Formal Learning within a Community of Practice

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Abstract

The Undergraduate Site Learning Program (USLP) has pioneered the integration of technical skills and broader generic attributes in engineering graduates. With site learning, the students spend 12 weeks on-site and simultaneously engage in the same syllabus as their peers who are on-campus. The USLP benefits all stakeholders – the students (both on-campus and on-site), the staff at the placement sites and the academics at UQ. Commencing in 2000, the USLP has made 36 placements, at 21 sites (including 2 international sites) in 12 organizations and across 7 engineering disciplines. The success of this program lies with the alignment of learning objectives to work tasks.

Motivation

During the 1990s there was a sustained global 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 ABET 2000 criteria 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. This review was initiated by the Australian Council of Engineering Deans, the Academy of Technological Sciences and Engineering and the Institution of Engineers, Australia (the accrediting body) and funded by DETYA. The resultant report entitled *Changing the Culture* (IE Aust, 1996) lead to a change in the accreditation of Australian engineering programs. The focus is now more on outcomes with a particular emphasis on the demonstration of broader graduate attributes. Engineering programs are now being accredited against this new standard.

In parallel the minerals industry has been concerned with the state of education for the professionals in their sector. *Back from the Brink* (MCA, 1998), a report from the Minerals Council of Australia, observed that "graduates often have a poor understanding of how their theoretical knowledge can be applied in practice" and that "they also tend to be unaware of the importance of communication and 'people skills', how business decisions are made, occupational health and safety, demands of life in (often remote) operational settings and other significant issues facing industry". A report in May, 2001 by the Australian Institute of Minerals and Metallurgy, entitled *Rising to the challenge*, suggests that there is still much to be done to improve the education of professionals in the minerals sector.

For engineering students, the traditional means of gaining some experience of the profession prior to graduation is vacation work, usually undertaken over the summer break. There is a requirement for students to gain 60 days industry experience, in part under the direct supervision of a professional. This work is often difficult to arrange, it is subject to cyclic fluctuation in the economy, and the quality of the experience is extremely varied. Increasing numbers of students are unable to find appropriate or sufficient industry experience prior to graduation. An alternative approach is the co-operative education (co-op) model in which students spend several periods of up to 6 months in an industry placement during their studies. This extends the degree program to 5 years. The placement is not linked directly to the program of formal study. Only a limited number of engineering schools offer co-op programs in Australia.

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. The result is the Undergraduate Site Learning Program (USLP).

USLP Development

The USLP was initially conceived in late 1999. It was developed and implemented by a pioneering team of people from Thiess Pty Ltd, the School of Engineering, the Department of Mining, Minerals and Material Engineering, the Teaching and Educational Development Institute and the library of the university. The first students went on placements in Semester1, 2000.

In semester 2, 2000, we offered the USLP to six mining and mineral processing students in the second semester of their 3rd year. At the end of 2000, a day long review was conducted to capture all the lessons learned from the two initial cohorts. These findings from this thorough evaluation were used to make improvements as necessary. The decision was made to limit the program to final year students.

In 2001, the USLP expanded to include disciplines other than mining and minerals processing and companies other than Thiess. The disciplines included Civil, Chemical, Environmental, Materials, Mechanical and Software Engineering as well as Mining and Minerals Processing. The organizations included Pasminco, Comalco, GHD, Egis, Soil Surveys, Dept Main Roads, Caboolture Shire Council, Boeing Australia, Golder & Associates, DuPont and SITA as well as Thiess.

The placements were in remote mine sites throughout Australia, in city offices of engineering firms, and two were places internationally, one in the USA and one in France. To date, a total of 21 sites have been involved in the USLP. Our target for 2002 is 36 students.

The USLP received early recognition in the awarding of a Highly Commended in the Motorola Innovation in Engineering Education Award presented by the Australian Association for Engineering Education in 2000.

Concept and Description

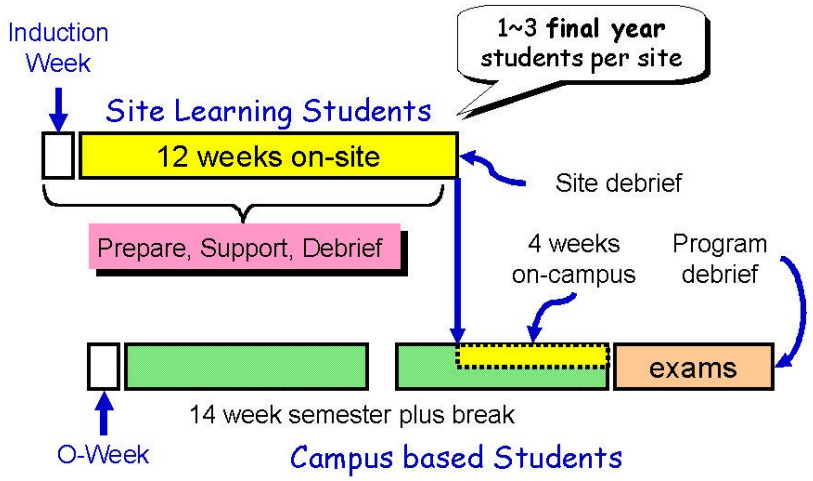
Unlike co-op education programs, site learning attempts to fully integrate a work placement into a period of study. The students on-site have a full study load and cover essentially the same

syllabus as their peers who are on-campus, but they have a different set of learning activities. Students on-site do not have lectures but are supported by access to lecture and other learning resources through a combination of paper-based and web-based delivery. As this is their final year, many of their courses are integrative and applied in nature, including an individual thesis project worth one quarter of the grade for the year.

A typical study program for the semester on-site includes thesis, professional development, one applied technical course and one other project or technical course. Each engineering discipline has a slightly different variant on this pattern. Being on-site has distinct advantages for the learner, including being able to see how theory-based content from courses in earlier years fits in professional practice. Assessment tasks are completed where possible 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.

Lave and Wenger (2000) challenge the nature of the apprenticeships, the relationships between the master, the apprentice and knowledge. They characterize the process by which learning takes place as "*legitimate peripheral participation*". They locate knowledge in the midst of participation, the learning curricula and communities of practice. The learning curriculum is composed of the "situated opportunities for the improvisational development of new practice - a set of learning resource in everyday practice viewed from the perspective of the learner". In contrast, a teaching curriculum implies more structured, instructional approach. The USLP embeds the notion of learner centred, as opposed to teacher centred, learning. The site provides a rich set of potential opportunities for legitimate peripheral participation of the students in real engineering work. This rests more or less comfortably within the formal framework of broad learning goals for the for-credit courses. The degree of synchronicity between these two apparently contradictory ideas - the learning curriculum and the teaching curriculum - depends on the degree of flexibility (and imagination) shown by the course coordinator.

Following the arguments of Lave and Wenger (2000) it would seem that to have maximum effect the students should be immersed in the placement company for the duration of the program. That is to become a member of an authentic community of practice (as much as this is possible in a limited time period).



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 local area and can attend university of up to one day per week, to fit in with learning activities involving their peers.

Prior to going on the placement, the students are prepared for site 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.

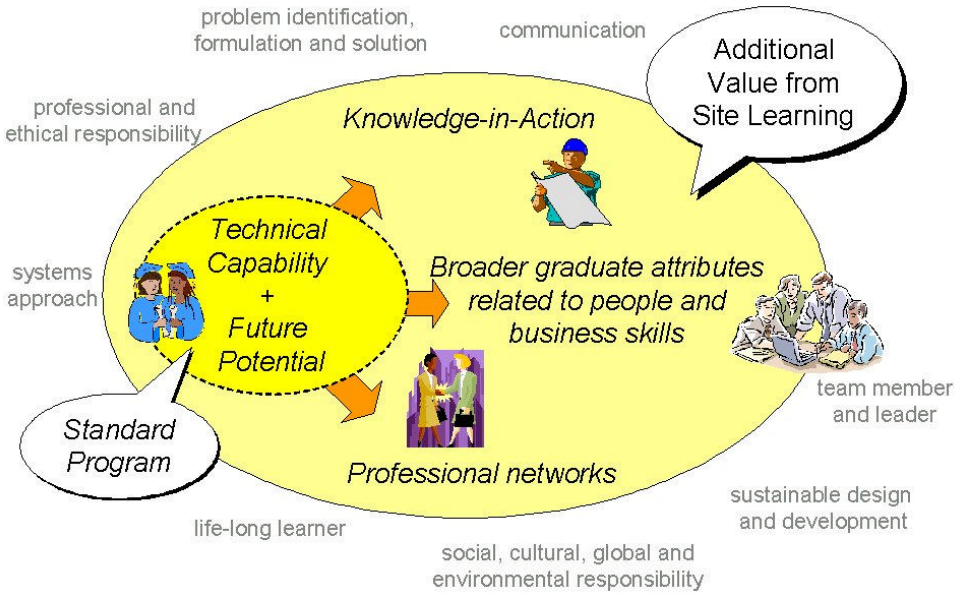
While on site the students are supported through a combination of email communication and teleconferences. They also maintain a professional log with regular submissions back to the USLP team to enable us to maintain track of their progress. Having the site students return to campus before the end of semester ensures that the whole cohort, not just the students on placement, draw benefit from the experiences on site. The site students have a portfolio workshop after returning to consolidate the transferable "soft skills" and professional attributes acquired in the placement.

The preparation, support and debrief phases now form the basis of a new course, Professional Development, which the USLP students can enroll in and thus gain academic credit for analyzing and reflecting on the professional aspects of the work in which they engage in on site.

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. Alignment between on-site work tasks and university assignments is the key, as in a later section. University staff provides learning materials and offer group tutorials by phone conference. Usually, university staff visit the students on-site during the placements, including the remote site. Students receive a performance evaluation from site staff upon completion. There is an on-site debrief involving the student, site personnel and university staff. In some instances, for remote sites, these debriefs are conducted using videoconference facilities.

Enriched 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 - professionally and ethically responsible, appreciation of the social, cultural and environmental context of practice, etc. - are the sorts of abilities that cannot be acquired by attending a lecture course. The students develop important industry contacts. Through structured exercises they develop habits of independent study and reflexivity, a necessary foundation for lifelong learners.



Win-Win-Win

An important tenant of the USLP is to achieve a win-win-win for all the stakeholders - the students, the site staff (and the company) and the university.

The benefits for the students include a USLP scholarship, an industry based thesis project and the placement counts towards the professional work experience requirement of the degree. They experience a professional working environment including working with people from different backgrounds and discipline areas. The students see the more subtle facets of management and professional practice in context. Students learn about their personal and professional strengths and areas for improvement. Some students report that not having lectures is an additional bonus.

The sites benefit from work done by the students, especially in the form of projects. Site staff gain access to the student's learning materials, contribute to their education and gain exposure to UQ staff, facilities and capabilities. A number of sites have commented on the fundamental difference between vacation work and USLP. USLP provides a more authentic experience for the student and, conversely, to the company who have a more realistic view of the student and their performance as a potential employee.

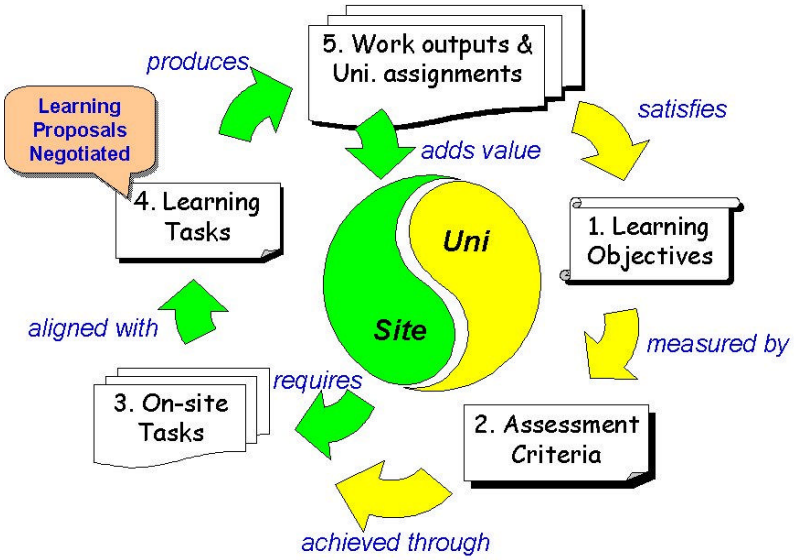
The university gains by having closer access to industry. The relationship development and co-ordination which is necessarily part of USLP, means that staff can see contemporary issues of professional practice up close. Students on the program provide valuable critiques of the university course and programs. The USLP also demands a more disciplined implementation of criteria referenced assessment and a more student centred approach to teaching and learning.

Alignment of Work and Learning

The key pedagogical idea that underpins USLP is alignment of work tasks and learning objectives. This idea turns on a shift to a learner-centered approach. This is the most difficult challenge in implementing the site learning concept. 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.

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 co-coordinators using learning proposals. Thus one piece of work can (potentially) provide two deliverables - one to the site and one to the university.



This alignment is exemplarfied in the thesis and the professional development courses. Together these account for 50% of the semester load and there can be one-to-one alignment since the thesis project is one that the placement company proposes. It is usually possible to get good alignment with at least one of the other two courses. Thus a total of 75% of the study program usually aligns well. Even if the final course does not have a direct link to the placement site, by being in a engineering setting the student can see where it fits into professional work.

Student Selection

USLP is not for every student - rather it provides an alternative mode of learning for students who prefer to be more independent and have a sense of adventure. Thus USLP adds diversity to teaching and learning modes available to the students. It could never be a compulsory program.

Students approaching the end for their penultimate year are invited to apply to go on the USLP. They complete an application form and those who are short listed are interviewed by a panel of university staff. The objective of the interview is to judge if the student is capable of the degree of self-management required to go on the program. Students have to micro manage their work and study while on site. This requires them to demonstrate a degree of initiative, self-confidence and communication skills. Their grade point average, while important, is a secondary factor. We have had students complete the USLP successfully with GPAs that range from the low 4s up to the mid 6s out of a possible 7.

Once the potential students have been selected, we firm up on the placements, to match the mutual needs of the students and the placement company. Students who are judged to be capable of handling the program then have an interview with the placement company to assess their fit with the company. If successful, the details of the placement are confirmed.

Lessons Learned

The development of this innovative approach has thrown up a number of issues that have had to be managed carefully. Some of these are a consequence of the expansion from a small pilot with relatively few parties involved to a scheme that encompasses most disciplines in the engineering school and organizations offering placements. Some of these issues arise as a consequence of different perceptions and personalities involved in the scheme ranging from the students, to the various personnel on site and the different faculty members involved.

When we had 3rd year, rather than final year, students on the program it was less successful. One of the reasons for this was that the 3rd year courses are more analytical and content rich whereas the final year courses were more project and practice based. In addition, the students were less mature and had had less exposure to professional practice than the final year students.

One of the keys to success is how well the various relationships involved are managed. These include the following relationships:- student-site mentor, student–course coordinator(s), student–USLP administration, site mentor-USLP administration, site-mentor-company liaison, and course coordinators-USLP administration. Additional relationships exist between the different course coordinators and the overall coordination of the site learning including overall relationships with the placement hosts.

Strategies that work in helping to manage these relationships include maintaining regular contact with students using different media as appropriate - email, phone, teleconferences and face-to-face meetings (where possible). Capturing these communications to ensure actions are followed up and that understandings are common can prove difficult. In most courses, students seek timely and instructive feedback on their progress. In the case of the USLP, feedback is especially important due to the students being remote from campus and corresponding feelings of being disconnected from the formal and informal channels of communication. They require feedback not only on their formal work but also in how they are going in the program generally.

End of semester course evaluations by students do not always elicit candid, instructive or constructive feedback to course coordinators. In particular, students seldom take the time to provide written feedback on standard evaluation instruments. Typically they "tick and flick" the quantitative part of the form and ignore the part for comments. To overcome some of these problems in the USLP we have experimented with informal on-site debriefs involving company staff and students and subsequent focus groups (run by a neutral party). This has provided a richer picture of what the students experience on the program. These were complemented by the weekly reflexive reports by students.

The sites must be prepared to receive the student. This may include visits to site by the USLP coordinator and other faculty to appreciate the context of the work placement. This is especially so in the case of remote sites (e.g. mines) that may have problematic computer or communication facilities. The most difficult aspect of preparing the host organization is providing an adequate

briefing for all the people concerned. Often in the initial negotiations, when an organization is buying into the USLP, senior staff in the head office are given an extensive briefing. Prior to the placement, the mentors are provided with information on their role and a briefing session, although few take it up.

A common problem is that of poor communication between the people in the placement organization who make the initial decision to participate in the program and the people on the site, including the mentor, who host the student. Ownership based on understanding needs to be obtained at all levels in the placement organization. This demands clear lines of responsibility and communication to be established within the company so that all concerned understand what is expected of them and of the student and the university. With the inevitable movement of staff within and between organizations, information and understanding gets lost over time, even with the most meticulous systems.

Faculty members also need to be fully briefed and prepared on how the USLP will impact on them. While the direct impact is designed to be as small as possible, the program requires a level of flexibility and transparency of processes that can cause fiercely independent faculty some concerns. It does require an initial investment on the part of the course coordinators but this is repaid if the developments (e.g. revised learning resources) are applied to both the on-campus and on-site students. At a fundamental level, the course fits most easily into the USLP when flexible learning practices are used. This equates to adoption of a student centred learning approach. At first this can be confronting for faculty members whose self-image is heavily dependent on the delivery centric approach to their teaching - *I lecture, therefore I am*.

For the Program to be sustainable in the long term a number of conditions should ideally be met. These include the following;

- Faculty members should approach it as an alternative (to traditional teaching) not an additional impost.
- There needs to be redundant communication channels between all the stakeholders.
- Coordination is the key - keeping everyone on the same page.
- The program must be in tune with the temporal, spatial, and operational rhythms of both the academic and the business years.
- Tasks must be devolved across a network of players each with an appropriate level of autonomy and corresponding accountability. This demands trust and commitment.
- Contingencies are a fact of life. This risk must be managed through flexible yet robust coping mechanisms.
- The program must be in a continuous state of improvement based on authentic feedback.
- Faculty and the university must be prepared to continuously challenging teaching practices and the assumptions on which they are based.

Future

The USLP has demonstrated how formal learning 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 which might increasingly be part of CPD and postgraduate programs run by the university.

It was never envisaged that USLP alone would provide the means to develop all the graduate attributes. Rather it points to the need to have a coherent program of experiences throughout the undergraduate program which actively and purposefully develop desirable graduate attributes. These experiences might include such elements as team projects, field trips, guest lectures, and experiential laboratories. The USLP is then a capstone experience.

Equally the form of site learning can be broadened to include study abroad or exchange programs, internships in research laboratories (especially for student considering a research career). Industry sites are then but one of a variety of types of site. Thus we move closer to a model of education where the students can make some decisions as to the form of a more tailored program of study including the context of learning.

Acknowledgement

I wish to acknowledge the many people who have made the USLP a success. In particular I recognize the inspiration for this program which came from Martin Abrecht of Thiess, the pioneering efforts of the staff in the Mining, Minerals and Materials Engineering Department, the efforts of the USLP coordinators in the other engineering departments who have made the roll out of the program possible, the unwavering efforts of the staff of the Catalyst Centre, the site staff who have hosted and mentored the students and the commitment of the companies to this new program and most importantly the sense of adventure shown by the students who have been co-pioneers in the development of the USLP.

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