An Investigative Study on the `Relevance' of Computing Courses at the National University of Samoa (NUS) to the Needs of Industry and the Workplace

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The research documented in this paper attempted to answer the question: How relevant is the content of the computing courses offered within programmes of the Computing Department at the National University of Samoa, to meet the needs of industry and the workforce? The study which was conducted in 2007 to 2008, surveyed seven institutions and 11 graduates from the aforesaid computing programmes. Findings from the survey indicated that the current course offerings within the Computing Department are relevant to the needs of industry and the workplace. However, there are aspects or topics which need inclusion or better coverage. Recommendations for potential areas for future research include: a) more sensitive surveys to assess more specific details of topics needing coverage or more in-depth coverage; b) the need for this type of research to be conducted on a regular basis to ensure alignment between the needs of industry and the workplace and the university curricula.

INTRODUCTION

The research documented in this paper attempted to answer the question: How relevant is the content of the computing courses offered within programmes of the Computing Department of NUS to meet the needs of local industry and the workforce? The current computing curriculum at the national university offers courses in the areas of computer applications, computer programming and information systems as part of a Certificate, Diploma or Bachelor's degree in computing. The department also offers service courses in computing to other faculties within the university. The computing curriculum is in its early stages of development. Starting in 1994 with a Certificate of Computer Studies and then a Diploma and Bachelor of Science majoring in computing in 2000, the programmes have netted 217 graduates since first introduced. The current situation has established a need to develop a content and pedagogical framework for the teaching of computer courses within the university. The goal was that the outcomes of this research would provide information about the relevance of the current content within the curricula and can be applied within the context of improving our course offerings within our programmes.

Another major issue and concern is the need to avoid obsolescence and adapt to changing needs within the industry. Information Communication Technology (ICT) is a field which is dynamic and rapidly changing (Tucker 1996). Thus there is a need to continually revise and update the computing courses offered by the department to avoid obsolescence and also to align with the needs of industry and the workforce. This need to align our courses with the needs of industry is well articulated within the following documents: The faculty response to the Faculty External Review Report, The Computing Department Corporate Plan 2006-2009 and the National ICT Strategic Plan.

For the current research, relevance is defined in terms of whether the computing skills and knowledge acquired by students from our courses can be effectively utilised to fulfil their occupational responsibilities.

The motivation to undertake this research arose from an interest in the effectiveness and relevance of the programmes offered by the Computing Department in order to meet the needs of industry and society. Members of the research team were all lecturers within the Computing Department at NUS. The study which was conducted in 2007 to 2008, surveyed seven institutions and 11 graduates from the computing programmes. The small number of participants is due to the fact that this is a recently established programme.

OBJECTIVES

The main objective of this research was to determine the relevance of computing courses offered within the computing programmes by the Computing Department of NUS to the needs of local industry and the workplace.

HYPOTHESIS

The research hypothesis was stated as follows: The Computing Department believes that their courses are relevant to the needs of the industry and the workforce.

LITERATURE REVIEW

Computer science is an enormously vibrant field. From its inception just half a century ago, computers have become the defining technology of our age. The field, moreover, continues to evolve at an astonishing pace and as new technologies are introduced, existing ones become obsolete almost as soon as they appear (CC2001 Report 2001).

It is frequently suggested that computer science curricula are generated by computer scientists in a vacuum with little or no regard for the 'real-world needs' of the student's ultimate employer. Members of the academic and industrial communities are continually discussing the issue of the gap between the training computer science graduates receive in academic institutions and the background industry and commerce requires of its new employees in computing related positions. Such discussions generally fall into one of two categories: (i) descriptions of the gap, and (ii) curriculum descriptions.

(i) Descriptions of the gap

Discussions are frequently held at educational technology conferences and workshops which attempt to characterise the gap by describing industry's needs and evaluating computer science curricula with respect to meeting these needs. The resulting descriptions of this gap are usually stated in rather broad terms, such as: computer science graduates cannot solve large, `real world' computing problems, adequately document their work, or function well as members of a team.

(ii) Curriculum descriptions

Many articles exist in the computing education literature (CC2001 Report 2001) which describe new courses, usually of the work/study or internship variety, and which attempt to bridge the academic/industry gap. The emphasis in such courses is usually not on a

particular area of computer science (such as operating systems) but rather on the areas mentioned above, that is, `real world' problems, such as documentation, and team work.

Computer science education too often focuses on individual contributions rather than on managed group efforts that depend on defined standards, methodologies and software processes. However, such group efforts are the norm in the software industry. New graduates often know little about what are regarded as `best practices' in the software engineering profession. This problem of inadequate preparation of current graduates is further intensified by the increasing demand for software engineers and other computing professionals (Hilburn, Mengel, Bagert & Oexmann 2001).

In the 2003 External Review of Computing courses at NUS, (FOS External Review Report 2003) the main aim was to revamp course offerings so that they were better aligned with the needs and requirements of the workplace and industry (Faculty of Science External Review Report 2003). Hence the focus was on closing the gap between curricula and industry requirements. The need to provide graduates with the ability to solve `real world problems' and engage in team work was identified as a priority. For example, the Java reader was rewritten so that all programming tasks were situated within the systems development life cycle to provide real world context to programming tasks within the Java programming courses. In the courses within the information systems strand, projects were implemented as part of teams, again with the aim of providing real world context. Projects were also aimed at providing local context and examples for concepts which in reference texts always had overseas examples and settings.

Furthermore, in addition to the issues previously raised, the question has recently been raised whether computer science programmes should prepare their graduates to be `tool users' or `tool builders'. A classic example of this is the creation of websites which can be created using tools such as present in software such as Dreamweaver and Publisher or alternatively can be created or built by programming using languages such as Javascript, Java and HTML.

The changes which have affected the computer science curricula over the last decade can be perceived as either technical or cultural. Technical advances over the past decade have increased the importance of many curricular topics, such as the following:

- The World Wide Web and its applications;
- Networking technologies, particularly those based on TCP/IP;
- Graphics and multimedia;
- Embedded systems;
- Relational databases;
- Interoperability;
- Object-oriented programming;
- The use of sophisticated application programmer interfaces (APIs);
- Human-computer interaction;
- Software safety;
- Security and cryptography, and;
- Application domains.

As these topics become increasingly important, it is tempting to include them as undergraduate requirements. Unfortunately, the restrictions of most degree programmes make it difficult to add new topics without taking others away. It is often impossible to cover new areas without reducing the amount of time devoted to more traditional topics

whose importance has arguably faded with time. The CC2001 Task Force has therefore sought to reduce the required level of coverage in most areas so as to make room for new areas (CC2001 Report 2001).

Computing education is also affected by changes in the cultural and sociological context in which it occurs. The following changes, for example, have all had an influence on the nature of the educational process:

- Changes in pedagogy enabled by new technologies,
- The dramatic growth of computing throughout the world,
- The increasing economic influence of computing technology,
- Greater acceptance of computer science as an academic discipline and,
- Broadening of the computer science discipline.

METHODOLOGY

The current research is investigative in nature. The intention was to attempt to survey all NUS computing graduates currently working in Samoa. However, due to time constraints, the research team only surveyed those employed in `Upolu. In the end the team were able to obtain responses from 12 NUS computing graduates working in eight different institutions in urban Apia. The Bachelor of Science (BSc) programme is relatively new with the total number of graduates employed in the workplace of 17. Hence, we were able to survey 70 per cent of the total population of BSc computing graduates. Relevance was measured by evaluating: (i) the perceptions of employers of the institution and, (ii) the perceptions of NUS computing graduates and current students employed in these institutions.

For each institution, surveys were distributed to NUS computing graduates and/or current students. A letter of consent accompanied each survey questionnaire and was sent to each participant. Participants were asked for their consent and were assured of the confidentiality of the information provided in compliance with the ethics guidelines as set out by the University Research and Ethics Committee (UREC).

DATA COLLECTION

Data collected was both factual and attitudinal. The two questionnaires consisted of some open ended questions and mostly Likert scale type questions. In the Likert scale type questions responses were typically:

1 = daily 2 = weekly 3 = monthly 4 = never Or
1. not covered 2. not relevant 3. relevant 4. very relevant

Section A collected general information such as personal data (age, gender and year of graduating) but also collected institutional data such as goals of the organisation, types of systems used within the institution as categorised within the three areas of information technology, namely; data processing systems, office automation and telecommunications.

Section B collected data on the frequency of usage of the various technologies such as communication technologies, computer applications, information systems, computer programming software, and equipment such as videoconferencing, hand-held technologies and scanners and digital cameras.

Section C collected data on the relevance of the curricular topics, and feedback on areas needing improvement and recommendations for these improvements. The two questionnaires were divided into sections reflecting the major sections of the curricula namely:

- Operating systems,
- Networks,
- Computer applications,
- Information systems and,
- Computer programming.

ANALYSIS

Data from the surveys was mostly qualitative but there were also empirical data on the frequency of usage and relevance of curricular topics. Analysis was done using both Excel and SPSS. SPSS was used for cross-tabulation, chi-square and correlational analysis. The data was presented using bar graphs and relative frequency tables from Excel.

RESULTS

The presentation of results is mostly in the order in which they appear in the questionnaire.

Organisational Goals and Systems

There were seven institutions and 12 graduates surveyed in this research.

Table 1. Organisational Goals

Institution'	Goals
A	financial management & reporting for government of Samoa's economic & policy planning
B	Not stated
C	to make Samoa electoral framework & process easily understood, trusted, accepted & widely used
D	Not stated
E	develop a management system for revenue in Samoa

F	high quality education
G	
H	quality medical services & healthcare

Table 1 represents the goals or the core functions of the institutions surveyed although three institutions B, D and G had left this out in their responses. In terms of the types of systems present in the institutions that were surveyed, most of the institutions have the usual information processing systems such as spreadsheets, word-processing, and databases. All of them have internet access. Very few had communication technology such as video conferencing.

Computer Skills Frequency of Usage

In terms of usage, applications such as internet, word-processing, spreadsheets, database programs were used by most of the institutions on a daily basis while at the other end of the spectrum, desktop publishing and presentation tools were used less frequently (weekly or monthly). The majority of these institutions had never used multimedia programs, hand-held devices, and videoconferencing.

Operating Systems

Most of the users have used file management, control panel settings extensively, including remote desktop connections, media and audio settings, the setup of network and user accounts, and the use of the device manager. Operating systems used were mostly Windows XP, Windows server, Windows NT, Windows 2000 and SQL 2000 with VBA.

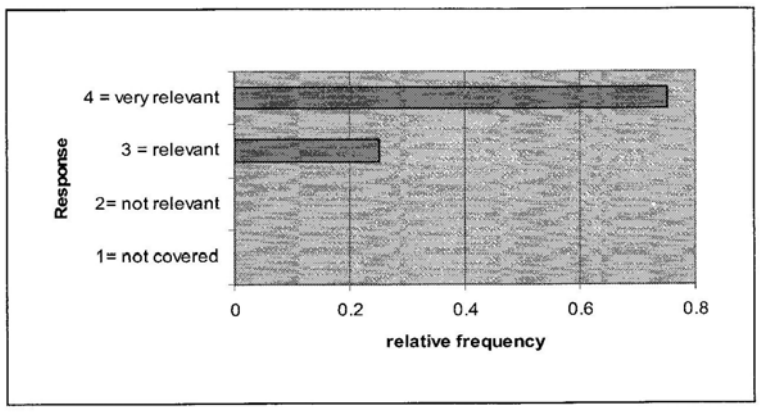

Figure 1. Relevance and Usefulness of Operating Systems

Respondents in all of the institutions found familiarity with operating systems to be relevant or very relevant, with 75 per cent indicating operating systems as very relevant.

Suggestions for Improvement

Responses from participants indicated that this was a topic they all considered as very important in the workplace. Suggestions for improvement, however, included skills such as loading operating systems, configuring settings and the need to teach the latest versions of operating systems.

Networking Skills

Features of networking used in the workplace include making and laying cables, programming routers and switches, Internet connections, broadband network bridges, remote access, building intranets, setting up of IP addresses and IP domains, permissions and access.

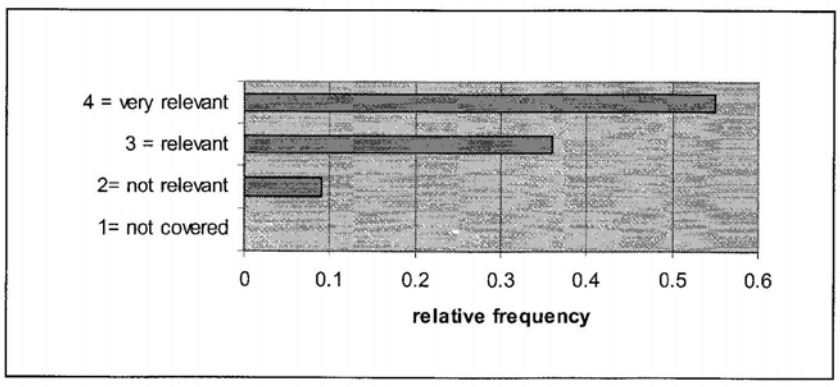

Figure 2. Relevance and Usefulness of Networking Skills

With the exception of one respondent, the majority (91 per cent) of the users found networking skills and communications to be relevant or very relevant to their work.

Suggestions for Improvement

The majority of the responses indicated a strong need for more practicals on networking skills in such skills as cable connections, LAN, WAN connections, setting up of IP domains, routers and switches. There were also suggestions for the inclusion of CISCO CCNA as part of the curriculum.

Word-Processing

Word-processing skills used in the workplace of the 11 respondents range from basic formatting to advanced features such as styles, macros and mail-merge.

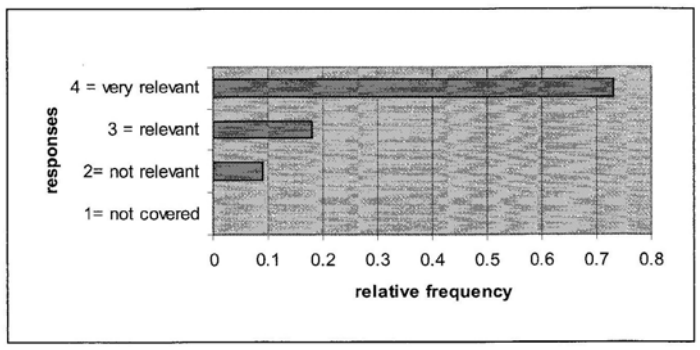

Figure 3. Relevance and Usefulness of Word-Processing Skills to the Workplace

The majority of the respondents (91 per cent) found word-processing skills to be relevant or very relevant to their work.

Suggestions for Improvement

The majority of the respondents thought that the coverage was adequate and had no suggestions for improvement. Features recommended for inclusion include mathematical symbols, web-pages and graphics.

Desktop Publishing

Features of desktop publishing used in the workplace are the same as responses listed for graphics programmes such as design of logos, brochures, postcards, advertising, business cards, notices, newsletters, invitations, graphics and slide shows.

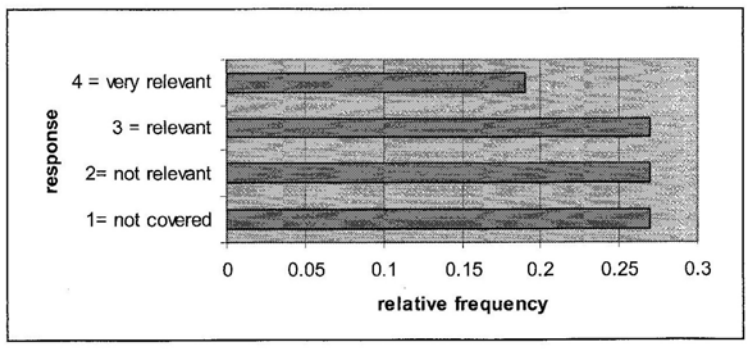

Figure 4. Relevance and Usefulness of Desktop Publishing Skills

Fifty four per cent of the respondents had either not covered or did not find desktop publishing content to be relevant to their work.

Suggestions for Improvement

The main suggestion for improvement of desktop publishing content from the responses is the inclusion of desktop publishing software such as Publisher and Pagemaker in the curricula.

Spreadsheets

Responses indicated extensive use of spreadsheets in the workplace. Features of spreadsheets used in the workplace range from basic skills such as formulae, graphs, tables to more advanced features such as exporting, importing data, linked worksheets and programming using VBA and VBscript.

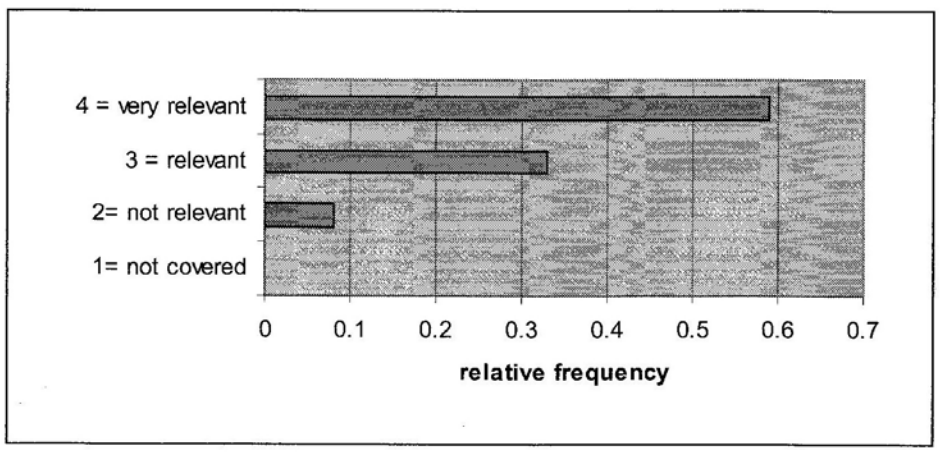

Figure 5. Relevance and Usefulness of Spreadsheet Skills

The majority of the respondents (92 per cent) found spreadsheet content to be relevant or very relevant to their work.

Suggestions for Improvement

Most of the respondents felt that there was adequate coverage of spreadsheets in the curricula. The main suggestions for improvement pointed to a specific need such as applying programming languages such as VB in programming Excel.

Presentation Tools

The most widely used presentation tool in the workplace is powerpoint. Features of Powerpoint used in the workplace included slide transitions, animations, action buttons, presentation notes, and narrations.

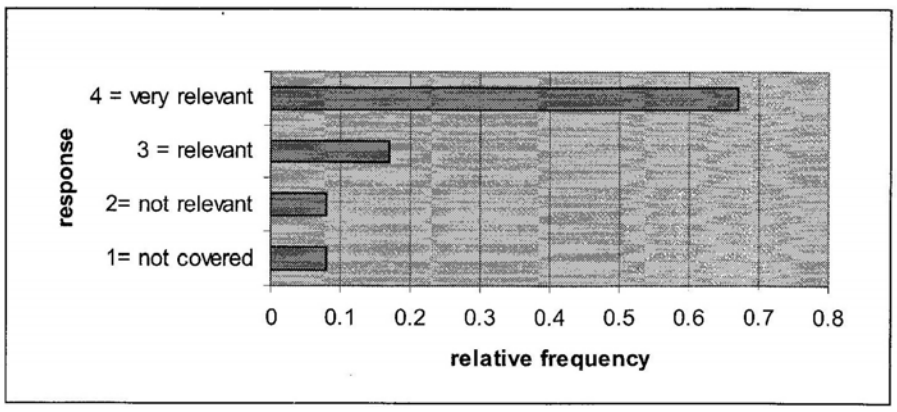

Figure 6. Relevance and Usefulness of Presentation Tools

Eighty four per cent of the respondents found presentation tools, that is, powerpoint relevant or very relevant to their work in the workplace.

Suggestions for Improvement

Suggestions for improvement included the need to cover all aspects of presentation, basic skills, action buttons, newer versions of slide layouts and planning before inserting slides.

Graphics Tools

Features of graphics tools used in the workplace included design of logos, brochures, postcards, advertising, business cards, notices, newsletters, invitations, graphics and slide shows.

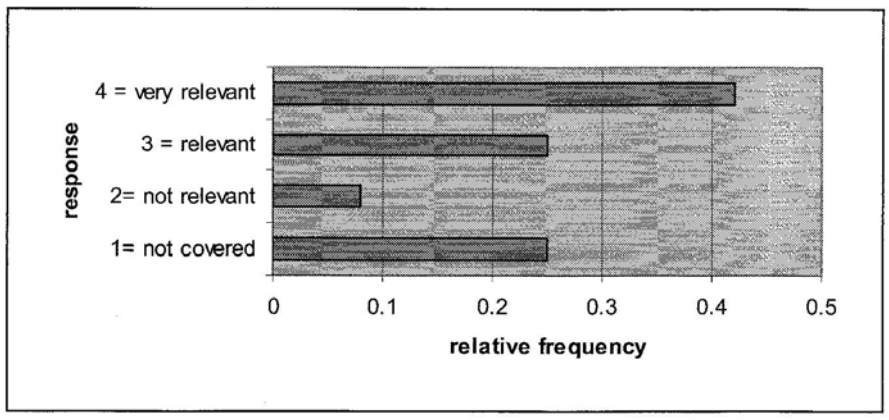

Figure 7. Relevance and Usefulness of Graphics Tools

Sixty seven per cent of the respondents indicated that graphics tools such as photoshop were either relevant or very relevant to the needs of their workplace.

Suggestions *for Improvement*

Suggestions for improvement included the design of advertisements as seen on television, all features of publisher and photoshop software, and the need for all students to learn the basic concepts of using and applying graphics.

Databases

List of Features of Databases Used in the Workplace

- Creating queries, forms, reports, getting external data;
- We use Access for running of the GST and we export data from Excel and put it into Access format and vice versa. Most important is MSAccess: designing of tables, queries, creating databases and should be covered in a broad manner;
- Creating databases, queries, forms, tables reports, macrons;
- *Very* good in this field;
- Creating databases, queries, forms reports, SQL programming searching;
- Reports, drag and drop programming;
- Creating databases, queries, SQL, forms, reports etc;
- Creating tables small databases used by a section in work make queries;
- All SQL programming searching databases, and;
- All flat file, drag and drop programming, SQL programming, searching databases.

The point to note is relative to other topic areas, most of the content of databases covered in the curricula are used in the workplace.

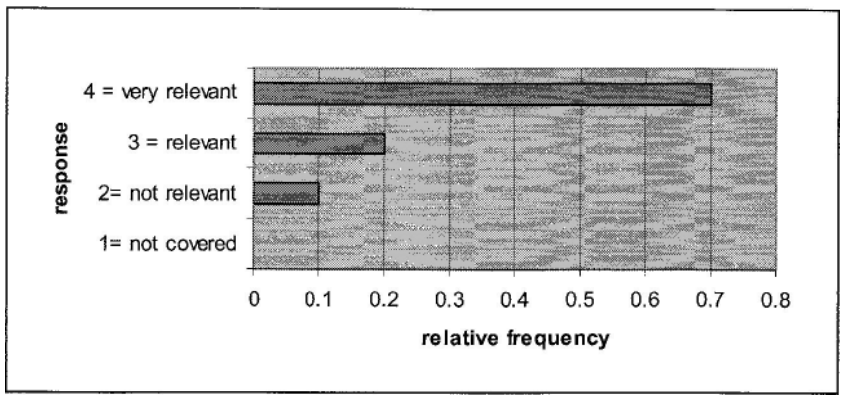

Figure 8. Relevance and Usefulness of Database Programs

Ninety per cent of the respondents found the database content of the courses to be very relevant or relevant to their work in the workplace.

Suggestions for Improvement

Most of the respondents found the curriculum content to be adequate and indicated that everything covered was relevant. Suggestions for improvement included SQL programming and VisualBasic, designing tables using SQL..

Information Systems

Responses indicated that information systems were not utilised in all of the workplaces. Within those workplaces using information systems, features that were being utilised included systems analyses, design and evaluations.

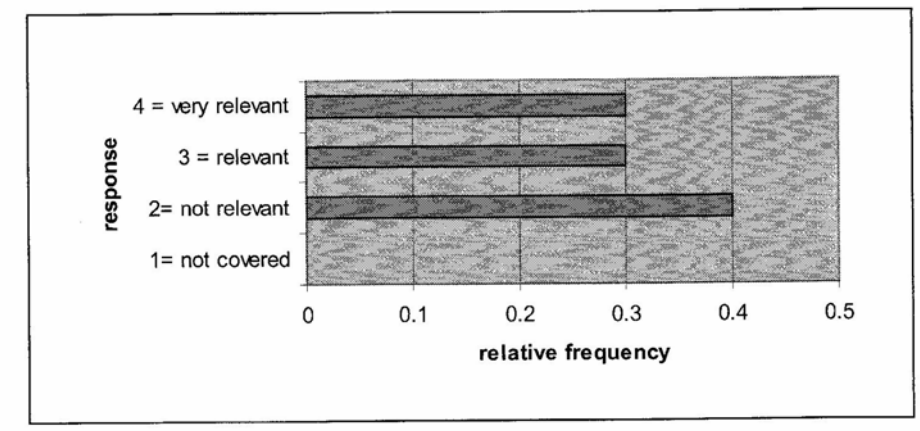

Figure 9. Relevance and Usefulness of Information Systems

Sixty per cent of the respondents indicated that information systems is relevant or very relevant to their work in the workplace. Forty per cent of the respondents indicated non-relevance.

Suggestions for Improvement

Suggestions for improvement on information systems content included: more lectures on the Systems Development Life Cycle (SDLC); the application of the life cycle with the use of computer systems, system design and evaluation.

Programming Languages

Programming languages used in the workplace included Visual Basic, Java, Javascript, VBScript, Html, .Net, SQL, and C++. However it must be noted that most of these listed were used by only one or two workplaces and with two institutions reporting not using any languages at all.

Aspects of programming used in the workplace included programming webpages, use of object oriented methods, classes, objects, modules, and events.

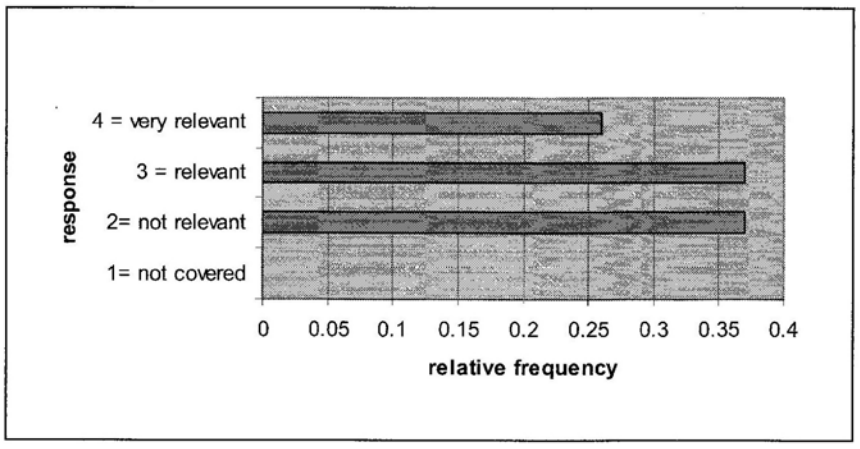

Figure 10. Relevance and Usefulness of Computer Programming

Sixty three per cent of the respondents found programming relevant or very relevant to their work in the workplace, whilst 37 per cent indicated that it was not relevant to their work.

Suggestions for Improvement

Recommendations for improvement of the programming content of the courses included: a) more on systems using .mdb, C++; b). Net programming, Visual Studio; c) more on SQL, Visual Basic and Joomla. One of the recommendations to include visual basic in the courses came from a student who had not taken HCS284, the course which covers Visual Basic programming.

Human Computer Interaction

Aspects of human computer interaction used in the workplace included design of forms, reports, webpages, use of visual basic programming, and the interface design life cycle.

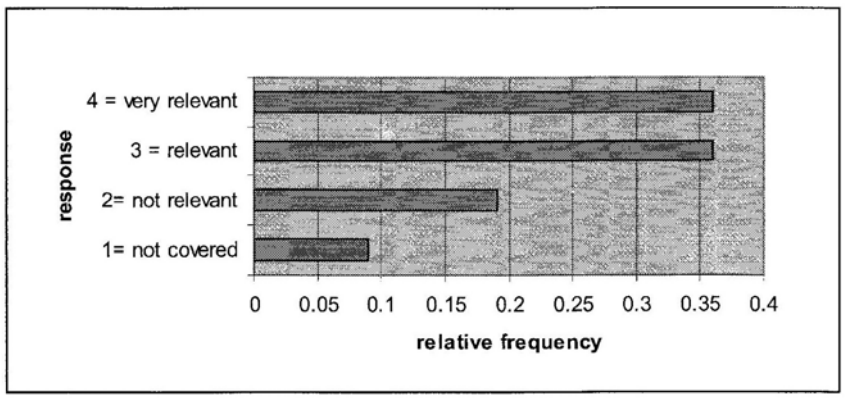

Figure 11. Relevance and Usefulness of Human Computer Interaction

Seventy two per cent of the respondents found human computer interaction content of the courses to be relevant or very relevant. One of the students who had indicated that this topic was not relevant, on examination of his transcript it was found that he had not taken HCS386 course which is the course that covers human computer interaction.

Suggestions for Improvement

Recommendations on improvements for this course included (a) covering all aspects of the human interface; (b) design of web-pages and web programming; and the need to improve materials on interface design.

Statistical Tests

Chi-square tests to test for any significant differences in responses between institutions on the frequency of usage of the technologies were not appropriate due to the small size of the dataset. Close inspection of responses indicated that while the majority of the institutions used internet daily, one institution used it weekly and another institution on a monthly basis.

Similarly chi-square tests to test for any significant differences in responses between institutions on the relevance of the curricular topics were also not appropriate due to the small size of the dataset.

Table 2. Cross-tabulation Data of Institution and Responses to Question 5 on Frequency of Usage of the Internet

		Q5internet/www			Total
		1= daily	2= weekly	3= monthly	
Institution	A	1	0	0	1
	B	2	0	0	2
	C	0	1	0	1
	D	3	0	0	3
	E	1	0	0	1
	F	2	0	0	2
	G	2	0	0	2
	H	0	0	1	1
Total		11	1	1	13

Chi-square tests to; i) evaluate any significant differences in responses based on gender achieved significance in responses to Question 14 on the frequency of usage of handheld technologies and, ii) to evaluate significant differences on responses to relevance of the curricular topics to the workplace were not appropriate due to the small numbers involved.

LIMITATIONS OF THIS RESEARCH

The computing programmes at NUS are fairly recent and hence the small population of graduates, the majority of whom we surveyed. Secondly, the validity of the survey depended on the veracity of the responses of the respondents and that they were actually communicating truthful responses. Thirdly, due to the scope of the material covered in the curricula, the survey was not detailed enough to capture more specific details of the areas or aspects of topics needing better coverage. For example, we were not able to capture in detail what aspects of programming and information systems topics needed better or lacked coverage. Perhaps a better strategy would have been to conduct surveys for each broad theme of a topic. However, as it is, the survey for the current research was quite lengthy and this was also a factor which respondents may have found prohibitive and discouraging.

SUMMARY AND CONCLUSIONS

The outcomes of this research have provided useful information about the relevance of the current content within the curricula and can be applied within the context of improving our course offerings within our programmes. The main recommendations for improving the curriculum are as follows:

- On the overall, the students found the majority of the aspects of the various topics in the curricula either relevant or *very* relevant to their employment in the workplace. However, there are aspects which need to be considered for inclusion in the curricula to achieve better alignment with industry needs. Whether they can be included or not depends on the time restrictions on the curricula and whether there is sufficient coverage time to cover these aspects. It must also be

pointed out that aspects not covered by the curricula as part of the skills of the graduate profile could become the responsibility of the workplace and become part of the domain of on the job' training.

- Perhaps the two areas which students have identified as needing most improvements were in operating systems and networking.
  (a) In the area of operating systems all the respondents recommended the need for coverage of a wider range of features of operating systems, as well as more in-depth coverage of existing topics.
  (b) In the area of networking, there was a consensus of the need for a more practical oriented approach and the need for inclusion in the curricula of practical skills such as laying cable, programming routers and switches, and assigning IP addresses.

- In terms of frequency of technology usage, there were some range in the degree of utilisation. Technologies such as the internet, word-processing, spreadsheets and databases were used by most users almost daily. However, other technologies such as desktop publishing, graphics tools, and programming tools were only used intermittently if at all.

- In terms of relevance, respondents found operating systems, word-processing, spreadsheets, databases, powerpoint and networking skills to be relevant to their work in the workplace but found graphics, desktop publishing, and human computer interaction relatively not as relevant to their work.

- Chi-square tests to; i) test for any significant differences in responses between students on the frequency of usage of the technologies and ii) test for any significant differences in responses between students on the relevance of the curricular topics to the workplace, were not appropriate due to the small size of the dataset. Similarly, chi-square tests to test for any significant differences in responses between institutions on the frequency of usage of the technologies were also not appropriate due to the small size of the data.

Recommendations for potential areas for future research include: a) more sensitive surveys to assess more specific details of topics needing coverage or more in-depth coverage; b) the need for this research to be conducted on a regular basis to ensure alignment between the needs of industry and the workplace and the university curricula.

To conclude, the survey has demonstrated that the current course offerings within the Computing Department are relevant to the needs of industry and the workplace. However, there are aspects or topics which need inclusion or better coverage. Whether these topics are amalgamated into the curricula will depend on time restrictions on the curricula and if they cannot be amalgamated due to time constraints then these recommended changes could be accommodated for by on the job' training. One other possibility is that the university might be able to offer periodic continuing education to practising professionals in those areas which are developing rapidly. Elsewhere, universities are making significant amounts of revenue by offering these programmes either as workshops or on line programmes. In the light of the computing discipline being dynamic and avoiding obsolescence is a challenge. The Computing Department also needs to aim at instilling more general principles and into its graduates

the ability to update oneself. It is hoped that the findings might lead the department to identify areas where it can improve and revise existing courses and programmes or develop new ones based on our findings. In this way, the department can use the results of this research as justification of future proposals for new courses and programmes submitted to the University Senate committee.

Note

[1] Institutions have been coded for issues of confidentiality.

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