Teaching and learning data analysis in a complex environment

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Two problems face courses in science that deal with data and the creation of information: first there is the complexity of the issues to be addressed; second there is the limited applicability of statistical approaches. Where the methodology is 'data making', classically through experimentation, the problem is not serious for the approach of statistics is very valuable. Where the methodology is 'data taking' the issues are different. Databases are large and rarely samples. Instead they are from the population: remote sensing, climate records, the population census are just a few. In this field the techniques of exploratory analysis and data mining are more appropriate. The problem for education is how to train students to deal with these environments.

The presentation discusses a course which explores these issues. It is supported by a poster. A new approach to data analysis and interpretation is necessary. It relates to the processes by which we comprehend our environment and develops analytical methods that are relatively assumption free. It relies heavily on computer aided learning modules and a range of case studies to develop experience. It sets, as a project, the problem of exploring variation in the climate in the longer term. Programs were prepared for the analytical steps and made direct and easy to use so that attention could focus on the tasks of application to the problem, knowledge of the analytical method and interpretation to create and communicate information.

IT skills of university students in 2001

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General background

This paper is the second in a series of investigations on the computer skills of undergraduate students at the start of university.[1] The use of computers is becoming more widespread in education and in the wider Australian community.[2-4] Increasingly, universities are depending more on information technology (IT) in their mainstream activities. Some examples of IT usage in Australian university teaching and learning include:

- dissemination of materials through the Web, email, bulletin boards, etc.;
- on-line assessment;
- electronic submission of assignments;
- typed (word processed) reports; and
- collaborative and cooperative learning through discussion groups and computer-mediated communication.

General university policy[4] and the use of information technology (IT) in university teaching and learning are implicitly based on **the assumption that university students are becoming more computer literate**.

Survey details

- University of Western Australia first year medical students
- Deakin University first year chemistry students (Geelong campus)
- Compulsory, first week of 2001 academic year
- Questions based on 2000 survey[1]

General IT skills

- Knowledge of Web, email, and word processing usage has increased
- Knowledge of spreadsheets is significantly lower than for other general skills
- Over 90% of students are multi-skilled
- All students (with one exception) know at least one of Web or word processing
- Student computer training can be designed to build on Web or word processing
- Generally, males have a greater extent of computer skills

Students (%) with general IT skills

	2000	2001		
	U Syd	Deakin U		UWA
	Ref [5]	Ref [1]	This work	
Web	} 82	87	94	93
Email		85	92	93
Word processor	89	99	98	97
Spreadsheet	50(a)	88(b)	77(b)	62(b)

(a) General spreadsheet use
(b) Spreadsheet use to analyse and plot numerical data

Students (%) with multiple skills(a)

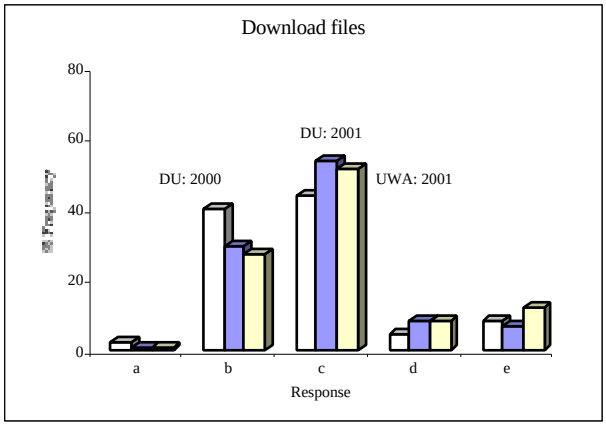
	2000	2001			
		Deakin U		UWA	
	Ref [1]	This work			
	All	Fem.	Male	Fem.	Male
4 skills	75	62	79	55	66
3 skills	15	34	12	32	30
2 skills	5	4	3	6	3
1 skill	4		6	6	2
none	1			1	

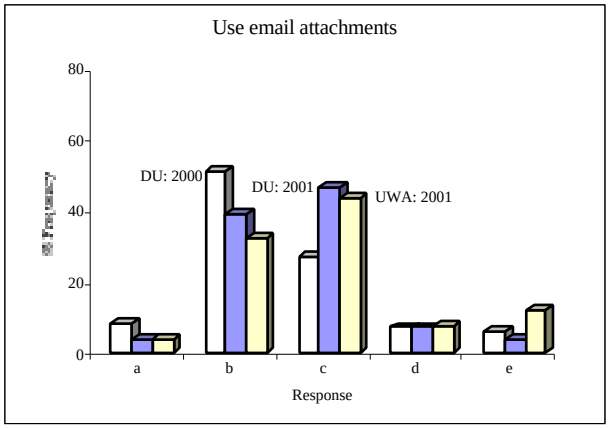
(a) Web; email; word processor; spreadsheet

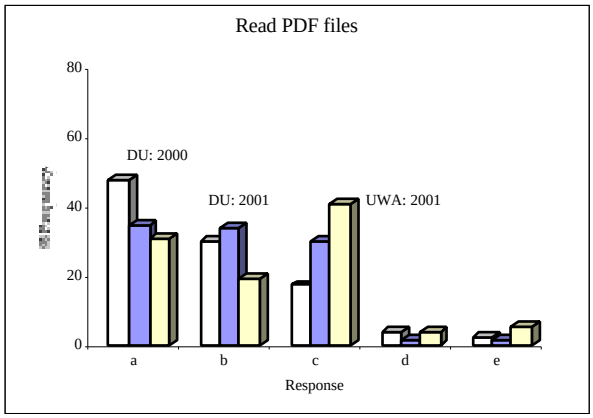
Specific IT skills

- Significant numbers do not know how to download files, use attachments or read PDF files.
- IT training is required for:
  - electronic delivery of teaching materials;
  - electronic assignment submission;
  - submission of (word processed) scientific reports.

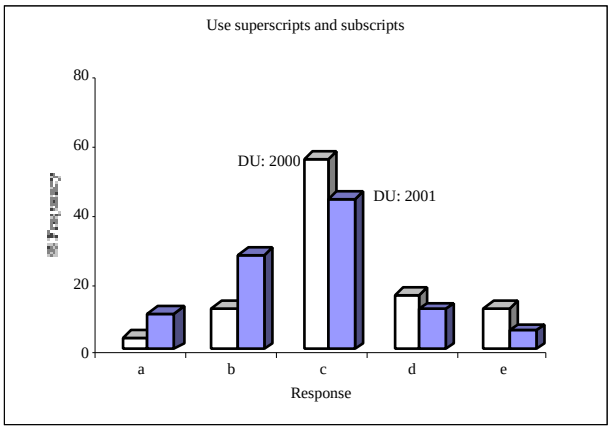
Web/Internet IT skills

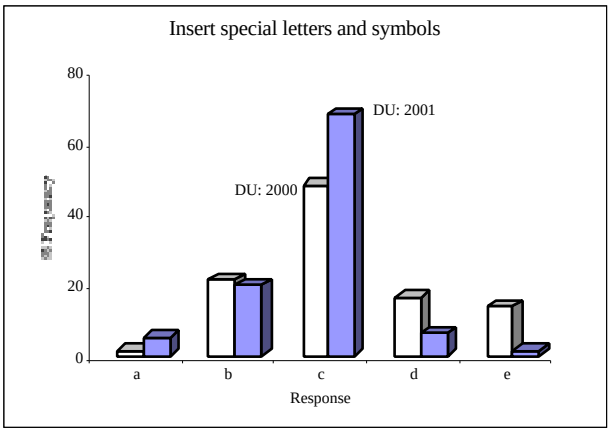


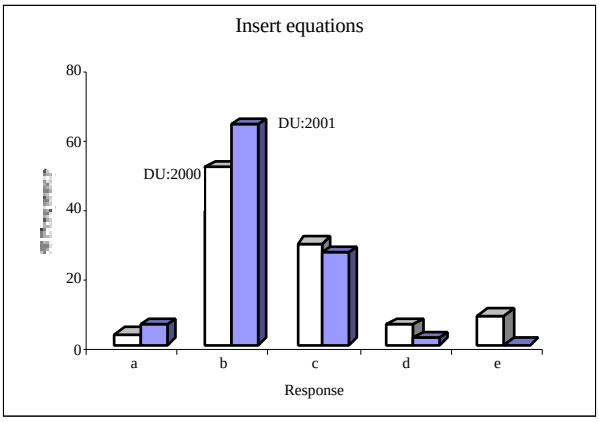




Word processing IT skills







Key to plots. (a) No awareness or knowledge; (b) Awareness but no knowledge of usage; (c) Knowledge to use the technology; (d,e) Expert knowledge to use the technology

Summary

- Students' IT skills are generally high and increasing.
- Students are weak in the use of spreadsheets.
- Students are not fully prepared for the use of electronic teaching media.
- Only the major conclusions have been presented here.

Contact Dr Kieran Lim for more details.

Acknowledgments

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References

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[2]Australian Bureau of Statistics (1997) *Business Use of Information Technology,* Canberra: Australian Government Publishing Service.
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[5]UniServe Science (2000) Survey of computing experience and skill development needs of incoming first year students at The University of Sydney in 2000, The University of Sydney.

Note

This paper presents the major preliminary results of 2001 surveys at Deakin University and The University of Western Australia. Contact Dr Kieran Lim (lim@deakin.edu.au) for more details.

Flexibility and efficiency in university soil science education: The *Oz Soils* 3.0 CD-ROM

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Abstract: Based on a 1997 CUTSD grant, we have developed 18 teaching modules for a CD-ROM based interactive multimedia program, called Oz Soils, which is integrated into the teaching curriculum of internal and external undergraduate units at The University of New England to assist students in understanding the fundamental concepts and processes of soil science. Oz Soils incorporates a flexible self-directed learning structure to help achieve this understanding. Other unit resources include a study guide, a practical workbook, and on-line quiz modules conducted through WebCT. Oz Soils makes use of interactive animations, still graphics, and text, and includes interactive self-assessment questions. The program can be readily integrated into a range of study areas which require a basic understanding of soil science including agriculture, forestry, ecosystems management, natural resources, ecology, engineering, mine site rehabilitation, geology, geography and biology. Oz Soils has been extremely well received by students and has been adopted by many Australian university departments which require teaching aspects of soil science. A brief rationale for developing the Oz Soils resource is presented, together with some outcomes of student questionnaires and research on a learning strategies study.

Rationale for developing *Oz Soils*

Soil is one of Australia's most valuable and fragile resources and it is crucial that future resource managers have a thorough understanding of how soils behave and how they interact with other components of ecosystems. Tertiary students have difficulty understanding the core concepts and processes of soil science. By using the *Oz Soils* CD-ROM as part of our teaching, we aim to foster a 'deep learning' approach in students (Biggs, 1991), by which they become more active and motivated in learning, and are encouraged to try to understand the mechanisms and inter-relationships of soil processes, rather than just memorising facts. Students in charge of their learning will be more likely to go on to relate their soils knowledge to the broader environment (e.g. the functioning of agricultural systems). Laurillard (1993) argues that multimedia resources containing self-assessment questions can address most of the requirements for effective learning, and are a substantial improvement over sole reliance on lectures and printed material. The use of animated graphics can encourage a deep