CSCL); continuous professional development (CPD) and education; and, evaluation.

Theme 1 – Creation and sustainability of Knowledge Building Communities

Reference	Scardamalia, M. (1999 to 2002). *Knowledge Building Communities: Phase II structure* (NCE proposal). Toronto: Ontario Institute for Studies in Education of the University of Toronto. Scardamalia, M. (1999 to 2002). *Beyond Schooling: Situating the K-12 research agenda in a knowledge society (TL-NCE Theme 4)*. Toronto: TeleLearning Networks of Centres of Excellence.
Area of Application	**Creation and sustainability of virtual knowledge building communities.**
Setting	International communal database (Knowledge Society Network; hosted by OISE/University of Toronto).
Objectives	To create an extended network of novices and experts from a variety of sectors (education, health care, business, social services, academe, etc.) to collaborate in a virtual medium for the purpose of creating knowledge artifacts of value to society.
Methodology	Design experiment (Brown, 1992; Collins, 1999)
ICT	Knowledge Forum®
Results & conclusions	To date, over 100 applied research communities worldwide from 14 different countries participate in a living design experiment called the Knowledge Society Network. Each local research community uses knowledge building pedagogy and technology. The average number of users in local knowledge building communities worldwide is 100 persons. Representatives from local communities come together in a global design experiment and database, the Knowledge Society Network, to share local innovations across sectors and geographies. The international community includes researchers, educators, health care professionals, business professionals, and students from multiple sectors around the world, many of whom participate in an annual knowledge building/Knowledge Forum® Summer Institute for professional development that has been hosted in Toronto over the past 5 years.
Limitations	Lack of multilingual interfaces for Knowledge Forum®. Bilingual (English/French) beta version of the software available.
Suggestions & future directions	To pursue cross sector applied research and extend international community to include experts in the field of transformational learning within workplace organizations (e.g., Y. Engstrom, K. Hakkarainan, and W. Choo). Need for Chinese, Greek, Finnish and Italian versions to advance Knowledge Society Network objectives.
URL	

Reference	Hill, A., Bugorski, D., Sippel, M., & Renaud, D. (2001). *Collaborative learning community: Expertise in motion.Final Report, Project #99086*. Ottawa: Office of Learning Technologies, HRDC.
Area of Application	**Creation and sustainability of virtual knowledge building communities.**
Setting	Fanshawe College and Community Service Organizations in Southwestern Ontario.
Objectives	Goal to use an ICT to improve literacy for children with disabilities and create an interprofessional learning community supporting this goal.
Methodology	Two-year design experiment (September 1999 to June 2001) in which 160 persons were trained to use Knowledge Forum®, client version, software to support creation of a virtual collaborative learning community. Participants included people with exceptionalities, families, educators, researchers and community groups from many geographic areas in southern Ontario including: London District School Board Thames Valley District School Board Thames Valley Children's Centre Pediatric Acquired Brain Injury Outreach Program Learning Disabilities Association Integration Action Group Association for Bright children Educational Assistant Post Graduate Program, Fanshawe College Lambton Kent District School Board Coaching to Inclusion Group Ontario Institute for Studies in Education/University of Toronto
ICT	Knowledge Forum® (client and web versions)
Results & conclusions	Project succeeded at orienting and training 160 community workers about knowledge building pedagogy and technology. Of the 160 persons who attended training sessions, approximately 40 people engaged in a 2-year online community addressing complex problems of understanding such as use of adaptive augmentation devices to support childhood literacy. Participants reported the collaborative experience and database to be of interest and value. However, the heterogeneity of group composition resulted in fractured collaboration at times. Twenty-one of the 39 views (or communal workspaces) in the database became active forums for meaningful discussion directed at the following themes: Expertise and Intelligence; Literacy and Knowledge Building; social Skills; Valuing Diversity; and, Augmentative Communication. These 5 themes constituted 62% of all interaction (notes read, created, modified and built-on) in the database.
Limitations	Difficult to sustain disparate communities in progressive online discourse unless there is more direction or shared purpose. Collaborative network dissipated over time. Client version of the software required participants have knowledge of installation procedures from CD-ROM or how to download from the internet. Overall computer literacy of participants was low and most had difficulty with technology (installation, download, etc.).
Suggestions & future directions	To pre-determine technical literacy skills in advance of training sessions. To tailor training to the needs of the participants. To

	create opportunities for small group collaborative knowledge building, focused on authentic problems of practice or inquiry. To increase dissemination activities throughout project to participants in an effort to sustain and encourage participation. To further analyse database interactions for the purpose of understanding online collaboration (impediments and facilitators).
URL	http://www.fanshawec.on.ca/clc-ea.html

Reference	Sippel, M., Lewis, A., & Calverty, S. (2001*) Knowledgebuilding justice circles*. London, Southern Ontario.
Area of Application	**Creation and sustainability of virtual knowledge building communities.**
Setting	Communal database – southwestern Ontario
Objectives	The purpose of this project is to support and foster Restorative Justice Circles using ICT. "Restorative justice is a concept, value or programme approach to crime which comprises the voluntary and equal participation of the person having committed the crime(s), those who have been victimized by the crime(s), and the community affected or otherwise involved". http://www.stleonards.ca/links.html#justice
Methodology	Justice Circles Pilot Study - community comprised of a number of agencies across Ontario interested in practicing restorative justice as an alternative form of justice. A Justice Circle is made up of the offender, perhaps the victim, a number of people from the community where crime took place, as well as a trained volunteer in justice circle process. The group comes together and decides what kind of restitution is needed for everyone involved. This alternative to court process is currently being used most often with young offenders. Future plans under consideration include restorative justice circles for other vulnerable populations such as the cognitively impaired elderly (e.g., Alzheimer's disease).
ICT	Knowledge Forum® (client and web versions)
Results & conclusions	Since October 2000, 60 persons have participated in training regarding how knowledge building pedagogy and technology may support Restorative Justice Circles mandate and goals. The program includes representatives from the St. Leonard's Society of London, The Sonier Centre (neighborhood resource centre), Ministry of Corrections, London Police Force, and Crown Attorneys. About the same time the St.Leonard's Society hired a facilitator to oversee the project and provide small group training and consultation. The goal is to develop the London model as an exemplar for other restorative justice circles in other geographies. Although the concept is taking root in communities across southwestern Ontario, the use of technology to support collaboration and learning was minimal.

Limitations	Skill level required to install client version of the software was beyond volunteers' computer capabilities. Interest in using ICT to support development and implementation of Restorative Justice Circles waned as a result of technological barrier. Subsequent participation was affected by computer literacy skills of participants.
Suggestions & future directions	To use WebKF to connect 10 different Justice Circles in 4 counties (Elgin, Oxford, Middlesex, and London). Participants would be people who sit on existing Justice Circles. Purpose of cross county collaboration would be to collaborate on cases, methods, and link resources and circles. Aborignal groups around the world are credited with longstanding restorative justice procedures and methodologies. Of interest, for future directions, would be to build on the restorative justice efforts across cultures.
URL	http://www.stleonards.ca/links.html#justice http://www.stleonards-london.on.ca/ http://www.fanshawec.on.ca/

Theme 2 - Telementorhsip

Reference	O'Neill, D. K., & Scardamalia, M. (2000). *Mentoring in the open: A strategy for supporting human development in the knowledge society.* Paper presented at the Fourth International Conference of the Learning Sciences, Mahwah, NJ.
Area of Application	**Telementorship.**
Setting	Two Toronto area high schools.
Objectives	To foster telementoring relationships between K-12 students and adult volunteers dedicated to progressive inquiry.
Methodology	Design experiment conducted in 2 high schools between 1997 and 1999. Students (N=112) were all enrolled in general science and biology courses from grades 9 to 11. Telementorship occurred as part of the course curriculum for a 10 week period. Adult mentors (N=not indicated) were partnered with students interested in similar themes (one mentor might mentor multiple students).
ICT	Web Knowledge Forum
Results & conclusions	A student satisfaction questionnaire determined varying levels of satisfaction with the mentorship relationship. Students exhibiting high levels of readership in the database compared personal experience to collective experience and rated mentors accordingly, some seeking more ideal mentorship models. Volunteer mentors ranged in their ability and interest to serve as reliable inquiry partners to students. Telementorship affected by developmental factors such as motivation and agency. ICT proved an effective and reliable medium for progressive inquiry and exchange of information.
Limitations	Reliance on volunteer pool of mentors may be both a limitation and an asset. Consensual understanding between mentor and mentee and negotiation of collaborative goal is essential in telementoring relationships. Significant time investment on part of mentor and mentee.
Suggestions & future directions	Kevin O'Neill, Ph.D., Simon Fraser University, is considered a leader in the area of telementoring research in Canada. Currently

	developing a software to support knowledge building and telementorhsip called the Telementoring Orchestrator (TMO). Telementorship generalizes well to workplace settings, especially health care where preceptor-intern models have a long history. ICTs promise to support telementorship within and between the health sciences professions.
URL	http://www.sfu.ca/~koneill/

Reference	Russell, A., Scardamalia, M., & Perris, K. (2000). *The Virtual internship project: Saint Elizabeth Health Care*. In N. LeFevre (Ed.). Toronto: Ontario Hospital Association.
Area of Application	Telementorship.
Setting	Community nursing agency.
Objectives	To provide a virtual environment for experienced nurses to mentor recent nursing graduates inexperienced in community nursing. This pilot study sought to determine how ICT may support preceptors to mentor nurse interns to the point of autonomous practice in the community.
Methodology	Saint Elizabeth Health Care is a provincial community nursing agency in Ontario. Nursing shortages have affected hiring policies by requiring community nursing agencies to seek new hires directly from university programs upon graduation. This contrasts with traditional hiring policies aimed at hiring only experienced and seasoned nurse practitioners in this sector. Eleven nurse preceptors were paired with 11 nurse interns to form a virtual community of learners over a 16-week period. The database activities were structured into: weekly readings and fireside chat. Weekly readings were a collection of theoretical and practical articles selected by program administrators and scanned into the database. Preceptors and interns read and commented on the reading in the Knowledge Forum® database. Fireside chats were views (communal collaborative spaces in the database) where clinical issues and/or problem were raised for discussion (typically unrelated to weekly readings).
ICT	Web Knowledge Forum®
Results & conclusions	A total of 32 views were created in the Knowledge Forum® database (16 weekly readings; 16 fireside chats). Nurse interns (graduates) possessed higher computer literacy skills than nurse preceptors and were more active in the database as measured by notes contributed, read, built-on and modified (Knowledge Forum® Analytic Toolkit, Burtis, 2001). As well, nurse interns tended to engage in collaborative problem solving with one another and provided mentorship in the absence of preceptor participation. Overall, younger nurses were more satisfied with ICT than older nurses. Most dyads expressed satisfaction that the goals of the internship (autonomous practice) were met.
Limitations	Time limited activity – no follow up to determine how to build upon successes and limitations of the pilot study.
Suggestions & future	A model and content of the virtual mentorship programme was

directions	developed by Saint Elizabeth Health Care and inputted into the Knowledge Forum® database. Future collaborative research between St. Elizabeth Health Care and OISE/UT include redesigning the program such that knowledge building pedagogical principles are embedded in collaborative activities.
URL	http://www.saintelizabeth.com

Reference	Russell, A., Perris, K., Scardamalia, M., & Bereiter, C. (2000). *Telementoring in health care: Model development (TL-NCE poster 6.2.2.e).* Paper presented at the TeleLearning Networks of Centres of Excellence Fifth Annual Conference, Toronto, ON.
Area of Application	Telementorship.
Setting	Faculty of Nursing/University of Toronto and hospital setting (Ontario).
Objectives	To provide a virtual environment for novice practitioners to collaborate, share and build knowledge about clinical practice with an interprofessional team of expert practitioners and clinical specialists in health care.
Methodology	This was a one year pilot study between the Toronto Rehabilitation Institute, Faculty of Nursing/University of Toronto and OISE/University of Toronto. Participants included graduate nursing students (N=2), Associate Dean of Research at the Faculty of Nursing (N=1), Interprofessional Practice Portfolio/Toronto Rehab (N=16), Researcher (N=1). Students created views in a health care database used to support interprofessional problem solving and knowledge building. Students identified learning goals for their period of internship and read database entries (notes and views) written by the interprofessional team. As well, the interprofessional team was encouraged to read and comment on nursing student notes and provide virtual telementorship during the period of participation.
ICT	Knowledge Forum® (client version 3.2)
Results & conclusions	Nursing students were more adept at navigating in the Knowledge Forum® database and demonstrated a higher readership of notes than health care professionals. Only 3 members of the interprofessional team provided virtual telementorship to the graduate nursing students. Nursing graduate students reported that knowledge building (process of expertise in action) was counter to traditional pedagogical models and found the experience valuable.
Limitations	Difficult to engage busy professionals in an interprofessional learning activity due to time constraints.
Suggestions & future directions	Target and design opportunities for interprofessional telementorship (e.g., time limited, focused, etc.).
URL	http://www.nursing.utoronto.ca http://www.torontorehab.on.ca

Reference	LaFerriere, T. (2001*). TeleApprentissage Communautaire et Transformatif.* Laval, Que: TeleLearning Networks of Centres of Excellence.
Area of Application	**Telementorship.**
Setting	University pre-service education.
Objectives	A collaborative research initiative aimed at understanding transformative pedagogical models and ICTs to support transformation of educational and occupational cultures and practices.
Methodology	Participant groups include: CITE (a community of inquiry for teacher education, University of British Colombia); McGill PDS Net; TACT (TeleApprentissage communautaire et transformatif, University of Laval); and, Knowledge Society Network (international knowledge building network, OISE/University of Toronto).
ICT	Internet; web pages; Knowledge Forum
Results & conclusions	Not indicated on web site.
Limitations	Unknown.
Suggestions & future directions	Unknown.
URL	http://www.tact.fse.ulaval.ca

Reference	LaFerriere, T. (2001*). TeleCatalyst Project.* Laval, Que: TeleLearning Networks of Centres of Excellence.
Area of Application	Telementorship.
Setting	CEFRIO, Workplace, Quebec.
Objectives	Fifteen communities of practice have been brought together to create a problem solving network with distributed expertise from a variety of workplace settings.
Methodology	This applied research is in its third year. Participant organizations include CSST, CEFRIO, Hydro Quebec, Quebec Treasury Department, Association of Nurses of Quebec, UQAM, Palliative Care Program, Laval University, etc. The goal is to use collaborative knowledge building environment (Knowledge Forum) to capture problem solving process, organizational expertise, and documents.
ICT	Knowledge Forum® and Lotus Notes
Results & conclusions	Design experiment in beginning stages.
Limitations	Undetermined.
Suggestions & future directions	Undetermined.
URL	

Reference	MacAuley, S., Tumblin, E., & Hawkins, T. (1999-2001). *Telementoring for teacher professional development: A design experiment between Nunavut, the North West Territories and Prince Edward Island*. Hawkins, T. (2001). *Frontier Earth: Knowledge building communities at a distance*. Annual TeleLearning Networks of Centres of Excellenece.
Area of Application	Telementorship.
Setting	Teacher professional development, Nunavut and North West Territories
Objectives	To provide a virtual environment for teachers, researchers, mentors and students to collaborate, share and build knowledge about how to integrate knowledge building pedagogy and technology in curricula.
Methodology	Two year pan Canadian design experiment to support teachers in Nunuvut, North West Territories and PEI. Teachers and researchers (N=6) from 3 different geographical locations choose authentic problems facing them in practice. Conversation in the database is aimed at problem solving and innovation. Examples of progressive discourse from the database over the past 2 years include technical problem solving to understanding space. Telementors are invited into the database as needed. For pedagogical and technological guidance and support, seasoned teachers and researchers from OISE/UT and the Institute of Child Study in Toronto engage in virtual knowledge building with teacher-researchers in Nunuvut, NWT, Toronto and PEI. For curricula inquiry, telementors from other disciplines may be invited into the database. A recent example included an astrophysicist who telementored teachers and students about scientific questions and discoveries concerning 'outer space'.
ICT	Knowledge Forum® (client version)
Results & conclusions	Supported continuous professional development of teachers and students. Teachers and students report high satisfaction with telementoring experience. ICT provides teachers and students from remote geographies access to a distributed network of experts.
Limitations	Internet and remote access not always reliable.
Suggestions & future directions	To broaden the professional community to include students and individuals from different sectors with specialized knowledge and expertise.
URL	http://www.ssdec.nt.ca/hc/KF_Projects.html http://www.schoolnet.ca/nis-rei/documents/pdf/NISUpdate_June2001.pdf

Theme 3 - Team Work and Computer Supported Collaborative Learning (CSCL)

Reference	de Laat, M., de Jong, F., & ter Huurne, J. (2000). *Supporting a community of practice: The role of workers as learners.* Paper presented at the Ed-Media, Montreal.
Area of Application	**Team work and CSCL.**
Setting	Dutch Police Force, Netherlands, Europe.
Objectives	To use Web Knowledge Forum to document, understand, and support collaborative learning and team work with a team of police officers in the field of criminal investigation.
Methodology	Eight volunteers from a special investigations unit of the Dutch Police Force participated in this pilot study for 2 months duration. Participants were informed that their work processes were being investigated and researched. Participants used Web Knowledge Forum to discuss work processes and problems.
ICT	Web Knowledge Forum (communal database)
Results & conclusions	Approximately 100 notes were contributed to the database. Each participant contributed an average of 12 notes. Fifty-six percent of all notes were read and 2 participants were responsible for 66% of all regulative activity in the database (e.g., directing inquiry, asking questions, etc.). Satisfaction questionnaire data revealed participants enjoyed ability to share knowledge in this virtual medium. They did not believe they engaged in knowledge building, or progressive problem solving. Participants reported requiring more pedagogical and consultative support (e.g., identifying problem, how to engage in progressive discourse, etc.). Authors conclude that sharing and building of knowledge does not happen automatically. Systematic and directive methodologies may be required for some collaborative efforts.
Limitations	Discussion lacked focus to solve authentic problems of practice to police investigators. Participants did not have enough experience with the pedagogy and technology to demonstrate higher order metacognitive activity researchers were interested in observing. Web forums generally are treated as discussion forums rather than mediums for progressive inquiry (discussion aimed at solving a problem or deepening understanding).
Suggestions & future directions	To introduce systematic and pedagogical supports to advance knowledge (problem solving strategies, didactic instruction, analogical reasoning strategies, etc.).
URL	

Theme 4 - Continuous Professional Development (CPD) and education

Reference	Lamon, M., Reeve, R., & Caswell, B. (1999). *Finding Theory in practice: Collaborative networks for professional learning.* Paper presented at the Annual Meeting of the American Educational Research Association, Montreal.
Area of Application	**Creation and sustainability of virtual knowledge building communities.**
Setting	Education (K-12, graduate, and professional development).
Objectives	To create a collaborative network of elementary students, teachers, researchers, and pre-service education students with the shared learning goal of understanding science concepts (e.g., flight, outer space, earth, weather). This study represented a 3rd iteration of an ongoing design experiment aimed at cultivating overlapping communities of learners.
Methodology	Participants (N=26). A Knowledge Forum® database was created called "Chance, Challenge and Change" in which goals of the grade 5/6 science curriculum were identified for inquiry. Mentor teachers (N=2), grade 5/6 students (N=12), researcher (N=1) and pre-service student teachers (N=11) participated in the database to further understanding about scientific concepts.
ICT	Knowledge Forum® (client version)
Results & conclusions	This study demonstrated that learners at various stages of development may profit from participation in database activities directed at deep understanding of conceptual structures. It was noted that all groups engaged in symmetric knowledge advances in their understanding. Scientific misconceptions were identified and clarified using this approach to collaborative knowledge building and participation in the database.
Limitations	Follow up studies assessing how pre-service teachers implemented a knowledge building pedagogy are needed.
Suggestions & future directions	None indicated.
URL	http://csile.oise.utoronto.ca/abstracts/finding_theory.html

Reference	Campbell, H., Russell, A., Scardamalia, M., & Bereiter, C. (2000 to 2002). *Fostering interprofessional practice in rehabilitation and complex continuing care through collaboration and virtual learning*. Ottawa: Office of Learning Technologies, HRDC, Project #99574.
Area of Application	**Interprofessional practice and team work.**
Setting	Rehabilitation and complex continuing care.
Objectives	To use knowledge building pedagogy and technology to foster interprofessional collaboration, learning and reflection.
Methodology	Two year design experiement. Participants include advanced practice clinicians and educators (N=23) from physiotherapy, occupational therapy, bioethics, nursing, and research. Participants submit monthly reflective learning reports to a communal database each month and engage in progressive discourse about shared problems of practice. Complex problems are identified in the interprofessional discourse and earmarked for further problem solving. New emergent views are created to address authentic problems of practice of increasing complexity.
ICT	Knowledge Forum® (client version)
Results & conclusions	To date over 100 views or communal workspaces have been created, and over 1,500 notes. Evidence suggests that knowledge building pedagogy and technology support interprofessional reflection and continuous learning. Continuous professional development has yet to be situated in an interprofessional context. This research offers a model for interprofessional knowledge building.
Limitations	Computer literacy skills required. Does not include front line staff, non-professional staff, nor patient and family.
Suggestions & future directions	To extend this applied research to the programs (muskuloskeletal, neurorehabilitation, cardiology, spinal cord, geriatrics, and complex continuing care) to support interprofessional practice. Examples include – evaluation of best practice guidelines, virtual rounds, virtual patient assessment and treatment.
URL	http://www.torontorehab.on.ca

Reference	Austin, Z. (2001). Knowledge building and pharmacotherapeutics. Toronto: Faculty of Pharmacy, University of Toronto.
Area of Application	**CPD and education**
Setting	Faculty of Pharmacy, University of Toronto
Objectives	To use ICT to assist foreign trained pharmacists to develop pharmacotherapeutic care plans for patients presenting with common and complex medical conditions in North America.
Methodology	Problem addressed in this pilot research is how to assist foreign trained pharmacists seeking licensure in Canada to pass a series of written and oral exams in the domain of pharmacotherapeutics (the clinical use of medicines in humans). The practice of pharmacotherapeutics is context dependent since different diseases present in different geographical contexts. Groups of 4 students (N=16) worked through a series of pharamacotherapeutic case studies for a period of 10 weeks. Each group was responsible for developing a pharmacotherapeutic care plan to address actual and potential drug related problems. Use of primary research literature was expected. Used ICT to develop care plans.
ICT	Web Knowledge Forum
Results & conclusions	Adult learners (professional pharmacists) were satisfied with the web platform and course content. Students expressed desire for more 'face-to-face' interactions.
Limitations	Author reported that major limitation was the use of a traditional experimental method rather than a design experiment method, the latter of which allows for ongoing redesign and intervention. Learning and knowledge building are not achieved without scaffolding by more experienced agent. Course facilitators trained in the underlying pedagogy are required to ensure success of intervention. Short duration of study (10 weeks).
Suggestions & future directions	To use Web Knowledge Forum as platform for all course delivery for the Department of Pharmacy, University of Toronto.
URL	http://www.utoronto.ca/pharmacy

Reference	Lax, L. (1998 to 2001). *Knowledge building and biomedical imaging: A 3- year longitudinal study*. Toronto: Faculty of Medicine, University of Toronto.
Area of Application	**CPD and education.**
Setting	University – adult education.
Objectives	To integrate use of ICT in a biomedical communications course to enhance visual knowledge Representation and communication.
Methodology	A biomedical imaging course is supported using a communal database technology. Students and medical experts collaborate around medical renderings. This course has used the same platform for virtual collaboration over the past 3 years.
ICT	Web Knowledge Forum
Results & conclusions	Biomedical imaging and rendering is supported by written discourse through progressive problem solving with students and medical experts.

Limitations	Limited graphics program in Knowledge Forum. Students use more advanced imaging software and import final visual renderings and reproductions into Knowledge Forum.
Suggestions & future directions	
URL	http://www.library.utoronto.ca/medicine/

Reference	Brett, C. (1998 to 2001). *Knowledge building and online Learning in the Education Commons at OISE/UT*. Toronto: Ontario Institute for Studies in Education, University of Toronto.
Area of Application	**CPD and education.**
Setting	Ontario Institute for Studies in Education/University of Toronto.
Objectives	To provide an integrated technical, informational and instructional supports for online learning, professional development and research initiatives.
Methodology	The Education Commons is a support service for the Ontario Institute for Studies in Education.
ICT	Web Knowledge Forum® and First Class
Results & conclusions	Course delivery and support Over the past 3 years, more than 300 Web Knowledge Forum® databases have been created to support online course delivery of 40 graduate courses and pre-service courses. Other uses of Web KF to support adult learners and continuous professional development include: adjunct conferences, Principal Qualification courses, Additional Qualification courses for teachers Distance Education Online support options for faculty and students currently includes information on what is needed to take or teach an online course, as well as online manuals, FAQ's, instructions for startup and course development. Professional Development for Faculty Short courses and spring offerings are available to faculty and instructors to learn how to use the online teaching technologies to design, implement and evaluate courses. Research on online learning. The Education Commons researches the effectiveness and characteristics of online learning.
Limitations	None indicated.
Suggestions & future directions	Distance education plans include web-based video clips on how to use course software, as well as bookable CD Rom's with instructions for online technology use.
URL	http://www.oise.utoronto.ca http://www.oise.utoronto.ca/staffhome.html

Theme 5 - Evaluation

- Analytic Toolkit (Burtis, 2001)

Reference	Burtis, J. (2001). *Analytic Toolkit for Knowledge Forum*®. Available: http://kf.oise.utoronto.ca/atk/cgis/atkdoc.html
Area of Application	**To evaluate knowledge building indicators in Knowledge Forum® databases.**
Setting	Knowledge Forum® databases.
Objectives	The Analytic Toolkit provides summary statistics on activity in a Knowledge Forum database. It shows how many notes are in the database, how connected they are, how many notes a user has created, which views a user is working in, what percentage of the notes have been read, whether build-ons, keywords, references and other knowledge building features are being used, who has read and written new notes during a particular time period, and social interactions. It is intended to be used by database managers, researchers, and participants in the database.
Methodology	The Analytic Toolkit is Web-based, and accessed with a browser through a URL. The Knowledge Forum database to be analysed can be located anywhere, provided there is Internet access to it. The URL for the Toolkit can be obtained from Learning in Motion or OISE/UT. The Toolkit uses only simple HTML, for the most part. It uses some JavaScript, if available, but will work without it. Most Internet browsers are therefore Supported. It is written as a set of CGIs in Perl.
ICT	Analytic Toolkit (Burtis, 2001)
Results & conclusions	Knowledge building indicators (below) provide individual and communal information about participatory collaborative activity in the database: 1) Database Overview gives summary statistics and group averages for a particular group's contributions to the database. It shows how many notes they've contributed, which views they've contributed to in the past month and past week, how much of the database users have read, and how many of their notes are Linked to other notes. It is intended to provide evidence on the extent of knowledge-building activity in the database, and also on where the recent activity has been. The next three reports give statistics for each user in the selected group. Means, medians, and standard deviations for the group are also given: 2) Basic Knowledge Building Measures are meant to be useful for assessing a user's contributions to the database from a knowledge building perspective. Is the user working with other users, or in isolation? To what extent is the user aware of other work in the database? Does a user's work span a variety of

	different views and problems, or is it concentrated in one area? The measures are: number of notes contributed, percentage of notes that are linked to other notes, percentage of notes that have been keyworded, number of views worked in, number of problems worked on, percentage of notes in the database that the user has read, and the number of times the user has revised a note. 3) Use of Features. These measures are intended to be useful in assessing whether users are using the knowledge-building features that are available in Knowledge Forum. When new features of Knowledge Forum are introduced to a group, which users have caught on to them? Is the use of these features correlated with advances in knowledge? The measures are: number of user's notes that are part of a build-on tree, number of keywords used, number of references in the user's notes, number of rise-above-it notes, number of views created by the user, and number of scaffold supports used. For KF2 databases, the number of collections and add-tos are also shown. For KF3 databases, the number of annotations that a user has made is shown. 4) Use of scaffold supports. This report gives a detailed breakdown of which scaffolds and supports each user has used. Are scaffolds being used well? Are new scaffolds being used? 5) Single User Report presents information on only one user, but it presents all of the measures in reports 2 to 4. It also presents as additional information the names of the notes that the user has contributed to each view, and the problems and keywords they have used. The next four reports analyse reading and writing activity in the database during particular time periods: 6) Activity (Note Creation/Note Reading). Who has been active in the database during a given time period? The report shows reading and writing activity in the database for a specified time period. Which views are users finding useful, and adding to? Which group interventions or changes to the database were effective, and for which users? 7) Activity (Note Creation--Details). What types of notes has each user contributed to the database during a given time period? The report shows details of what each user has been doing--how many build-ons vs regular notes the user has contributed, group notes vs individual notes, and so on.

	8) Activity Log for Single User. A detailed log of every time the user read or wrote a note in KF, during a selected time period. Patterns of use of individuals can be traced, and related, for example, to knowledge-building episodes seen in the notes. 9) Activity Log for Multiple Users Same information as for the single user, but for everyone in a group. The next five reports all look at social interactions in the database. Who is working with whom? How is knowledge building affected by particular interactions? If there is more than one group working in the database, what are the interactions between groups? The first four reports show specific types of interactions, while the last one combines all of the KF interactions that could be considered as "linking". 10) Who's read whose notes? 11) Who's coauthored notes with whom? 12) Who's built on whom? 13) Who's referenced whom? 14) Who's linked to whom? (where linking includes building on, referencing, and use of rise-above-it notes, and add-tos (and, for KF2 only, collections).) The next two reports give information in terms of notes, rather than users: 15) Who Has Read Each Note. Shows which users have read each note in the database.
Limitations	Currently available to researchers and managers only. Goal to make Analytic Toolkit available to all user. The ATK is a quantitative tool only.
Suggestions & future directions	To integrate analytic toolkit with client software such that use of analyses tools is transparent. To integrate qualitative analysis tools with the ATK.
URL	http://kf.oise.utoronto.ca/atk/cgis/atkdoc.html

Reference	Burtis, J. (2001). *Vocabulary Analysis.*
Area of Application	**To evaluate the uptake and spread of domain vocabulary in databases**
Setting	Knowledge Forum® databases.
Objectives	The Vocabulary Analysis provides a summary of new domain vocabulary introduced by a participant in a Knowledge Forum database as well as how specific vocabulary is taken up by other participants.
Methodology	The Vocabulary Analysis tool is Web-based, and accessed with a browser through a URL. The Knowledge Forum database to be analyzed can be located anywhere, provided there is Internet access to it. The URL for the Toolkit can be obtained from Learning in Motion or OISE/UT. The Toolkit uses only simple HTML, for the most part. It uses some JavaScript, if available, but will work without it. Most Internet browsers are therefore Supported. It is written as a set of CGIs in Perl.
ICT	Knowledge Forum Vocabulary Analysis
Results & conclusions	Analyses of vocabulary in databases shows (1) use of domain specific vocabulary, (2) does introduction of domain specific vocabulary spread throughout the database, (3) how many new words are introduced into the database and by whom
Limitations	Currently available to researchers and managers only.
Suggestions & future directions	To integrate analytic toolkit with vocab analyser and client software such that use of analyses tools is transparent.
URL	http://kf.oise.utoronto.ca/vocab/va.html

5b. Annotated bibliography pertaining to ICT and interprofessional practice in health care.

Search Strategy

Databases searched	Limits	Search Terms Used
Ovid: The Cochrane Database of Systematic Reviews	1999-to present	• Interprofessional practice • Professional practice • ICT and team work • Technology and health care

Reference	Foxcroft, D., Fulbrook, P., Johnston, L., & Stevens, K. (2001, May 30, 2000). *Organisational infrasturctures to promote evidence based nursing practice* (1), [The Cochrane Database of Systematic Reviews]. Ovid: The Cochrane Library.
Area of Application	**Organizational design and support of nursing clinical practice.**
Setting	Health care organizations with practicing nurses delivering care patient care.
Objectives	To identify the determinants of organizational infrastructure that support and promote evidence based nursing practice.
Methodology	Participants in this metaanalysis will be health care organizations, nurses, midwives and health visitors in hospital and community settings. Organizational infrastructures include provinces, departments, hospitals, community organizations; or, processes, systems and services of the organizations including quality improvement programs, policies, etc.
ICT	Not indicated.
Results & conclusions	
Limitations	
Suggestions & future directions	
URL	

Reference	Gorman, P. N., Redfern, C., Liaw, T., Mahon, S., Wyatt, J. C., Rowe, R. E., & Grimshaw, J. M. (2001, August 29, 2000). *Computer-generated paper reminders: Effects on professional practice and health care outcomes* (Issue 1), [The Cochrane Database of Systematic Reviews]. Ovid: The Cochrane Library.
Area of Application	**Clinical practice supported by ICT.**
Setting	Practice settings (e.g., hospitals)
Objectives	To assess efficacy of computer technology to remind health care practitioners via cue sheets, check lists, patient profiles, profile checklists. To distinguish between studies investigating computer supported reminders for patient or factual information from expert advice or reminders for response. To assess efficacy of types of reminders (paper, computer generated, on-screen).
Methodology	Metaanlysis.
ICT	Not indicated.
Results & conclusions	
Limitations	Reminders are one type of cognitive cue but relationship between reminders and learning is not clear from stated objectives of metaanlysis.
Suggestions & future directions	
URL	

Reference	O'Brien, M. A. T., Freemantle, N., Wolf, F., Davis, D. A., & Oxman, A. D. (2001, November 11, 2000). *Educational meetings, workshops and preceptorships: effects on professional practice and health care outcomes*, [The Cochrane Database of Systematic Reviews]. Ovid: The Cochrane Library.
Area of Application	**Professional practice and health care outcomes**
Setting	
Objectives	To determine the effectiveness of educational meetings, workshops or preceptorships (including conferences, lectures, seminars, symposia, courses, or traineeships) to improve health care outcomes.
Methodology	Participants were health care providers responsible for patient care. Health care outcomes defined as objective measures of performance or patient outcomes. Randomised controlled trials and non-equivalent group designs will be included in metaanalysis. Promising approach to deal with heterogenity of research yeild (sub group analysis, recontacting researchers for missing data, etc.).
ICT	None indicated.
Results & conclusions	Previous research in the area suggests traditional educational activities do improve health care outcomes if participants

	practice. Lack of clarity concerning how strategies such as small group versus large group effect outcomes. Results will be published in Issue 2 of The Cochrane Library.
Limitations	
Suggestions & future directions	To expand search strategy to include historical perspective (1966 onwards).
URL	

Reference	Parkes, J., Deeks, J., Milne, R., & Hyde, C. (2001, August 29, 2000). *Teaching critical appraisal skills in health care settings*, [The Cochrane Library Database of Systematic Reviews]. Ovid: The Cochrane Library.
Area of Application	**Teaching critical appraisal skills to health care practitioners.**
Setting	Health care clinical setting.
Objectives	To teach critical appraisal skills to health care practitioners in order that they may better deal with information overload and integrate research evidence into practice.
Methodology	Participants may include health care practitioners in any clinical setting. Critical appraisal for the purpose of this metanalysis is defined as a "process of assessing and interpreting evidence by systematically considering its validity, results and relevance to one's own work (Sackett, Haynes, & Tugwell, 1991)".
ICT	Not indicated.
Results & conclusions	Publication date not indicated.
Limitations	
Suggestions & future directions	
URL	

Reference	Zwarenstein, M., & Bryant, W. (2001, Febraury 24, 2000). *Interventions to promote collaboration between nurses and doctors* (Issue 1), [The Cochrane Database of Systematic Reviews]. Ovid: The Cochrane Library.
Area of Application	**Interprofessional practice and collaboration.**
Setting	Hospital settings, including primary care.
Objectives	To assess efficacy of collaboration interventions for physicians and nurses.
Methodology	Two studies qualified as methodologically sound and were selected for review. Particpants in the studies reviewed were physicians and nurses in hospital settings, including primary care. Study 1 was a randomized control trial (RCT) in an academic hospital where both patients and staff were randomly assigned to inpatient services; and 1/2 of the wards were randomly received collaboration intervention which was joint interprofessional decision making dung daily rounds. Study 2 was a controlled before and after (CBA) study in two wards in a Thai academic hospital. Two all female wards were compared. The experimental ward used joint decision making as the collaboration intervention while the control group did not.
ICT	
Results & conclusions	Study 1 – reduced patient length of stay and hospital charges but no difference in mortality rates or care upon discharge. Study 2 – no differences in patient length of stay or mortality rates on either ward.

Limitations	Authors suggest that there is "limited evidence that consciously structured nurse doctor collaboration interventions can produce useful reductions in length of stay without harmful side effects on mortality (Curley 1998; Jitapunkul 1995)". Dubious claim based on only 2 studies. Not clear how researchers trained or established effective collaborative techniques. Return on investment approach is based on business rather than learning model (e.g., LOI, mortality and reduced cost versus improved understanding of clinical issue, etc.). Increased LOIs may be positive outcome of improved collaborative processes – not explored in this review. Subsequent to an exhaustive review of hundreds of abstracts meeting search criteria, 31 studies were selected for review and only 2 qualified for review in this article. Disqualified papers did not meet the criteria (e.g., absensce of contamination). For example, one study was excluded because the intervention to promote collaboration was combined (unspecified) and the effects could not be disentangled. Learning and knowledge building are complex activities. Criticism here concerns using experimental method to assess complex human activity.
Suggestions & future directions	Need to find a balance between evaluation rigour versus rigidity. Need to assess usefulness of using Cochrane Library System for review of complex human behaviour (cognition, learning, innovation, etc.). Need to review source articles.
URL	