

Development of IT/IS Skills for New Forms of Organisations

A Challenge for Educators?

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Abstract

This paper considers the industry's IT/IS skill requirements in relation to the notion of new forms of organisations such as learning organisations and virtual organisations. The challenge facing IT education is to create a learning environment that helps developing skills (eg double loop learning and an ability to handle complex and unstructured problem situations) required by organisations, which are dynamic and in a continuous state of change. The paper reviews the data from an ongoing empirical study among university IT students - male and female, which aimed at exploring the reasons for low female participation in IT studies. Of particular interest is how students' views of IT as an area of study and as a career are being affected by the IT study environment, and the implications of this for learning and virtual organisations. Examples of students' experiences have been drawn upon to highlight the complexities involved for students in negotiating the dynamics of the learning environment of an Australian based IT degree.

Keywords: IT/IS skills, learning organisations, IT education

BRT Keywords: IA 03, BD 0102, BD 05

Introduction

Despite the increasing need for information technology (IT) personnel the number of computer science degrees awarded is not reflecting this growth. In the USA alone the numbers of computer science graduates have dropped from a high of 50,000 in 1986 to 36,000 in 1994, reported the Office of Technology Policy (1998). The shortage of IT workers is a global problem shown eg. by reports of Stanford Computer Industry Project (SCIP 1998), including Australia (ASTEC 1995) where the empirical research for this paper has been carried out. The demand is both quantitative and qualitative: due to the expansion of information technology and telecommunication (IT&T) industry and due to new forms of organisations which require new types of information systems development (IS) skills for exploitation of IT. The basic university degrees fail to attract students and consequently fail to meet the growing demand for IT personnel .

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(SCIP 1998), including Australia (ASTEC 1995) where the empirical research for this paper has been carried out. The demand is both quantitative and qualitative: due to the expansion of information technology and telecommunication (IT&T) industry and due to new forms of organisations which require new types of information systems development (IS) skills for exploitation of IT. The basic university degrees fail to attract students and consequently fail to meet the growing demand for IT personnel .

This paper contributes to the discussion of these problems by considering the skill requirements in new forms of organisations and by studying IT students' views of IT as a field of study and work in an IT degree course in an Australian university. Our particular objective is to explore problems in the study environment that potentially contribute not only to the declining number of students, but also to the (inadequate) development of IT/IS skills required by new forms of organisations which are dynamic and operating in a continuous state of change. Especially the skills required by learning organisations and by those operating in virtual environments are considered.

Background Research

The empirical research referenced in this paper is a longitudinal research study since 1995 to date into the declining numbers of female students enrolling in IT degree courses.

Research site

The School of Computing and Information Technology at Griffith University, Australia, has approximately 740 students in several degrees but the largest (with approximately 450 students) and the one in which this research has been carried out is the Bachelor of Information Technology (BIT) degree. The three year BIT degree comprises a compulsory first year consisting of two programming subjects, two mathematics subjects and four introductory subjects in computer systems, artificial intelligence, information systems, and software environments. The first year program also includes studies in technical communication and organisational communication which are oriented to IT work. In the second year students are required to study a third programming subject, project management, and ethical and professional issues in computing and commence their major studies. Most students choose to study two majors; currently these are information systems, software engineering, artificial intelligence, and computer science. In the third year the students continue their major studies and must also complete a one year information technology project for a real client. Depending on whether one or two majors are chosen the students may take several elective subjects within the school or from other schools in the university. At present the most popular majors are Information Systems (approximately 70% of students) and Software Engineering (approximately 50% of students). 39% of students major in Artificial Intelligence and 41% in Computer Science. Many of the subjects in the BIT degree course require students to work in groups. Some 10% of BIT students, providing their grades are well above average, move on to the Honours programme, which is a post-graduate degree consisting of course work in advanced topics in the chosen major and a dissertation which is based on independent research.

The percentage of female students varies between 15 and 19 percent at the undergraduate level whereas at Honours level the half of the students are females. One fifth of all students - male and female - are of Non-English speaking background,

primarily Asian, but approximately half of the female students are of Non-English speaking background. Entry to IT degree programmes in Australia is relatively easy indicating that IT is not a popular career choice. (ASTECC 1995) The School has 24 full time and 19 sessional academic staff members. 25% of full-time academic staff members are female and 30% of sessional staff are female.

Research base

This research, which is being funded by the Australian Research Council, has involved extensive data collection by surveying and interviewing all IT students' perception of IT studies and careers. To date about eight hundred students have been surveyed (all first year students in the BIT degree course since 1995) and one hundred students, including twenty-three male students, have been interviewed either in focus groups or individually. In order to take into account factors at high school that affect students' perceptions we also surveyed 135 students in three high schools and carried out follow up interviews with thirty-three of these students

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The focus group and the individual interviews were structured according to the following topic areas: career perceptions and aspirations (occupation, employment, salary, status); views of IT as a field of study and work and how they have changed since starting the course; study environment (experience, assessment, support, culture, climate, work practices); positive and negative experiences during the studies, particularly those which were ascribed to ethnicity and gender; sources of motivation (original motivation for enrolling in an IT degree vs current motivation for performing well in the course); strategies to cope and succeed; previous IT studies and personal experience that motivated them to do an IT degree; life history (personal background and characteristics, self image, gendered values); ethnicity (language, family background, national, cultural, and religious identities).

For this paper the interview material up to date including the more recent in-depth interviews with 25 students (10 male and 15 female) in September-November 1998 is being discussed together with survey data collected in October 1998 among 70 second year students and 25 third year students taking the IS major to explore their reasons for choosing the major study area in the BIT degree.

New Organisational Forms: Learning and Virtual

New organisations are increasingly networked and organic in structure (Morgan 1986) and their practices are characterised by extensive forms of collaboration and continuous negotiation with partners. (Rockart and Short 1991) These organisational forms are significant for their ability to be able to learn and adapt to new technological and social challenges. Collaborative rather than individualistic technologies are therefore suggested

to be the most appropriate. (Applegate 1994) However, the success of utilising these technologies, as in all organisations, rests upon the way in which they are implemented and introduced into the organisation. How best to translate existing organisational skills and work rationale to the new, user-focused IT environment is a challenge facing the current IT industry. (Couger 1996) The common requirement of technical IT/IS skills is best captured as "understanding IT capability", "know why" and "meeting the challenge of understanding IT capability over time, at whatever level is required". (Feeny and Willcocks 1997)

Two specific organisational forms are utilised as reference points in this paper; the learning organisation and the virtual organisation. This paper does not discuss different views of organisational learning or definitions of virtual organisations but considers the types of skills appropriate for the new organisational forms and how the study environment and study practices may inhibit or support the development of such skills. This paper takes an interpretive perspective which involves understanding individual interpretations of the environment and the "alignment and interaction of organisational members' environmental interpretations" (Hine et al. 1996: 50).

An important distinction made in the literature of organisational learning concerns the mode of learning. Argyris and Schön (1978) maintain that there are three modes of learning - single loop, double loop and deuterio learning. Expressed briefly, single loop learning occurs when errors are detected and corrected and the individual or firm carries on with its present goals and policies. Double loop learning occurs when the individual or organisation is able to reflect on what is relevant and to modify existing knowledge accordingly. Deuterio learning enables the employee/organisation to learn how to learn - that is how to carry out single and double loop learning. The organisational environment required to support learning is considered crucial. (McGill and Slocum 1993) However, in his discussion of whether organisations can learn to learn, Morgan concludes that there may be "important conflicts between the requirements of learning ... and the realities of power and control". (Morgan 1986: 108)

The virtual organisation in its broadest sense exists when traditional organisational boundaries are blurred (Olson 1997, Applegate 1994). This blurring includes a diverse range of possibilities including physical proximity and geographical location, the way in which products and services are offered to clients and the organisation's meta-physical construction. (Greenhill 1998) The organisational form tends to be transient and dynamic in nature (Kraft and Truex 1994: 113) therefore requiring those individuals working in such an environment to develop the appropriate skills for such an existence.

It is difficult to pinpoint particular skills required for individuals to operate in a virtual organisation. However two overarching skill types are necessary, those of flexibility and adaptability. The individual is required to function in an organisational setting that is in a continuous state of change and emergence (Kraft and Truex 1994) or in a compressed state of time and space (Giddens 1990, Baudrillard 1983, Greenhill 1998). This state of existence in turn impacts on the skill requirements of the individual. The skills needed to operate in a virtual organisation also occur at a compressed rate, altering the negotiation between soft skills and IT specialised skills usage. For example an on-line conference which is negotiated by all participating individuals occurs at a variety of geographical locations, time frames and cultural settings. The individual must heavily rely on their soft skill ability to clearly navigate through the business meeting so as to achieve appropriate business outcomes. At the same time specialised IT skills are also called upon both to establish and maintain the Internet link and/or to develop the

appropriate Java script that the client requires for a global communication and transaction system (for example). The notion of learning in these new types of organisations assumes that double loop or deuterio learning is desirable to cope with a complex and rapidly changing competitive environment.

In this paper we consider the way the university environment (specifically the IT school) acts as a contextual influence - in terms of accepted study practices, the value placed on certain types of skills and the ambience or climate (Halloran 1997), including the stresses which students experience. In this paper we also explore the notion of the learning environment in the university and in an educational context in an attempt to draw parallels between IT skills development and industry needs. Our concern is whether the learning environment and the study practices of the students supports the acquisition of appropriate IT/IS skills.

The dynamic nature of new organisational forms has several implications for the development of appropriate IT/IS skills. IT exploitation in organisations requires substantial reskilling of the existing IT organisations. Specific technical skills that are dependent upon current technologies will become obsolete at a faster and faster rate (LaPlante, 1997). IT activity has also shifted from being an operational "doing" function to a more business oriented advisory function to meet the system development needs in an increasingly turbulent environment. (Rockart, et al. 1996) New ways of organising IT activities such as outsourcing requires IT managers and staff to be at least as technically skilled as the outsourcer, but at the same time have a strong management skills in order to integrate business and IT into effective solutions. Interpersonal skills, such as team building are essential. As IT is increasingly distributed to users, this creates a new ambiguity between the roles of IT expert and IT user, with some business-side users being seen as more knowledgeable than the in-house IT/IS specialist. (Feeny and Willcocks, 1997) Re-skilling existing IT staff to become able to make the transition from technical to business and organisational skills is not expected to be easy; up to 50% of existing personnel will not be able to learn the appropriate business skills. (Rockart, et al. 1996)

Changing Needs for IT/IS Skills

Our research suggests that these developing views of IT and the new organisational forms which create and are created by IT innovations are not well understood by students. Also, IT educators may not be conveying these changes and their relevance very effectively. For example, one of the students interviewed, a first year female student compared her different experiences in two subjects Firstly, in a specific "technical" subject: "It was very ambiguous all the stuff we were learning" and secondly in a systems development subject: "They went off into a very business like way and I just found it very interesting".

The problem of trying to convey relevance and the changing nature of the use of IT in organisations may contribute to the problem of trying to recruit students into IT degree programmes. The research among high school students referred to in section 2.2 also showed that high schools students find IT subjects boring and hard and they see IT mainly as concerning the construction of technical systems. This is confirmed by some first year students who find the studies "too analytical". Although initially interested in programming, after studying it, they find they don't like it: "It is very logical and it's not all that creative ... it's not for me, I guess".

Students who do take up the IT degree are surprised in first year at the amount of maths and programming they have to do, especially as this seems to contradict their experience of what is expected in the real world. We referred earlier to the increasing ambiguity between the role of IT expert and IT user. This is complicated by the many students who manage to get paid employment, especially in work on the construction of World Wide Web pages. These students believe that this experience shows them what is relevant to study and they do not accept that foundation subjects in programming and maths are necessary. In some cases their work experience confirms their initial impressions of IT work as difficult and boring. One first year male student expressed it thus: "yeah, I know exactly where I could end up. In a suit, in a high rise with a tie on, typing out".

Although some students would prefer the subjects to allow for more creativity, most students seem to hold a very narrow view of IT studies. The BIT requires students to undertake a lot of group work and has several subjects which should encourage students to reflect on their learning and on the changing context in which IT is used. However, most first year students are concerned primarily with understanding more about computers. A survey of 25 third year students showed that many of them are preoccupied with learning more about specific technical skills and dislike the study of more conceptual ideas about human activity systems which may be supported by IT. This involves the continuing misunderstanding of IT as technical systems - which may be seen as single loop learning - since it does not involve reflection on rules and procedures or the forms of technology.

The 'softer' skills which are increasingly valued by industry are emphasised in the BIT through compulsory studies in communications and ethical issues in IT. However, their importance seems to be overshadowed by the continuously expanding need for specific technical IT/IS skills. These 'soft' skills are also not valued highly by most students. A study carried out in 1994 and 1995 in the first year Communication subjects showed that students had a strong dislike of these subjects, even though 95% of the students perceived themselves as being very weak in communication. (Anthony and Nielsen 1996) However, some of these "soft" skills, such teamwork and communication, particularly support double loop learning. Moreover, according to Morgan (1986) self-criticism and collaboration and openness are required in a learning organisation, which suggests that a student is involved in collaborative study practices is more inclined to be engaged in double loop learning. Our research indicated that the study environment is becoming increasingly competitive so that students are less willing to be engaged in collaborative study practices.

Several research studies also indicate that personnel need to be equipped with special expertise in the analysis, design, development and evaluation of computer-based information systems for people in different organisational settings. (Cheney, et al. 1990, Davis 1993, Feeny and Willcocks 1997, Lee, et al. 1995, Todd, et al. 1995, Van Slyke, et al. 1998) A second year IS subject in which students are taught to analyse complex human activity systems with a view to developing appropriate information systems, includes methods such as Soft Systems Methodology. (Checkland and Holwell 1998) Very few of the second year students surveyed thought that this skill was relevant, although several students thought that being able to analyse different situations was useful. One student found this subject valuable because of the teaching method used; getting students from different backgrounds together in groups to go through a case study: "it is good to get people from a different culture to view the situation cause they will see it differently than anyone else".

The ability to conceptualise problems and analyse situations, is similar to the notion of double loop learning. The value of this skill is supported by authors such as Feeny and Willcocks (1997) who point out that in practice even the technical specialists "seem to rely on their mental models of technology than on formal training in the latest products". This view was confirmed by a recent BIT graduate, currently employed as an Account Executive within decision support systems, who stated that the most useful things he learned from the degree was "the ability to look at problems from different points of view and to understand the context within which a system would be used". (Abraham, personal communication, 1998)

The IT Study Environment

Although the multicultural study environment would be ideal for developing skills required by new organisational forms, working together with people with different backgrounds rarely take place. Some BIT students described themselves as fairly passive and shy which could be inhibiting such an interaction. The IT study environment has complexities which may further inhibit the development of appropriate skills, for example several students referred to the relative ranking of different groups and discriminatory behaviour against groups of lower standing. At the highest level to be male and a high achiever (preferably white), followed by being a white male, a high achieving pretty female, a pretty female, a high achieving though not pretty female and all 'others' including all non white, less intelligent, non pretty (in a conventional sense) people. Discriminatory behaviour and exclusion from study groups operate against work practices that has been acknowledged to be important for new organisational forms.

Our recent interviews revealed also condescending behaviour towards female students. Two females separately described their personal learning experiences, which we have called the "pretty smart girl syndrome". Student A spoke of the problems of being categorised by the other students, firstly on their intellectual achievement but also on their appearance. Females are placed into the 'pretty girl' camp or the 'other' grouping. Prettiness is assessed via the conventional or stereotypical (mainstream Australian) assessment of physical characteristics which tends to exclude most non-Australian and females who are members of sub-cultural groups (for example, the female students who dress in Gothic or alternative fashion styles). Inclusion into the pretty/smart girl group allows the individual the privileged feeling of acceptance into the broader male dominated cultural setting.

The second student B provided an example of how individuals are reminded of their positioning within this ranking order. She considered herself a high achieving but non-pretty female, who is regularly reminded of her female status. On one occasion a male member of her third year project systems development team told the entire project team that he thought females were not as smart as men and therefore that there should be no places for them at universities let alone studying within an information technology degree. When approaching male staff members for advice she was recommended to regard such behaviour as part of making it in her chosen career. The male student was not reprimanded or even spoken to but the female student was advised to learn to cope with working with people who hold such beliefs. This is an example of the problems female students face in the study environment and of how entrenched the male dominated culture is within the IT faculty. The culture was reinforced in this covert manner and left unchallenged by the academics through their handling of the situation.

The condescending behaviour in choosing study partners for group work or assignments was also revealed by a comment made by a male student who said women "are pretty good source to get information from" and that he had done a few brainstorming sessions "just to get help with assignments" when asked if studied or worked together with women. These examples have been drawn upon to highlight the complexities involved particularly for female students in negotiating the discriminatory and highly volatile learning environment of an IT degree in an Australian university.

Finally an issue in the study environment was the problem of motivating oneself to study even the boring parts of subjects. The success of some students is dependent on whether they see the studies as relevant or enjoyable. Male students acknowledged that most women seemed to work hard whereas they (male students) didn't put in the hours, the reason being "not liking it" and "too much maths". Maths content was making the degree less appealing, not because of general dislike for mathematics but because of not understanding the relationship between maths and the IT profession. Some students are prepared to put up with boredom for long term gain. For example, they acknowledged that "nothing [in the BIT course] is really easy" but "Knowing there is something at the end, knowing something good is going to come out of it" gave motivation to one first year female student. However, this 'knowing' seems to come more from the student's expectation of getting a good job than from many of the lecturers providing a sense of the long term value of what they are learning. At the other end there were students who valued IT skills for escapism from the grind of study and work, but felt that IT subjects are very rigid, stifling creativity and not allowing the use of ones imagination.

Conclusions and Recommendations

This paper has considered IT students' views of IT as a field of study and work in an IT degree course in an Australian university. It has also considered the problems in the study environment that potentially contribute not only to the declining number of students, but also to the (inadequate) development of IT/IS skills required by new forms of organisations. The skills required by learning organisations and by those operating in virtual environments are the ability to be engaged in double loop learning, flexibility and adaptability to different forms of interaction in dynamic and continuously changing environments. The latter especially highlights the so called 'soft' communication skills needed to support interaction with staff of different cultural backgrounds in a variety of situations. However, our research highlighted problems in the learning environment that may inhibit appropriate skills development. We propose that the commonly held view of IT/IS skills as being focused on technical systems is inadequate and that IT/IS skills definition needs to be enlarged to encompass these skills as relating to the technical implementation of social systems. (Hirschheim, et al. 1987, 1995) However, students do not recognise the relevance of individual elements of IT studies to IT work. Even the students with a positive attitude towards IT/IS mostly described it as something around computers consisting of variety of a technical skills ("there is a little bit of programming, business and technology involved, but a lot of innovation developing new ideas and possibility to be artistic, eg with games and developing new and better ways of doing things") failing to specify the relevancy of such skills to IT work. The whole notion of IT/IS skills has to be redefined and to show the relevance all interested parties have to sit together and work out together to consider skills needed and how they should be developed. The IT&T industry is evolving rapidly at a speed which requires interaction

and actions among all interested parties - IT&T industries, government, and education departments - to meet the short-term and long term needs IT/IS staff, and to improve the provision of adequate skills. Before you submit your paper, check this list first.

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