



Managing educational change in the ICT discipline at the tertiary education level

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Executive summary, conclusions and recommendations

Introduction

This report on the Australian Learning and Teaching Council Information and Communications Technology (ICT) Project is a scoping study in ICT higher education. The core focus is the university curriculum and its perceived relevance among ICT stakeholders. The primary ICT stakeholders include high schools, university staff, students, employers, the community, professional bodies, graduates in the workforce and government. ICT also permeates all other disciplines, society, work practices and industry at all levels. Compared to other disciplines, ICT is a field that changes rapidly in response to innovations. The broad range of stakeholders and rapidly changing circumstances require dynamic and responsive high school and university curricula that balance a range of demands.

Initial consultations of the academic community indicated that the main issues and challenges facing the ICT higher education sector could be gleaned from three groups: ICT academic staff, ICT graduates currently in the workforce, and employers of ICT graduates. A broad range of academic staff were consulted, including deans and other senior managers, professional groups, and attendees at a variety of conferences across the ICT spectrum. Recent graduates in the workforce were contacted through university alumni organisations, which invited their relevant graduates to participate in an online survey. Employer requirements of ICT graduates were determined from the literature and a pilot survey of a range of ICT employers.

The findings from each of the three consultations, and the conclusions and recommendations flowing from them, are summarised below.

Academic consultations

Academic consultations were conducted through face-to-face discussions, wider canvassing of statements from these discussions, and written expressions of concerns and priorities facing the ICT sector from professional groups and attendees at meetings and conference forums. These three approaches revealed that there is a broad range of issues and challenges on which there is considerable agreement.

There is much debate about which disciplines comprise the ICT spectrum. Teaching of ICT is done through several different faculties and schools, including engineering, science, and business or economics. Various professional groups are concerned with different parts of this spectrum. In this climate, it is difficult to reach agreement on a single set of disciplines.

Nevertheless, for the purposes of this project, the core disciplines were taken as electrical engineering, computer engineering, telecommunications engineering, software engineering, computer science, information technology, and information systems.

There was widespread concern among academics that the ICT discipline is fragmented and in need of a representative unifying peak academic body such as an ICT council. Such a council was formed in July 2008, and is known as the Australian Council of Deans of ICT (ACDICT). Participants in the consultations felt that this council would find it challenging to bring together relevant stakeholders (including various professional bodies, high schools,

industry and government) and a fragmented community to address the complex issues raised.

The most common area of concern was the fact that the sector is in crisis because of declining student enrolments (and subsequent skills shortage). This situation was attributed to erroneous and poor perceptions of the ICT profession and career prospects among students, high school teachers, career advisors, parents and the general community. One example cited was that the implementation of the Computer Professional Program of the Australian Computer Society is not widely known or recognised, and in any case the name only represents a part of the ICT spectrum.

A major challenge is surviving the downturn in enrolments and any university downsizing, with possible loss of capacity, in an environment with increasing industry demand for skilled ICT personnel. Under these circumstances there was concern over maintaining the quality of ICT teaching in high schools and universities and maintaining an appropriate balance of fundamental knowledge, current technologies, business understanding and generic (or 'soft') skills such as communication and problem-solving. It was broadly felt that the federal government should express more concern for the crisis in the ICT sector, which is a significant and essential contributor to the economy.

There was a strong desire for greater involvement of the ICT industry in marketing the profession and in teaching at all levels. Greater involvement of industry in education would enable the development of industry-relevant curricula; provide more work-integrated learning and authentic (real-world) learning experiences for students, which would improve their employability; and strengthen the teaching–research–industry–learning nexus for the mutual benefit of academia and industry.

Lack of understanding of students amongst academic staff was an issue, particularly in regard to motivation, class attendance and attrition rates (which are apparently higher than in engineering and science) within the context of a mixture of local and international students, uneven workplace opportunities, academically less able students, and the relatively low number of enrolments in ICT by women.

The academic consultations identified several areas of notable good practice in the sector (such as teaching, recruitment strategies and industry associations). Participants felt that identifying and sharing these would benefit the sector as a whole.

Survey of recent ICT graduates in the workplace

ICT graduates employed in ICT jobs over the past five years were surveyed through their university alumni organisation. The survey sought to elicit these graduates' views on the effectiveness of their university preparation for employment in five areas:

- personal/interpersonal abilities
- thinking/cognitive abilities
- business abilities
- technical abilities
- learning and university experience.

The survey yielded 719 valid responses from graduates from 21 Australian universities.

Analysis of the data allowed information to be gathered in several other areas, such as gender differences, workplace experience, the effects of having a higher degree and of studying ICT in high school (both had a positive effect), and a comparison between universities to identify good teaching practices.

The graduates were also asked to provide further qualitative information about their university courses, such as whether they felt their universities prepared them well, what aspects were missing from their courses, what elements were least and most valuable, and how their courses could be improved. There were between 533 and 660 individual responses to each of these open-ended questions.

This study found that graduates consider a range of abilities from the personal/interpersonal, cognitive, business, technical and learning domains to be important for performance of their work. These include communication, teamwork, problem-solving, organisation of information, project management, client liaison and technical expertise. However, there was a significant overall disparity (88%) between the abilities graduates consider to be of high importance for their work and their perceptions of how effective universities are in developing those abilities.

While the majority of graduates seemed to be satisfied with how their universities prepared them for the technical aspects of their work, many felt they were underprepared in terms of personal and interpersonal skills, and business and industry knowledge. Graduates also stated that they would have benefited from more exposure to new and emerging technologies and the technologies used in industry. They suggested that a well-rounded ICT graduate requires relevant technical know-how, workplace experience, problem-solving skills and the ability to work in a team for success in professional employment.

Overwhelmingly (about 70% of free text responses in the survey), the graduates suggested that there needs to be some form of work-integrated learning to address both what was missing from their courses and what needed improvement. The benefits of work-integrated learning to students, industry and the university have been documented elsewhere, including recently by Universities Australia (2008).

The literature was used to interpret identified gender differences in the male-dominated culture of ICT. However, the data from this survey could not point to specific curriculum changes required in this regard, except to imply that a more gender-inclusive pedagogy would be desirable and would probably help with the recruitment and retention of more women.

Analysis of the survey data showed that different universities have different strengths with regard to teaching practices. This provided support to the academic community's view that identifying and sharing good practices would benefit the sector as a whole.

Analysis of the survey data identified the following areas for curriculum reform:

- work-integrated learning for all ICT students
- involvement of industry professionals in teaching
- use of 'real-world' examples, case studies and scenarios
- balancing of teaching up-to-date technologies and practices with fundamental theoretical approaches
- gender-inclusive pedagogy
- identification and sharing of good educational practices
- inclusion of business practices

- development of personal skills, including communication of all kinds
- authentic problem-solving activities
- group work related to industry practices of teamwork
- project work related to industry and project management
- teaching practices that involve more interaction between teachers and students
- clear demonstration of subject relevance to employment.

Survey of ICT employers

The Australian Information Industry Association conducted a pilot survey of employers of recent ICT graduate recruits for this project. The results were compared to employer concerns published in the literature. While there was broad agreement between these, the surveys also provided some new insights.

Most employers reported that graduates met their needs in relevant ICT knowledge, foundation in theoretical principles, literacy and numeracy, computer languages and software applications. The main area of weakness was commercial awareness, again suggesting that this is an issue for curriculum development. Some employers indicated that their needs were met in project management knowledge, written communication skills and understanding of business processes. There seemed to be a more-or-less equal demand among employers for graduates with fundamental knowledge and experience with current technologies.

Less than half of employers were satisfied with the personal qualities and interpersonal skills of their graduate recruits. The areas most in need of improvement were communication and problem-solving skills. Other areas for improvement were self-management, initiative, planning abilities and independent learning. Employers ranked the need for improvement in teamwork very low, which suggests that Australian universities are preparing students well in this regard.

With respect to improving the employability of recent graduates, and in agreement with published findings, employers indicated that universities and the ICT industry need greater cooperation in designing curricula. They also felt that courses should include experience in the industry, and in particular that students need more work placements to gain industry experience, and that teaching staff should also have industry experience.

The time and cost of getting recent graduates up to speed in industry can be considerable: it can take three to 12 months and sometimes longer, and commonly costs in excess of \$10,000 for each graduate.

Conclusions and recommendations

Addressing the issues and challenges raised by ICT academic staff, graduates and employers requires action by a national organisation to ensure accountability and responsibility for implementing recommendations. The body created during this project to respond to the academic needs of the entire ICT spectrum is ACDICT. The recommendations from this project are therefore intended to inform the work of ACDICT. It is hoped that these nine recommendations will assist ACDICT in formulating the most appropriate responses.

There was widespread support from the academic community for the formation of a national representative ICT council to address the fragmentation of the sector. Now that ACDICT has

been formed, it needs to focus on promoting unification, engaging the community, and establishing itself as the peak academic body.

Recommendation 1

ACDICT should establish a relationship with relevant stakeholders (including various professional bodies, high schools, industry and government) to consult with and provide advice on the issues raised during this project.

Improving the perceptions of ICT in many areas of the general community is seen by most academics as the main avenue for resolving the ICT crisis.

Recommendation 2

ACDICT should work with industry and key professional bodies to investigate, develop and implement strategies for improving community perceptions of the ICT profession and career prospects.

Recommendation 3

To enhance the standing of the ICT profession, ACDICT should work with the Australian Computer Society and other stakeholders to improve the relevance and recognition of the Computer Professional Program qualification for the whole ICT spectrum.

Respondents generally felt that there was a deficiency in understanding students and their needs in the ICT context, and that ICT is a male-dominated field. Relatively high attrition rates and the lack of women are symptoms of the problem.

Recommendation 4

To help understand students better, ACDICT should support research into student motivation, class attendance, attrition rates, the enrolment of women in ICT, and gender-inclusive pedagogy in relation to a range of demographic variables and contexts.

The three perspectives (academics, graduates and employers) had much in common and provided solid evidence for improvements. One area in which there is strong agreement is the need for greater university and industry collaboration. Graduates in the workforce strongly recommended it and a willingness to collaborate was expressed by academia and industry. While this desire is apparently broadly felt, and therefore seemingly achievable with the appropriate actions, possible reticence on the part of industry may have been revealed by the relatively small number of employer participants in this survey and in an earlier employer survey that also had low participation (Hagan 2004). Rhetoric, commitment and action need to be brought together through the leadership capacity of ACDICT.

The employer survey and the literature indicate that employers value recruits with industry experience – whether or not they have only recently graduated. This is confirmed by recent graduates in the workforce, who overwhelmingly say workplace experience is missing from their education and that the curriculum is most in need of improvement in this regard. The implication is that the marked disparity between what graduates say they need in the workplace and what is provided by universities to prepare them for the workplace could be addressed in large measure by appropriate workplace experience.

The dissatisfaction with the personal qualities and interpersonal skills of graduate recruits expressed by employers could also be mitigated by workplace experience. Universities Australia (2008) has advocated a national internship scheme that would improve the

employability of all graduates and also benefit universities and industry. ICT graduates in the workforce and ICT employers have identified common deficiencies (such as communication skills, business awareness and problem-solving abilities).

Recommendation 5

ACDICT should establish a relationship with ICT industry leaders to develop strategies for greater university and industry cooperation in the design, implementation and teaching of an industry-relevant curriculum that meets the needs of graduates in the workforce and employers.

Recommendation 6

ACDICT and industry leaders should investigate the possibilities for greater work-integrated learning by all students of ICT, and develop a scheme that has local and national applicability.

Graduates in the workforce reflected on their experience of university teaching and made several suggestions for improvement. Consideration and adoption of these suggestions may address motivation and retention issues, as well as address concerns that ICT teaching is in need of improvement.

Recommendation 7

ACDICT should encourage teaching staff to:

- demonstrate subject relevance,
- have interactive sessions with students,
- use real-world examples and case studies,
- keep up to date with technology changes,
- provide group work related to industry practices, and
- design meaningful problem-solving activities

in order to improve university teaching.

Understanding and strengthening the teaching–research–industry–learning nexus that seems to be at the heart of ICT learning and teaching would lead to curriculum improvements.

Recommendation 8

To fully understand the teaching–research–industry–learning nexus in the ICT context, ACDICT should support research into clarifying perceptions and identifying best practices for the mutual benefit of academia, students and industry.

Analysis of the data from the survey of graduates in the workforce showed that different universities had different strengths in the teaching of ICT. As noted by academic staff during the consultation process, it would be beneficial to identify and share good teaching practices.

Recommendation 9

ACDICT should facilitate the documentation of good teaching practices and the dissemination of this information across the sector.

These recommendations have far-reaching consequences for academia, students and industry and, even if only partly adopted, have the potential to revolutionise the ICT curriculum.