Has the computing competence of first year university students increased during the last decade?

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Computers have become ubiquitous. The perception is that they are used effectively and with authority by much of the younger population. Previous generations used computers to manipulate data, mainly in employment. The current generation considers use of computers to be part of their social life. This paper reports on the results of a longitudinal study of students in an introductory computing class at Lincoln University. Results from 1999 were compared with results from 2008 to see if there were any differences in the overall computing confidence reported by students from both cohorts. The computing activities of the 1999 and 2008 students have been compared. Results show that the current students are more likely to be computing online and their overall confidence is higher than in the earlier study. This confidence is not matched by increased skills in offline computing. There is some evidence that the 2008 students are less competent users of productivity software such as spreadsheets and databases than the 1999 students.

Keywords: first year students, computing competence, computing knowledge, online computer literacy, offline computer literacy, skills perception level

Introduction

There is a general perception that first year university students are now much more computer literate than was the case a decade ago. Increasingly students are being exposed to a digital environment at younger ages than in the past. They have computers at home and at school, and they own cell phones with which they can access the Internet. They are used to rapid change in technology. However, while they may be more adept at using internet resources for research and communication, this does not necessarily equate to them having have good skills in basic calculations or the management and manipulation of data (Kline & Strickland, 2004; Bartholomew, 2004; Hoffman & Vance, 2005).

Lincoln University is a small university in rural New Zealand. COMP101 Computing has been taught, in some form or other, for more than 20 years. During this time its content has been reviewed a number of times, but it has remained an introduction to computing concepts and end user computer skills. The objective is to continue to provide appropriate practical skills and background computing knowledge to enable students to complete their degrees and successfully enter the workforce. COMP101 has always been compulsory for all commerce (business) degree students. They normally complete it in the first year of study. This will change next year with its removal from this degree as a core course from 2009. It is believed that while the course is useful, particularly for mature aged students, the majority of new students will be sufficiently computer literate (Eves & Dalziel, personal communication, 23 July 2007). This change is not surprising as other universities have dropped their requirements for new business students to study dedicated end user computing (Case, MacKinnon & Dyer, 2004).

We decided to compare the computer skills and competency (or at least the students' perceptions of these!) of students entering COMP101 in 2008 with those in COMP101 in 1999. The survey instrument used in 2008 was an updated version of one used in 1999. We wanted to know if the current students perceived their computing abilities to be higher than those of the 1999 cohort. We were also interested to see if levels of confidence had changed between these two cohorts. In both surveys the same specific end user computing questions were used as method to indicate competence in the important areas of spreadsheeting and database management.

The remainder of the paper describes the surveys, and the key results and conclusions are presented and discussed.

Method

Quantitative data were gathered using a survey instrument administered, in the first week of Semester 1, to COMP101 classes in 1999 and 2008. The 2008 instrument was essentially the same as the earlier survey except for an expanded question about computer usage. The surveys collected some demographic data about students' genders, schooling including previous computing education, and current computer usage. Students were also asked to rate both their knowledge of and confidence in using computers. Individual students who participated in the survey cannot be identified in any way. (Copies of the full survey instrument can be obtained from the authors.)

Three knowledge based questions were included to give an estimate of students' competencies in end user computing. For each student the number of correct answers for the problem solving questions was calculated. While it would be useful to ask further knowledge questions only a short amount of lecture time is available for the survey. The specific end-user computing questions asked in 1999 are still considered to be a relevant measure. Computer competency has been defined in a number of ways (see for example Yoon and Lee, 2007). In this study the authors use the term competency to mean having knowledge and capability to complete specified spreadsheet and database tasks.

Survey results

There were 345 responses in 1999 and 155 in 2008 and the response rates were similar 71% for 1999 and 67% for 2008. (The very much lower number of students in 2008 sadly reflects a marked decline in the number of business students at this University.) About 60% of the students in both years were male. In both surveys similar percentages of the students were recent school leavers; 47% in 1999 compared with 51% in 2008. Approximately 70% of students in both cohorts had left school in the last three years. This suggests both classes had very similar proportions of mature aged students. Not surprisingly in 2008, significantly more students, 59% compared with 34% in 1999, had completed at least one computer course at high school.

Comparative results for the two cohorts will be presented for the following topics:

- Self rating of computing knowledge
- Perceived confidence in using computers
- Access to computers and the Internet
- Competence in end user computing.

Self rating of computing knowledge

In both years, survey respondents were asked to rate their knowledge of computers by choosing one of the following categories: absolute beginner, some knowledge, average knowledge, pretty knowledgeable or expert. These choices were given a Likert type score (ranging from one for absolute beginner to five for expert). The averages of 2.4 for 1999 and 2.7 for 2008 suggest a perception of increased knowledge in the latter year. The graph in Figure 1 compares the 1999 and 2008 results. The distribution for 2008 appears to have shifted towards the higher levels compared with that for 1999 although; somewhat surprisingly no one in 2008 rated themselves as expert. The difference between the means was tested using a 2 tailed paired test. The results are shown in Table 1.

Table 1: Levels of knowledge for 1999 and 2008

Levels of knowledge	1999	2008
Beginner	16.52%	5.16%
Some knowledge	41.45%	33.55%
Average	33.33%	47.74%
Pretty knowledgeable	7.83%	13.55%
Expert	0.87%	0.00%
Correlation coefficient	0.85568	
P value (highly significant as <= 0.01)	0.00003	

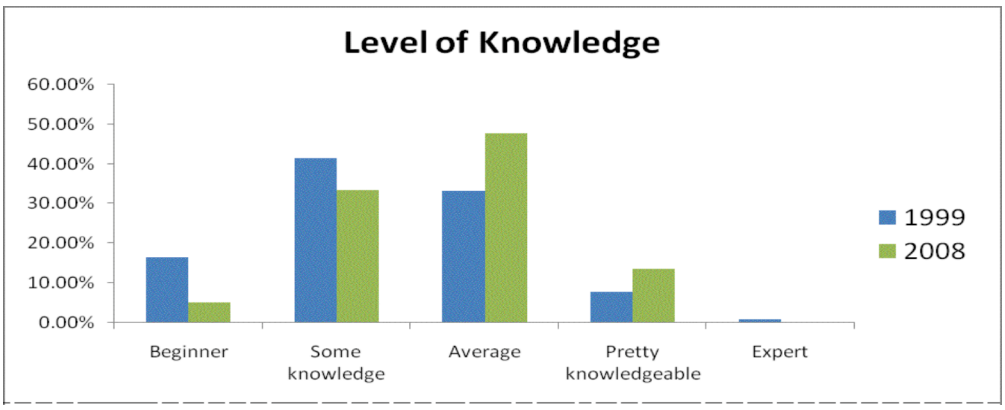

Figure 1: A comparison of students' perceptions of their computer knowledge for 1999 and 2008 COMP101 students

Perceived confidence in using computers

Both cohorts were asked to rate their own level of confidence in computer use. The category choices were: not confident, a little confident; average; confident or very confident.

The mean scores, computed using a Likert type score similar to the previous section, were 2.6 in 1999 and 3.0 in 2008.While the difference does not appear to be statistically significant the graph in Figure 2 suggests that there has been a shift from the lower categories towards average and a calculation of the correlation coefficient of 0.81 does indeed suggest some statistical significance. Indeed further analysis using a paired sample t-test returned a p value which was <=0.01 (0.00027). This result suggests that the confidence levels between the two cohorts have indeed increased with the 2008 cohort having a higher level of confidence.

Table 2: Levels of confidence for 1999 and 2008

Levels of confidence	1999	2008
No confidence	18.84%	5.81%
A little	27.54%	26.45%
Average	33.62%	37.42%
Confident	15.94%	26.45%
Very confident	4.06%	3.87%
Correlation coefficient	0.81	
P value highly significant at <= 0.01	0.00027	

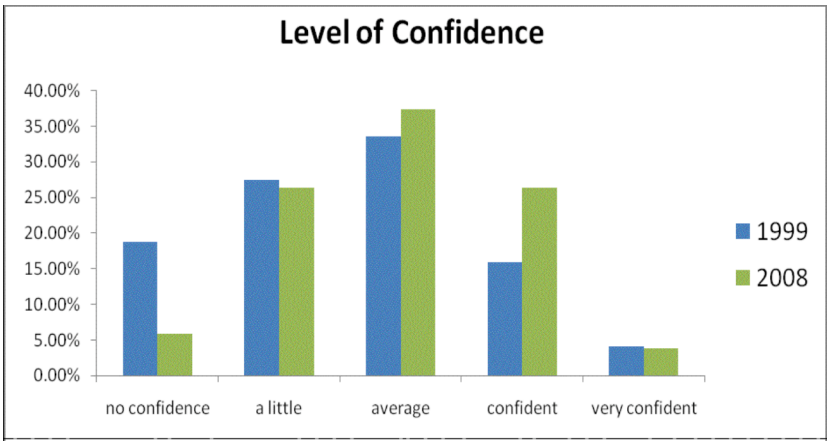

Figure 2: A comparison of students' perceptions of their confidence using computers for 1999 and 2008 COMP101 students

Access to computers and the internet

As expected a greater percentage of the 2008 cohort had access to home computers than was so in 1999. Almost all (97%) of the 2008 cohort had some access compared with fewer than 60% of their 1999

contemporaries. Similarly, 85% of the 2008 cohort had a home Internet access compared with 38% of the 1999 cohort.

In the 2008 survey a question was added in order to investigate home computing activities. Not surprisingly most of the use centred on online activities (those using the Internet).Given the high Internet access, the reasonably high online activity as shown in Table 1 was expected. These results were consistent with the findings of other such studies. Greenberg, Berktold & Hebert (2006) reported that the Internet is a "fully integrated part of young adult's lives." Nearly all the young adults they surveyed reported spending more than 20 hours each week online.

Table 1: Selected computing activities of 2008 survey respondents

Online activity	% Participating	Offline activity	% Participating
Social networking	66	Office software	78
Email	93	Programming	16
Online Auctions	62	Offline Games	34
Music/Video downloads	67	Other	15
Chat/VOIP	38		
Online games	25		
Other Internet	78		

Competence in end user computing

Questions 12 to 14 in the survey were designed to test students' basic knowledge of spreadsheet techniques and database query logic. These questions are listed in Appendix 1. Competence in solving these problems was considered to indicate knowledge of end user computing to be useful for university study and later employment. The competency measures used were considered indicative of the skills we would expect students completing the course to have mastered. Summarised results are given in Table 2. The first of these questions, a comparatively straight forward spreadsheet IF function, was answered correctly by no more than 10% by either cohort. The second, arguably trickier question, about copying a mixed reference cell in a spreadsheet was badly answered with 43% getting the wrong answer in both years. A higher and similar percentage, in both years, got the correct answer for the database query.

Table 2: Summarised survey responses to the problem solving questions in 1999 and 2008

Question Topic	1999			2008		
	correct	wrong	don't know	correct	wrong	don't know
Question 12: Spreadsheet IF	9%	9%	82%	10%	15%	70%
Question 13: Mixed reference	6%	43%	50%	2%	43%	61%
Question 14: Database logic	41%	35%	24%	43%	26%	34%

Figure 3 shows the detailed results for question 12, the spreadsheet IF question, in both years. We were surprised to find the distribution of answers somewhat similar for both cohorts. Questions 13 and 14 had similar distributions for both 1999 and 2008.

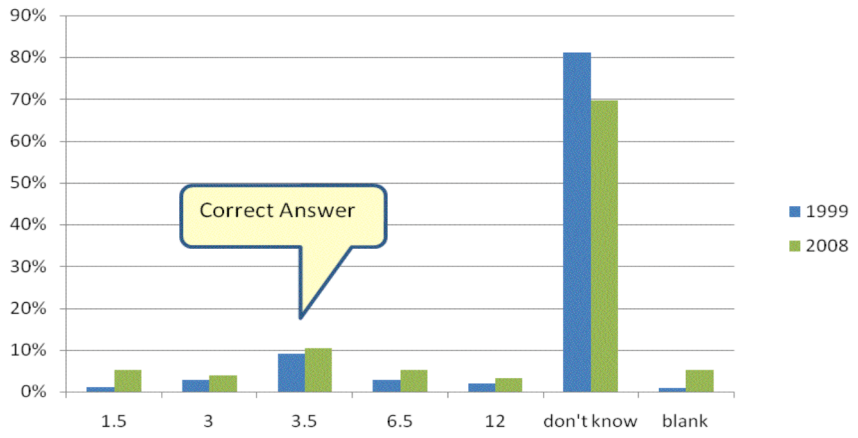

Figure 3: Percentage of responses for each of the options in question 12 by 1999 and 2008 COMP101 students

The total number of correctly answered questions, out of three, is given in Table 3. Once again the two cohorts have very similar distributions. There is no difference in the average number correct (0.55 in 2008 and 0.56 in 2008). It might have been expected that more 2008 students would have answered all questions correctly given their stronger computing education and perceived competence. Both years did equally poorly.

Table 3: Number of correct responses (out of 3) to problem solving questions in 1999 and 2008

Number Correct	1999	2008
0	52%	52%
1	43%	43%
2	4%	5.2%
3	2%	0.6

Discussion of survey results

The confidence and knowledge results were evaluated against the end-user problem solving results to determine if there was any association between how people perceived their own abilities compared with the correctness of their answers to specific questions. Figures 4a and 4b below show the proportion of the people in each category who got from 0 to 3 correct answers.

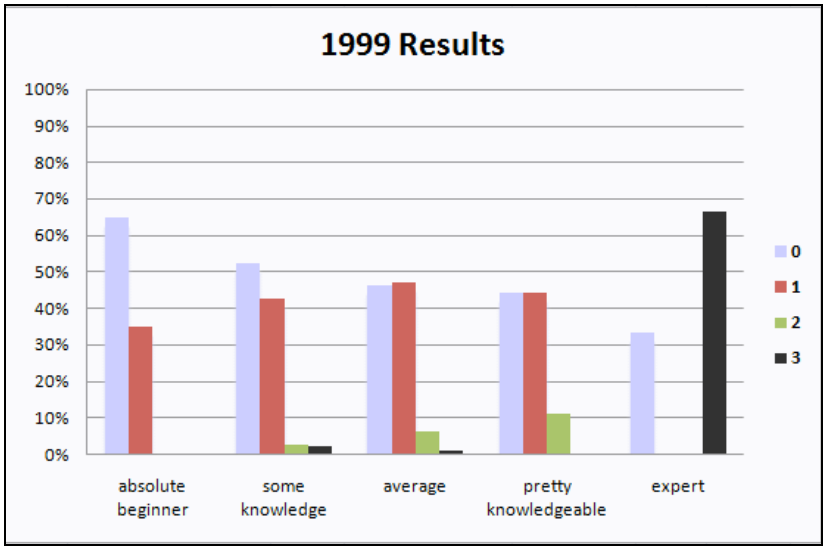

Figure 4a: Percentage of people in each knowledge category who got 0 to 3 end-user computing questions correct in 1999

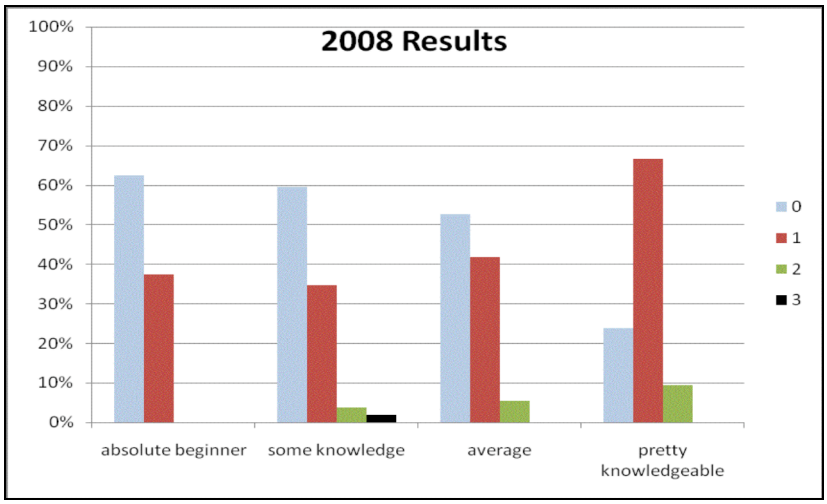

Figure 4b: Percentage of people in each knowledge category who got 0 to 3 end-user computing questions correct in 2008

The results for the two years are fairly similar especially when it is remembered that the majority of people are in the "some knowledge" and "average" knowledge categories (75% in 1999 and 81% in 2008). In both years 94% of the students in these categories got one or two question wrong as did the 14% of "pretty knowledgeable" students in 2008. The 1999 equivalents did a little better. The interesting results for "experts" in 1999 only correspond to 1% of the cohort and in 2008 there were no "experts". In 2008 the only person to get all answers correct identified with having "some knowledge". These results show perceived knowledge is not a good predictor of end user skills, especially in 2008.

Self-ratings have been found to be inaccurate elsewhere. Studies have shown that students entering university from high school overrate their computing knowledge and competence (Karsten & Roth 1998; Zhang & Espinoza, 1998; van Braak, 2004; Ballantine, Larres & Oyelere, 2007; Lim & Lee 2000; Easton & Easton, 2004; Wallace & Clariana, 2005).

Figures 5a and 5b show the distributions for comparing confidence with the number of questions correct. Once again we need to be careful of the small numbers of people in the outer categories. For the both cohorts increasing confidence relates to a small increase in average number of questions correct. In 1999 it ranges from 0.5 questions correct for *not* to 0.9 for *very confident*. The 2008 data ranges from 0.3 to 0.8. There is some indication that those who considered themselves to be more confident did score a little higher. The correlation coefficient for the 2008 data is weak at 0.17.

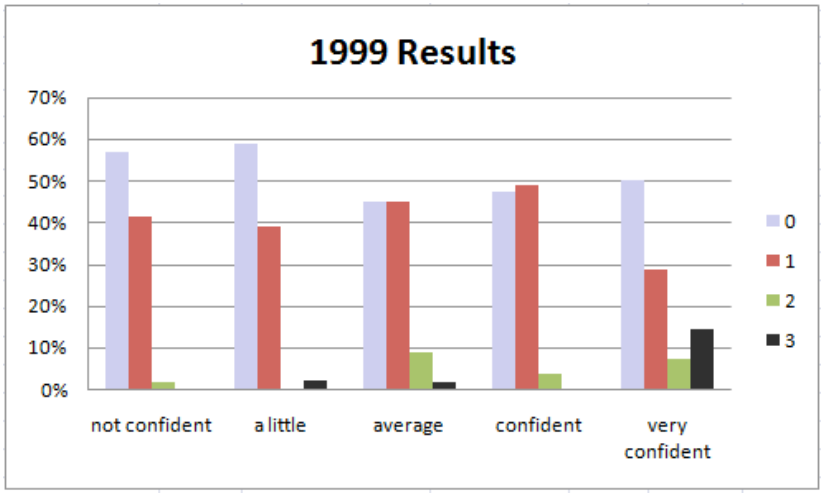

Figure 5a: Percentage of people for each confidence level who got 0 to 3 problem solving questions correct in 1999

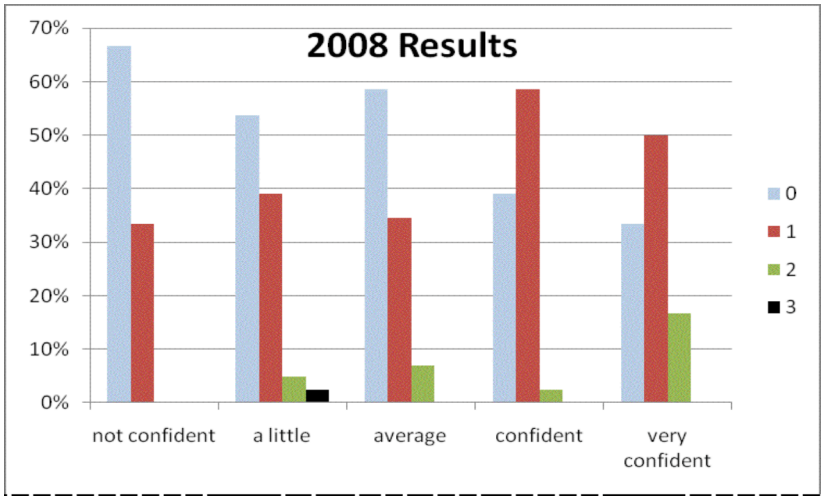

Figure 5b: Percentage of people for each confidence level who got 0 to 3 problem solving questions correct in 2008

It is interesting to note that the increased use of technology has not led to a corresponding increase in end user skills as we measured them. Other authors have also found this. Van Braak (2004, p. 309) said,

> Access to computers, however, does not guarantee that all students are equally proficient in performing computer-related tasks.

A number of tertiary institutions are now recognising this gap and testing the IT competencies of incoming students. They are also providing appropriate remedial instruction. Updated IT literacy assessment instruments, appropriate for millenial generation students, are being developed. (Perez, Murray & Myers, 2007).

Conclusion

This study investigated the perception that students entering university have a greater knowledge of and competency in, computing skills than in the past. Survey data, collected in 1999, was compared with that collected from COMP101 introductory computing students in 2008. The resulting data shows that while the 2008 cohort now own and use computers much more extensively there are still gaps in their computing knowledge. It is interesting to note that while usage and ownership have increased most of the activities the 2008 cohort participate in are online, with many being regarded as social activities. The 2008 cohort rate themselves as more knowledgeable and confident than their 1999 counterparts did. No doubt this confidence comes from by their daily use of the Internet and all it has to offer. The results of the knowledge based questions suggest that they are not more competent at using office applications. The analysis also confirmed that self-rating is not a reliable indicator of competency.

While the data presented are not exhaustive it suggests that it may well be premature to remove COMP101 as a compulsory subject for commerce and IT students at Lincoln. While the 2008 data showed us that many more students are now likely to have studied computing at high school, this previous study did not convert into greater competency with end user data management and manipulation. The authors believe that in New Zealand tertiary institutions there is still a place for introductory computing subjects. The results presented here suggest that this will remain the case in the near future. Ongoing studies are needed to monitor the situation as the technological and education environments change.

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Appendix 1: End user computing questions included in the survey

12. The formula =IF(J2+5<10,10-J2,J2/2) is in cell I2 of a spreadsheet. If the value in J2 is 7, the value in I2 will be:
    (Choices were a: 3.5, b: 3, c: 12, d: 1.5, e: 6.5 or f: don't know.)
13. The cell reference =$D4 is entered into a spreadsheet in cell A1 and copied to cell B2. How would it appear in cell B2?
    (Choices were a: =$D4, b: =$D5, c: =$E5,d: =$E4, e: error or f: don't know.)
14. A database keeps information about students which includes information about their age and whether they are living "at home" (residence = "at home"). Which of the following expressions would select all students who are under 18 as well as all students living "at home"?
    (Choices were a: Age <19 AND residence = "at home", b: Age <18 OR residence = "at home", c: Age <18 AND NOT (residence = "at home") or d: don't know.)