AN INVESTIGATION OF THE POTENTIAL OF TECHNOLOGY SUPPORTED ENVIRONMENTS TO SUPPORT PROFESSIONAL AND LIFELONG LEARNING

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ABSTRACT

As tertiary education moves towards greater accountability, and the emphasis is on the development of transferable skills, pedagogies and learning activities need to be reconceptualiased and redesigned. This paper reports on the capacity of technologies to scaffold learner-centered activities that foster self-directed inquiry and a range of lifelong learning skills. A Web-supported learning environment is analysed with a view to demonstrating how leaner centered pedagogy and inquiry-based tasks foster self-management, inquiry, reflection, and problem-solving strategies. The implications for tertiary educators and instructional designers are examined, and recommendations are made to enable the integration of lifelong learning skills into existing learning environment design.

INTRODUCTION

Lifelong learning can be broadly defined as purposeful learning that people engage in throughout their lifespan. The proliferation of knowledge and the accelerating use of information and communications technologies combine to create a demand for professionals who are flexible, motivated, and self-directed as well as multiskilled (Longworth & Davies, 1996). Recently, there has been an increasing focus on developing professional skills and competencies as part of tertiary learning. Graduates are expected to meet the demands of employers for social, communicative, and cooperative skills, as opposed to abstract disciplinary knowledge. There is also greater pressure on tertiary institutions to align academic outcomes with the demands of working life and the needs of employers. Therefore, developing lifelong learning skills is imperative if graduates are to remain productive, competitive, and open-minded. As the current information age is characterised by continual dynamic change, graduates need the skills of independent inquiry, information literacy, self-organisation, and learning skills. In this paper, we describe the attributes of a Web-based learning environment designed to support these competencies and provide a theoretical rationale for a range of learning tasks designed to foster lifelong learning.

LIFELONG LEARNING AS DIVERSIFIED GRADUATE SKILLS

Candy et al. (1994) define the key lifelong learning qualities as an inquiring mind, helicopter vision, a sense of personal agency, and a repertoire of learning skills, such as knowledge of one's strengths and preferred learning style. These skills have been endorsed by many tertiary education institutions in Australia and are embedded in mission statements, vouching for the quality of education received and the competence of graduates to enter the workforce. Longworth & Davies (1996) also emphasise the need for individuals to be multi-skilled and flexible, and to have the capacity to take up more than one career in a lifetime. The skills needed for such flexibility are learning to learn, applying new knowledge, questioning and reasoning, managing oneself and others, information literacy, communication skills, team work, and updating one's knowledge base.

The key skills included in the mission statements of most universities tend to include higher level aims relating to critical thinking, inquiry, and a capacity for lifelong learning. Generic skills described in the literature for university graduates include:

- skills that students need to develop to become successful and self-sufficient learners, for example, information literacy and metacognitive skills (e.g. Candy, 1994);
- the development of intellectual and imaginative powers, understanding and judgement, problem solving skills, critical thinking skills, and an ability to see relationships (e.g. Ramsden, 1992);
- personal and interpersonal skills needed for communication, cooperative and collaborative teamwork, and leadership (e.g. Ashcroft & Foreman-Peck, 1994; Gibbs et al. 1994);

- skills required for successful work practices including time management, task management leadership, and self-evaluation (e.g. Gibbs et al., 1994; Blumhof et al., 1996).

Bennet et al. (1999) offer a concise model to conceptualise key skills in the higher education sector by suggesting a framework comprising four broad managerial skills (see Table 1). The authors argue that the important key skills are fundamentally those associated with being able to manage self, others, information, and task. They propose that such a model can be applied "to any discipline, to any course and to the workplace and indeed to any other context" (p 77). Table 1 displays this framework and shows the various elements within. Underlying the current debate about generic competencies and lifelong learning there is a common concern with the development of cognitive competencies such as problem solving, critical thinking, information literacy, and management of information. Given these demands, it is incumbent upon tertiary educators to develop powerful environments which encompass generic skills and lifelong competencies. Candy (1994) asks, "Can the learning that takes place in the cloistered atmosphere of a tertiary institution be realistically transferred into other, more rough and tumble learning contexts?" (p 127).

Given the expectation that graduates should have the capacity for self-directed learning and inquiry, didactic approaches which emphasise knowledge transmission are not appropriate for fostering the skills of knowledge generation, self-management, and evaluation. The importance of academics developing a new mindset towards technology as a 'cognitive tool' rather than a teaching machine is essential, as is the adoption of a learner-centered educational theory. Active engagement of learners in the skills of inquiry and self-regulation are the key ingredients of pedagogy directed towards lifelong learning.

Management of Self	**Management of Information**
Manage time effectively	Use appropriate sources of information
Set objectives, priorities and standards	Use appropriate technologies
Take responsibility for own learning	Use appropriate media
Listen actively with purpose	Handle large amounts of information
Use a range of academic skills	Use appropriate language and form
Develop and adapt learning strategies	Interpret a variety of information forms
Show intellectual flexibility	Present information competently
Use learning in new or different situations	Respond to different purposes/contexts and audiences
Plan/work towards long-term goals	Use information critically
Purposefully reflect on own learning	Use information in innovative and creative ways
Clarify with criticism constructively	
Cope with stress	
Management of Others	**Management of Task**
Carry out agreed tasks	Identify key features
Respect the views and values of others	Conceptualise ideas
Work productively in a cooperative context	Set and maintain priorities
Adapt to the needs of the group	Identify strategic options
Defend/justify views and actions	Plan/implement a course of action
Take initiative and lead others	Organise sub-tasks
Delegate and stand back	Use and develop appropriate strategies
Negotiate	Assess outcomes
Offer constructive criticism	
Take the role of chairperson	
Learn in a collaborative context	
Assist/support others in learning	

Table 1: Generic management competencies

THE CAPACITY OF TECHNOLOGY TO SUPPORT LEARNING

The major shift that has occurred in views of knowledge and learning with the advent of Web-based course support tools, is from information presentation to learner construction of understanding and meaning by using tools such as synchronous and asynchronous conferencing, application sharing, image and resource archives, and self-evaluation tools (Jonassen, 1996; Duffy & Cunningham, 1996: Jonassen et al., 1999; Oliver & McLoughlin, 1999). Technological change is enabling networked, collaborative learning experiences to be developed. Information technology can become a form of intellectual support, cognitive tool or 'partner in cognition', according to several theorists, as it extends the intellectual capabilities of humans (Salomon & Globerson, 1991; Hazemi et al., 1998; Jonassen & Reeves, 1996). Instead of having passive roles as receivers of knowledge, Web-based environments can engage learners in active, intentional, authentic, and self-directed collaborative experiences. Three different uses of the Web can be defined: information access, interactive learning, and networked learning. Teachers need to understand the relative benefits of each level of use and how each relates to student learning outcomes.

Figure 1 depicts the Web as a continuum which can support various levels of activity; from information access to interactive learning to networked learning (Oliver, 1998). At the lowest level of learner engagement and control, students can access information and units presented online by a teacher, and read and browse these resources. Teachers who see the Web as a place to upload content for students to access, are simply using the technology to reinforce existing didactic patterns of teaching and not using the technology to its best advantage.

The next level of engagement is interactive learning with tasks to engage learners in planning, comparing, and evaluating information, which demand higher levels of cognition and self-direction. These activities can be undertaken by individuals following questions or problems set by a teacher, or through learning tasks and simulations that enable learners to act upon and modify representations of knowledge. The highest level of cognitive demand is created by using the Web for networked learning and by creating learner-centred environments that support communicative, collaborative, and cooperative activities among students (McLoughlin & Oliver, 1998a). Integration of the Web for networked learning requires teachers to become task and learner orientated; teaching becomes an activity concerned with supporting learning: giving students control over tools and access to resources where they construct their own understanding.

The greatest potential of the Web is the scope it offers for networked learning, where constructivist, interactive, and collaborative forms of learning can be fostered. In such environments, the role of the teacher has come under intense scrutiny and is recognisably transformed. In 1995, the American Psychological Association (1995) issued a list of twelve learner-centred principles that affirm the extensive research on learning with technology, and have since become a foundation for reform and restructuring of learning activities. For example, in a learner-centred environment, technology is in the hands of learners who browse, link, juxtapose, and summarise information. Learners become actively involved in constructing and creating knowledge, as they have access to online resources, communication tools, and networks to communicate and compare viewpoints.

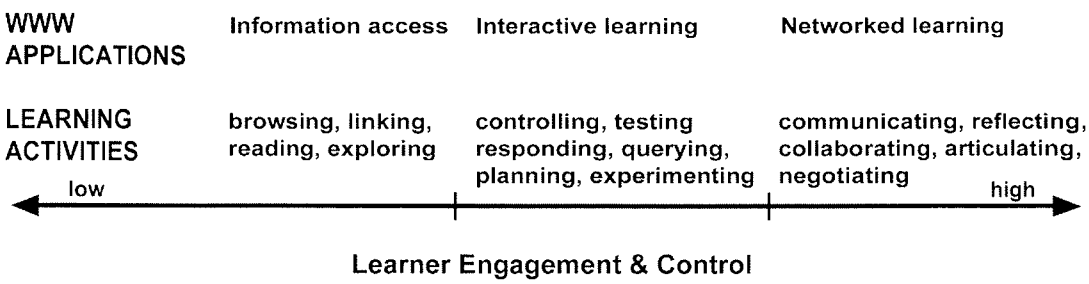

Figure 1: Levels of learner engagement in Web-based learning

Collaborative dialogue tools such as bulletin boards create new contexts for learning, where conversations about learning can occur outside the

With networked learning, predefined course content and prescribed information is limited, and documents and content emerge as a consequence of the communicative and collaborative activities of participants who use e-mail, computer conferencing, chat, and bulletin boards to discuss and share ideas. Students create knowledge through self-directed learning and networked investigation. The conferencing facilities of many Web course support systems provide forums for discussion, shared spaces for revision of ideas and display of multiple perspectives, and a 'community of inquiry' where participants build new conceptions and co-construct knowledge (McLoughlin, 1999; Lipman, 1991; Selinger, 1998). When we consider the nature of learning resources offered to learners in traditional classrooms and those available on the Web, it becomes clear that the Web is characterized by:

- structured information held according to individual and personal perspectives and preferences;
- flexible, dynamic and expandable hyperlinks to related data;
- multiple pathways for accessing information;
- a constantly expanding knowledge base;
- information that can be accessed randomly, browsed, compared, and searched according to the interests of the learner.

These characteristics of electronic resources mean that information is dynamic, multibranching, and beyond the scope of individual comprehension and control. Traditional classrooms, on the other hand, are characterised by:

- a relatively stable set of resources and experiences prescribed by a teacher;
- learning pathways defined in advance by a teacher who is already familiar with the learning material;
- teacher control over the learning process by defining for learners the progression and sequence of tasks and skills.

McFarlane, (1998) claims that with the adoption of Web-based teaching, new pedagogies need to be adopted, and that shifting the focus from teaching to managing learning is the most fundamental shift. This has occurred because the potential for negotiation, discussion, collaboration, and dialogue that is part of learning online, enables learners to classroom, beyond the control of the teacher, and learners become more self-directed, thus developing essential lifelong skills obtain multiple perspectives on issues and to develop personal insights and understandings, thereby constructing knowledge. The lack of fit between potential for 'learner-centered learning' via the Web and the structure of conventional teaching has brought about a re-evaluation of the nature of teaching (Duffy & Cunningham, 1996; Scardamalia & Bereiter, 1996). Theories that enable the interweaving of communication, the social processes of learning, and the capacity of technology to support cognition are linked to social constructivism (Laurillard, 1993; Crook, 1994).

SCAFFOLDING LEARNING: MULTIPLE SUPPORTS FOR COGNITION

Many theorists maintain that cognition is distributed in the social world rather than being confined to individual minds (Salomon, 1993; Lave, 1988). Essentially, social-constructivist theories of learning maintain that mind, human action and learning are so tightly interwoven that cognition must be supported by the social context in which it is situated. Educational research has turned increasingly to socio-cultural theory to evaluate and understand technology-supported learning environments (Vygotsky, 1978; McLoughlin & Oliver, 1998a). According to socio-cultural theory, learning involves social interaction, dialogue, negotiation, and collaboration, and that 'scaffolded' or assisted learning can increase cognitive growth and understanding.

What is scaffolding? Scaffolding is a form of assistance provided to a learner by a more capable teacher or peer that helps the learners perform a task that would normally not be possible to accomplish by working independently. Integrated into pedagogical practice, scaffolding is intended to motivate the learner, reduce task complexity, provide structure, and reduce learner frustration. Scaffolding can be provided both by technology and by tutors or peers, and may be a progressive self-test, hints about solving a problem or completing a task, or guided tasks that lead the learner towards more complex, extended, independent performance (McLoughlin & Oliver, 1998b). The most important point about scaffolding is that it engages the learner actively at his/her current level of understanding until the point where the support is no longer required. Technologies can provide a range of supports for learning and can be used to create contexts for thinking and knowledge construction (see Table 2).

Technology as scaffold	Cognitive process supported
Tools for knowledge construction	Representation of ideas, beliefs and understandings
Information vehicles for exploring knowledge	Accessing information, comparing & evaluating perspectives and world views
Contexts to support learning by doing	Representing and simulating real world environments and situations
Controllable, shared problem space	Sharing and comparing ideas, revising, hypothesing and arguing
Social medium for conversation, communication and collaboration	Knowledge creation by supporting discourse, argument and inquiry among a community of learners
Intellectual partner to support learning by reflecting	Articulation and reflection, mindful thinking and meaning making by constructing personal representation of reality

Table 2. How technologies scaffold learning.

Web-based instruction may also be used to support experiential learning so that the process of learning is integrated with real world experiences, where students engage authentic problems and real life events, and develop problem-solving strategies. Learning on task enables learners to develop 'know how' or procedural knowledge, which is essential in the professions and is characteristic of the cognitive flexibility of lifelong professional learning (Eraut, 1994). For Kolb (1984), the actual experiences people go through become the starting points for learning. In an experiential learning cycle, the learner passes though each of four stages: concrete experience, reflective observation, abstract conceptualisation, and active experimentation. The cycle begins again with the implementation of new ideas. It is possible to relate the experiential learning cycle to technological tools and technology-supported tasks as follows.

Task engagement: Engaging in a computer supported task or problem through a computer-based simulation or visualization using multimedia (e.g. Cox & Brna, 1995);

Observation and reflection: Analysing the output of the task, or the problem solving approach through discussion, e-mail or conferencing activity (Bonk & Cummings, 1998);

Formation of an abstract concepts: Building a theory or mental model of task or problem by using software or through engagement with new ideas via communications networks (Collis, 1998);

Active experimentation: Applying the new knowledge to a novel task or problem, posting a solution to a bulletin board, testing new ideas and perspectives in virtual learning groups (McLellan, 1996; McLoughlin & Oliver, 1999a; English & Yazdani, 1999).

In the experiential learning cycle, technology acts as a scaffold at each stage of the process, and the entire cycle is learner centered. Gibbs et al. (1994) argue that the development of lifelong learning skills involves an experiential learning cycle which includes experiencing the skills, reflecting on performance, formalising the gained knowledge, planning, and preparing activities. Web-based teaching and learning environments providing a range of learning experiences can foster lifelong learning, as the following case study illustrates.

Case study: Online, problem-based learning to develop generic lifelong skills

The Web together with Web-based course support systems can be harnessed to develop students' generic skills (McLoughlin & Oliver, 1999b; Oliver & McLoughlin, 1999). We have developed a Web-based system that involves learners working in collaborative groups, as an example of networked learning. From these activities we have observed learners developing a raft of lifelong learning skills.

A. The learning system

The online system we refer to is a database-driven, Web-based learning system designed to support a form of problem-based learning. The database elements enable the system to record, manage, and support the interactions of a large number of networked students and tutors. The system supports problem-based learning by providing a means for students to collaborate on set problems, to share resources, to display and discuss solutions, and to compare and review answers from other groups. Typical use of the system in a course of study revolves around problem-based learning activities and online discussion. The system is Web-based

and all the following activities are undertaken using online support systems.

- Each week a problem is presented to students, the purpose of which is to contextualise and authenticate the weekly content of the course.
- Students are required to work within groups of 3 or 4 to define and research the problem, locate relevant information and resources, consider the various options and outcomes, and to create a response which is informed and well argued.
- The group posts a response to the system bulletin board, an action that gives them access to the solutions of the other groups in their cohort. Each group is asked to review the solutions of the others and, through their feedback, the solutions are given a peer-assessed grade. Each tutor also reads the solutions and gives a mark that is added to the peer-assessed grade to give an overall mark for the solution.
- Students are able to view the marks achieved each week in a number of ways and this mark accumulates throughout the semester as each new problem is solved.

B. Learner activities

This style of problem-based learning involves a number of activities and tasks that appear to provide strong support for the development of a number of key skills. The activities which the students are required to undertake each week include the following.

- **Information seeking**. The tasks require students to seek information from appropriate sources to create an answer that reflects current thinking and knowledge. The students are able to use the Web as an information source but have to select from the abundant resources available, those that are relevant and helpful.
- **Critical thinking**. Having obtained relevant information, the students are required to apply this to the immediate setting to explore the options and possibilities available in developing a solution. The students have to examine the information, consider the scope of their inquiry, and decide the parameters in which they are going to work.
- **Collaboration**. Each group consists of 4-5 members. The problem-solving task requires members to organise themselves into productive teams who share the workload, undertake separate tasks, and maintain tight deadlines and schedules from one week to the next. Such activities demand that students consider the requirements of others, be adaptive, responsible, and flexible.
- **Problem Solving**. Each task is different and needs to be tackled in varying ways. Students need to use their initiative and cognitive skills to consider the form the solution will take, and resolve how the solution can be expressed concisely and succinctly.

The nature of the learning involves high degrees of self-regulation on the part of the students. Scaffolding is provided through peer support, and students have to judge when and where their research will stop and when to present and review a solution.

C. Outcomes

In our use of the system, the postings which the students are required to make are assessed by peers and tutors in terms of the quality of the solution provided for the given problem. The problems are intentionally created to be ill-defined, ensuring that there is no one correct answer. Students are required to craft a response which uses current information and informed arguments in a concise and succinct fashion. In judging the responses, the criteria that the tutors and students use are such aspects as quality of the arguments presented, level of research evident, quality of the language and information presented, and strength of arguments and reasoning. Evaluation of verbal exchanges using a qualitative approach has shown that students demonstrate reasoning, knowledge creation, and reflection (McLoughlin & Luca, 1999; McLoughlin & Oliver, 1998c). It is interesting to note that since there is no firm model answer, the solutions are judged in terms of the quality of the thinking processes associated with developing and submitting a solution, more so than with the solution itself.

D. Skills development

We have used this system in several units now, involving groups of between 30-40 in their final year of study. The learning outcomes achieved have indicated that the problem-based learning model provides very powerful contexts for learning the course content. The activities encourage the learners to interact with the course content, to read and explore beyond the immediate setting, and to reflect on what is being read. At the same time, the learning activity supports many other lifelong skills

such as metacognition and question generation. Evaluation of the interaction processes involved in these tasks suggests a high degree of learning is occurring in the form of higher order thinking and reasoning. The lifelong learning skills being fostered are as follows.

Management of self. The activity requires students to complete a large and unstructured task within a set timeframe and within a number of constraints and limitations. Learners need to plan their steps, explore the domain, and work towards a goal. In the process, they need to confront unexpected outcomes and hurdles, reflect and judge their progress, and use a variety of learning strategies to develop their solution.

Management of others. In the group setting, students are required to work with others and maintain a good working relationship throughout the semester. On a day to day basis, they need to be cooperative and adaptive to the group's needs, defend their own stance, negotiate, and give and accept criticism.

Management of information. In this regard the activities demand that students apply the various technologies to seek information, and to deal with the large amounts obtained. They need to interpret the information and deal with the multiple perspectives presented. They then proceed to the creation of a succinct summary requiring reflection and critical thinking.

Management of task. In terms of managing the task, these activities compel students to identify sub-tasks and to conceptualise what was being asked and how it could be dealt with. The activities require the learners to instigate and carry out the course of action and to reflect on the outcomes and directions.

IS TECHNOLOGY ENOUGH TO SUPPORT LIFELONG LEARNING?

Technology of itself does not elicit and develop lifelong learning skills. Changes in pedagogy are required, and a mindset that regards technology as a cognitive tool and a scaffold for higher order thinking rather than a conveyor of information. There are two versions of the 'technology-in-support-of-learning' argument, one a strong and one a weak, each with a considerable body of supporting literature. In the weak version, Clark (1983) argues that media, including computers, are mere vehicles to deliver instruction, but do not influence the psychological or cognitive processes of learning. Kozma (1991) contests this view, and puts forward the strong version of the media theory. According to Kozma, learning technologies can produce unique cognitive results and learning benefits, as media and method are inseparable. In a technology-supported environment, the learner constructs knowledge in interaction with medium and method. The learner forms a partnership with the technology, and cognitive responsibility for lower order tasks such as data retrieval and storage can be handled best by the technology.

The media theory debate is set to continue, and the jury is still out on a final conclusion. A justifiable point of view, however, is that Web-based teaching can support lifelong skills such as inquiry, self-determination, and lifelong competencies if it is embedded in learner-centered environments with an orientation towards student construction of knowledge, understanding, and problem solving. Such environments are 'generative' as they require students, alone or in groups to take responsibility for organising, elaborating, and representing procedural and declarative knowledge in an organised manner (Scardamalia & Bereiter, 1991; 1992; Grabinger & Dunlap, 1996; Schank & Jona, 1991). Tasks that require students to solve a problem, take action, make a decision based on evidence, or analyze conflicting viewpoints, demand complex knowledge creation skills. Through the process of generating knowledge rather than passively receiving it from a teacher in a prepackaged form, generative learning tasks equip learners with the strategies, metaskills, and habits of lifelong learning.

CONCLUSION: SUPPORTING LIFELONG LEARNING SKILLS WITH TECHNOLOGY-BASED ACTIVITIES

In this article a number of strategies and approaches to the development of lifelong learning skills in tertiary learning environments have been proposed. Table 3 shows how technology-based tools and scaffolding can create contexts and support for learning processes, independent inquiry, helicopter vision, and a repertoire of learning strategies.

Lifelong attribute	Performance examples	Support by learning technologies
Inquiring mind	Solve problems, think critically; evaluate multiple perspectives	Computer networking, collaborative problem solving
Personal agency	Self-directed learning, inquiry, motivation to learn	Support for individual inquiry and autonomous learning, access to information, capacity to represent and create mental models
Helicopter vision	Capacity to see the relate concepts, integrate ideas from different perspectives	Provision of multiple perspectives and situated contexts for learning; Tools for building consensus and comparing views
Repertoire of learning strategies	Capacity to select and apply a range of skills such as self-evaluation, management of self and others	Support for articulation of ideas, for accessing needed information and mindful, reflective learning

Table 3. Summary of how lifelong attributes can be supported by technology applications

The ability to engage in lifelong learning entails the development of certain core attributes as defined by Candy (1994, see Table 3). To achieve this requires moving away from a view of learning that is controlled by an external agent, to a view of learning that is controlled by learners who collaborate, exchange views, and reach their own understandings. This means that tertiary teachers need to adopt new pedagogies and redesign tasks to engage learners. Learning tasks must be generative in order for graduates to be productive, competitive, and professional. Fostering lifelong learning skills requires that learners become drivers of the learning process by engaging in inquiry-based activities that meet their learning needs and goals. In this article, we have described a Web-supported environment where students are engaged in developing a plan of action; researching Web resources; creating; defining and solving problem by independent investigation; and analysing, representing, and justifying points of view. In this Web-based environment, learners engage in inquiry skills and strategies needed for lifelong learning as they develop domain-specific content and knowledge. The combination of learner-centred pedagogy and task design, technology as scaffold, and learners as active agents, are the essential attributes of learning environments that foster lifelong learning.

REFERENCES

America Psychological Association, (1997). Learner centred psychological principles: A framework for school redesign and reform. Retrieved from the World Wide Web: http://www.apa.org/ed/lcp.html#.

Ashcroft, K., & Foreman-Peck, L. (1994). Managing teaching and learning in further and higher education. London, UK: The Falmer Press.

Bennett, N., Dunne, E. & Carre, C. (1999). Patterns of core and generic skill provision in higher education. Higher Education, 37(1), 71-93.

Biggs, J. (1987). Student Approaches to Learning and Studying. Melbourne: Australian Council for Educational Research.

Bonk, C. J., & Cummings, J. A. (1998). A dozen recommendations for placing the student at the centre of Web-based learning. Education Media International, 35(2), 83-89.

Blumhof, J., Honeybone, A., Pearlman, D., & Pinn, K. (1996). Tackling the problem of skills development in a modular degree programme: the Skillswise Project. In G. Gibbs (Ed.), Improving student learning: Using research to improve student learning (pp 328-339). Oxford, UK: Oxford Centre for Staff Development.

Candy, P., Crebert, G., & O'Leary, J. (1994). Developing lifelong learners through undergraduate education. Canberra: Australian Government Publishing Service.

Clark, R. (1983). Reconsidering research on learning from media. Review of Educational Research, 53(4), 445-459.

Collis, B. (1998). WWW-based environments for collaborative group work. Education and Information Technologies, 3, 231-245.

Cox, R., & Brna, P. (1995). Supporting the use of external representations in problem solving: The need for flexible learning environments. Journal of Artificial Intelligence in Education, 6(2/3), 239-302.

Crook, C. (1994). Computers and the collaborative experience of learning. London: Routledge.

Duffy, T. M., & Cunningham, D. J. (1996). Constructivism: Implications for the design and delivery of instruction. In D. H. Jonasssen (Ed.), Handbook of Research for Educational Communications and Technology (pp 170-198). London: Prentice Hall International.

English, S., & Yazdani, M. (1999). Computer-supported cooperative learning in a virtual university. Journal of Computer Assisted Learning, 15(2), 2-13.

Erhaut, M. (1994). Developing professional knowledge and competence. London: The Falmer Press.

Gibbs, G., Rust, C., Jenkins, A., & Jaques, D. (1994). Developing Students' Transferable Skills. Oxford: The Oxford Centre for Staff Development.

Grabinger, S., & Dunlap, J. (1996). Rich environments for active learning. In P. Kommers, S. Grabinger, & J. C. Dunlap (Eds.), Hypermedia learning environments (pp 211-223). Mawah, New Jersey: Lawrence Erlbaum.

Hazemi, R., & Wilber, S. (Eds.). (1998). The digital university: reinventing the academy. London and Berlin: Springer Verlag.

Jonassen, D. H., Peck, K. L., & Wilson, B. G. (1999). Learning with technology. London: Prentice Hall.

Jonassen, D., & Reeves, T. (1996). Learning with technology: using computers as cognitive tools. In D. H. Jonassen (Ed.), Handbook of research on educational communications and telecommunications. New York: Scholastic Press.

Kolb, D. A. (1984). Experiential learning. Englewood Cliffs, N.J.: Prentice-Hall.

Kozma, R. B. (1991). Learning with media. Review of Educational Research, 61(2), 179-211.

Lave, J. (1988). Cognition in practice: Mind, mathematics and culture in everyday life. Cambridge: Cambridge University Press.

Laurillard, D. (1993). Rethinking University teaching: A Framework for the Effective Use of Educational Technology. London: Routledge.

Lipman, M. (1991). Thinking in education. Cambridge: Cambridge University Press.

Longworth, N., & Davis, W. K. (1996). Lifelong learning. London: Kogan Page.

McFarlane, A. (1998). Information, knowledge and learning. Higher Education Quarterly, 52(1), 77-92.

McLellan, H. (1997). Creating virtual learning communities via the World Wide Web. In B. Khan (Ed.), Web-based learning environments (pp 185-190). Englewood Cliffs: Educational Technology Publications.

McLoughlin, C., & Luca, J. (1999). Lonely outpourings or reasoned dialogue? An analysis of text-based conferencing as a tool to support learning. In J. Winn (Ed.), ASCILITE '99 – Responding to Diversity: Proceedings of the 16th annual conference of the Australasian Society for Computers in Learning in Tertiary Education (pp 217-228). Brisbane: Queensland University of Technology.

McLoughlin, C., & Oliver, R. (1999a). Pedagogic roles and dynamics in telematics classrooms. In M. Selinger & J. Pearson (Eds.), Telematics in education: Trends and issues (pp 32-50). Amsterdam and Oxford: Elsevier Science.

McLoughin, C., & R. Oliver. (1999b). Problem-based learning: Developing learning capability through the World Wide Web, Open, distance and flexible learning: Challenges of the new millennium (pp 301-303). Geelong: Open and Distance Association of Australia.

McLoughlin, C. (1999). Culturally responsive technology use: developing an on-line community of learners. British Journal of Educational Technology, 30(3), 231-245.

McLoughlin, C., & Oliver, R. (1998a). Maximising the language and learning link in computer learning environments. British Journal of Educational Technology, 29(2), 125-136.

McLoughlin, C., & Oliver, R. (1998b). Scaffolding higher-order thinking in a telelearning environment. In B. Collis & R. Oliver (Eds.), Proceedings of Ed-Media/Ed-Telecom 98 World Conference on Educational Multimedia and Hypermedia (pp 977-983). Charlottesville, VA: AACE.

McLoughlin, C., & Oliver, R. (1998c). Planning a telelearning environment to foster higher order thinking. Distance Education, 242-264.

Oliver, R. (1998). Teaching and learning with the World Wide Web. Perth: Edith Cowan University (Monograph).

Oliver, R., & McLoughlin, C. (1999). Using Web and problem-based learning environments to support the development of key skills. In J. Winn (Ed.), ASCILITE 99: Responding to diversity (pp 229-238). Brisbane: Queensland University Press.

Ramsden, P. (1992). Learning to teach in higher education. London: Routledge.

Salomon, G. (Ed.). (1993). Distributed cognitions: Psychological and educational considerations. Cambridge: Cambridge University Press.

Scardamalia, M., & Bereiter, C. (1991). Higher levels of agency for children in knowledge building: A challenge for the design of new knowledge media. The Journal of the Learning sciences, 1(1), 37-68.

Scardamalia, M., & Bereiter, C. (1992). An architecture for collaborative knowledge building. In E. D. Corte, M. C. Linn, H. Mandl, & L. Verschaffel (Eds.), Computer-Based Learning Environments and Problem Solving (pp 41-66). Berlin: Springer-Verlag.

Scardamalia, M., & Bereiter, C. (1996). Adaptation and understanding: A case for new cultures of schooling. In S. Vosniadu, E. DeCorte, R. Galser, & H. Mandl (Eds.), International perspectives on the design of technology supported learning environments (pp 149-164). Mawah, New Jersey: Lawrence Erlbaum Associates.

Salomon, G., Perkins, D., & Globerson, T. (1991). Partners in cognition: Extending human intelligence with intelligent technologies. Educational Researcher, 20(3), 2-9.

Schank, R. C., & Jona, M. Y. (1991). Empowering the student: New perspectives on the design of teaching systems. The Journal of the Learning sciences, 1(1), 7-35.

Selinger, M. (1998). Forming a critical community through telematics. Computers in education, 30(1), 23-30.

Vygotsky, L. (1978). Mind in society: the development of higher psychological processes. Cambridge MA: Harvard University Press. (Original material published in 1930, 1933 and 1935).