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SHOULD IS MANAGEMENT COURSES PROVIDE "HANDS-ON" EXPERIENCE IN COMPUTER AND NETWORK INSTALLATION?

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Abstract

Recently a group of IS Management students attending an Australian university either studying, or had studied, e-commerce, networking or computer programming units in the Faculty of Business were interviewed whilst completing a questionnaire. These students were asked to express their opinion on a number of issues relating to their course. Some questions were asked using an open PC and associated equipment as a reference. Students were asked a range of questions about the setting up of Internet sites, LANs, including typical hardware and software requirements, costs and expected capabilities for a range of typical business scenarios. Significantly nearly all of the students interviewed thought that 'hands on' practical experience in computer networking and PC hardware would be either required by employers or would enhance their confidence as IT professionals, and should be included as a course component. Such experiences were not provided as part of their curriculum and these issues could be particularly relevant as IS managers are increasingly taking on responsibility for Internet implementation and need a good understanding of computer networks and their management. The suitability, importance and associated problems with 'hands on' components within IS Management and e-commerce units are considered.

Introduction

Recent years have seen an enormous increase in the number of university students enrolled on business IS and e-commerce units. Such units are often regarded as distinct from those in computer and network technology traditionally provided by computing science departments. It might be thought likely that computing science students would possess skills required in such areas as computer and network support. However, nearly all 3rd year computing science students investigated at Edith Cowan University (ECU) did not possess the skills demanded by employers in this field despite the fact that they had successfully completed all of their units (Maj et al, 1996). These findings are consistent with those of Nwana (1997) who noted that: *"Perhaps most worrying of all is the persistent view that computer science graduates are not suitable for some employers, who appear to distrust computer qualifications"*. The lack of student 'hands-on' skills in PC hardware and computer networks led to the development and successful introduction within the Computing Science department at ECU of two new units, Computer Installation & Maintenance (CIM) and Network Installation & Maintenance (NIM). Both units have been consistently oversubscribed and attract students from other faculties within ECU and from other universities within Western Australia. Both are single semester full credit units each with a weekly two-hour lecture and an associated two-hour 'hands-on' workshop. CIM and NIM have a significant 'hands-on' practical component and been successfully independently evaluated (Maj et al, 1996). Identical studies were undertaken on an international level and revealed a similar lack of 'hands-on' skills in PC hardware and computer networks(Maj et al, 1998). These findings led the authors to consider the possibility that a comparable situation could be occurring within IS Management courses. Such a possibility was given particular credence, as IS Management students from local universities were also enrolling in the CIM and NIM units. Research by Trauth et al (1993) had shown the existence of an expectations gap between IS Industry and the academic preparation undertaken by IS Students.

The Questionnaire

A questionnaire was designed to determine IS Management students' 'hands-on' skills, knowledge, and practical experience in computer networking, Internet and PC hardware and software, and their provision via the IS management units. Each questionnaire was completed as a part of an interview session that lasted between 20 and 50 minutes. Thirteen students participated who were on either undergraduate or graduate programmes. Some of the graduate students interviewed already held managerial positions and were upgrading their qualifications, whilst were engaged in employment and wished to move into IS management. A number of those interviewed either were, or had been, employed in the IS area and all were volunteers. Just under half (46%) of those questioned said that they had never opened a PC to replace parts, or that if they had it had not been successful. However, 3 students who had stated that their part replacement had been successful failed to note the use of an anti-static or ground strap whist taking the PC apart. Only 31% of students interviewed noted this requirement. Good workshop practice mandates the use of an antistatic strap or comparable measures. Managers in the field of business IT need to know this. Should these students have attempted replacing parts without any anti-static protection then there would have been good chance of damaging the PC. Such results are in line with findings from Maj et al (1996) who, whilst observing computer science students initially undertaking similar tasks, noted that *"Students who claimed to have prior experience in this field damaged more equipment than the novices. Clearly 'self evaluation' of skills is inadequate. It was found that students must be given the opportunity to repeat many of the tasks in order to acquire the necessary skills"* .

Questions were asked regarding their previous studies, IT related employment, and what sort of computer related skills prospective employers might want them to possess. When asked whether they considered that the IS Management units they had undertaken adequately prepared them to meet these employer expectations the answers given fell into two roughly equally sized groups. Within the group who answered 'yes' some noted that they were intending to seek a higher managerial level post that would require some background IS and IT knowledge although not at a high level of technical detail, or that their programming and web page authoring skills were sufficient. Students from the other group noted that the units that they had studied were useful and provided some of the 'hands-on' skills required by employers. However, this second group also expressed the opinion that there was a need for 'hands-on' practical skills in the area of networking, including Internet-working, the physical realities of putting together an actual working network, as well as the skills required to make changes within a PC. Asked whether their IS Management course should provide a practical component such as 'hands-on' workshops in networking and computer installation 77% of the all students interviewed replied that it should. These replies also included responses such as: *"employers are looking for such skills"* and *"I would feel more confident in the role of an IT professional"*.

Just over half those questioned (54%) responded that they could set up a simple Internet presence, i.e. a web presence only, for a company of less than 10 people (both hardware and software). However, a student working in the field noted that they thought it unlikely that students could achieve this task solely as a result of their IS Management units. Significantly 85% of all respondents thought that the IS Management curriculum should provide the opportunity for them to obtain the necessary theoretical and practical skills be able to do this task. This could be particularly relevant at the present time as IS managers are increasingly taking on responsibility for Internet implementation and need a good understanding of computer networks and their management. Some students had already undertaken similar tasks as part of their employment. When questioned about the installation and management of a more complex web interactive Internet presence, allowing information exchange, for a legal firm of about 100 staff only 15% thought that they had the necessary skills. It should be noted that there are many technical management issues associated with this case study eg distributed architectures, scalability, security etc. Of the students interviewed 69% thought that the IS Management curriculum should provide the necessary theoretical and practical skills and knowledge to enable them to be able to perform these tasks. Those disagreeing with the need for such provision cited reasons such as *"being too complex for the course they were undertaking"* , or *"specialists should do this work"*.

Student Concerns

Most of the students interviewed noted that there was a need for 'hands-on' experience in computer networking and PC hardware. Notably 3 students believed that such 'hands on' experiences could help to reinforce their theoretical understanding of the subject area. Such concern is in line with statements by Havard et al, (1998) *"The world of work requires people who 'know how and not just know what'. Graduates invariably fall into an 'information gap' of having knowledge about a specific subject area but do not necessarily know how to operate in the working environment"*. Whilst investigating job skill requirements from newspaper advertisements Todd et al, (1995) *"concluded that organizations are looking more to technical requirements in the hiring process"* cited by (Crook and Crepeau, 1997, pp.138).

Many undergraduates may not be aware of the needs of industry in their field of study. Havard et al (1998) has also noted that: *"On completion of their academic programme the graduate was given no way of knowing how their skills compared to the requirements of industry".* The results of a study specifically concentrating upon the perceptions of IS Students of the needs is the IS Industry found that: *"students are in remarkable agreement with employers"* (Mawhinney et al, 1995, pp.234). Furthermore, Dunn and Carson (1998) note that *"Higher Education, while vocationally orientated, is often viewed as focusing on theoretical bases of professional practice. However, contemporary graduates are required to be able to practice with effect as soon as they begin their profession".* An Australian government commissioned report entitled: *"Employer satisfaction with Graduate Skills"* noted specific problems in the IT and electronic communication area: *"In regard to course content, we found very few complaints by employers except in regard to more advanced areas of information technology and electronic communications"* (DETYA, 2000, pp.9). Whilst the MSIS 2000 Model Curriculum notes that one of its objectives is to *"overcome the skill shortage that exists and is expected to continue in the years ahead. Students graduating with an MS degree should possess enough skills that they can take responsible rather than entry-level positions and serve as mentors to people with lower levels of education"* and that *"to make students more employable students take a related set of courses reinforced by practical experience within information systems"* (Gorgone et al, 1999, pp.6). Another Australian Government commissioned report commenting the recruitment of new graduates also noted that employers *"recruit on the assumption that graduates have satisfied the academic requirements of each institution, thus allowing them to focus on the particular skills and attributes they believe are most essential for the particular work environment. Generally, employers emphasis skills and attributes which are more difficult to evaluate than academic skills"* (NEEB, 1995, pp.23). An earlier Australian government report had found that *"90% of employers surveyed indicated that they used academic results as part of their criteria to select new graduates and only 36% used previous job experience"* (NEEB, 1992, pp.14).

A large proportion of the students interviewed in our investigation had either undertaken or were undertaking the Business Studies Network Management unit. One student stated that this unit was *"very informative as to the physical realities associated with networks"*. Whilst another student noted that *"The unit failed to provide a description of the facilities provided by the Novell or NT network operating systems, neither did it include a discussion about their relative strengths and weaknesses"*. Notably one student interviewed stated that *"there were no practicals involved in assigning rights to users, or setting up new users on to a computer network".* A unit description stated that it *"will give students the skills and knowledge necessary for managing computer networks".* Further classification needs to be made regarding the level of expected of initial employment of undergraduate students upon graduation. Maybe this is predominantly at initial entry level? However, with respect to the postgraduate students the situation can be very different. One postgraduate student noted with respect to their units that: *"Postgraduate students are often employers themselves and quite often already in management roles."* And further that: *"I found, apart from the overseas students, most people in level 5 (Postgraduate) units were quite experienced in the management of IS/IT. They were either from the technical staff that had moved to management positions or managers who have had to take on the role of managing the resource. At that level of experience one tends to have a good idea of what one needs to know to make decisions."* With respect to the expected size of the enterprise that graduating students would enter they further noted that "It appeared to be assumed by the university that students would work for a large company and so not need to know how upgrade or set up a network as an IT manager. Whereas most businesses within Western Australia are Small to Medium sized Enterprises (SMEs)".

Such views are also in line with a paper entitled *"A profile for the IT manager within SMEs"* Gramignoli et al (1999, pp. 201) stated that *"the deeper the IT manager's technical knowledge, the more effective will be the end users training programme and day-by-day support".* And they further add that: *"Within SMEs the traditional IS management activity is often replaced by the management of the relationship with the technical partners: because of the shortage of IS dedicated staff, the IS design, implementation, and development are often outsourced. In such a context, in-depth technical knowledge is essential to correctly weigh up the technical validity of the partners' proposals".* The crucial importance of IS managers in assessing proposals is noted in the article by O'Brian (2000, pp.12) entitled *"SMEs blame suppliers for solutions failures"* he noted that *"Most feel let down by poor relationships, misleading advice and inadequate support"* He goes on to state that *"SMEs miss out on Internet opportunities because suppliers do not provide them with appropriate business solutions, according to a new report. 'Mind the Gap', compiled by the University of Durham Business School and IT solutions vendor Flexion Systems, revealed that more than three-quarters of the 300 SMEs questioned found relationships with their information and communication technologies (ICT) suppliers frustrating or disappointing"* Many large companies are out-sourcing their IT and IS department functions and their IS manager become contract and negotiation managers who require strong technical knowledge to control the out-source partner (Willcocks and Fitzgerald, 1996).

'Hands-on' PC and Computer Networking Skills for Business IT Students

The provision of 'hands-on' skills in computer networking, PC hardware and setting up internet sites, including hardware and software, can be both time consuming and expensive but could be vitally important in enabling students to at least gain entry level admission into many organizations. Without such skills students may not get that important first job in their field. Even if most students succeed in this aim under present conditions, should there be a downturn in demand then the additional possession of these skills could become a deciding factor in initial employment decisions. Exposing students to 'hands-on' experiences in PC networking and hardware could also enable them to participate more effectively in IT decisions in their employment, particularly as managers making decisions about IT/IS investment. One graduate student interviewed noted that on the programming unit students are informed that as managers in the IT field they needed to experience programming to aid their understanding of the processes involved, even though in the final analysis they would not become programmers. This student made the observation that similar reasons were not used when considering 'hands-on' experiences in the fields of PC hardware or networks. Furthermore, this student also stated that *"At university Business Management courses include at least one accounting unit. You don't teach a manager how to read a balance sheet or Profit & Loss without teaching them basic accounting principles. They need to understand fundamentals for good decision-making. So too it should be for computer and computer networking skills"*. Some students expressed a concern that they will need to incur additional expense immediately after completion of their Business IT course to order to gain practical experience and qualifications in the IT field from TAFE or a private provider. In Australia TAFE is a federally funded vocational education and training provider. Werner (1998) has noted that in South Australia more students went from university to TAFE than from TAFE to university. The increasingly popular trend of enhancing employment prospects via private training providers as an addition to higher education study, or as an alternative pathway, has been noted by Abelman (2000).

The CIM and NIM Units

The use of dedicated workshop and storage space demands a large allocation of resources compared to conventional IT laboratories, which will incur extra cost. Tutors are often postgraduate students who have previously attended the CIM and NIM units. A tutor must be present whenever students are using the 'hands-on' workshops for safety, insurance and legal reasons, as well as to help to prevent possible damage to equipment. The costs of student 'hands-on' damage to equipment and its replacement due to the rapid pace of technological advancement can be expensive. (Veal et al, 1999). Without sufficient time and money devoted to updating both lectures and 'hands-on' workshops, such units will become rapidly outdated. At a cost of AUS $20K the CIM unit has recently been updated to include upgrading equipment, Widows 2000 professional exercises in setting up peer to peer networking, security and resource allocations, a Linux dual boot installation, as well as a USB CAM, USB PC to PC Link and an internal USB port installation. The NIM unit now includes Windows 2000 Server workshops in addition its Novell based workshops.

A Business Studies student who had been a consultant to companies changing their financial systems, which also involved upgrading the computer and network infrastructure, stated that *"Personally I often have felt at the mercy of the computer technicians and suppliers, relying upon their, (often conflicting!) advice in order to make decisions about spending large sums of $$$. Hence units such as CIM and NIM gives me the basic understanding of what it is all about"*. Both the CIM and NIM were designed to be technical management units. In addition to forming part of the standard undergraduate options as first year full credit units within the computing science department at ECU they have been run as short intensive courses on a commercial basis.

The CIM and NIM workshops are based on standard PCs. Each two-hour workshop consists of a set of tasks for the student to undertake and all students undertake the same set of tasks in a given workshop. In the CIM workshops students are required to install and test a range of components such as, Master-slave hard disk drive; Network interface card installation; CD-ROM installation, etc. The CIM unit is often the first opportunity that many students have had to work with computer hardware. The problem of lack of training in observation techniques is also of initial concern as many students do not correctly note how a piece of equipment is put together before proceeding to take it apart. Allowance must also be made for students to acquire experience in applying correct levels of force and attainment of the manipulative abilities required in the assembly and disassembly processes. The use of decommissioned equipment for the first few workshops can help minimise the financial cost of initial mishaps. Students in the NIM unit have the opportunity to design, install and test a small Local Area Network (LAN). This includes establishing a file server, client, construction and testing of cabling, and the design and installation of the directory tree.(Veal and Maj 2000). The CIM and NIM unit workshops initially cost AUS $35K for the equipment plus the cost of technical support and a dedicated laboratory. In the subsequent unit, Computer System Management, students have the opportunity to install and test DVDs, a flat bed scanner, PC video camera, an infra-red communications link, and establishing and testing a video conference

communications link via a local area network. In this subsequent network unit more emphasis is put upon NT systems. These two units required AUS $60K in initial equipment costs plus the cost of technical support and a dedicated laboratory.

Within the CIM unit Safety & Health are important from a safety and a legal perspective as both employees and employers have legal responsibilities, which cannot be delegated. Students are given practical safety demonstrations as well as being informed and examined on the legal aspects of safety. Sets of multi-choice questions have also been trailed in an attempt to further extend student appreciation and understanding of safety issues.

Competency Based Assessments (CBAs)

The IS'97 Model Curriculum Guidelines note that: *"The basic idea is that graduates of IS programs should have competencies, skills and attitudes that are necessary for success in the workplace and life-long learning as an IS professional or provide the basis for graduate programs"* (Davis et al, 1997, pp. 37). Both CIM and NIM were designed to integrate theoretical understanding gained through lectures with practical exercises. Then assessment of 'hands-on' skills could prove to be a cause of concern for the staff involved. However, CBAs have been found to be to more suitable for testing aspects of students' 'hands-on' skills and knowledge than written assignments. Competency has been defined as *"The ability to perform in the workplace"* by Goldsworthy (1993). CBAs have been described as: *"an approach to establishing occupationally-relevant standards of competence. The emphasis is on demonstrated competence in the skills relevant to an occupation"* (DEET, 1992). Within a university context, CBAs are somewhat unusual according to Ashenden (1990) who observed that *"Training for many occupations is conducted in universities and colleges where the standards set often have more to do with educational or scholarly performance than performance as an engineer or doctor or accountant. It is in this context that the idea of 'competency assessment' has grown up"*.

Under a heading of *"Education v Training"* Denning (1998, pp. 17) noted that *"Learning the professional practices of a specialty of information technology is every bit as important as learning the intellectual core of computing. The mark of a well-educated professional will be a balance of the two, earned perhaps through partnerships and training companies. The current academic inclination to distain skill-specific training does not fit a profession"*.

However, the intended use of CBAs within the CIM and NIM units is not to supplant but to supplement the more conventional means of student assessment. The importance of measuring practical skills and especially associated safety skills and awareness can seen from the following:

"Students' theoretical understanding and knowledge on the CIM and NIM units are assessed via a conventional three-hour end of semester written examination and two written assignments. The students were assessed during a standard two hour workshop. The work was conducted in a normal manner with the assessor independently evaluating students. At no point was the workshop interrupted, or extra time taken. Ten students were evaluated. Despite the fact that considerable emphasis is placed on ensuring that students are provided with the highest possible standard of good workshop practices to underpin Health & Safety the results clearly indicated that some students did not demonstrate a satisfactory competency in basic safety practices. It would not have been possible to determine this result without a CBA" (Veal et al, 1998).

Were such "hands-on" units as described above to be included in IS management courses then the time spent on this provision would need to come from somewhere else in the curriculum. The updating of curricula knowledge often leads to similar situations where topics must be changed if courses are to remain relevant. The resultant 'per unit' cost of providing these 'hands-on' experiences to large number of students, for example 200, would be considerably diminished due to economies of scale as each weekly workshop provision still requires the development of only one set of exercises and associated equipment to be used in the same dedicated laboratory. A potential downside of increasing student numbers on such units is that workshop equipment is also be more likely to suffer from the effects of increased usage as has been recently discovered on the CIM unit which has now has 125 currently enrolled students.

Conclusions

Most of the business IT students who volunteered to be interviewed noted that employers would expect 'hands-on' practical skills such as upgrading computer hardware, and network implementation but did not think that their course had provided them with these experiences, although they thought that their course was worthwhile and provided some useful 'hands-on' IT skills in the form of programming and web authoring. The authors made no attempt to rank the relative importance of these topics, as understood by the students, although this will be undertaken during further investigations.

Due to the limitations of a single investigation with only 13 participants in a business faculty of a single university in one country these results, though certainly cause for attention, does not constitute a definitive study. More extensive investigations need to be undertaken to determine both the source of student concern about employer exceptions and their extent. It is vital to interview potential IS management employers to determine their expectations regarding the 'hands-on' skills and experiences highlighted in this paper. Should it subsequently be found that most IS students and employers believe that such "hands-on" experiences are important then such findings should be regarded as a significant factor for serious consideration of their inclusion in future curriculum provision. Setting up 'hands-on' workshops in computer networking and PC hardware can be expensive over and above the general demands of more conventional IT or IS units. CBAs can offer a means to efficiently and meaningfully assess 'hands-on' skills. Workshops in PC hardware present additional problems such as Safety & Health implications and possible damage to equipment. However, the potential benefits could result in students graduating from IS and business IT courses with a wider range of skills and abilities within their field leading to improved employment prospects. Furthermore, enhanced faculty reputation amongst both potential students and potential employers could derive from the additional provision of 'hands-on' skills and experiences in the vital areas of networking and PCs. The IS and Business IT fields are changing rapidly whilst changes in unit provision can take a relatively long time to bring on stream. A potential scenario resulting from the omission of such 'hands-on' provision, or from leaving their introduction too late, is that students along with reputations could go elsewhere.

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