

USING WEB AND PROBLEM-BASED LEARNING ENVIRONMENTS TO SUPPORT THE DEVELOPMENT OF KEY SKILLS

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Abstract

This paper reports on a project in which the development of key skills among university students was considered in the context of a problem-based learning environment delivered on-line. The results suggest that such learning environments provide many opportunities for students to develop key skills and there is great prospect in further exploring these opportunities and outcomes.

Keywords

on-line learning, World Wide Web, collaboration, student-centred learning, instructional design, key skills, life skills, problem-based learning

Introduction

Lecturers today often tend to view courses as collections of units, and to view units as collections of learning objectives linked to domain specific outcomes. But effective university teaching and learning extends far beyond the development of skills and knowledge in specific subject domains (eg. Dearing Report, 1997). There are other forms of skills and knowledge that are seen as important outcomes of university education that are common to all courses and units irrespective of their subject domain. These key skills are those that students need, to become successful learners and successful practitioners in their fields of study and work and in other aspects of their life. We are now seeing increased reference to this extended set of outcomes in curriculum and teaching initiatives across all sectors of education.

The growing use of technology in teaching and learning appears to be having a circular effect on thinking in relation to key skills and appropriate competencies among learners. While the new technologies are creating opportunities for teachers to help develop students' key skills, the consequence of their increased use is causing many to consider skills in learning with computers, as important and emerging key skills in themselves. The purpose of this paper is to explore the contemporary notion of key skills and to report on a study in which the development of key skills was explored in the context of a university course delivered through an on-line learning environment.

Defining key skills and competencies

Defining the full range of generic and transferable skills that are useful (or essential) for university students is an exhaustive process. It is almost as exhaustive as finding agreement in the terms which might best be used to describe the set. In the context of this paper we use the term *key skills* to describe the generic and transferable skills that are considered to be essential life skills for people both in and out of the workforce. There has been interest in key skills as outcomes of education for many years now. It was perhaps the Finn Report (1991) which introduced this concept into Australia. The Finn Report used the term key competencies to describe 'certain essential things that all young people need to learn in their preparation for employment'. The subsequent Mayer Committee (1992), further clarified the concept of employment-related key competencies in compulsory education and training. The key competencies proposed by the Mayer Committee were:

- collecting, analysing and organising ideas and information;
- expressing ideas and information;
- planning and organising activities;
- working with others and in teams;
- using mathematical ideas and techniques;
- solving problems; and
- using technology.

In different countries, different sets of skills are listed, all with similarity and consistency to each other. The 1993 New Zealand Curriculum Framework proposed 8 essential skills as important outcomes of New Zealand Schooling. These were: communication skills; information skills; self- management and competitive skills; physical skills, numeracy skills, problem solving skills and co-operative skills, work and study skills.

In the United Kingdom, The Qualifications and Curriculum Authority developed a set of key skills that the government and much of industry consider as essential for successful lifelong learning and a flexible workforce. The QCA key skills comprise 6 main areas; communication skills; information technology skills; application of number; skills in working with others; skills to improve learning and performance and problem solving skills.

The conceptualisation of key skills is problematic in many ways. Bennett, Dunne & Carre (1999) describe a number of synonyms including personal, transferable, generic, common, work and employment related skills. Are they skills or are they competencies, capabilities or learning outcomes? The key skills that are reported as important outcomes of schooling tend to be broad and extensive. In university teaching, the skills set is often narrowed to focus on those that are not, or cannot, be taught as discrete components of coursework. At the same time, the key skills sought by university education assume learners are numerate and literate as a consequence of the requirements of university entrance. 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.

Key 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, metacognitive skills (eg. Candy, 1994);
- The development of intellectual and imaginative powers, understanding and judgement, problem solving skills, critical thinking skills and an ability to see relationships (eg. Ramsden, 1992);
- Personal and interpersonal skills needed for communication, cooperative and collaborative teamwork, and leadership (eg. Ashcroft & Foreman-Peck, 1994; Gibbs et al. 1994).
- Skills required for successful work practices including time management, task management leadership and self evaluation (eg. Gibbs et al. 1992; Blumhof et al. 1996).

Table 1: A framework for the development of key skills (Bennet, Dunne & Carre, 1999)

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

Bennet, Dunne & Carre (1999) offer an elegant model to conceptualise key skills in the higher education sector by suggesting a framework comprising 4 broad managerial skills. These authors argue that the important key skills are fundamentally those associated with being able to manage self, others, information & 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.

Developing key skills

By their very nature, key skills are difficult to teach through formal instruction. Most writers argue that the skills are best developed in meaningful contexts and through instructional approaches integrated into the normal teaching programs. Gibbs et al. (1994) argue that the development of such skills involves an experiential learning cycle which includes experiencing the skills, reflecting on performance, formalising the gained knowledge, and planning and preparing activities. Many of the activities associated with the development of key skills are activities that can provide support for meaningful learning in the various units being studied formally.

Candy & Crebert (1990) suggest on-line learning as a useful vehicle for developing generalisable skills and list the following as competencies that can be derived from this form of learning environment:

1. Making reasoned decisions in problematic situations;
2. Adapting to change;
3. Reasoning and thinking critically;
4. Collaborating productively in groups or teams;
5. Self-directed learning; and
6. Understanding issues from multiple perspectives.

The provision of key skills and competencies can be undertaken through a variety of forms. Traditionally it has been attempted through 3 main types of learning activity: integrated approaches, stand alone approaches or approaches where key skills are developed in parallel with the conventional curriculum. (eg Drummond et al. 1997 cited in Bennet, Dunne & Carre, 1999). Many writers question whether it is really possible for the learning taking place in university settings to be transferable to vocations and the work place. One school of thought suggests that through situating learning in meaningful contexts, this transfer can be facilitated (eg. Brown, Collins & Duguid, 1989). Contemporary thinking is that university learning can be significantly strengthened through workplace-based practica and applications (eg. Seagraves, Kemp & Osborne, 1996).

Much of our work at Edith Cowan University has explored the use of technology to support the implementation of situated learning environments and inherent in much of this work has been the development of learners' key skills (eg. Herrington & Oliver, 1997). Our recent explorations of problem-based learning environments (eg. Oliver, Omari & Stoney, 1999) has furthered our interest in this area and provided the impetus for this paper and line of inquiry.

On-line problem-based learning

We have been using the WWW in our university teaching for several years now and recognise that one of the major benefits of the use of this technology is the facility it

provides to incorporate learning activities which help to develop students' generic and transferable skills. In the introductory multimedia course in our undergraduate program, we have embraced a Web-supported problem-based learning environment with which the students engage and interact with the course content. The system involves learners working in collaborative groups to explore the solutions to open ended and ill-defined problems related to the weekly course content. From these activities we have observed among learners developing a raft of key skills through their interactions and activities in the Web-based course.

a) The learning system

The on-line system we have been using, RonSUB, 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 students and a large number of tutors. The system supports problem-based learning by providing a means for students to collaborate on set problems, to share resources, to post solutions and to compare and review answers from other groups. The system is described more fully in another paper in these proceedings.

The system was designed with a degree of flexibility in mind to enable it to be used in a variety of ways in a variety of units and courses. Typical use of the system in a course of study is expected to revolve around the following activities which were characteristic of our initial implementations and trials. The system is Web-based and all the following activities are undertaken using on-line technologies:

- 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 explore the topic, locate relevant information and resources, consider the various options and outcomes and to create a response which is informed and well argued.
- The group post this solution to the system bulletin board, an action which then reveals to them 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 which 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:

1. **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 WWW as an information source but have to isolate from among the myriad of resources available, those that are relevant and helpful.
2. **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.
3. **Collaboration.** Each group has a number of members. The problem solving task requires members to organise themselves into productive teams who share the workload, undertaking separate tasks and maintaining tight deadlines and schedules from one week to the next. Such activities demand that students consider the requirements of others, be adaptive, be responsible and flexible.
4. **Problem Solving.** Each task is different and needs to be tackled in varying ways. Students need to use their initiative and intellects to consider the form the solution will take and to consider ways in which 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. There is very little support or help provided and students have to judge when and where their research will stop and when and where their summarising and reviewing will stop.

c) Outcomes

In our use of the system, the postings which the students are required to make are assessed by the students and tutors in terms of the quality of the solution provided for the given problem. The problems are intentionally created in an open-ended fashion 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. It is interesting to note that since there is no firm model answer, the solutions are judged in terms of the quality of the processes associated with developing and submitting a solution more so than on the solution itself..

Key skills development

We have used this system in several units now involving relatively large numbers of students. In each instance we have been surprised and delighted with the learning which has been achieved. It is patently clear to us 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 encourages and supports many other useful tasks. And a close

examination of these tasks suggests a high degree of incidental learning is occurring in the form of key skills.

When the activities and tasks undertaken by the students exposed to this form of learning environment are examined in the light of the model proposed by Bennett, Dunne & Carre (1999), its capacity to support generic skills development immediately becomes evident.

The learning setting helped and encouraged learners to practise and develop key skills across the full range of managerial skills.

1. **Management of Self.** The activity required students to complete a large and unstructured task within a set timeframe and within a number of constraints and limitations. The activity required learners to plan their steps, explore the domain and work towards a goal. In the process, they needed to confront unexpected outcomes and hurdles, reflect and judge their progress and use a variety of learning strategies to develop their solution.
2. **Management of Others.** In the group setting, students were required to work with others and maintain a good working relationship throughout the semester. On a day to day basis, they needed to be cooperative and adaptive to the group's needs, defend their own stance, negotiate and give and accept criticism.
3. **Management of Information.** In this regard the activities required students to apply the various technologies to seek information and to deal with the large amounts obtained. They needed to interpret the information and deal with the multiple perspectives presented. They had to then create a succinct summary requiring reflection and critical thinking.
4. **Management of Task.** Finally in terms of managing the task, these activities compelled students to identify sub-tasks and to conceptualise what was being asked and how it could be dealt with. The activities required the learners to instigate and carry out the course of action and to reflect on the outcomes and directions.

Table 2 shows, in italics, those activities and tasks from this model which appeared as common components and elements in our implementations of the on-line problem-based learning setting described above. Students were immersed in the problem-based setting for ten weeks and in that time were able to improve their skills. All students interviewed claimed to have improved their skills and knowledge in the problem-solving process as a consequence of these learning activities and we are confident that the activities were extremely beneficial in developing their key skills.

Table 2: Key skills practised through the RonSUB on-line problem-based learning setting

<p>Management of Self</p> <ul style="list-style-type: none"> Manage time effectively Set objectives, priorities and standards Take responsibility for own learning Listen actively with purpose Use a range of academic skills Develop and adapt learning strategies Show intellectual flexibility Use learning in new or different situations Plan/work towards long-term goals Purposefully reflect on own learning Clarify with criticism constructively Cope with stress 	<p>Management of Information</p> <ul style="list-style-type: none"> Use appropriate sources of information Use appropriate technologies Use appropriate media Handle large amounts of information Use appropriate language and form Interpret a variety of information forms Present information competently Respond to different purposes/context and audiences Use information critically Use information in innovative and creative ways
<p>Management of Others</p> <ul style="list-style-type: none"> Carry out agreed tasks Respect the views and values of others Work productively in a cooperative context Adapt to the needs of the group Defend/justify views and actions Take initiative and lead others Delegate and stand back Negotiate Offer constructive criticism Take the role of chairperson Learn in a collaborative context Assist/support others in learning 	<p>Management of Task</p> <ul style="list-style-type: none"> Identify key features Conceptualise ideas Set and maintain priorities Identify strategic options Plan/implement a course of action Organise sub-tasks Use and develop appropriate strategies Assess outcomes

The capacity of our on-line problem-based learning system to support the development of such a large set of key skills suggests many more contexts and applications for its use. While our initial rationale for its development and design was to promote learning in discipline areas, its capacity to promote learning in other key areas makes it more valuable again. In our previous research we have explored the forms of learning enhancement achieved in the context of discipline content and skills. We are now very much encouraged to pursue our inquiries of the use of this teaching strategy to promote the development of key skills.

Summary and conclusions

Problem-based learning has long been proposed as a powerful and flexible form of learning for university settings. The support for PBL has come from many quarters and for many reasons. It offers the flexibility to cater for a variety of learning styles and the means to create meaningful and authentic settings in which to situate learning. It provides the opportunity to create engaging and stimulating student-centred learning activities. With problem-based learning, the focus moves from dealing with content and information in abstract ways to using the information in ways which reflect how learners might use it in real-life.

This paper now presents yet another powerful argument that can be used to support greater use of this learning activity in on-line environments. With appropriate design and implementation, problem-based learning can be seen as a very useful way to promote the development of key skills through its ability to encourage, enable and support tasks and behaviours across all 4 managerial skills described in the key skills framework of Bennett, Dunne & Carre (1999). It is our intention now to continue to implement problem-based environments as described in this paper with the view to exploring ways in which they can be designed to influence the attainment of particular key skills and those difficult to develop through other means.

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