ABSTRACT

This paper initially looks at the reasons for the current interest in ePortfolios across the educational sector from the recording of assignments to a more sophisticated use for continuing professional development. The second part of the paper looks at the ePortfolio developed and adopted by the University, in 2005, working in partnership with a small business, and the various ways it can be used to enhance personal and professional development. It then highlights engineering staff views about the way in which the ePortfolio can be incorporated into the engineering curriculum. They suggest the greatest benefits are through the assessment strategy and that there is most benefit in using the ePortfolio on work based modules or modules for professional development. The paper then presents the views of a survey conducted with students and staff of the ePortfolio for their studies. In the light of the results, the final section presents the implementation plans of the School of Engineering to use the ePortfolio for the assessment aspects of a postgraduate polymer-engineering programme.

BACKGROUND

It is widely acknowledged, that the primary role of HE is to train students by enhancing their knowledge, skills, attitudes and abilities and to empower them as lifelong critical and reflective learners. Combining this with the recognised fact that graduates need to market themselves, has led to the widespread recommendation of personal development planning (PDP) by Dearing(1), Burgess(2) and QAA(3). The primary objective of a PDP is to improve the capacity of individuals to understand how they learn, and to help them review, plan and take responsibility for their own learning.

Engineering students need to be able to reflect on their achievements and present this evidence to an employer and, later in their careers, to the professional institutions. They also need to be aware that these skills are being developed through the curriculum in order to apply them, Yorke(4). These personal and professional requirements need to use a portfolio. Traditionally that has been in paper form but the benefits of using ePortfolios are being widely discussed across the whole of the educational sector. The next section looks at some of the reasons for the current interest in ePortfolios and the advantages over their paper based forms.

THE USES AND BENEFITS OF EPORTFOLIOS

A portfolio of any form is simply an organised collection of work. Engineering students and professionals have built portfolios for decades to present design work and reflect on the process during developments as well as when submitting to be considered for Chartered Engineer status. Three current trends that make e-portfolios particular attractive are that:

- Students’ work is now mostly in electronic form,
- Most students have access to the Web.
- Databases are available through Web sites, allowing students to manage large volumes of their work, Batson(5).

EPortfolios have been criticised for focusing on just one element of PDP, that is recording and presenting achievements. Some are simply a product rather than a support structure for engaging in the all important processes outlined in the previous section. Used effectively, they do offer opportunities for collaboration, regular feedback, reflection and ultimately presentation to an employer or professional body. The greater convenience,
in terms of portability of an electronic system over paper bulk and the opportunity for increased formative feedback from staff and peers along with an ability to add live clips by video has seen a tremendous surge of interest in ePortfolios, especially amongst the HE community.

Most ePortfolio systems have been developed in North America where the educational ethos is qualitatively different to the UK. American-based ePortfolio systems include those by Chalk and Wire(6); Nuventive(7); ePortaro(8) and the open-source product OSPI(9).

Those developed in the UK tend to have been produced for specific groups of students undertaking well-defined programmes of study particularly in medicine-related areas ePET(10). Recent developments have also seen the entry of learner management system (LMS) vendors e.g. Blackboard(11), into the ePortfolio arena offering bolt-on systems. These seem to be finding favour with some institutions if only because they may ease the implementation phase due to staff already being familiar with the common elements of the system.

A survey of these commercial systems and ePortfolio products concluded that there was no suitable ‘off the shelf’ software package that could support personal development planning in the reflective and development way desired by the University or employers. As a result in April 2004 the University went into partnership with Pebble Learning to develop a pedagogically informed product. PebblePAD (12) resulted, the opening screen of which is shown in figure 1.

The system developed at the University of Wolverhampton by Pebble Learning (2005), Pebble Pad, has been designed to be generic – an institutional necessity with 10 schools, 200 subjects and a diverse student body of 22,000. The system provides 6 structured entry forms designed to accommodate the recording of a range of skills, experiences and reflections typical of most learning experiences. Additionally students can store a wide range of external file types in the system. Records and files within the ePortfolio can be easily aggregated into complex WebFolios (personalised websites) and can be shared with others using user-defined permissions to facilitate the gathering of feedback or assessment.

Following a University wide implementation and evaluation, Halstead et al(13). PebblePAD has been adopted across the University by staff and students. The next section looks at the potential opportunities for the implementation of the ePortfolio within Engineering programmes, before going on to examine the advantages and disadvantages from the staff and student perspective. Finally the paper highlights the plans of the Engineering department.

STAFF VIEWS ON IMPLEMENTATION

For the ePortfolio to be successfully implemented, engineering staff felt that there were three potential areas within the engineering programmes that would lend themselves to this type of development offering real benefits to students. The areas identified were:

- Modules that already had well developed reflective practices
- Work based project modules and
- Professional training modules.

All staff felt that it must be incorporated within the assessment criteria within the modules. Where it is to be used, both staff and students need to be introduced to the ePortfolio at the start and the benefits for the development of their professional practice clearly articulated. Staff were concerned that the ePortfolio might be difficult to use and that it might discourage rather than encourage students to focus on their professional development. The next section reviews the response of staff and students within the University to the use of the ePortfolio.

STAFF AND STUDENT VIEWS

Staff and student views were obtained using an on-line questionnaire, focus and individual interviews.
On-line questionnaire

The questionnaire published and developed in Surveyor(15), consisted of 66 questions that explored the students' previous experience of such products, the ease of use, their views of the functionality and the benefits. Fifty users responded. There was general agreement that the ePortfolio was advantageous in being:

- easy to navigate and input existing achievements and evidence
- useful for reflection; identifying strengths and weaknesses; identifying transferable skills; target setting; and supporting professional and personal development
- helpful in presenting themselves to employers

The students felt that they

- Needed more face-face support from staff to get the most out of it
- Needed examples of webfolio to optimise their chances of gaining successful employment.

Staff perspectives from focus group discussions

All staff agreed that the interface was attractive and inviting to use. They had similar experiences to the students in that they found it easy to use and share information. They thought that the sample webfolio gave a good example of the final product. They liked the potential for encouraging students to organise reflective practice with the added potential for collaborative sharing and learning. It was less bulky than the current paper based versions and could be easily tailored to professional development making the process more relevant.

The main disadvantage from the staff perspective was the time to up-skill and, as students, they would have liked more one-to-one help.

Student perspectives from focus group discussions

All students considered that the interface was attractive, engaging, easy to navigate (even for technophobes), very professional and addictive.
One student had used an ePortfolio within Blackboard that had no interaction and had simply not been able to use it. Against that experience she reported that it was easy to use, very collaborative and had helped her to become a confident technology user.

The group sharing was seen as a major success, and an activity that could not be achieved with paper. This provided a strong bonding activity for the group, the initial tutor-led tutor support changed to student support over the programme.

Over 50% of the students involved said that they would continue to use the ePortfolio for personal and professional development without a tutor whilst the remaining students felt they would need the added motivation that a tutor provides.

In terms of additional support, the majority of the students confirmed in the on-line feedback that they could have been helped by

- More examples of WebFolios
- extra guidance from staff
- general one to one technical support

PLANS FOR THE FUTURE
IMPLEMENTATION OF EPORTFOLIO

The positive feedback from staff and students as well as the significant advantages of using the tool to prepare a professional portfolio, has resulted in the School of Engineering deciding to utilise it within a postgraduate module in Polymer Engineering. The module delivered by staff at Rapra Technology (A UK specialist in plastics and rubbers) in partnership with staff at the University, is for mature students in full-time employment within the plastics and rubber industry. The course is delivered with residential periods at RAPRA and the students participating in coursework back in their companies. It is the guidance, formative feedback and assessment of this work that gains the students the qualifications that is intended to complete through the ePortfolio.

The pilot scheme will

- develop templates within the ePortfolio to enable the engineering students to progress through the assignments with timely feedback from staff.
- to provide the staff and students with the technical skills necessary to be able to use the ePortfolio and see the benefits for their CPD
- assess the benefits of using the tool to enhance the individuals professional and personal development within an assessment context.
- explore and evaluate the experience of the staff and students
- reflect on the appropriateness of the tool to provide innovative assessment in a work-based environment.

The outcomes of this implementation will be the subject of a forthcoming publication(14).

DISCUSSION

This paper has introduced a new ePortfolio, PebblePAD, that has been developed with the end-user in mind and to assist students and professionals in presenting their qualities and achievements to an external audience by means of a webfolio. Staff and students views are clear that the product is easy to use and supports collaboration with others and good communication with the tutor. The survey of staff and student views has indicated that the use needs to be embedded within the curriculum and the staff see that it has to be embedded with the assessment strategy. If it is to be implemented successfully the benefits of use must be clear to both staff and students and there needs to be a high level of hands-on support at the beginning of the training.

To obtain the maximum benefit from such software, the engineering staff have selected a part-time postgraduate course run in a work-based setting. These participants will be engineers who are continuing their professional development. The ePortfolio will be used to provide guidance on assignments and assessment criteria as well as examples of webfolio used in this way. The participants will be able to obtain formative feedback through the ePortfolio by sharing their work with colleagues and tutors. In addition the final assessment of this work will be through the presentation of a webfolio. The webfolio will be able to be interrogated at various levels to
enable the tutor to examine the development process that the student engaged in whilst developing the final webfolio.

CONCLUSION

This paper has captured some of the HE sector excitement around the introduction and use of ePortfolios.

It has established that both and staff and students are clear about the benefits of the PebblePAD ePortfolio in terms of the ease of its use, its pedagogical strength of collaboration with colleagues and ability to encourage reflection.

The advantages of such an ePortfolio is that students are able to get rapid formative feedback during the development stage of the work, from both tutors and colleagues.

The ePortfolio stores the assessment guideline and offers a powerful presentation tool for potential employers or professional bodies via the webfolio.

Engineering staff involved with this work see opportunities for the development of professional portfolios and deployment and postgraduate level.

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PROFESSIONAL STUDIES FOR ENGINEERING STUDENTS:
AN INNOVATIVE PROGRAMME

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ABSTRACT

Professional Studies is a programme in the University of Bristol Engineering Management Group, which has been innovatively structured around the latest requirements of the Engineering Council for professional accreditation.

This paper explains our experiences in designing this important programme which is delivered by a blend of external experienced engineers and academic staff and is supported by its own Handbook and Blackboard site. The integrative approach adopted for teaching, learning and assessment provides an excellent environment for our students to practice and develop a set of additional skills, which are widely recognised as key to successful employment and career development. For example, the new design enabled setting team tasks, which lead to expansion of the subject through collaborative learning and research. Through this process, it is expected to build a bank of new case studies for future courses on a rolling year on year basis and to allow the ‘whole class team’ to contribute to the continuous improvement of this programme.

INTRODUCTION

Industry Needs

The trend of engineering companies toward more project-oriented work and greater complexity and pace required for ever more effective innovation and competitive added value, means there is an increasing need for professionals who blend sound technical knowledge with strong management and business capabilities. The Canadian Society for Engineering Management found that ‘almost half of all engineers enter a management position within 10 years of graduation.

Half of all registered professional engineers primarily utilise management skills rather than technical skills’.

Professional Studies Programme

Professional Studies (PS) is a cross-faculty programme that complements the technical tools of engineering with the knowledge and skills of business and management. It bridges the gap between engineering and management to enable graduates to work with and through people to get things done with a high professional standard. This is a fundamental element of all undergraduate Engineering programmes at the University of Bristol. It is taken by about eight hundred students each year. The PS course is designed to provide the generic professional knowledge and awareness required to meet the accreditation criteria of relevant professional institutions. It is structured around the 5 principle Learning Outcomes specified in the latest professional accreditation guidelines issued by the Engineering Council(1) covering the following topic groups:

- Commercial and Economic
- Management Techniques
- Sustainable Development
- Legal Framework & Health and Safety
- Professional and Ethical Conduct

In addition to enabling professional accreditation, the PS programme aims to stimulate the acquisition of knowledge and skills in topics which are complementary to technical disciplines and recognised as professional success factors. It also aims to introduce visionary goals for the role and value of engineering in society and to act as a forum for meeting with and hearing from experienced academics and visiting professionals.

Professional Studies is a set of two complementary modules, PS-A and PS-B. PS-A
mainly addresses learning outcomes related to the commercial, economic and management context of engineering processes in addition to introducing the principles of health and safety. This module is aimed at providing an insight into the professional engineer’s personal, organisational and health and safety roles and responsibilities. PS-B builds upon all the PS-A topics and addresses the interrelationship between engineering processes and the wider context within which they operate, including sustainability, commercial drivers, legal framework, health, safety & environment and professional and ethical issues. Appendix 1 shows the mapping of PS contents into the 5 principle Learning Outcomes specified by the Engineering Council (UK). Each PS unit has a detailed Handbook and a Blackboard site. The Handbook is used to communicate clearly the theme, the contents and the learning objectives of each lecture. It also explains the assessment process and provides copies of standard assessment criteria and submission forms and instructions.

The following section outlines how the learning objectives have been translated into the design of the PS Units.

IDENTIFICATION OF LEARNING OBJECTIVES

Employability is a concept that is still gaining more and more attention from government and higher education institutions. Often, it is the ability to communicate and to manage time and work which mark out the graduate who is preferred for employment. The Engineering discipline is a foundation for a rewarding career and adding value in many job roles and in many types of industry. However, success in employment and career development depends as much on well recognised transferable skills as it does on the chosen Engineering discipline. The skills that are on the top of the wish list of most engineering employers, as found by Wearne(2), Leiper and Khan(3), Race and Brown(4), include:

- Leadership and the management of projects
- Teamwork and working with others
- Managing resources and time
- Written and oral communication
- Analytical thinking, problem solving and decision making
- Commitment to life-long learning and continuing professional development
- Critical assessment and evaluation

Therefore, the design of the Professional Studies programme has a prime mission to introduce and develop these PLUS (and highly transferable) attributes and knowledge. It would be pointless to attempt to learn these skills as a set of formal procedures which can be reproduced for examination, as success only comes through interpersonal active learning and practice. To this end, the programme’s structure, delivery and assessment methods are devised to be a vehicle to develop and practice these skills, which form part of the principal overall learning objectives of the PS units. The detailed learning objectives of individual lectures are outlined in the unit Handbook.

TEACHING AND LEARNING METHODS

Integrated Teaching, Learning and Assessment

Designing a course unit should be a well-planned process to carefully craft effective learning opportunities for students. The traditional approach of producing a list of selected topics is no longer acceptable. An informed and well integrated unit design is a key success factor in today’s education. Innovative approaches in teaching, learning and assessment and the introduction of new technical resources has made it possible to deal with the complex issues and to develop the design, implementation and evaluation of an improved PS programme.

For students to be at the heart of the educational process, their needs and requirements should receive more attention. ‘Increasing student involvement in group work, project work, oral presentations and task and problem-based learning all contribute to turning the essential focus onto the student learning process’, Taras(5). Large class size is increasingly less accepted as an excuse for not adopting such effective approaches.
Research shows how selecting appropriate teaching strategies can overcome difficulties derived from large classes, Gibbs and Lucas(6).

Team Work

Team coursework has been introduced to enable team interactive and cooperative learning. Without recognising and employing the great potential of students in the learning process, it would be impossible to create any viable dialogue and interaction in large classes. Introducing team work and peer assessment have helped to create a lively, diverse and opportunity-rich learning environment for students. Through group coursework, important skills can be developed and practiced such as communication, teamwork and leadership. It enables sharing knowledge and provides a medium for discussion which is otherwise very limited in the lectures due to the large class size (395 students this year). It has also had the benefit of reducing the marking load by half so that it is no longer required to mark 395 individual hand-written exam scripts.

Considering the large number of teams (over 80 for each unit), it became essential to delegate some responsibilities to students which was also intended to create a sense of ownership. Unfortunately, forming interdisciplinary teams was not possible due to timetabling restrictions. Teams are encouraged to agree some ground rules to help them in completing the team coursework successfully. Examples of team rules agreed by students from 2004-05 include:

- ‘Motivate each other to get things done on time’
- ‘Contribute our individual strengths in order to meet deadlines and have a successful team’
- ‘Only offer constructive criticism’
- ‘Rotate team leadership among the group for each assignment’
- ‘Have fun’.

Teams also negotiate scores to reflect individual contributions in the team assignment and these are submitted with each assignment to set individual marks.

ASSESSMENT METHODOLOGY

Topic Assessment

To meet the intended learning outcomes and reinforce the teaching and learning methods adopted for the PS units, the assessment process is divided into two parts; a ‘formative’ developmental team coursework and a final individual exam. For example, the assessment methodology adopted for PS-A, which is illustrated in figure 1, is carried out through group coursework (60%) and a one-hour final exam designed for computer marking (40%).

The coursework element consists of a pre-unit assignment and a second main assignment that should be completed in parallel with the unit’s lectures.

The pre-unit assignment is organised in two main sections. In the first section, teams investigate and reflect upon the necessary skills an engineer needs for a successful career upon graduation and what can be done while studying at the university to acquire and develop these skills. This is to appreciate the importance of developing generic transferable skills alongside sound technical competencies.

In the second section, each team is asked to write a short imaginary story, a news article or a poem or produce a short film about the challenges facing engineers in early years of their career. This is intended to promote deep reflection, which helps to develop a better understanding of real working environments. Improving report-writing skills is also at the heart of this process in addition to encouraging creativity. This exercise produced some
entertaining and highly perceptive contributions, which demonstrated the creative talents and engagement of students in the subject. Selected poems and stories will be published annually on the unit website to further promote sharing knowledge and encourage collective learning.

In the second assignment, teams are asked to prepare an audit of a successful engineering company in relation to topics covered in the lectures. This is intended to achieve a number of personal learning and PS course benefits:

- Active application of the PS topics.
- Scope to research new material which extends the subject.
- The opportunity to create added value, for example by revealing new examples, developing and proposing new philosophies/methodologies or recommending new solutions.
- The completed reports are also intended to provide new Case Study material for future PS and Engineering courses, thus enabling students to contribute real value to future students and teachers on a rolling year on year basis.
- It is expected that students will engage with professional practice in a way which will positively contribute to success with job interviews and career development.
- Students will also learn a lot about their subject company (its mission, structure, culture and policies, current business challenges, management practices, areas of professional excellence and opportunities for improvement). The topic works across an important axis which many companies have insufficient time and resources to focus on, and therefore has the potential to add genuine value for the company.

By promoting deeper reflection of the teaching and further research of a real situation this assignment provides an opportunity to improve essential skills such as project management, problem solving, teamwork and time management.

Assignments are submitted electronically and scanned using plagiarism software. For each assignment, teams provide their own assessment of individual contributions. This is used to set individual marks within each team. Figure 2 illustrates the flow of the newly introduced assessment process based on the coursework element of the PS-A unit.

Peer marking

Anonymous peer marking is used to add further learning elements, such as encouraging students’ autonomy, critical evaluation and higher order thinking skills. It aims to improve the quality of learning, to empower learners and the sharing of knowledge between groups. Also by posting selected assignments on the unit’s Blackboard site, a further objective of collaborative learning for the whole class is achieved. By assessing the work of others, students gain insight into their own performance, Brown et al.(7). Peer marking also promotes a degree of useful competition between students.

Comparing group peer marks with staff marks
showed no considerable deviation as shown in figure 3. A simple statistical analysis (PEARSON) resulted in a Correlation Coefficient of 72%, indicating a strong relationship between academic staff and students’ marks.

It encourages students to take responsibility for their own learning and gives them a sense of ownership which helps to improve motivation, Race(8) and Race and Brown(9).

As the unit coursework accounts for the soft nature of the topics covered, the final exam (40% of unit mark) is based on Multiple-Choice Questions designed for electronic marking by the Optical Mark Reader. Where possible, multiple options with various degrees of appropriate answer are provided for each question and students are asked to choose the best available answer.

CONCLUSIONS

As can be seen from the previous section, the assessment process is designed to be an integral part of the learning process rather than a separate activity conducted a few months after the completion of the unit with little added value to students. Student feedback showed very clearly that the new design has improved their interest in the PS programme, which has been traditionally considered as an ‘extra’ element compared to other ‘essential’ technical units. Beside other changes, peer marking has proved very useful in sharing knowledge and stimulating more interest in the PS programme. Students started to make comments such as ‘I am in the process of applying for jobs, and Professional Studies is the most useful subject we study to help provide intelligent answers to questions they ask. The majority of people on our course will at some point have to manage a project in their careers, so I feel that this is an essential part of our degree, in order to give us marketable skills’. However, some students did not like the standard marking scheme and, being engineers, have made suggestions on how to make it more specific. Looking ahead, we are assessing the benefits of more integration between the PS programme and Personal Development Planning (PDP). In preparation for this, the current PS-A class has already been asked to provide its views on the benefits of PDP and how this might be implemented as part of the course.

REFERENCES

Appendix 1: PS curriculum mapping (2005–06)
INTRODUCTION

Few would dispute that the profession of engineering plays critical roles in building stable nations and the global knowledge economy through design, implementation and maintenance of physical and communications infrastructure, and through the creation of manufactured products and services. The present global demand for engineers and the need for good engineering remains high in order to provide systems through which more of the world’s population will enjoy good health and prosperity, as we tackle issues arising from climate change, security and potential pandemics. This positivist view is supported by recent statements on the critical importance of science and innovation by political leaders from India and China, as well as industrialised nations. For example, the Australian Federal Minister of Education Bishop recently declared that ‘the prosperity of Australia depends on education, on science and innovation and on building and maintaining a world class skills base’(1). More specifically, meeting 14 of the 79 key targets South Australian government’s Strategic Plan(2) will require engineering effort. These targets aim to secure long-term environmental, social and economic sustainability. Community and business leaders clearly envisage that engineers will design and implement new technologies that will contribute to environmentally sustainable development, and be creative in delivering new products, systems and services.

Despite the opportunities for engineers there has been a steady decline in the numbers of Australian school leavers (and especially women) opting for engineering study and subsequent careers. There is thus widespread concern about current and future skills shortages in many technical areas. The Australian government is undertaking an audit of skills formation in science, engineering and technology, DEST (3). One recent survey of professional engineering shortages indicated a 21% vacancy rate(4), approximately vacant 20,000 positions nationally.

Engineering faculties are expected to address such shortages and increase enrolments into their programs. There are some critical questions to answer if we are to succeed, including: do our faculties provide good curricula for future needs and teach them well; do we successfully communicate the diversity of engineering to all prospective students? This paper first discusses the evolving diversity of engineering. Data on the decline of science study at school and subsequent undergraduate choices is provided as a prelude to discussing how the University of South Australia (UniSA) is engaging intensively with school students and their teachers to improve communication of the nature and importance of engineering. Subsequent sections discuss improvements to engineering curriculum and teaching that are strongly informed by student perceptions and other stakeholder data.

ENGINEERING DIVERSITY

Manifestly, professional engineering has great diversity in its branches and sub-branches. Engineers Australia, the professional accrediting body, lists more than 110 different degree names for accredited programs at Australian universities. In their practice, engineers undertake a very wide range of tasks, from research and design to executive management of engineering enterprises. These two dimensions of diversity are attractive features to many engineering practitioners. But our experience is that their extent and complexity also contributes to the problems of attracting contemporary students simply because they take time to explain.

New engineering branches and sub-branches in areas such as software, bio-medical, environmental, mechatronics, photonics and
nanotechnology have evolved from good science, innovation and application being systematised as distinct and functional bodies of knowledge and practice. Most of the new areas are inter- or multi-disciplinary, requiring curricula built on new combinations of underpinning science and mathematics.

The overwhelming success of engineering has been to encapsulate relevant knowledge into reliable and available tools, materials, sub-systems and processes so that most engineering problems do not have to be 'solved from first principles' or with totally raw materials. The quality control of modern manufacturing systems ensures highly reliable and robust products. These outcomes of modern engineering contribute inter alia to changes in professional engineering practice. Kline's profound ideas on systems thinking and multidisciplinarity(5) are becoming more important in tackling multi-dimensional complex problems.

Many engineers have enthusiastically adopted principles of environmentally sustainable development into engineering practice and curricula, many following the progressive ideas of Hawken, Lovins and Lovins(6). Young engineering leaders are setting good examples to their peers. For example, Hargroves and Smith(7) have recently produced a comprehensive collection of papers for engineers and others subtitled 'business opportunities, innovation and governance' that is being used in several engineering faculties, including that at UniSA.

Engineering is about solving new problems, and is therefore intrinsically creative. Cropley and Cropley(8) have defined this as ‘functional creativity’ linked intrinsically to purpose and using systems and divergent thinking. Furthermore, Florida(9) has identified the ‘creative class’ as the key driver of modern economies, with ‘technology’ as developed by graduate scientists, engineers and information technologists as the key class members. (The South Australian government has followed Florida’s ideas in its Strategic Plan). But engineering is not perceived by prospective students to be as ‘creative’ as architecture, music performance or journalism, King(10). Stressing and developing creativity in engineering curricula may well contribute to redressing student enrolment trends away from engineering, since creativity is a prominent element of modern youth culture.

PROSPECTIVE STUDENTS AND ENROLMENT TRENDS

Most secondary school students have limited knowledge about engineering and its practice unless they have family knowledge or specific exposure. Many know that engineering studies are known to be hard and longer than generic science or business degrees. The also know from stated pre-requisite study requirements that the closest school subject matches are mathematics, physics and chemistry. In Australia, these subjects are increasing unpopular. Between 1992 and 2002, school physics and chemistry enrolments both dropped by approximately 24% while total Year 12 subject enrolments rose by approximately 20%, Dobson(11). These downward trends are nationwide, and have continued since 2002. In South Australia they contribute to approximately 15% fewer school leavers applying to university for science and engineering programs between 2002 and 2006. The Australian school education sector is engaged in many studies and initiatives to examine and redress these trends.

The distribution of first-degree university places between disciplines and programs in Australia is driven mostly by student demand to local universities. Application data show clearly that mathematics, physical sciences, engineering and information technology are losing ground to biological sciences, psychology, health sciences, education, arts (especially communications and media), architecture and creative arts. The shift shows two trends: one to direct human services, the other to areas of expressive creativity. Such application preference data is primary evidence; but we lack detailed quantitative analysis of the reasons for the trends, especially from students who have not chosen engineering.

Teachers, parents and peers are known to be major influencers on prospective students’ preferences. Contributing factors to the decline of engineering preferences frequently cited amongst the community include:
• few secondary school teachers have engineering qualifications or direct contact with engineers;
• science and mathematics are poorly taught within schools, partly because their teachers are not familiar with contemporary applications of these subjects;
• the engineering and information technology industries are cyclical and may not provide reliable (local) employment;
• engineering and science are highly specialised and are continually changing, and it is safer to choose a less dynamic area; much engineering work is undertaken in remote sites and in situations that are unsuitable for women.

The trend towards tertiary study that involves creativity merits further comment in relation to the previous section. We have an opportunity to demonstrate more effectively that creativity is intrinsic to engineering, but we must ensure that our curricula develop relevant functional creativity skills that improve the effectiveness of the next generation of engineers.

Prospective students appear to be relatively unresponsive to subsequent employment markets. Annual graduate salary surveys show that graduates from the popular creative arts and health sciences (apart from medicine and dentistry) areas do not enjoy high remuneration, while the very high graduate salaries in engineering (and particularly mining) have not reversed the downward enrolment trends.

The growth in participation and success of women in engineering is seen by many to be critical to meeting skills shortages. This was argued strongly in the last national Review of Engineering Education (12). Table 1 shows the female participation and compares course success rates for women and men studying in the three schools of engineering at UniSA, averaged over 2000 - 2004.

<table>
<thead>
<tr>
<th>engineering branch</th>
<th>female, mean participation, %</th>
<th>female, mean success, %</th>
<th>male, mean success, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>mechanical &amp; manufacturing</td>
<td>6.2</td>
<td>90.7</td>
<td>78.6</td>
</tr>
<tr>
<td>electrical &amp; information</td>
<td>10.0</td>
<td>74.5</td>
<td>73.3</td>
</tr>
<tr>
<td>civil</td>
<td>16.8</td>
<td>87.2</td>
<td>83.4</td>
</tr>
</tbody>
</table>

On average, women have higher course success rates than men, and therefore tend to have faster program completion rates. The female participation rates are typical for the disciplines, nationally. While there are many issues related to the participation and success of women in engineering, see Stonyer (13), at UniSA we:

• support women students with a network of female staff, students and practicing engineering mentors;
• ensure that the curriculum is ‘inclusive’ of women and indeed all groups, Mills and Ayre (14);
• mentor and support women in their transition to industry employment;
• undertake research into women’s careers and impediments within the engineering workplace, Gill, et al. (15).

COMMUNICATING AND MARKETING ENGINEERING

To attract more students into engineering we need to address all of the issues outlined in the previous sections. As well as explaining the branches of engineering we must communicate: the wide range of career opportunities; that a good engineering program opens very wide career doors; and that women can succeed at least as well as men, drawing on data and other informed study as described above.

UniSA’s marketing brochures and recruitment activities (including school visits and open days) are necessary, but far from sufficient for the task. Therefore our engineering staff and students have developed, with others, several activities that essentially communicate the relevance of school mathematics and science and the opportunities offered by engineering careers. The engagement with school teachers in most of these activities is critical, since they have very significant influence on
students’ subject and career choices. The three most significant programs, listed below, have gained funding to operate them on a reasonable scale:

- **student peer mentoring** – has been operating since 2002, and is a program in which senior university students are trained (with course credit) to assist teachers in Years 10 – 12 school science and mathematics classes in 15 local schools. This process is positive for the university students in developing their communication skills and confidence, is directly supportive to teachers and also puts them in touch with engineering students and ideas, and is positive to the school students who see science and mathematics being enthusiastically used by members of their own generation.

- **robotics peer mentoring** – commenced operation in 2003, as a program in which university students from the electrical and information engineering area support classroom teachers and their students in building, programming and developing applications around a microcontroller card, including a robotic vehicle. This program has won national awards, and is being built into the science and mathematics school curriculum at Years 8 – 10. During 2006 it is expected that more than 1200 school students will be involved in this program.

- **science@work** – was introduced in 2004, through the South Australian Investigator Science and Technology Centre, ISTC(16), for secondary school students. UniSA sponsors and supports two half-day on-campus activities that cover clever technologies (such as bio- and nano-materials), and environmental considerations in designing new technology, such as demonstrating how the use of renewable energy and good design can reduce our ecological footprint.

Needless to say, we monitor and evaluate the outcomes of these specific programs to improve their effectiveness and impact, and are beginning to see positive contributions to engineering student recruitment.

In addition to these activities, we work with *Engineers Australia*, non-academic members of the profession, alumni and ‘student ambassadors’ to provide contemporary information about engineering and engineering careers. Engineers Australia has good print media exposure, and in recent years there has been an increase in the number of prime time television programs related to engineering, science and invention. There are almost daily media messages about one or other aspect of skills shortages, inferences about the importance of well engineered and sustainable infrastructure and of advanced manufacturing to the economy that may also be contributing to perceptual and real change.

**ENGINEERING PROGRAMS AND CURRICULUM ISSUES**

If we are to be successful, it is also necessary for undergraduate engineering programs themselves to be perceived by the students and graduates to be well conceived, taught and assessed. There is considerable program diversity across the 31 of the 38 public Australian universities that offer professional engineering. The degree award programs themselves are developed, approved, operated and evaluated by each university’s academic processes. *Engineers Australia*, a Washington Accord signatory, provides the professional accreditation system for 4-year Bachelor of Engineering programs against sets of graduate attributes and competencies. All Australian B.Eng. programs must have a balance of underpinning science and mathematics, discipline-oriented engineering science, engineering design and synthesis, introduction to engineering management, and exposure to engineering practice. The accreditation requirements are not over-prescriptive, and do not discourage diversity or curriculum innovation.

Accordingly, programs differ considerably, as each engineering faculty gives expression to particular emphases, approaches and specific employers’ needs. Differences between programs (within and between universities) and educational approaches (between universities) are aspects of ‘product differentiation’ that have to be communicated in the process of marketing to prospective students.
UniSA runs a mid-sized engineering operation of about 1,500 students. Programs are offered in three areas: civil engineering (School of Natural and Built Environments), electrical, mechatronic, computer, electronics and telecommunications engineering (School of Electrical & Information Engineering), and mechanical and manufacturing engineering (School of Advanced Manufacturing and Mechanical Engineering). These schools are members of the academic Division of Information Technology, Engineering and the Environment headed by the author. UniSA’s engineering emphasises industry practice, systems engineering and integration, and multidisciplinarity, particularly related to sustainability. The programs are directed particularly towards serving local and international manufacturing needs and the defence and electronics systems sector that has its national focus in the state. Most of the engineering programs are also offered in 5-year ‘double degree’ programs in which a second 3-year degree (e.g. Bachelor of Management) is also awarded. These study patterns include the core courses of both degrees, with less specialisation and fewer electives than the single degrees.

The university’s educational approach is ‘student-centred’, with strong emphasis on developing students’ as autonomous and resourceful learners through open-ended project work, and use of on-line resources, as well as classroom activities. All programs are designed to produce graduates who can demonstrate seven generic ‘graduate qualities’: knowledge, communication skills, problem-solving, teamwork and independent work, understanding of ethics, an international perspective, and capacity for life-long learning. The development of these qualities is embedded within the curriculum. Program design is also influenced by student, graduate and employer feedback. The latter continually stress the importance of the generic skills, as well as adequate technical knowledge.

The 1990’s was a period of growth in diversity of engineering programs, particularly as the information engineering area responded to a diversifying specialist employment market. Since 2001, there has been a downturn in employment and student demand in this area, and some recovery of enrolments into civil and mechanical/manufacturing engineering. We now sense that offering too many program options is not effective and have now simplified entry to each branch.

UniSA has not followed the several Australian engineering faculties that have instituted a ‘common first year’ containing introductions to all available branches of engineering, as well as generic mathematics and sciences. We believe the three branches of engineering we offer are sufficiently different in terms both of their science and their domains of practice to justify largely separate programs. We aim to satisfy industry’s needs for graduates with high levels of expertise in a branch of engineering together with generic skills. We take advantage of the setting of each branch with its own customary family of non-engineering disciplines. For example, information engineers have greater affinities to computer and information sciences, and electronic and photonic physics than other engineering branches. Through extensive project work, our electrical and information engineering area develops a strong functional creativity theme around the needs of the defence systems industry.

The most recent structural improvement has been to incorporate civil engineering into the academic school that covers construction management and economics, environmental law, urban and regional planning, geology, geographical information systems and surveying, ecology and natural resource management. Thus, we aim to produce specialist professionals in all of these disciplines who will have good understanding of how other disciplines relates to, and sometimes conflict with, their own. Civil engineers working in the transport or water infrastructure fields will frequently work alongside planners. Undertaking common courses and collaborative project work should improve both groups’ effectiveness as professionals. Since 2004 we have been developing cross-disciplinary activities to produce the best possible professionals for the environmentally sustainable infrastructure development.
IMPROVEMENTS BASED ON GRADUATE AND STUDENT PERCEPTIONS

The engineering curriculum (as for most science-based professions) will always be full and the student workload relatively heavy. High workloads do not necessarily lead to low rates of graduate satisfaction with their programs, as shown by data collected in the annual national graduate survey and a number of internal university survey instruments. Summarising, engineering students and graduates report:

- reasonably high rates of overall satisfaction. Typically 60–80% agree that ‘they are satisfied with the whole program, course or general experience’.
- high rates of agreement (65–90%) with propositions that ‘programs and courses are enabling the development of generic and workplace-oriented skills’.
- moderate rates of agreement (40–60%) with propositions concerning ‘consistency of marking, assignment turn-round and quality of marker comments’.
- rather poor rates of agreement (<40%) with propositions that ‘teaching is of good quality’, although this rate is increasing slowly year by year.

Such response patterns are similar across most disciplines, and engineering tends to be rated relatively higher than arts and social science areas on skills development. However, engineering does tend to be rated lower on Good Teaching than many other areas. This is addressed in the next section.

The Dean (Teaching & Learning) in each academic division leads the processes of curriculum and teaching improvements. These are strongly informed by detailed analysis of the perceptions data at course and individual teacher levels. After continuous poor feedback on Assessment practice, for example, the university has instituted policy to reduce excessive assessment load on students, and also improve the quality of staff feedback to students, by requiring each course to have not more than three items of summative assessment (one item could be a sequence of laboratory assignments), plus an examination. While consistent with encouraging self-critical study, this change may be hard for students who find marked work as a strong incentive to study. The policy is being implemented very effectively in the project-based learning approaches that we adopting in the engineering programs.

IMPROVING ENGINEERING TEACHING

As reported above, students and graduates do not rate their programs highly for ‘good teaching’. We take this very seriously as this is implicitly part of the program’s marketing position as well as relating directly to the quality of learning achieved. Teaching can be improved by many measures, including assessment, but here we focus on the personnel issues.

Academics are mostly highly accomplished researchers, and ideally, engineering academics have experience of practice outside the academy. Few have formal training in educational methodology and practice before being appointed to university teaching positions. They learn to teach by doing, drawing on their own experiences, and most aspire to gain good teaching ratings.

The University supports improvements in good teaching practice through professional staff development activities run by the Flexible Learning Centre. Each year, the Division identifies activities aimed at making substantial improvements. Examples include large-class teaching and development of structured on-line course materials. The Dean (Teaching & Learning) also runs a number of within-division educational projects and teaching support activities.

All new academics are required to participate in a 2-day induction to Teaching at UniSA. For several years academics have been supported to take the Graduate Certificate in Tertiary Education offered by external study at the Queensland University of Technology. Engineering academics have been the largest group of UniSA participants in that program, and all who have completed it have improved their own teaching as a result. The university has now mandated all new teaching academics to take a similar award program now being developed internally. This will incorporate and build on the induction, and will allow staff to take its course components during their three year probationary period.
A small number of engineering academics have research degrees in areas of engineering and science education. These staff and many others are active innovators in engineering education and report their work in the national and international conferences of engineering education. There remains a challenge to engineering educators, however, to systematically evaluate the contribution of many innovations to long-term learning outcomes (as there are rarely control groups), and to set their innovations in the context of sound educational and learning theories. The university has instituted a number of ways to acknowledge excellent and innovative teaching and teachers. Annual academic performance management requires staff to consider quantitative student perception data to craft improvement plans, and academic promotion also requires peer review of teaching.

Since teaching engineering is a demanding activity, and successful academic life also requires excellent research performance, the university has also introduced the roles of Academic Support Officer and Program Support Officer. The former group will normally possess a discipline qualification so that they can assist academics in materials preparation; the latter group answer the myriad of largely administrative student queries that relate to their program. These roles should free academics from much of the low-level work associated with running programs and courses.

CONCLUSIONS

The engineering profession will prosper only if it attracts excellent students to study well conceived programs that are delivered effectively by excellent teaching staff. The paper has outlined improvement initiatives being undertaken at the University of South Australia. The initiatives are informed by needs and information. The first group are intended to improve school students’ understanding of engineering and increase subsequent enrolments. The second group addresses general improvements to the engineering curriculum that take into account student perceptions. The third group relates to improving the quality of teaching. The extent to which these initiatives will succeed in reversing the current trends of prospective students away from engineering cannot yet be estimated. Nevertheless, educators and leaders in the engineering profession will need to continue to work together along these and similar lines, to ensure that national and global development goals can continue to be met through engineering enterprise.

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WORKING EXPERIENCE, LEARNING OVERVIEW FACTORS AND PERFORMANCE OF ENGINEERING AND COMPUTING MAJORS: A STUDY IN CONTINUING EDUCATION

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ABSTRACT

Continuing education is set up by the university to meet the needs of the workforce and lifelong learning pursuits of an individual. The programs and courses offered facilitate the aspirations of part-time distance students who are working towards a degree for the purpose of personal and professional growth. The purpose of this research paper is to study the views of individual learning on academic performance among part-time adult learners who are pursuing on-campus undergraduate engineering and computer courses. Their performance is based on the Cumulative Point Average (CPA) obtained at the end of the semester. Their overview of individual learning concerns their attitude on motivation, understanding, soft skills, application, responsibility, thinking and experience in general. Questionnaires were distributed to the part-time students. One hundred and seventy nine (179) responded, and their results analysed for answering research questions: (a) what is the profile of the respondents base on age, marital status, the time they decide to pursue continuing education, the distance and transport for pursuing on-campus education and personal responsibilities; (b) what is the relationship between profile, performance and their own learning overview. The research findings conclude there is a significant difference between performance and factors of their own learning overview.

INTRODUCTION

Knowledge workers are currently the most sought after human resource for the country. There is a continuous demand for fresh graduates of engineering and computing to fill the manpower need of a developing country. Training knowledge workers is time consuming, and retaining them requires a lot of effort either for individuals, or with cooperation of their employers. There is a need to find ways of increasing participation and attracting workers. Continuing education is set up by Universiti Teknologi Malaysia known as SPACE(13) to meet the needs of the workforce and lifelong learning pursuits of an individual. The programs and courses offered facilitate the aspirations of part-time distance students who are working towards a degree for the purpose of personal and professional growth. The purpose of this survey is to study on the view of adult learners’ own learning on the performance among part time undergraduates of engineering and computing courses at the university.

BACKGROUND

Today knowledge is increasingly becoming an integral competency in the human resources of every developed and developing nation. The knowledge economy dictates current human resources in such a way that knowledge workers have catapulted to the frontline of a nation’s competitive advantage. To address the current need of the country, the university is undergoing dynamic changes in its courses such as engineering, information technology and business by offering continuing education on a part time basis to the workforce in upgrading knowledge and skills for their own personal growth and enables employers to remain competitive.

The dynamic changes involve 35 choices of programs available at 15 centres throughout the country for adult learners. Features of the continuing education are the mode of delivery is by face-to-face lecture, the courses are structured providing generous flexibility, are customer friendly regardless of age, and the classes are held on weekends only. The continuing education programs have been in operation since 1993 5,326 graduates have successfully completed their studies since the
program started(1). This number is alarming because more should have graduated since the programs began twelve years ago. Feedback from lecturers teaching these continuing education programs notice that some of the adult learners ‘drop out’ without ever finishing their studies. There are some students who are not able to continue studying due to financial constraints, there are those who just lose interest in the pursuits of lifelong learning, some due to personal problems may not be able to complete higher education, and some are ‘missing in action’. The main purpose of this survey is to find out some of the factors which may contribute or hinder their lifelong learning pursuits.

This paper seeks to answer the following questions: (a) Who are the adult learners? (b) What are the reasons to continue education while still working? Why do they choose to study on a part-time basis? (c) What is their opinion regarding views of their own learning? (d) How is the strength of the relationship between factors regarding the view of their own learning and academic performance and (e) Is there any significant difference between the factors and academic performance?

LITERATURE REVIEW

Candy(3) states that continuing education includes all those processes that contribute to the advancement of an individual’s knowledge, skill, understanding, competence, and general professional and personal development. It builds a bridge between an individual’s private and employment-related worlds. It also includes attendance at ‘courses’ but it is recognised that most professional learning takes place outside formal education systems. He further explains the concept of lifelong learning has had international currency since at least 1972, with the appearance of the Final Report of UNESCO’s International Commission on the Development of Education. ‘Lifelong learning takes, as one of its principal aims, equipping people with skills and competencies required to continue their own ‘self education’ beyond the end of formal schooling’ (p.15). On its Memorandum on lifelong learning (LLL) the European Commission advanced the following definition of LLL: ‘All learning activity undertaken throughout life, with the aim of improving knowledge, skills and competences within a personal, civic, social and/or employment-related perspective’. Candy(3) furtherreports, ‘What then are the dominant changes that are impacting on our lives and bringing about a requirement for continuing learning and adaptation?’ He pointed out, the first and most obvious is the ‘pervasive effects of new technologies.’ He describes the second as a major wellspring for new learning that is ‘the phenomenon of globalisation.’ The third is the ‘changing patterns of work’ whether precipitated by globalisation, technology or simply by changes in organisational structures. These also provide a significant pressure for new learning.

With the above dynamic changes in education, the university offers part-time study on a wide range of diploma and degree programs. This reflects the continuing importance to the University of working within the city and region to develop pathways and open up the university’s resources to all who can benefit from them. The main objectives of setting up the continuing education program at the university(1) are: (a) to produce quality part-time learning and professional education programs (b) to extend education opportunities to every level of the community (c) to instil the culture of lifelong learning (d) to concentrate on customer wants and market needs (e) to increase market share in continuing education and (f) to optimize the use of resources and physical amenities.

Knowles(8) method of adulthood learning description of six characteristics of adult learner is given as follows:

i. Adults are autonomous and self-directed. They need to be free to direct themselves and the lecturer must actively involve adult participants in the learning process.

ii. Adults have accumulated a foundation of life experiences and knowledge that may include work-related activities, family responsibilities, and previous education. They need to connect learning to this knowledge base.

iii. Adults are goal-oriented. Upon enrolling in a course, they usually know what goal they want to attain. They appreciate an educational program that is organized and has clearly defined elements.
iv. Adults are relevancy-oriented. They must see a reason for learning something. Learning has to be applicable to their work or other responsibilities to be of value to them.

v. Adults are practical, focusing on the aspects of a lesson most useful to them in their work. They may not be interested in knowledge for its own sake.

vi. Adults need to be respected. Lecturers must acknowledge the wealth of experiences that adult participants bring to the classroom. The adults should be treated as equals in experience and knowledge and allowed to voice their opinions freely in class.

Brookefield(2) examine issues in understanding adult learning in four major research areas such as self-directed learning, critical reflection, experiential learning and learning to learn. On the aspect of self-directed learning, he noted, ‘More longitudinal and life history research is needed to understand how periods of self-directedness alternate with more traditional forms of educational participation in adults’ autobiographies as learners. Recent work on gender has criticised the ideal of the independent, self-directed learner as reflecting patriarchal values of division, separation and competition. The extent to which a disposition to self-directedness is culturally learned, or is tied to personality, is an open issue. We are still struggling to understand how various factors - the adult’s previous experiences, the nature of the learning task and domain involved, the political ethos of the time - affect the decision to learn in this manner. We also need to know more about how adults engaged in self-directed learning use social networks and peer support groups for emotional sustenance and educational guidance.’

For the second areas of major research, Brookfield(2) provides evidence for critical reflection and further explains, ‘that adults are capable of this kind of learning can be found in developmental psychology, where a host of constructs such as embedded logic, dialectical thinking, working intelligence, reflective judgment, post-formal reasoning and epistemic cognition describe how adults come to think contextually and critically’. Brookefield(2) describes the third as experiential learning. He noted, ‘Our experience is culturally framed and shaped. How we experience events and the readings we make of these are problematic; that is, they change according to the language and categories of analysis we use, and according to the cultural, moral and ideological vantage points from which they are viewed. Second, the quantity or length of experience is not necessarily connected to its richness or intensity. For example, in an adult educational career spanning 30 years the same one year’s experience can, in effect, be repeated thirty times. Indeed, one’s ‘experience’ over these 30 years can be interpreted using uncritically assimilated cultural filters in such a way as to prove to oneself that students from certain ethnic groups are lazy or that fear is always the best stimulus to critical thinking.’

The fourth is learning to learn which Brookefield(2) describes as the ability of adults to possess a self-conscious awareness of how it is they come to know what they know; an awareness of the reasoning, assumptions, evidence and justifications that underlie our beliefs that something is true – to become skilled at learning in a range of different situations and through a range of different styles - has often been proposed as an overarching purpose for those educators who work with adults.

The Centre for Learning and Teaching, University of Technology Sydney(14) provides a useful literature, ‘A guide to evaluating teaching and courses at UTS’(3). The guide consists of a list of several types of questionnaires for various purposes of evaluating teaching. This researcher was attracted to the questionnaire ‘Student view of own learning’ due to the fact that it is very closely related to the issues address above. Fifty three items in the questionnaire are analysed and adapted and broken down to measure factors (the common keywords found in the questionnaire) such as (a) understanding (12 items) (b) skill (8 items) (c) application (9 items) (d) responsibility (7 items) (e) thinking (6 items) (f) previous experience (5 items) (g) motivation (6 items). Therefore in this survey the factors directly related to the theoretical framework by Brookefield(2) are explained. Understand, motivation and responsibility relate most to self-directed learning; thinking relates to critical reflection; previous experience relates to experiential learning; skill and application relate to learning to learn. Research on adult learning is vast. Besides the four major research areas as mentioned, others include adult learning in
cross cultural settings as highlighted by Roy(12), Alsanat(1), Chang(5), Cassara(4), Ross-Gordon(11) and Pratt(10). Another popular research areas is evaluation of adult learning in various settings, among those are by Elliot-Leck(7) and Yeh(15).

**RESEARCH METHODOLOGY**

The respondents were students attending continuing education programs on a part-time basis. The students were mostly working adults employed in the country but this survey focused only on those attending face-to-face lectures at the city campus. In this survey, questionnaires were distributed to 250 students and 218 of them responded. Using SPSS PC+, only selected cases from engineering and computing courses were analysed for this purpose.

The questionnaire on ‘Student view of own learning’ by University of Technology Sydney(14) was used as an instrument to measure factors such as understanding, skill, application, responsibility, thinking, previous experience and motivation. Students were required to respond once on a Likert Scale from 1 (strongly disagree) to 5 (strongly agree) to provide a quantitative representation. Other information included in the questionnaire was their profile, academic and social related information. Another section of the questionnaire comprised open ended questions which required the respondents to indicate by writing their opinions regarding their views on current problems; the reason for them to continue education; and the person who motivated them for this lifelong learning pursuit. The written comments were necessary to check the inner feeling of the respondents and at the same time to check contributing or hindering factors which influence their participation in getting a degree through continuing education. The questionnaire was distributed to the students during the first semester, session 2005/2006. The andragogy model description of some of the characteristics of adult learners by Knowles(8) is utilized to explain the written comments.

**RESEARCH FINDINGS**

The profile of respondents based on sex, age, course and marital status is shown in table 1. The respondents consisted of 179 adult learners, between 19-44 years old; male (62.57%) and 37.43% female. As for their marital status, 51.4% were married and 48.6% single. Regardless of their marital status, 57.0% of the respondents had no children and 43.0% had children. A majority (38%) were 25-29 years old.

Table 2 shows academic related information on the aspects of courses pursued, cumulative point average (CPA) obtained during the semester and the year.

The engineering and computing courses are Bachelor in Geomatic Engineering (SGU) 28.5%, Diploma in Civil Engineering (DDA) 20.7%, Bachelor in Computer Science (SCK) is 20.1% and (SSK) 7.8% respectively, Bachelor in Mechanical Engineering (SMM) 7.8%, Diploma in Computer Science (DDC) 5.6% and (DCK)

<table>
<thead>
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<th>Profile</th>
<th>No of respondents (Frequency)</th>
<th>Percentage of respondents</th>
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Table 1: Profile of respondents
The cumulative point average indicates 24.0% obtained a CPA of 2.6-3.09, followed by 22.9% between 2.1-2.59, 21.8% obtained lower than 1.59, 18.4% between 3.1-3.59, 12.3% between 1.6-2.09, 0.6% between 3.6-4.00.

Table 3 indicates the achievement calculated as the mean of Cumulative Point Average (CPA) base on a 4-point scale. It is interesting to note that those respondents with a working experience of 21-25 years perform well (3.0813) followed by those working for 11-15 years (2.8526).

The worst performance is shown by those respondents who have worked less than five years with a mean CPA of 1.9591. The same is true for those working for more than 30 years with a mean CPA of 2.0400, followed by those with a working experience of 6-10 years (mean 2.0762). Figure 1 illustrates the research finding in a graphic form.

Further analysis to explain the results of Table 3 seek to focus on the factors of learning overview in relationship to working experience. Table 4 confirms factors such as achievement/CPA (0.01), thinking (0.032) and motivation (0.020) are significant at the 0.05 level.

Table 5 indicates factors regarding skills (0.121), application (0.242) and responsibility (0.69) are not significant at the 0.05 level.
DISCUSSION AND CONCLUSION

From the results above, engineering and computing continuing education students need to work for at least five years to be successful in academic achievement. Lack of working experience certainly affects their achievement (Cumulative Point Average), thinking and motivation to pursue further studies on a part-time basis during weekends. This finding is supported by their comments regarding difficulty in balancing career and studying. They have difficulty in time management as most of the students are still learning their roles and job functions as a career person.

These findings support the research of Cosman-Ross (6) who concluded that adult students were motivated to learn mainly by self improvement and sense of achievement. Other is a research by Elliott-Leck (7) found that learning achievement correlates positively with step-by-step progression, frequent review, and appropriate pacing. His research examines the influence that application of teaching and evaluation methods based on adult learning principles has on student motivation and achievement.

Discussion of written comments in relation to Knowles (8) andragogy model found that the role of work, study and family are very challenging tasks. There is very little time for review as their jobs are demanding. They mention that time management is very important in order to be successful in balancing roles. The andragogy model characteristics number (ii) is very difficult to achieve in reality.

Respondents state the reasons for them to continue education is lifelong learning, personal satisfaction and development, achieving their dream, to get a better post or job, and better pay. This explains the reason for Knowles (8) andragogy model characteristics number (iii), which explains the self motivating factor.

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