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Student perceptions of skill acquisition during undergraduate Information Systems studies – report of work in progress.

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Abstract

To explore the possible reasons for declining numbers of student registrations in tertiary education programmes in Information Systems, a questionnaire was administered to final year students in a South African and a New Zealand university. Student perceptions of skills development during the tertiary educational experience, the time and effort required to obtain those skills, and the relative importance of those skills were explored. Using Spearman's rank-correlation procedure, it was found that there was considerable agreement on the skills acquired and the importance of those skills, with lesser agreement on the time and effort spent on obtaining those skills.

Keywords

Information systems, skills perceptions, tertiary education programmes.

INTRODUCTION

A decline in student registrations for Information Systems and Electronic Commerce programmes (Scott (2003) and Johnston (2003)) could have its roots in any number of different causes. It may reflect skepticism about the continuing role of Information and Communications Technologies (ICT) in driving economic growth. To explore possible causes of this decline in enrolments, it was considered that the perceptions of students who have been through the relevant Information Systems degree courses could provide crucial insights, and assist curriculum developers to tailor their offerings accordingly.

While surveying the perspectives of students in one institution may be enlightening, comparing their responses with those of students at a different institution in a different country could have significance for curriculum planning and development, for an understanding of common perceptions about the core elements of the discipline, and perhaps even implicit agreement internationally about the core contents of undergraduate curricula in Information Systems. Furthermore, using the same instrument to survey past graduates now practicing their careers in the marketplace would similarly help enrich the perspective.

Accordingly, this investigation compares the perspectives of final year undergraduates at two universities in two different southern hemisphere countries about the skills they acquired from the core elements of the information systems curricula. It is designed to compare student perceptions of the skills acquired with the importance of those skills in terms of the time and effort put into their acquisition.

LITERATURE REVIEW.

Student perceptions are likely to vary according to the skills emphasis that is implicit in the curriculum design of the programme for which they register. So, what is taught will determine the amount of time students spend on any specific skill development process and this in turn leads on to determine which skills students consider to be important. Curriculum development will also be sensitive to student perceptions of what is importance, creating a cyclical process and therefore the likelihood of a high degree of homogeneity in perceptions within any single cohort of students. In addition, some institutions may have a more technological rather than managerial orientation and their students will see those aspects as being of greater importance.

The question is whether there is a standard bill of fare with which one can compare the course offerings and emphases of different IS schools. In a recent article, Benbasat and Zmud (2003, p184.) maintain that " .. a dominant

design for the IS discipline has yet to be realized" and that "the core phenomena being explored through IS scholarship .. remains amorphous," and finally, that "topical diversity can, *and has*, become problematic *in the absence of a set of core properties*, or central character, that connotes in a distinctive manner, the essence of the IS discipline." (Benbasat & Zmud, 2003, p 185)

On the other hand, Lee, Koh, Yen & Tang, (2002) record that "Many researchers report persistent gaps (from a moderate to a very serious level) between knowledge skills that are taught in academia and those that are demanded by the IS industry." (Lee, Koh, Yen & Tang, 2002, p51). Quoting a range of researchers over a period from 1972 to 1996, Lee *et al*, (2002) maintain that many researchers "report persistent gaps (from a moderate to a very serious level) between knowledge skills that are taught in academia and those that are demanded by the IS industry." (Lee, *et al*, 2002, p51). And that "there is no generally accepted classification of IS knowledge/skills nor is there consensus on which knowledge/skills are the critical ones and some are more important than others in the IS profession." (Lee *et al*, 2002, p 52).

Attempts have been made to create IS/IT curricula with the assistance of the industry (Couger et al., 1995; Ehie, 2002; Gonzenbach, 1998; Gorgone et al., 2002). Important as these initiatives are, the rapidly changing technologies on which they are based leave them in constant need of revision every two or three years. In the same way, new IS skill areas such as m-commerce and IT security can manifest a demand in the job marketplace long before universities can equip themselves to respond.

Due to the wide range of skills and technologies involved, combined with rapid changes in related emerging technologies, agreement on topics for Information Systems curricula is elusive. To some extent the dedicated work done by the Association of Information Technology Professionals (AITP, 1997), Couger et al., (1995), Ehie, (2002), Gonzenbach, (1998) and Gorgone et al., (2002) in developing model curriculum has helped shape a set of standards that create international comparability of Information Systems programmes and educational outcomes. Nevertheless there appears to be no agreement on the "essence of the IS discipline" (Benbasat & Zmud 2003), nor "an accepted classification of IS knowledge/skills" nor "consensus on which knowledge/skills are the critical ones" (Lee *et al* 2002). Several authors have provided different ways of categorising IT skills for research purposes (Lee, Trauth, & Farwell, 1995; Leitheiser, 1992; Liu et al., 2003; Tang et al., 2001; P. Todd et al., 1995). They all share a common differentiation – they can be broken down into two basic categories: soft and hard skills (Byrd & Turner, 2001).

Quoting several authors' attempts to classify IS knowledge, Lee *et al* (2002, p 53) developed a tabulation of the items of core IS knowledge/skills derived from an analysis of the writings of those authors justifying each skill or knowledge item in each category. (See Table 1 below.)

Category	**Items**
IS core knowledge	*IS management:* visions about IS/IT competitive advantage and knowledge of IS technological trends *IS technology and development:* hardware, software (packaged products, operating systems, networking/communication software, and programming languages), and systems development and maintenance (systems analysis/design/development methodologies/approaches)
Organization and society	Specific function areas, specific organizations, specific industries and general environment.
Interpersonal	Interpersonal behaviour, interpersonal communication, international communication ability, teaching and training skills
Personal traits	Personal motivation and ability to work independently, creative thinking, critical thinking.

Table 1. Items of core IS knowledge/skills (from Lee *et al,* 2002, p53.)

A comparative examination of Table 1 with the "core properties" identified by Benbasat & Zmud (2003) above reveals a considerable commonality between with those of the other writers studied by Lee *et al*. As they stated "the lack of a common classification taxonomy and terminology made the job of constructing our survey instrument difficult and the authors had to rely on sampling question items from several sources as well as on the authors' own knowledge." (Lee *et al* (2002), p 53) However this argument is considered, it would appear that as long as the

survey instrument contains the elements of categories and items identified in Table 1 above, and as long as the instrument is applied consistently between the variables identified (academics and practitioners in the case of Lee *et al*) then a comparison of the findings could be considered acceptably indicative.

In a study at the University of Cape Town (UCT), Hildebrand *et al* (2002) derived an instrument to establish a comparison between the skills taught at the University of Cape Town (UCT) and to compare them internationally (Hildebrand *et al* 2002, p 11). In developing their instrument, they constructed the following tabulation of skill categories. (Hildebrand *et al*, 2002, p 5)

Skill	**Description**
Business	Business analysis and business knowledge
Communication	Written and verbal communication
General IS skills	Operating Systems, IS concepts
Specific IS skills	Technical Software Development skills
General	Analytical thinking, decision-making
People/organization management	Teamwork, motivation
Project Management	Planning, budgeting, measuring

Table 2: Systems development skills categories (from Hildebrand, *et al,* 2002)

These were then broken down into eight categories with several sub-categories in each to define the component parts of the relevant knowledge/skills to be studied. To ensure a common understanding of the scope of the questionnaire a brief description of each category and its sub-component items was indicated as shown in Appendix 5.

The skills and descriptions used by Hildebrand *et al* (2002) fit comfortably into the categories and items described in Lee *et* al (2002). This is shown in Appendix 1 that tabulates Lee *et al*'s categories against those of Hildebrand *et al* and then identifies the relevant sections in the questionnaire. In this way, the core elements of the discipline had been addressed and described, and accorded to the broad components subsequently identified by both Benbasat & Zmud, (2003) and Lee *et al,* (2002). The concern expressed by Lee *et al* about "the lack of a common classification taxonomy and terminology" for IS knowledge and skills is eliminated by ensuring a common understanding by describing the scope and coverage of each question to the students completing the questionnaire. Thus, however the specific courses were described in each curriculum in each university, the topic description in each question defined the concept concerned. The instrument used is available at Appendix 5.

Accordingly, the questionnaire derived by Hildebrand *et al* incorporated all the core elements determined by Lee *et al* and allowed a comparison to be made between the level of skill development or knowledge acquired, the time/effort spent in that acquisition, and the student's perception of the importance of that knowledge or skill. Furthermore, the instrument lent itself to administration in class as it could quickly and easily be completed by the students concerned, and collected up afterwards. In addition it ensured anonymity for participants, especially when administered in the large group situation of an initial lecture.

RESEARCH OBJECTIVES

The overall objectives of the study were as follows:-

1. to identify the students' perceptions of their own knowledge and skills levels developed during their undergraduate education;
2. to identify which they considered were the most important;
3. to identify whether the amount of time/effort they considered they had put into the process of acquiring that knowledge or skill corresponded to the perceived importance.
4. to compare the results obtained from applying the same survey instrument to final year students in two universities.

METHODOLOGY

The questionnaire was initially administered to 203 third year Information Systems students at the University of Cape Town in July 2002. To ensure good response rates it was decided to make the hand in of the completed questionnaire compulsory to all students. The mentor approved this approach and the students submitted the completed questionnaire with their next assignment. (Hildebrand *et al*, 2002)

In New Zealand, the instrument was administered to a class of 80 third year electronic commerce students at Victoria University of Wellington in the first lecture of the first trimester of 2003. All the students were in their final year of study and had at least two years of study in information systems and/or electronic commerce to have been accepted for the ELCM 303 course. An indeterminate, but comparatively small, number of the respondents were at VUW on an international exchange programme whereby they obtained credit for their degrees at other universities by spending a specified time in New Zealand. Nevertheless, the questionnaire in Appendix 3 was considered sufficiently comprehensive as well as generalisable for a wide range of information systems education to gain comparable and indicative data. Although not all the students completed all the questions, the data provided in all questionnaires was captured and formed the basis of the analysis.

DATA ANALYSIS

Using the five point Lickert scales a mean was calculated for each section of the questionnaire. The skills were ranked according to the mean value for each skills category indicating "the extent that the students perceived that they had gained or developed" those skills as a result of their university education.

1. Student perception of their skill development in rank order (Appendix 2)

Whatever the academic objectives considered as important when the VUW curriculum was first determined, the students perceive that their team or group work skills and the communication skills associated are the most developed. What is even more interesting, perhaps, is how little they consider they have developed technical skills in such categories as object-oriented programming, data-access, debugging and error-trapping, network communications, systems security and client server architectures. That perception makes a clear statement about "soft" skills development as opposed to the development of the "harder" technical skills that one would associate with a degree in information systems. Part of that statement is the significance attached to business understanding and business analysis skills, possibly gained outside of the IS and electronic commerce courses themselves. AT VUW these were considered to be much more important than their UCT counterparts, whereas systems analysis, database structures and data access issues were perceived by the UCT cohort to be much more important than by the VUW students.

Nevertheless, the Spearman rank-correlation shown in Appendix 6 demonstrates that there is strong association between the perceptions of the UCT and the VUW students about the skills they have acquired during their studies. Irrespective of the variations in teaching methods and individual course content between the two universities, the end results show that there is significant agreement in the skills the students have acquired by the time they have reached their graduating year.

2. Skills category ranked by student perception of the time and effort taken to acquire those skills. (Appendix 3)

The second analysis related to the amount of effort or time that the students perceived themselves to have invested in the development of different categories of skills. Again, with slight changes in ranking, the "softer" skills of teamwork and communications were perceived by VUW students to have demanded the most effort, with project management, modeling and systems analysis following closely. Down at the bottom of the table, we again find object-oriented programming, data-access, debugging and error-trapping, network communications, systems security and client server architectures. It would appear that these skills have not been developed either because not enough time was spent acquiring them or enough time was allocated to them during the teaching programme. That may be indicative of the emphasis placed on these technical aspects in the curriculum or in the course structure.

At UCT on the other hand, there is much less emphasis placed on communications skills, especially on the verbal skills. Significantly, UCT recognizes the importance of general programming, whereas VUW students rate that much lower. Overall, the Spearman rank-correlation shows a lower level of agreement of 0.563 as opposed to 0.703 for the previous "skills development" category. Clearly time and effort are allocated to the acquisition of different skills in the two universities – reflective, no doubt, of different curricular structure and emphasis.

3. Skills category ranked by student perception of importance (Appendix 4)

Skills categories that the students perceive as most important or least important would normally be expected to correlate with those on which most time was spent, or in which the students considered that they had developed the most. While group work and communications skills remain at the top of the table, for VUW students, their ranking has been disturbed slightly by the injection of project management and business understanding. Down at the bottom of the table debugging and error-trapping, prototyping, systems design, data-access, network communications, object-oriented programming and client server architectures languish unappreciated. Systems security has gained some recognition for being important even though the students perceive themselves as not having significant skills in that area, nor of having spent much time on the topic.

The greatest difference between the UCT and VUW students lies in their perceptions of the importance of business understanding and feasibility analysis. Nevertheless, the Spearman's rank-correlation procedure shows a figure of 0.641 demonstrating some overall correlation between the perceptions of students in both universities about the importance of the topics, although not as much as in Appendix 6.

CONCLUSIONS

This exploratory study of student perceptions provided a quick way of obtaining student insights at a time when registrations for information systems and electronic commerce courses were declining. From the questionnaire and tabulations it can be seen that the research core is different from the core teaching topics. However, it is considered that there is sufficient explanation of the scope of each question for any differences or misunderstandings to be eliminated.

Of course, student perceptions are likely to vary according to the skills emphasis that is implicit in the curriculum design of the programme for which they register. So, what is taught will determine the amount of time students spend on any specific skill development process and this in turn leads on to determine which skills students consider to be important. Curriculum development will also be sensitive to student perceptions of what is importance, creating a cyclical process and the likelihood of a high degree of homogeneity in perceptions within any single cohort of students. In addition, some institutions may have a more technological rather than managerial orientation and their students will see those aspects as being of greater importance. It is important to note that the technological component of the curriculum is likely to change most as the technology changes and develops.

There is a greater degree of correlation and therefore agreement on student perceptions of the skills they have developed than between their perception of the time and effort they spent on acquiring those skills. Similarly, there is a greater correlation and therefore agreement on the importance of the skills acquired. From this it can be concluded that despite their different educational experience there is significant agreement between the students at the University of Cape Town and the Victoria University of Wellington on the level of their IS skills acquisition and the importance of those skills.

Of course one could expect a high degree of homogeneity in responses among students coming from the same organization. The reason for this is the expectation that they will have absorbed the emphases placed upon the topics for study as determined by the curriculum. What would be interesting is if there was significant correlation between students from the same universities over equal periods of time, despite the difference in emphasis, style and overall content. The next step will be to continue this comparison over a period of years.

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APPENDICES Appendix 1: Categories of Lee *et al* (2002) and Hildebrand *et al* (2002) combined

Category	Items	Skill	Description	Questions
IS core knowledge	*IS management:* visions about IS/IT competitive advantage and knowledge of IS technological trends *IS technology and development:* hardware, software (packaged products, operating systems, networking/communication software, and programming languages), and systems development and maintenance (systems analysis/design/development methodologies/approaches)	General IS skills Specific IS skills	Operating systems, IS concepts, technical software development skills	Section 2. Q 2-3 Section 3 Q1-3 Section 4 Q 1-5 Section 5. Q1-2 Section 6 Q 1-2
Organization and society	Specific function areas, specific organizations, specific industries and general environment.	General Project Management	Business analysis and business knowledge. Planning, budgeting, measuring	Section 1 Q 1 Section 1. Q3 Section 2 Q1
Interpersonal	Interpersonal behaviour, interpersonal communication, international communication ability, teaching and training skills	Communication	Written and verbal communicatio n	Section 7 Q 2-3
Personal traits	Personal motivation and ability to work independently, creative thinking, critical thinking.	People/organiza tion management	Analytical thinking, decision-making Teamwork, motivation	Section 1 Q2 Section 7 Q1 Section 8

Appendix 2 Spearman's rank correlation of student perceptions of skills development

Skill	UCT Mean	UCT Rank	VUW Mean	VUW Rank	d	d2
Team / Group work	**3.87**	1	**3.74**	**1**	**0**	**0**
Systems Analysis	**3.7**	2	**3.11**	**9**	**-7**	**49**
Database structures	**3.67**	3	**3.08**	**11**	**-8**	**64**
Business Analysis	**3.63**	4	**3.22**	**5**	**-1**	**1**
Modelling / Diagramming	**3.62**	5	**3.15**	**7**	**-2**	**4**
Database Relationships/normalisation	**3.61**	6	**3.16**	**6**	**0**	**0**
Data-Access	**3.6**	7	**2.54**	**18**	**-11**	**121**
Written communication skills	**3.54**	8	**3.48**	**2**	**6**	**36**
Verbal communication skills	**3.52**	9	**3.44**	**3**	**6**	**36**
Graphical User Interface (GUI) design	**3.51**	10	**3.04**	**12**	**-2**	**4**
Project Management	**3.44**	11	**3.15**	**7**	**4**	**16**
System design	**3.43**	12	**2.81**	**15**	**-3**	**9**
Specific business knowledge	**3.4**	13	**3**	**13**	**0**	**0**

Business understanding	**3.4**	14	**3.23**	**4**	**10**	**100**
General Programming	**3.32**	15	**2.72**	**16**	**-1**	**1**
Feasibility Analysis	**3.28**	16	**3.1**	**10**	**6**	**36**
Debugging / Error Trapping	**3.2**	17	**2.34**	**19**	**-2**	**4**
Prototyping	**2.96**	18	**2.87**	**14**	**4**	**16**
Network Communications	**2.84**	19	**2.33**	**20**	**-1**	**1**
System Security	**2.78**	20	**2.29**	**21**	**-1**	**1**
Client-Server	**2.64**	21	**2.24**	**22**	**-1**	**1**
Object Orientated	**2.59**	22	**2.57**	**17**	**5**	**25**
Sum						**525**
n						**22**
rs						**0.703557312**

Appendix 3 Spearman's Rank-correlation of student perception of time and effort spent in skill development

Skill	**UCT Mean**	**UCT Rank**	**VUW Mean**	**VUW Rank**	**d**	**d^2**
Modelling / Diagramming	3.62	1	3.23	5	**-4**	**16**
Team / Group work	3.61	2	3.59	2	**0**	**0**
General Programming	3.6	3	2.95	15	**-12**	**144**
Systems Analysis	3.57	4	3.21	6	**-2**	**4**
Business Analysis	3.44	5	3.16	11	**-6**	**36**
System design	3.44	5	2.96	14	**-9**	**81**
Written communication skills	3.43	7	3.63	1	**6**	**36**
Data-Access	3.41	8	2.73	17	**-9**	**81**
Business understanding	3.31	9	3.2	7	**2**	**4**
Developing database structures	3.3	10	3.18	10	**0**	**0**
Project Management	3.27	11	3.26	4	**7**	**49**
Debugging / Error Trapping	3.27	12	2.49	19	**-7**	**49**
Database Relationships/normalisation	3.25	13	3.2	7	**6**	**36**
Specific business knowledge	3.22	14	3.06	12	**2**	**4**
Graphical User Interface	3.22	14	3.19	9	**5**	**25**
Verbal communication skills	3.21	16	3.45	3	**13**	**169**
Feasibility Analysis	3.03	17	3.03	13	**4**	**16**
Object Orientated	2.83	18	2.73	17	**1**	**1**
Client-Server	2.78	19	2.34	22	**-3**	**9**
Prototyping	2.72	20	2.82	16	**4**	**16**
Developing System Security	2.67	21	2.38	21	**0**	**0**
Network Communications	2.65	22	2.43	20	**2**	**4**
Sum						**780**
n						**22**
rs						**0.559570864**

Appendix 4 Spearman's Rank-correlation of student perception of importance of skills developed

Skill	UCT Mean	UCT Rank	VUW Mean	VUW Rank	d	d^2
Team / Group work	4.2	1	4	4	**-3**	**9**
Systems Analysis	3.94	2	3.66	10	**-8**	**64**
Project Management	3.93	3	4.01	1.5	**1.5**	**2.25**
Developing database structures	3.9	4	3.77	7	**-3**	**9**
Verbal communication skills	3.89	5	3.99	5	**0**	**0**
Written communication skills	3.85	6	4.1	1	**5**	**25**
Debugging / Error Trapping	3.85	7	3.51	16	**-9**	**81**
Database Relationships/normalisation	3.84	8	3.7	9	**-1**	**1**
Business Analysis	3.83	9	3.73	8	**1**	**1**
Data-Access	3.8	10	3.39	19	**-9**	**81**
General Programming	3.8	11	3.52	15	**-4**	**16**
Business understanding	3.78	12	4.01	1.5	**11**	**110.25**
Modelling / Diagramming	3.75	13	3.57	12	**1**	**1**
System design	3.7	14	3.42	18	**-4**	**16**
Specific business knowledge	3.68	15	3.63	11	**4**	**16**
Developing System Security	3.59	16	3.56	14	**2**	**4**
Graphical User Interface	3.57	17	3.57	12	**5**	**25**
Feasibility Analysis	3.53	18	3.85	6	**12**	**144**
Object Orientated	3.44	19	3.31	21	**-2**	**4**
Network Communications	3.36	20	3.38	20	**0**	**0**
Client-Server	3.34	21	3.13	22	**-1**	**1**
Prototyping	3.16	22	3.49	17	**5**	**25**
Sum						**635.5**
n						**22**
rs						**0.641163185**

Appendix 5 Questionnaire administered to VUW and UCT students (Hildebrand, *et al,* 2002) on next page

GENERAL BUSINESS	Skill Development					Time/Effort					Importance				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Specific business knowledge Knowledge of specific areas of business (e.g Accounting, Finance, Law, HR)															
Business understanding Strategic thinking, decision-making, understanding of business principles															
Feasibility Analysis Determining the feasibility or viability of a proposed system (e.g. SWOT or Cost Benefit analysis)															

ANALYSIS	Skill Development					Time/Effort					Importance				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Business Analysis Analysing business problems (e.g. context, business areas)															
Systems Analysis technical analysis of problems (e.g. process modelling, data flow modelling)															
Modelling / Diagramming Modelling or diagramming of a proposed system's scope, processes and data flows.															

DESIGN	Skill Development					Time/Effort					Importance				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Graphical User Interface (GUI) design Designing a graphical interface/layer with which the user interacts															
System design Design of components or modules that make up a system or program (e.g. systems architecture)															
Prototyping Using prototypes or example programmes to design a system															

PROGRAMMING	Skill Development					Time/Effort					Importance				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
General Programming General programming skill															
Object Orientated Programming with components, objects and classes (e.g. properties and methods)															
Client-Server Programming client-server applications															
Data-Access Connecting to / manipulating databases from programming platform (e.g. SQL, ADO, DAO, RDO)															
Debugging / Error Trapping Finding and eliminating bugs and errors in the program															

DATABASE	Skill Development					Time/Effort					Importance				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Developing database structures Developing database tables, queries etc															
Database Relationships/normalisation Developing relationships between tables and reducing data redundancy															

DATA COMMUNICATION	Skill Development					Time/Effort					Importance				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Network Communications Setting up and configuring physical networks															
Developing System Security Programming and managing system security (e.g. user access,integrity, virus protection etc)															

INTERPERSONAL	Skill Development					Time/Effort					Importance				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Team / Group work The ability to work in a team and communicate with team members															
Verbal communication skills Interviewing, negotiation and presentation skills															
Written communication skills System documentation, incl. reporting on user requirements, system design, user manuals, help doc.															

PROJECT MANAGEMENT	Skill Development					Time/Effort					Importance				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5