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Keywords

information and communication technologies (ICT), ICT competency, ICT skill, computer literacy, spreadsheets, teaching and learning

Cover Page Footnote

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A Survey of First-Year University Students' Ability to use Spreadsheets

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Abstract

Universities are using more information and communication technologies (ICT) in their teaching and learning environments. An anonymous multiple-choice survey self-assessed the spreadsheet skills of students enrolled in first-year units at the beginning of 2003. The results of the survey indicate significant deficiencies in the use of spreadsheets. There is a significant proportion of students who are unable to use spreadsheets as part of their education at the start of their university studies. The implications for tertiary education are discussed.

Submitted October 2003; revised and accepted December 2003.

Keywords: information and communication technologies (ICT), ICT competency, ICT skill, computer literacy, spreadsheets, teaching and learning

1 Introduction

There is an assumption that students who are entering university are becoming more computer literate with each passing year. Government policy relies on this premise: [12]. Universities are making increasing use of information and communication technologies (ICT) in teaching and learning (e.g., [3], [24]). The Australian Chamber of Commerce and Industry (ACCI) and the Business Council of Australia (BCA) have identified basic ICT skills as part of the framework of employability skills for the future [27]: also see similar reports ([2], [4], [25]). Interestingly, Microsoft Excel is the only software package specifically identified in [27]; all other software types are identified only as generic types, e.g., word processor.

Based on responses from 2632 junior secondary school students to a national survey, conducted in May 1998, Meredyth *et al.* [26] reported that 84% of Australian Year 10 students have the skill to "use spreadsheets or databases". University policy has been

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Table 1: The survey instrument asked students to agree or disagree with the following statements.

I know what a spreadsheet program is. (e.g. Excel, Quattro).
I know how to use a spreadsheet program.
I know how to use a spreadsheet program to analyse numerical data and do calculations.
I know how to use a spreadsheet program to plot numerical data.
I know how to use a spreadsheet program to sort data.

based on the assumption that, by the end of secondary school, university matriculants would have skill levels higher than the 1998 Year 10 levels reported by Meredyth *et al.* Anecdotal evidence at the author's institution, and other universities, indicate that the actual spreadsheet skills of students entering university contradict this assumption. This paper reports the results of a survey of students enrolled in first-year units at the author's institution. (Other institutions use the terminology "classes", "courses" or "subjects" instead of "units".) The survey was conducted at the start of the 2003 academic year and included sample groups from all five faculties in the university. The aim of the study was to address the question: Do students have the ability to use spreadsheets as part of their university education?

2 The Survey

2.1 The study methodology

This study is based on student's self-assessment of their ICT skills, using an anonymous multi-choice (paper-based) survey instrument. A previous study had shown that students have an overwhelming dislike of on-line testing [21], which might distort data collected by an on-line survey. The respondents were asked to agree or disagree using a 4-point Likert scale to a number of statements examining their general awareness of spreadsheets, their general competency, and details of particular spreadsheet skills: see Table 1. The survey instrument also examined general awareness and competency in other common generic software types (for example, use of WWW, or word processing), using statements similar to the first two statements in Table 1.

An even-numbered scale was chosen so students who had a response towards the centre of the scale would be forced to decide if their knowledge level tended towards the "knowledgeable" or towards the "lack of knowledge" ends of the scale. The survey instrument measures the level of student confidence in ICT usage, which according to academic staff, who teach ICT courses, over-estimates the actual level of ICT skill [10]. (Note that the ability of students to use technology, and their willingness to persevere in the face of difficulty is governed by their confidence, that is on their perceived ability, rather than their actual ability.)

2.2 Survey Analysis

Students responded to printed survey instruments, which were scanned and digitised for analysis. On-line assessment was deliberately not used, to prevent skewing the survey results by students who are more computer literate. The statistical analyses were done manually with standard statistical methods and formulas [17], [23], using MS Excel for the calculations and data management.

The 4-point Likert scale ranged from 1 = "Strongly disagree" to 4 = "Strongly agree" to statements, which are all worded to have computer access or to have a particular skill/knowledge. The data were analysed to give three types of information:

- Mean scores and standard deviations. This is the usual arithmetic mean and standard deviation about the mean;
- Percentages of students who report they have a particular skill (or computer access). Responses 3 and 4 ("agree" or "strongly agree") are interpreted as having the (self-) assessed knowledge or skill. The binomial distribution standard deviation has been used;
- Percentages of students who report they have no knowledge of a particular skill (or no computer access). Response 1 ("strongly disagree") was interpreted as not having the (self-) assessed knowledge or skill. The binomial distribution standard deviation has been used. Note that "no knowledge" (Response 1) is a subset of "do not have skill" (Responses 1 and 2: "strongly disagree" or "disagree") as some students may have some knowledge, but on the whole that this knowledge is insufficient to say that the student has the particular skill.

The significance of differences between two groups (for example, female and male students) was tested using the 2-sided Student's t-distribution or the 2-sided normal distribution (as appropriate) [17], [23] (null hypothesis: no significant difference; hypothesis: the mean scores of group is significantly more than or significantly less than the mean scores of the other group).

2.3 The main result of the survey

Table 2 shows that most students report having good ICT skills. Over 90% of students reported being able to use word-processing, WWW and electronic mail software. These high levels of competency reflect the three types of software most commonly used in the high-school environment [26], [29]. There is a big drop to the spreadsheet competency level (82%). There are variations by gender, campus location, and faculty of enrolment, but the main finding is obvious: there is a significant proportion of students who report being unable to use spreadsheets as part of their education at the start of their university studies. The explanation of the analyses and the detailed results are set out in the following sections.

Table 2: Percentage of students reporting that they have ICT skill to use a particular software type. Uncertainties are one standard deviation.

Software type	**2000**[1]	**2001**[1]	**2002**[1]	**2003**
Word processing	99 ± 1	98 ± 2	100	97 ± 1
World wide web	87 ± 4	94 ± 3	88 ± 5	97 ± 1
Electronic mail	85 ± 4	92 ± 3	92 ± 4	94 ± 1
Spreadsheet	88 ± 4	77 ± 5	80 ± 6	82 ± 2

3 Details of the Survey and Results

3.1 The survey sample group

The survey sample group consisted of students enrolled in first-year units in the author's home institution at the start of the 2003 academic year. At least one unit from each faculty was surveyed: see Table 3. Human Ethics Approval was granted to run the surveys in class, resulting in a very high response rate. The exact response rate is unknown for all cohorts, since "head counts" were not conducted to determine the number of students *in attendance* in each class.

The units were chosen by finding unit teaching teams that were willing to participate in the study. The only restriction on the choice of the cohorts was to find at least one cohort from each faculty and at least one from each geographic location. Although the cohorts are not true "randomly selected units", there is nothing about these units which would suggest that the students enrolled in them would be more or less computer literate than other groups of students in each faculty.

The sample cohorts were chosen to have at least one first-year unit from each of the five faculties. The author's institution has campuses in a major metropolitan area (Melbourne), a major regional centre (Geelong) and a rural centre (Warrnambool). At least one cohort from each city was sampled.

3.2 Differences by gender

Within some cohorts, there were significant differences between the mean scores for female and male students on individual questions. The questions (skills) with significant differences are shown in Table 4.

[1] The 2000-2002 results are based on very limited surveys of the author's first year undergraduate chemistry class [20], [21], [22]. The 2003 results (this work) are from a survey of first year classes from every faculty in the university.

[2] Not all tutorial groups were included in the survey.

[3] The percentages of female and male respondents do not total 100% because some students did not give their gender (Question 1).

Table 3: Number of questions (skills) with significant differences in reported spreadsheet skill levels (mean scores) between female and male students.

Faculty/Unit	Location	Total responses	Total enrolled	Female/Male % responses	Female/Male % enrolled
Arts ALW 101 Writing 1A	Metro-politan	77	82	64/36	63/37
Education EXE 101 Understanding Children and Adolescents	Metro-politan	147[2]	430	78/22	75/25
Health and Behavioural Sciences HPS 111 Introduction to Psychology A	Regional	133[2]	169	78/20[3]	78/22
Business MSC 120 Business Information Systems	Law	Regional	154	292	44/56
Science and Technology SBC 111 Chemistry A	Regional	127	128	60/40	59/41
Science and Technology SQP 104 Introduction to Aquatic Pollution	Rural	68	69	46/54	42/58

Table 4: Number of questions (skills) with significant differences in reported spreadsheet skill levels (mean scores) between female and male students.

Unit	Female : male responses[4]	Gender with higher skill level	Questions[5]	Significance[6] Level
ALW101	49 : 28	No significant difference on spreadsheet questions		$\alpha = 0.05$
EXE101	114 : 33	No significant difference on spreadsheet questions		$\alpha = 0.05$
		Male	Analyse num. data	$\alpha = 0.01$
HPS111			Plot data	$\alpha = 0.05$
	104 : 27		Sort data	$\alpha = 0.01$
MSC120	68 : 86	Male	Sort data	$\alpha = 0.05$
SBC111	76 : 51	Male	Analyse num. data	$\alpha = 0.05$
			Plot data	$\alpha = 0.05$
SQP104	31 : 37	No significant difference on spreadsheet questions		$\alpha = 0.20$

Male students tended to have a number of skills at a significantly higher level than female students. This is consistent with other studies showing males to be dominant in the use of ICT (for example, [11], [15], [16], [26], [30], [31]), although there is disagreement why this is so (for example, [28].

- Faculties of Arts and Education cohorts have no significant ($\alpha = 0.05$) gender difference for any reported spreadsheet skill.
- Male students in the Faculty of Health and Behavioural Sciences report having significantly better spreadsheet skills than their female classmates at the $\alpha = 0.05$ (or higher) level.
- 1st-year male students in the Faculties of Business and Law, and Science and Technology cohorts on the regional campus report having significantly better spreadsheet skills than their female classmates for at the $\alpha = 0.05$ level in one or two spreadsheet skills.

Data from the University of Sydney indicates that the self-assessed higher skill levels for males is independent of opportunity or access [29]. Regardless of whether these reported skill levels are real or merely perceived, the data do reflect students' self-perception and confidence: female students in most faculties will not use spreadsheets in learning as readily as males.

[4] The female:male ratio is the actual number of responses identified as female or male (see footnote 2).

[5] See Table 1 for the exact wording of the statements in the survey instrument.

[6] Two-sided t-distributions or normal distributions have been used to test the hypothesis there is no gender difference.

Recommendation 1: Any spreadsheet-skills training program should proactively target female students.

3.3 Differences by geographic location

The Faculty of Science and Technology students on the rural campus had the lowest overall level of ICT skill (both spreadsheets and other skills). It is postulated that this cohort is different from the others because of the distinct “regional” nature of this campus. Although the data from the study reported here, are not sufficient, in themselves, to “prove” this conclusion, the data are consistent with the work of Hellwig and Lloyd [16], which indicated that the “digital divide”, between those who have and those who do not have computer access, has strong correlation with socio-economic factors: the lack of computer access correlates with difficult financial conditions in many rural and other communities. (Meredyth *et al.* [26] and Hakkarainen *et al.* [15] have previously reported that student ICT skill is correlated with home computer access. The correlation between home computer usage and factors associated with geographic location has been confirmed by more recent data [5].)

Recommendation 2: Any spreadsheet-skills training program should proactively target students from rural communities and other equity groups.

3.4 Differences by faculty of study

Table 5 shows the mean scores and their standard deviations of the responses for general ICT skills and specific spreadsheet skills. A four-point Likert scale has been used: 1 = “strongly disagree”; 4 = “strongly agree”. It can be seen that, on average, all students report having easy access to computers (scores ranging from 3.24 to 3.85). General awareness and ability to use the WWW, electronic mail and word processors are high across all faculties, with little gender or campus variations.

Students enrolled on the rural-centre campus (Warrnambool) and in the Faculties of Arts, and Education, and female students in the Faculties of Health and Behavioural Sciences, and Science and Technology report having the lowest levels of spreadsheet skill, with specific skill scores ranging from 2.71 to 2.93. Male students in the Faculties of Health and Behavioural Sciences, Business and Law, and Science and Technology report having the highest levels of spreadsheet skill, with scores 3.18 to 3.52.

Although students in business-based and science-based disciplines are perceived to have a greater need of spreadsheet competency, Lawson and de Matos have shown that a high level of spreadsheet competency is also required of graduates in the arts and in education [19]. At the same time, employers (of graduates from all disciplines) are demanding that their future employees have competency in the use of spreadsheets [27].

This need for spreadsheet competency has not been recognized by the mainstream educational community. There are a number of historical and commercial factors at work here. Firstly, calculators are a more familiar technology. Access (or non-access) to computers present a serious “equity” problem of ensuring that all students have an equal opportunity to learn: the low cost of calculators means that this is not an issue if calculators are used. Calculators are more abundant than computers. It is easier to prevent "improper conduct" in examinations when calculators are used, and harder to do so if computer spreadsheets are used. One major calculator manufacturer (named after a North American state) has invested heavily in the development of hardware interfaces (dataloggers) between their calculators and laboratory instrumentation, as well as the development of resources for teachers promoting the use of their products: advertisements for this brand of calculator can be seen in many major educational journals having a high-school science-teacher readership.

The Australian high-school curricula and examination system encourages the use of programmable and graphics calculators [6], in preference to spreadsheets. This may explain the difference between spreadsheet and other ICT skills, which have significantly higher scores than the former. It is the author's belief that both school and university curricula need to be revised to place greater emphasis on the use of spreadsheets.

Recommendation 3: Greater use of spreadsheets should be encouraged at school and university.

3.5 Generalization to other Australian institutions

In a study conducted in 2001, the author compared the ICT skills of his first-year chemistry students with first-year medical students at an interstate university (UWA) [21]. In 2000, the University of Sydney surveyed its first-year students, across all faculties, but using a different set of questions [29]. The reported [21], [29] levels of spreadsheet skills at the two interstate universities were lower than those in Table 2, suggesting that the national picture is either the same as, or worse than, that reported in this paper.

3.6 Generalization to other countries

In September 2001, 67% of Australian households owned or leased a computer [1]. Australia is ranked second to Korea (70%), and slightly ahead of the USA (imputed to be 65%), Sweden (65%), and Singapore (64%), followed by Hong Kong, New Zealand, Norway and Taiwan (58–62%). Since student ICT skill is correlated with access to a computer at home [15], [26], Australian students would be expected to have among the highest computer skill levels in the world. With the exception of students in Korea, USA, Sweden and Singapore, the international picture can be expected to be worse than that reported in this paper.

3.7 Implications for teaching and learning

Table 6 shows the percentage of students who report no knowledge of a particular skill (or no computer access: response 1 = "strongly disagree"). This analysis is slightly different from those in the previous Tables: Table 4 and Table 5 are based on the mean scores and standard deviations; Table 2 indicates students reporting they have a general skill (responses 3 and 4). Students reporting they have some (but inadequate) skill (response 2) have not been directly quantified.

Table 5: Mean scores and standard deviations (4-point Likert scale) for survey.

Faculty	Arts	Education	Health & Behav. Sciences		Business & Law		Science & Technology		
Location	Metropolitan	Metropolitan	Regional		Regional		Regional		Rural
	All	All	Female	Male	Female	Male	Female	Male	All
Access	I have easy access to a computer at home or in the residences.								
	3.69 ± 0.65	3.75 ± 0.62	3.66 ± 0.69	3.59 ± 0.64	3.76 ± 0.55	3.85 ± 0.42	3.57 ± 0.81	3.35 ± 0.93	3.24 ± 1.08
Commonly used software	I know what the World Wide Web is.								
	3.99 ± 0.11	3.90 ± 0.36	3.81 ± 0.52	3.89 ± 0.58	3.88 ± 0.32	3.92 ± 0.28	3.92 ± 0.27	3.92 ± 0.44	3.82 ± 0.46
	I know how to access information on the World Wide Web								
	3.87 ± 0.41	3.71 ± 0.55	3.68 ± 0.63	3.89 ± 0.58	3.75 ± 0.44	3.86 ± 0.35	3.78 ± 0.48	3.80 ± 0.53	3.51 ± 0.68
	I know what an electronic mail program is. (EUDORA, OUTLOOK)								
	3.69 ± 0.69	3.38 ± 0.92	3.40 ± 0.91	3.30 ± 1.03	3.40 ± 0.95	3.53 ± 0.75	3.58 ± 0.82	3.57 ± 0.78	3.12 ± 1.06
	I know how to send and receive electronic mail.								
	3.90 ± 0.42	3.69 ± 0.67	3.64 ± 0.71	3.59 ± 0.89	3.74 ± 0.64	3.81 ± 0.42	3.66 ± 0.70	3.71 ± 0.58	3.51 ± 0.80
	I know what a word-processing program is. (WORD, WordPerfect)								
	3.96 ± 0.19	3.84 ± 0.48	3.71 ± 0.63	3.70 ± 0.72	3.91 ± 0.41	3.91 ± 0.36	3.91 ± 0.29	3.80 ± 0.57	3.75 ± 0.53
	I know how to use a word-processing program.								
	3.87 ± 0.34	3.79 ± 0.47	3.68 ± 0.64	3.70 ± 0.72	3.81 ± 0.50	3.88 ± 0.36	3.86 ± 0.42	3.84 ± 0.42	3.68 ± 0.58
Spreadsheet	I know what a spreadsheet program is. (e.g. EXCEL, QUATTRO).								
	3.51 ± 0.85	3.58 ± 0.73	3.29 ± 0.87	3.63 ± 0.69	3.66 ± 0.64	3.68 ± 0.66	3.49 ± 0.74	3.63 ± 0.69	3.35 ± 0.81
	I know how to use a spreadsheet program.								
	3.18 ± 0.96	3.25 ± 0.91	3.05 ± 0.93	3.52 ± 0.80	3.35 ± 0.73	3.55 ± 0.73	3.25 ± 0.88	3.53 ± 0.81	3.06 ± 0.86
	I know how to use a spreadsheet program to analyse numerical data and do calculations.								
	2.88 ± 1.06	2.92 ± 1.04	2.77 ± 1.03	3.52 ± 0.75	3.04 ± 0.97	3.32 ± 0.85	2.92 ± 1.02	3.33 ± 0.89	2.81 ± 0.98
	I know how to use a spreadsheet program to plot numerical data.								
	2.92 ± 1.04	2.93 ± 1.02	2.80 ± 1.04	3.37 ± 0.84	3.00 ± 0.90	3.31 ± 0.90	2.87 ± 1.08	3.31 ± 0.88	2.85 ± 0.98
	I know how to use a spreadsheet program to sort data.								
	2.71 ± 1.10	2.80 ± 1.10	2.73 ± 1.06	3.48 ± 0.75	2.87 ± 0.98	3.25 ± 0.90	2.79 ± 1.05	3.18 ± 0.91	2.76 ± 0.99

Table 6: Percentage of students reporting no access or knowledge (response=1 on 4-point Likert scale) for particular skills. Binomial distribution standard deviations are indicated. Standard deviations less than 0.5 have been omitted

Faculty	Arts	Education	Health & Behav. Sciences		Business & Law		Science & Technology		
Location	Metropolitan	Metropolitan	Regional		Regional		Regional		Rural
	All	All	Female	Male	Female	Male	Female	Male	All
Access	I do not have easy access to a computer at home or in the residences.								
	3	2	2	0	1	0	4	6 ± 1	13 ± 1
Commonly used software	I do not know what the World Wide Web is.								
	0	0	2	4 ± 1	0	0	0	2	0
	I do not know how to access information on the World Wide Web								
	0	0	2	4 ± 1	0	0	0	2	0
	I do not know what an electronic mail program is. (EUDORA, OUTLOOK)								
	3	5	7 ± 1	11 ± 2	9 ± 1	2	5 ± 1	2	15 ± 2
	I do not know how to send and receive electronic mail.								
	1	2	3	7 ± 1	3	0	3	0	6 ± 1
	I do not know what a word-processing program is. (WORD, WordPerfect)								
	0	1	2	4 ± 1	1	0	0	2	0
	I do not know how to use a word-processing program.								
	0	0	2	4 ± 1	1	0	0	0	0
Spreadsheet	I do not know what a spreadsheet program is. (e.g. EXCEL, QUATTRO).								
	5 ± 1	3	5	0	1	1	3	2	
	I do not know how to use a spreadsheet program.								
	9 ± 1	5	7 ± 1	0	3	2	5 ± 1	4 ± 1	3
	I do not know how to use a spreadsheet program to analyse numerical data and do calculations.								
	12 ± 1	12 ± 1	14 ± 1	0	7 ± 1	5	9 ± 1	4 ± 1	9 ± 1
	I do not know how to use a spreadsheet program to plot numerical data.								
	12 ± 1	11 ± 1	13 ± 1	0	4 ± 1	6 ± 1	12 ± 1	4 ± 1	10 ± 1
	I do not know how to use a spreadsheet program to sort data.								
	18 ± 2	16 ± 1	16 ± 1	0	9 ± 1	5	12 ± 1	4 ± 1	12 ± 1

Table 6 is consistent with the trends discussed above, but its value is that it shows where training in the use of spreadsheets should be targeted. Table 6 confirms that students (13%) from rural communities report a lack of easy access to computers at home or in the student residences [16], even though the reported average level of computer access (Table 5) is only slightly lower than other cohorts.

Almost no students report lack of the general awareness or knowledge of commonly used software (WWW, electronic mail, word processing). An exception is that more students (up to 15%) report not knowing about electronic mail programs, even though many of these students report they can use electronic mail: this discrepancy is explained by the fact that many (most?) students use web-based electronic mail, and thus lack knowledge of dedicated electronic mail software.

Table 6 shows that 9% to 18% of students enrolled in the following groups report having no knowledge of various spreadsheet skills.

- Students enrolled in the Faculties of Arts, and Education. Employers of arts and education graduates require their new employees to have spreadsheet skills [19]. For example, education graduates (school teachers) are expected to incorporate information technology in teaching and learning activities. Data logging, spreadsheets, modelling and simulation, use of the Internet for research and data exchanges are specifically mentioned in the curricula for the mathematics and science key learning areas (KLAs); for example, [8], [9], [18].

- Students enrolled on a rural campus [16].

- Female students in the Faculties of Health and Behavioural Sciences, and Science and Technology. All students in these faculties are expected to be able to plot, analyse and sort data. Note that there is some tendency to use specialized programs (for example, SPSS, MINITAB, ORIGIN, MATHCAD) for these purposes, but the use of specialized programs may create obstacles to learning [14], that can be avoided by more generic software like spreadsheets (for example, [13]).

University-level educators cannot use spreadsheets in the curriculum without first providing spreadsheet training.

4 Summary and conclusions

This paper reports the spreadsheet skills of students enrolled in first-year units at the author's institution. Comparison of previous studies by the author [20], [21] with data from interstate universities [21], [29] indicates that the results from the author's institution, presented here, are representative of interstate trends and are probably [1], [15], [26] indicative of international trends.

Spreadsheets serve a very useful role in education: see papers in this and other Journals, especially the review by Baker and Sugden [7] in the previous issue. However, the results reported here indicate significant deficiencies in students' knowledge about

Table 7: Recommended policies to remedy deficiencies in ICT skills

1.	Any spreadsheet-skills training program should proactively target female students.
2.	Any spreadsheet-skills training program should proactively target students from rural communities and other equity groups.
3.	Greater use of spreadsheets should be encouraged at school and university.

the use of spreadsheets at the start of their first-year studies. Specific spreadsheet skill levels are significantly lower than the general spreadsheet skill level, which in turn is significantly lower than other ICT skills. University educators must first make provision for spreadsheet training before using spreadsheets in teaching and learning activities: see Table 7.

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The research described in this paper has been approved (EC 239 2002) by the Deakin University Human Research Ethics Committee.

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