Learning Through Self-Direction: The Influence of Task Design on Team-Based Professional Knowledge Building in an Online Environment

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Abstract

There is a growing emphasis in tertiary education that students should develop professional and work related skills within the course of their education. In order to learn these skills effectively, students must be able to learn in a self-regulated way, which means having the capacity to plan, set goals and analyse tasks to achieve particular outcomes. Often referred to as self-directed or metacognitive skills, these abilities characterise learners who are equipped with a range of personal transferable skills. Designing learning activities that support self-direction must become one of the core concerns of tertiary educators if enduring learning outcomes are to be achieved. This paper takes as its focus a professional learning context where students learn project management and work related skills in the final year of their studies. In this study, students were required to submit solutions to an on-line discussion space, where other teams provided peer assessment and constructive feedback. Analysis of verbal transactions informed by socio-cultural theory showed that successful learning took place, the evidence for which was the quality of group processes, problem solving and verbal interaction, together with personal reflections on task and self-reports of skills developed. Several important issues emerge from this research that have implications for the design of online courses for professional learning at tertiary level. These include task design that enables team-based problem solving, feedback processes, autonomy in student learning and support for reflection.

Keywords

Professional skills, Problem solving, Team-work, Collaborative online learning, Group processing skills

Introduction

During the last ten years there has been a major reappraisal of higher education, its purpose, outcomes and resourcing (Coldrake, 1998; Hager, 1998). There is now a more pronounced emphasis on the higher education-employment nexus, and particularly on the skills or competencies that can be transferred from a university setting to the workplace. In this changing environment, which is mirrored in New Zealand and Europe, it can be argued that peer assessment and peer learning are an appropriate response to the preparation of tertiary students for the workplace (Assiter, 1995). This study focuses on a context where peer support, assessment and feedback is integrated with problem solving tasks to help develop professional skills through collaboration and asynchronous group dialogue.

To develop professional skills, such as knowing how to learn, how to formulate relevant questions about new problems, and how to apply appropriate information within the context of the problem, learners have to engage in tasks that enable them to practice these skills. Often this requires changing both pedagogy and learner roles. Computer supported environments offer learners greater scope and flexibility to practice these skills ie a more democratic environment, access to group knowledge and resources together with the potential for multiple forms of feedback from peers and tutors (Collis, 1998). In this study we demonstrate that online environments utilising asynchronous communication tools are ideal environments for the refinement of professional skills.

Adult learning theory and the integration of pedagogical principles that inform professional learning must support the design of tasks and the learning environment. Such principles include building knowledge which is practical, contextualised, process-based and validated by a community of peers (Taylor, 1997). This case study profiles an on-line approach to self-directed, professional learning for a class of project management students and illustrates how a range of skills can be achieved through task, interaction design and group processes.

Professional Knowledge

One of the characteristics of being a professional is having the capacity for self-directed learning and being able to apply practical strategies and skills in contexts that require them. Professionals have a body of expertise and

in addition have lifelong learning skills and self-direction. Boud (1988) suggests that the capacity for self-direction includes elements of dependence, independence and interdependence and proposes that these form a continuum whereby the learner progresses from dependence, to independence and then to interdependence. In the initial stage, the learner is dependent on a teacher, and then progresses to independent learning. A more advanced level is reached when the learner is able to combine self-direction with collaboration, peer learning and positive interdependence.

For example, the research of Billet (1996) shows that learning in the workplace requires interdependence in the sense of learning from others, choosing among multiple courses of action, learning about organisational culture and using a wide range of opportunities to shape one's professional identity. For many individuals, moving from the isolation of individual learning to interdependent learning requires a learning environment that scaffolds social and participatory learning. Many would argue that the networked capabilities of the World Wide Web offer scope for the social and communicative aspects of learning (Crook, 1994; English & Yazdani, 1999). This is succinctly expressed by Bonk & King (1998: 45) who state that:

> "Educators must begin to realise that the lockstep factory model of education is out of sync with prevailing views of learning. Today, with the complementary nature of socio-cultural theory and collaborative learning tools, learning is viewed as fundamentally social and derived form authentic engagement with others in a community of practice."

Several theorists have documented different types of professional knowledge, the processes by which knowledge is created and the conditions required for fostering this knowledge (Schon, 1987; Kolb, 1984; Andersen & McMillan, 1992). In essence, these authors contend that professional knowledge is created through action and reflection within a community of peers. Within this community, professionals build and use knowledge which is practical, contextualised, tacit and validated by their peers. A further difference between traditional tertiary higher education and professional knowledge is that the former emphasises the centrality of **propositional** knowledge, while professional education emphasises **personal** and **process** knowledge as equally important (Erhaut, 1994). The framework proposed by Erhaut of *personal, process* and *propositional knowledge* is widely acknowledged and provides the foundation for the discussion of professional skills developed in this case study.

According to Erhaut (1994), these three kinds of knowledge contribute to professional knowledge and understanding. These are illustrated in Table 1. This framework proposed by Erhaut can be adopted as a starting point for course design of generic skills, both online and in face-to-face contexts. The implications are that if such skills are expected of graduates as promoted by employers, then teaching methods and learning resources must foster process, personal and propositional knowledge. For tertiary educators, the increased emphasis on generic transferable skills will require a re-alignment of teaching practices (Biggs, 1999).

Propositional knowledge	Process knowledge	Personal knowledge
• Discipline based concepts • Generalisations and practical principles • Specific propositions about cases, decisions and actions	• Acquiring information • Skilled behaviour • Deliberative processes • Giving information • Controlling one's behaviour	• Interpretation of experience • Understanding of assumptions • Self-evaluation of competencies

Table 1: Three forms of knowledge in professional education (Erhaut, 1994)

Theoretical Foundations: Technology Used to Support Professional Skills

Information and communication technologies have the capacity to support a wide range of learning goals and are now integrated into teaching approaches of many higher educational institutions. Laurillard (1993) for instance suggests that computer-based learning has a major role in promoting self-directed learning and increased student autonomy, an educational system in line with technological development and increased information literacy, thus ensuring that graduate skills are in tune with those of employers. Shaffer & Resnick (1999), maintain that technology can be used to create authentic contexts for learning, and provide resources that give students opportunities for:

- *connectivity*: to connect to the world outside the classroom, to research topics that would otherwise be inaccessible, to access experts and to engage in conversation with peers
- *computer modelling*: to create simulations that assist the creation of authentic tasks and contexts for assessment
- *epistemological pluralism*: to express and represent ideas in many different ways

Computer facilitated learning can help develop students' collaborative skills and well as developing their research, information literacy and data management skills through access to WWW sites, bulletin boards and other on-line resources. However, many students find their experience in tertiary institutions too general or out of context, and cannot transfer these skills into their own professional disciplines (Hicks, Reid et al. 1999). Learning environments need to be designed which offer learners an authentic context in which to anchor their learning. To promote this shift to student self-direction means that students need to take more responsibility for their own learning, but may need assistance in achieving this skill. In the context of this study, an online environment was created to promote and support the development of project management professional skills. The environment was designed using Shaffer & Resnick's (1999) taxonomy to promote skill development by utilising the technology as follows:

- peer conversation (*connectivity*)
- the creation of authentic problem task and presentation spaces for display of solutions (*modelling*)
- exposing learners to multiple ways of reasoning, presenting and communicating problem solutions (*epistemological pluralism*).

The learning environment also ensured that there was adequate scaffolding to enable student learning of specific project management skills and contextualised knowledge.

Context of the Study

Final year students enrolled in the Interactive Multimedia course at Edith Cowan University are required to develop skills and expertise in project

managing the development of multimedia products. Skills are taught through the unit IMM3228/4228 where students practice the creation of a team-based project using project management models, performing needs analysis, developing design specifications, (storyboards, concept maps and rapid prototypes), conducting formative and summative evaluation, addressing legal and copyright/intellectual property issues.

The unit consists of thirteen, three-hour class sessions and runs over a full semester. Each session consists of a one-hour lecture followed by a two-hour group-based activity. Team skills and collaboration are continually promoted and reinforced throughout the unit with teams of four students working together to promote the development of project management and generic skills. Required student learning outcomes are to:

- make a significant contribution to the development of a team-developed web-based product
- develop a project management model which includes analysis, feasibility, scope, content outline, legal documentation, design, prototyping, production, formative & summative evaluation, testing and implementation
- report on project management issues related to the process, which includes a critical analysis of timesheets, estimates, QA procedures, team dynamics, communication strategies and overall costs
- evaluate the quality and effectiveness of the product
- communicate and collaborate effectively and make appropriate decisions in a team based environment
- write reports (analysis, scope, legal, design) which are representative of industry expectations
- evaluate and reflect on processes used in teamwork to effectively develop a multimedia product

Students are required to complete three assignments: ‘Analysis and Plan’ worth 30 marks, ‘Design’ worth 30 marks and ‘Final Web Site’ worth 40 marks. Each of the assignments contain four assessment components as follows:

- a team-based mark based for the quality of the written assignment and final web product, addressing fixed criteria
- a team-based mark based for the development of on-line problem solutions and feedback given to other students
- an individual reflective report which encouraged students to reflect on team and client issues they have identified as important in each stage and discuss how they would do it differently next time

- a peer assessment score, negotiated with the team. Team members who are not performing lose points that are added to the score of other team members. This encourages students to carefully consider their role and contribution in relation to the others while working in a team.

There were 73 students involved in the study, which was delivered through a web site (see http://www-scam.cowan.edu.au/imm3228), in order to make the learning resources available to both internal and external students and also to enhance the quality of the learning environment. Features of the web site included problem solving software, a Listserv, anonymous bulletin boards, time management tool, syllabus and assessment materials, lecture notes, legal/QA templates, relevant URL's, web sites developed by previous students and a student details database.

Learning Environment and Task Design

Project work and group-based problem solving were chosen for their relevance and congruence to the learning outcomes that were sought. Many authors promote these as successful methods that can be used to support the development of professional expertise and vocational skills in many contexts (Collis, 1998; Klemm & Snell, 1996; English & Yazdani, 1999). Based on these concepts, the following strategies were implemented:

- *Problem Solving*: The tasks required students to seek information from appropriate WWW sources in order to solve problems that reflected state-of-the-art knowledge about project management.
- *Peer Evaluation:* Having solved the problem, student teams were then required to develop assessment criteria to apply to others' solutions.
- *Collaboration:* Each group consisted of 4-5 members. The problem-solving task required members to organise themselves into productive teams and share the workload, undertake separate tasks and maintain tight deadlines and schedules from one week to the next.
- *Personal Reflection on Task and Process:* Each student created reflective notes in which personal views of self-progress were recorded. Students considered the skills and competencies they applied, noted the skills that needed to be developed and developed learning goals that carried over to the next task. This provided a strong framework for the development of personal and process knowledge.

A key pedagogical feature of the environment was the integration of assessment and learning processes. In recent years, research on assessment has emphasised its role in supporting learning, by for example, providing feedback on processes designed to assist learning. In particular, the literature emphasises peer and self-assessment. Authentic

assessment practices utilise a range of assessment approaches which involve learners in self-regulation and self-monitoring of performance (Dochy, Segers et al , 1999). Assessment was based on authentic tasks planned for their relevance to workplace settings. Also, students worked in teams to create a product that was offered to clients and peers for evaluation, and tested for functionality in a real context. Problem-solving scenarios supported the team-based project work. Working online enabled students to provide peer support though shared tasks, teamwork, collaborative work and peer review.

In this study, students were supported in developing the communicative, cognitive and interpersonal skills for solving authentic, ill-defined problems, which are typical in project management environments. Examples of the problems used for assessment are as follows:

- *Assume that you are building a web site for a difficult client who thinks they know lots about multimedia design and development. Outline how you will scope the project, collect the content, develop acceptance criteria, control scope creep and cost the overall project.*
- *If the client asks for changes in design or content after you have commenced production, what should you do? How can the design specifications be tied into the legal contract?*
- *If you were the client, how would you ensure that the final product met the original objectives? If you were the developer how would ensure that you had satisfied the original objectives to the letter of the original contract?*

As illustrated in Figure 2, the following process was used in designing the problem solving application:

- Student teams (four students per team) collaborated to develop a solution to an authentic ill-defined problem and posted it onto an on-line application. The application allowed students to post and mark other students anonymously.

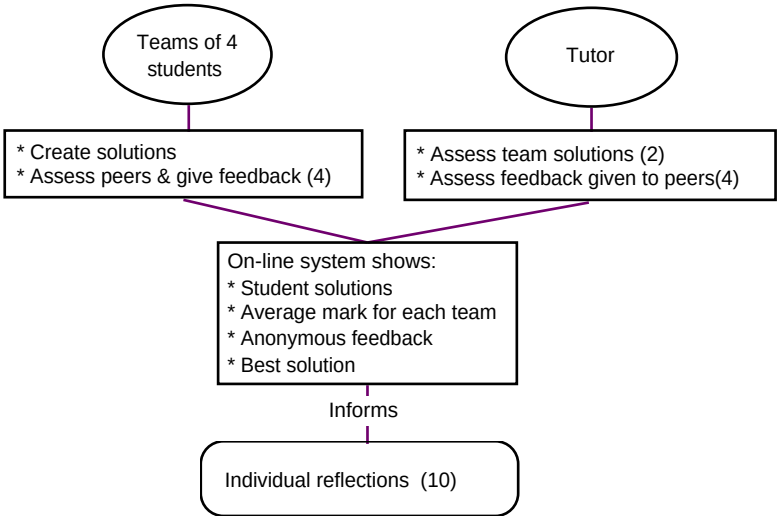

Figure 2: Environment and Task Overview

- Student teams then assessed each other's solutions and allocate a mark out of four. They justified the allocation of marks by explaining what they perceived to be positive aspects, negative aspects and how the solution could be improved. This feedback was then assessed by the tutor
- After the team and tutor assessed the solutions and gave feedback, the students then individually reflected on the process of problem solving and team collaboration. These individual reflections were based on activities related to the management of self, management of others, development of the team's solution and the management of the process (Bennett et al, 1999).

Methodology for Evaluation of Learning Outcomes

In order to evaluate the resulting learning outcomes of this online environment, a number of observational measures and analytic frameworks were applied. To achieve a better understanding of the learning outcomes, a combination of research instruments and approaches were used. First, the text-based responses to the problem solving forums were compiled to provide a corpus of data. In the online area, students posted responses to the problems, thus providing text-based records. The researchers conducted a transcript analysis using a content analysis approach based on Erhaut's (1992) framework to investigate whether there was evidence of propositional knowledge, process knowledge and

personal knowledge. Evidence was sought from the transcripts of the three kinds of knowledge (Table 1). In addition, an analysis of students personal reflections on the team process, their views on the quality of interactions and the strategies they used to resolve problems that occurred in the group problem-solving tasks were scrutinised. Content analysis of these individual reflections was a further tool used to provide indications of how personal knowledge developed. The procedure used for data analysis was to examine transcripts for text-based problem solving responses and look for evidence of propositional and process knowledge in the team-based posting of solutions. Further analysis of individual reflections enabled evaluation of teamwork, collaboration and decision making in team environments, which were key learning outcomes of the unit. Although the content analysis approach yielded numerical data, it was decided to adopt interpretive rather than statistical analysis for several reasons. First, the study was designed as a pilot to test and validate the learning environment. Second the number of students involved in the study was too small for statistical inference. Detailed qualitative analysis of how the problem-solving tasks and reflective component fostered professional skills was therefore considered more appropriate.

Findings: Evidence for Different Forms of Professional Knowledge

Investigation of team responses, individual responses and problem solutions enabled triangulation of data and provided a multifaceted view of the dynamics and processes of on-line team based problem solving. The survey instrument and the analysis of transcripts involved a series of procedures. First, Erhaut's (1994) three-dimensional framework for professional knowledge development was combined with a content analysis of solutions presented in the online collaborative environment. A summary of findings is displayed in Table 2.

Type of knowledge	Definition	Examples of knowledge found in transcripts
Propositional knowledge	• Generalisations and practical principles • Specific propositions about cases and decisions	• Storyboarding skills • Project planning • Design specifications • Record keeping • Hardware/software knowledge
Process knowledge	• Acquiring information • Deliberative processes • Controlling ones behaviour	• Negotiation skills • Communication • Evaluation • Roles of team members
Personal	• Interpretation of experience	• Self-awareness

knowledge	• Understanding of assumptions	• Self-assessment of skills

Table 2: Content analysis of types of professional knowledge in problem solving transcripts

The second phase of analysis investigated individual reflections on task, group performance and personal skills development in a team environment. The findings showed that individuals valued particular forms of group processing and teams were similar in their interpersonal dynamics and ways of resolving problems. The reflections also provided insights into the ways in which team problem solving and group processing developed personal knowledge in individuals.

Content analysis focussed on individuals observations of self, others and tasks. Most students self-evaluated themselves in terms of their contributions to the team, their communication skills and their capacity to contribute to problem solving. Groups reported both positive and negative group-processing behaviours. On the negative side, the majority of students reported on communication breakdown, lack of negotiation skills, and difficulties experienced in sharing ideas. One question that elicited some interesting responses was: "How do others influence the development of your ideas and skills?" Table 3 shows that a range of personal knowledge skills were developed and demonstrated in the reflective tasks undertaken by individuals. Some examples correspond with Erhaut's (1994) definition of personal knowledge, for example, interdependence, multiple perspectives and awareness of the assumptions underpinning one's own view.

Personal knowledge	**Example of positive comments**	**Example of negative comments**
Interdependence	*I learnt to balance group work with independent work*	*Others saw team work only as a division of set activities between team members*
Initiative	*I learnt to be more productive in initiating communication*	*There is a tendency for member to blame individual rather than seek constructive ways of resolving problems*
Self- awareness	*I have been able to deal with constructive criticism from group members*	*There is a lack of directness in the way people deal with conflict*
Interpretation of experience	*I recognise that group interaction is for professional development*	*Not every group member is contributing equally*
Reasoning	*I am willing to contribute my ideas and provide reasoning for them*	*The group seems unable to make our meetings productive*
Multiple perspectives on knowledge	*There is growing confidence as more viewpoints are being aired with every discussion. This is excellent for getting a better understanding of a particulate*	*There are areas that could be improved such as how we deal with people who are not contributing to the best of their ability.*

	subject	

Table 3: Examples of personal knowledge developed by students

Other areas of personal knowledge that emerged from the transcripts were development of reasoning, self-awareness and an appreciation of multiple perspectives. Further evidence of the development of team skills can be inferred from the results of the team processing and feedback mechanisms that were built on assessment design. Table 4 shows the results of four teams who completed two problem-solving scenarios. Except for team 1, who suffered team conflict issues, all other teams showed improvement in the points they won for the quality of feedback provided to other teams. Problem 2 showed closer correspondence in scores awarded by tutor assignment (row 2) with peer assigned scores (row 1), which lead to higher scores being allocated by the tutor for student feedback (row 3). Although the change is not statistically significant, it proves further evidence that when solving problem 2, student teams had a clearer understanding of how to justify allocated marks. Combined with the results obtained from analysis of the reflective tasks (as exemplified in Table 3), there is evidence of improvement in team-based problem solving, such as giving constructive criticism and providing a reasoned analysis of other teams' approaches.

Problem 1

	Team 1	Team 2	Team 3	Team 4
1. Student peer mark received by each team (represents an average mark from peers) /4	3.0	2.6	2.6	2.8
2. Tutor mark given to team solution /2	1.1	0.8	0.7	1.4
3. Tutor mark given to team feedback /4	1.0	1.2	2.0	2.3
Total /10	5.1	4.6	5.3	6.5

Problem 2

	Team 1	Team 2	Team 3	Team 4
1. Student peer mark received by each team (represents an average mark from peers) /4	1.8	3.0	2.8	2.8
2. Tutor mark given to team solutions /2	0.7	1.7	1.5	1.2
3. Tutor mark given to team feedback /4	0.5	3.4	2.1	2.6
Total /10	3.0	8.1*	6.4*	6.6*

* Improved overall performance for team-based assessment

Table 4: Comparative data on peer assessment tasks for problems 1 and 2

Implications of the study

Though the evaluation of this environment is still in its early stages, there is positive evidence that the tasks and environment design support the development of skills and knowledge identified as crucial for professional learning (Erhaut, 1992; Bonamy & Hauglusaine-Charlier, 1995). These are supported through student performance improvement on problem-solving tasks, through communicative skills displayed in on-line postings to the bulletin board and in the reflective comments made by individuals. These sources of evidence attest to the success of the design features of the environment. Essentially, process-based learning is achieved by providing students with authentic problems to be solved in a team environment. This gives students a realistic “picture” of the tasks they will face in a real-world context The team based approach enables students to develop and put into place communication and peer assessment protocols to ensure that groups run smoothly and remain task-focussed ie the integration of learning and assessment gave student an experiential focus, and allowed them to monitor self and others throughout the unit. While group-based project learning was adopted to foster project management skills, student were also supported in the problem solving process by having access to a problem solving tutorial and a set of heuristics that gave them procedural prompts for problem solving (Lynch, 2000). In addition, tutors assisted in the feedback process by monitoring group feedback and providing timely and relevant input in team solutions and group-assessment processes.

Summary and Conclusions

The study provides evidence and support for the adoption of a process-based approach to developing professional skills in tertiary learners. Task design promoted knowledge construction through group-work, active learning, collaboration, knowledge sharing and reflection. In this study, a network of teams was used as a basis for the creation and sharing of ideas and as a replication of a “learning organisation" frequently found in work-based contexts. Group-work and peer-assessment proved to be successful in achieving an awareness among students about the difficulties that abound in teamwork, and of their own skills in communicating and managing team conflict. Several factors emerged from the study to enable the development of better team processes. One was the difficulty experienced by teams in working collaboratively to break the task into subtasks and then individual’s taking responsibility for these. In cases where this was not carried out effectively, it often affected the ability of the team to perform well ie. interpersonal problems that occurred related

to individuals not contributing to the task, leading to disputes and dissension. For groups to work effectively, there needs to be further support for collaborative team building, both online and in face-to-face contexts. If group-based problem solving is to achieve professional knowledge building skills, appropriate group practices need to be fostered, practiced and assessed.

The results show that there is a compelling relationship between individual reflections on group processes, and the actual analysis conducted of group processing behaviours, the evidence for which are feedback patterns that are evident when groups commented on each other's work. Further research and evaluation of learning processes is leading us to the development of an instrument to assess group processing behaviours, and relate these to learning outcomes. In conclusion, we advocate that learning environments designed to develop professional skills should harness the technology to provide supportive, holistic context where learners can achieve connectivity, have access to resources that support self-directed inquiry, and provide authentic contexts for feedback and assessment.

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