Educational Technology & Society 5(2) 2002
ISSN 1436-4522

Technological and Pedagogical Convergence between Work-based and Campus-based Learning

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ABSTRACT

There is a strong technological and economic push for higher education providers to adopt online learning strategies. This is driven, in part, by the requirement of industry for lifelong learning on a flexible, just-in-time basis. Simultaneously, there is a rising awareness amongst engineering faculty of the pedagogical issues that underpin good teaching and learning practice, stimulated by revised accreditation approaches and related reviews. These significant drivers of change are often experienced as discordant if not competing issues. This paper presents a case study of work-integrated learning that parallels traditional on-campus learning. Technology and pedagogy begin to converge when: (1) pedagogical assumptions are identified early; (2) flexible learning is not confused with on-line learning; (3) intrinsic and external motivations of stakeholders are aligned; (4) there is broad ownership; and (5) a sustainable development strategy is adopted.

Keywords

Engineering education, Flexible learning, Graduate attributes, Learning technologies, Student-centred learning, Work-integrated earning.

Introduction

New information and communication technologies (ICT) continue to transform workplaces and work practices. This shift has been accelerated via the unprecedented uptake of mobile and networked technologies and the work-a-day use of email, the WWW and other Internet facilities. This technology push has powered the surge in global initiatives in online learning and e-learning. Many instances of the adoption of new technologies in campus-based, higher education seem to be based on a transmission model of learning rather than a constructivist learning paradigm. These pedagogical assumptions on which particular ICT applications are based are often implicit rather than explicit. In the process, the real needs of learners can be overlooked (Felder et al., 2000).

Over the past decade, there has been growing interest in the workplace as a learning environment with particular focus on lifelong, self-directed and negotiated learning programs (Boud & Solomon, 2001; Candy & Crebert, 1991). Such programs are problematic, especially for traditional universities as they challenge our fundamental conceptions and assumptions about knowledge, how and where it arises and what we mean by university education. Work-based learning can be especially challenging for learners if we ask them to be co-designers of learning programs and directly influence both the learning activities and the learning outcomes that will be assessed. This represents a different level of participation and responsibility compared with tradition encounters in formal education. This sharing of responsibility and power between learner and teacher might begin earlier in the educational cycle, for example in undergraduate programs and in work-integrated learning programs such as co-operative education.

This paper draws on the tensions between the pedagogical pull and technology push in conventional campus-based programs and opportunities and challenges offered by work-based learning. Most workplaces now have the technological infrastructure to support a variety of learning activities. Workplaces offer experiential opportunities that are far richer than those in traditional campus-based learning environments.

Technology Support for Flexible Learning

Societal changes, competing demands on students' time, and changing expectations of formal institutions all point to the need for more flexible approaches to how we support learners in higher education. What do we mean by flexible learning? In the broadest sense, flexible learning is about a learner-centred, rather than a teachercentred approach to learning (Palmer, 2001). In this view, technology is an enabler. However, in many discussions, flexible learning and flexible delivery are used interchangeably. The latter is increasingly associated in the minds of faculty with the adoption of multimedia and web-based technology. As a result, the most effective use of new learning technologies is held back by poor underlying pedagogical assumptions.

Flexibility can have many dimensions. Brown (1999) identifies nine dimensions of flexibility in flexible learning.

Dimension	Less flexible	➔	Moderate Flexible	➔	More Flexible
Access	fixed time/place	➔	some choice	➔	many ways
Structure	fixed	➔	core + options	➔	alternative choices
Content	fixed	➔	negotiated	➔	learning contracts
Media	face-to-face	➔	online	➔	print
Mix	one medium	➔	more than one	➔	resource based
Methods	lect /tut / prac	➔	PBL	➔	self-directed
Interaction	passive	➔	(arts) tutorials	➔	high interaction
WWW	content	➔	bulletin boards	➔	collaborative
Assessment	lecturer directed	➔	mix	➔	negotiated

Table 1. Dimensions of flexibility in flexible learning (Brown, 1999)

Any particular course might adopt a profile of flexibility across these nine dimensions. Course effectiveness does not require maximum flexibility in all dimensions. The point is to maximize effectiveness, not flexibility. It is a matter of matching degree of flexibility on each dimension to achieve the objective. It is worth noting, for example, that the most flexible media is print. This is counter to the expectations many faculty have when the topic of flexible learning, as compared with flexible delivery, is discussed. Technology is deployed as appropriate to support a required degree of flexibility, that is student control for each dimension. Table 1 provides a powerful checklist for evaluating courses and planning new ones.

There is also a spatial and temporal dimension to how courses are run. Figure 1 provides a useful framework for locating various technologies that might support flexible learning.

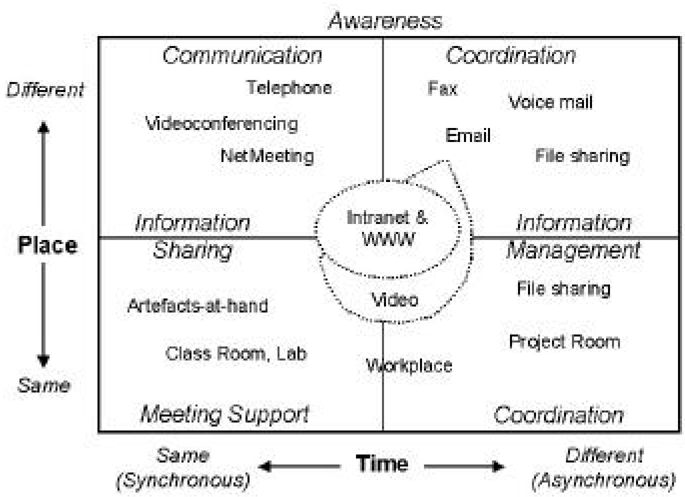

Figure 1. Enabling technologies in a spatial-temporal learning continuum

The only explicit technology in the nine dimensions is the WWW. Figure 1 shows the interaction between WWW and the access dimension, the *where* and *when* of learning. With respect to media, face-to-face can only occur in the bottom left quadrant (same time and same place), whereas online could be in all quadrants as could print. Thus, this is not a simple mapping between the dimensions of flexibility and the spatio-temporal domain. Both have to be considered simultaneously.

One of the dimensions is interaction, which can have different degrees of flexibility in the same place-same time quadrant, but equally various technologies can make possible a similar range of interactions in other parts of the continuum. The place-time continuum also illustrates that interaction can be synchronous or asynchronous. For example, remote access to notes on a web page affords interaction at a different place. Remote access can be more interactive through the use of chat rooms or teleconferencing. Remote access can also occur through emails or shared files or work products. In summary, effectiveness, flexibility and interactivity are interrelated, but not in a simple manner.

Case Study – the Undergraduate Site Learning Program

Background

During the 1990s, there was much debate about the nature of engineering education, the most significant review since the engineering science revolution transformed engineering education in the 1950's and 1960's. In the US, the outcome was a restructuring of the accreditation process for undergraduate programs. The resultant criteria developed by the Accreditation Board for Engineering and technology, ABET 2000, have caused a fundamental shift to focus accreditation on the graduate outcomes. A parallel process occurred in Australia from 1995-96 through the national Review of Engineering Education (IE Aust, 1996). The resultant report entitled *Changing the Culture* lead to a change in the accreditation of Australian engineering programs, with the focus more on outcomes with a particular emphasis on the demonstration of broader graduate attributes.

The challenge was to see if it was possible to develop a new type of program that could provide students with industry experience in a meaningful way that helped to develop the broader graduate attributes without extending the length of the program. A novel solution to this problem - the Undergraduate Site Learning Program (USLP) - has been developed over the past 2 years at the University of Queensland. The USLP integrates a full formal learning program with a work program. Thus, it is pedagogically and operationally different from co-operative education programs. The students on-site cover exactly the same syllabus as their peers who are on-campus. Assessment tasks are substantially completed while on-site through assignments. A limited number of examinations are held at the end of the semester based on lectures that the students attend while they are on campus. At present, it is limited to engineering students in their senior year. In principle, the USLP concept of integrating work placement and formal learning could be extended to other related disciplines.

This program is used as a case study to illustrate how we can see the convergence of technology and pedagogy that has implications for both work-based learning and campus-based learning. This is achieved by explicitly making the workplace a learning place with the support of appropriate ICT.

Structure and Support

In the original program, the students spent 12 weeks on-site, commencing prior to the scheduled start of semester. They returned to campus for the final four weeks of semester. This basic pattern has been tailored to suit the needs of particular engineering program requirements. Now some students go to remote sites and are off-campus for the entire 12 weeks, while others are based in the region of the University and can attend for up to one day per week, to fit in with learning activities involving their peers.

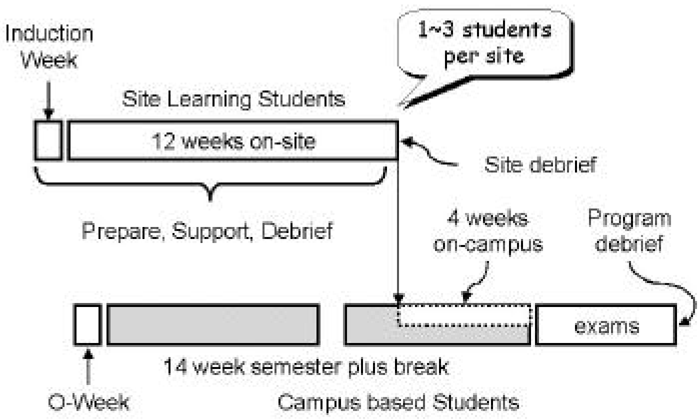

Figure 2. Structure of undergraduate site learning program

Immediately prior to the placement, the students are prepared for the work setting via a 3 or 5 day induction program involving hands-on training in lifelong learning, communication, negotiation, time management, safety, information skills and maintaining a professional log - all part of developing broader graduate attributes. They are also briefed on the courses they will be taking while on the USLP.

While on site the students work individually and in teams on a variety of learning and work activities under an industry mentor. Students undertake reading and private study, prepare assignments and make progress reports to University staff. They are supported through a combination of communications and other technologies. They have email communication and regular teleconferences and, where applicable, videoconferences. The students have the WWW on-site, even in remote mine sites. They can thus access course pages including WebCT, the library catalogue and other web-based services. Subject to firewall restrictions, they also access to the university intranet and on-line databases; dial-in access is one means of overcoming the firewall problem. They also have access to books and copies of journal articles and other print material by mail from the library and the course coordinators. Technologically, in terms of their access to university learning resources, the students on-site are no different to a practicing professional.

Technology-mediated access is complemented by face-to-face contact with the faculty during the placement either by visits to campus or through visits by faculty in the case of remote sites. The level of technological intervention used in the USLP has ranged from minimalist to sophisticated, educationally designed, multimedia. The best example of the latter was a set of course materials including web, interactive tutorials, multimedia simulations and a comprehensive study guide (Drinkwater & Schroder, 2001). At the other extreme, there were tape recorded lectures and very basic, hand written lecture notes.

Alignment of Work and Learning

One of the dilemmas of the new accreditation process is how do we develop graduate attributes without either extending the length of the program or diluting the technical content. The USLP finesses this by placing the formal learning in a professional context. Site learning provides an enriched learning environment. The goal is to enable students to achieve the same technical capability as if they were studying on campus, but to add value to this through the development of other graduate attributes. These attributes - professional and ethical responsibility, appreciation of the social, cultural and environmental context of practice, and so on. - are the sorts of abilities that cannot be acquired by attending lecture courses. Through structured exercises and a professional log, the students develop habits of independent study and reflexivity, a necessary foundation for lifelong learners. Having the site students return to campus before the end of semester ensures that the whole cohort, not just the students on placement, draw benefit from the experiences on site.

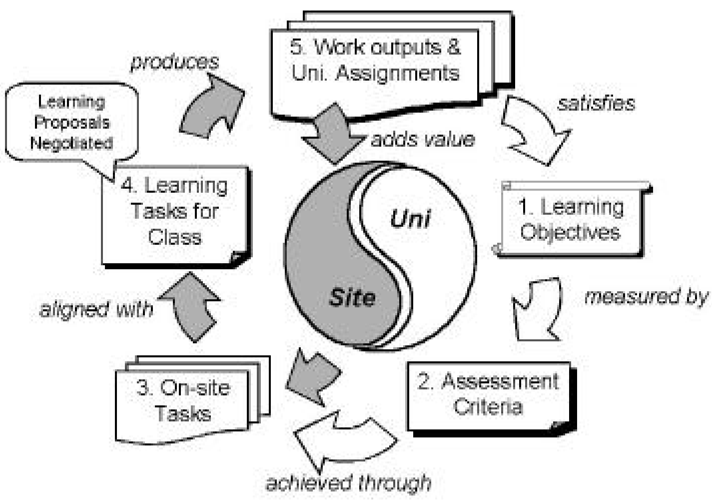

Figure 3. Aligning learning and work

The key pedagogical idea that underpins USLP is the alignment of work tasks and learning objectives as illustrated in Figure 3. In essence the workplace becomes the classroom and the work tasks are the learning tasks. Where possible students substitute the set assessment with work they are doing on-site. Students negotiate the substitution of assessment with their course coordinators using learning proposals. Thus one piece of work can (potentially) provide two deliverables - one to the site and one to the university.

A cornerstone of this alignment is the final year thesis. This represents at least one quarter of the semester load and there can be one-to-one alignment if the project is one that the company requires to be undertaken. The challenge is to achieve similar alignment in more content driven courses. This is the most difficult challenge in implementing site learning concepts. It requires academic staff to be able to provide an appropriate set of learning objectives and a corresponding set of assessment criteria and standards that are not tied to a single mode of learning.

Discussion

The USLP has demonstrated how formal leaming can be integrated into workplace environment. It provides an alternative mode of learning for students who prefer a more contextual learning environment. The USLP points to new modes of work-based learning that might increasingly be part of graduate development, continuing professional development and postgraduate programs run by the university. It illustrates how pedagogy should precede technology.

The integration of work and learning in an off-campus setting, cause the underlying pedagogical and operational assumptions of a course to be exposed in a way that typically does not happen when it is purely campus-based. The fact that some students are on-campus and some are off-campus helps to bring out the tacit assumptions that would otherwise remain hidden.

All the stakeholders – academic staff, students and industry people - operate from a set of pedagogical assumptions or a world view of the nature of learning. These are often deeply held and usually unstated/implicit. Experience on the USLP shows that it requires considerable discussion and reflection to even begin to bring these to the surface. Unless or until this is done, communication is distorted about what is being done and why. Failure to devote time to discussion and reflects leads to poorly managed expectations and subsequent problems.

Flexible learning was understood to mean student-centred learning. Flexibility in the context of learning has many dimensions – temporal, spatial, technical, social, organisational and cultural. There is no single best combination which best suits all circumstances. This was demonstrated in the wide variety of implementation across different courses.

Problems arise when the intrinsic motivations of the “students” to learn and those of the people preparing the learning program are inconsistent or the external work environment is at odds with the intrinsic motivations.

It is generally understood that learners should have input into the design of learning programs. In practice, however, ensuring that all stakeholders in the learning value chain are engaged in a timely, appropriate and consistent manner is problematic. This is essential if real ownership of the learning process is to be attained. The USLP students have a degree of control in that they can submit learning proposal based on work-based tasks, to substitute for on-campus assignments.

The investment in developing new materials and approaches based on new learning technologies can be high. Maintaining the program can be equally high, thus the whole of life cost can be considerable. A more flexible approach that considers the life cycle cost and effectiveness of the program and places emphasis on the sustainability of programs from the outset, through the agency of the learner community, should be pursued.

Conclusions

The principles of work-based design underpinning the USLP have implications for aligning work-based and campus-based leaning through technological and pedagogical convergence. These include:

- The different understandings (often tacit) of learning, training, competency and capability held by university and industry staff need to be made explicit.

- An integrated and coherent approach to the design of learning programs and the assessment of outcomes in relation to professional development in the workplace is essential.
- Meta-learning process – learning about learning – must be managed by those responsible for the development and operation of work-based and university learning programs.

The opportunities afforded by appropriate combination of technology and pedagogy to align work-based learning and campus programs are considerable. Achieving this could foster a radical shift in how we approach lifelong learning for professional engineers.

In order to realise this potential, however, more research needs to be conducted into how engineering students gain professional capabilities in class room and in work-place settings. The related question is how do various technologies actually support this learning process and the continuous development of engineering abilities, especially now the workplace is a rich ICT environment. As with other professions, the formation of engineers takes place over an extended period of time, traditionally involving formal and informal learning activities. Longitudinal studies that track this formation process and measure the acquisition of both explicit and tacit knowledge at university and in the workplace would accelerate the technological and pedagogical convergence highlighted in this case study.

Acknowledgements

I wish to acknowledge the many people who have contributed to the USLP including the students, Thiess and other placement companies and their staff, the Department of Mining, Minerals and Materials Engineering staff, the USLP coordinators in the other engineering departments, and the staff of the Catalyst Centre.

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