A comparison of student usage of traditional verses ICT learning resources in the Life Sciences

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Introduction

Given the increased emphasis that tertiary institutions are placing on online learning, including its replacement of traditional modes of delivery, understanding how students use available resources can inform the way(s) in which online learning modules are constructed (or modified) and integrated into the curriculum. Examining how students use traditional and ICT (information and communications technology) resources available to them in their unit of study program allows tertiary educators to assess the role and effectiveness of each learning resource and whether resources are complementing each other within the unit of study curriculum.

Online learning modules and communications technologies are commonly used in the College of Science and Technology, The University of Sydney. In the Life Sciences, computer-based materials are used to simulate dissections, to direct laboratory-based experiments, to replace/supplement tutorials and to assist students to self-assess their learning outcomes. For academic staff, the introduction of online modules to support learning is appealing, particularly as these modules can be used to reinforce and/or replace elements within the curriculum.

Students taking first year Human Biology at The University of Sydney were surveyed in Semester 2, 2000, to determine how first year students use teaching resources (both 'traditional' and IT) available to them in the unit of study, and how effective they found these resources for learning (Franklin, Peat and Lewis 2002; Peat, Franklin, Lewis and Sims 2001a). The IT materials comprised non-compulsory tutorial modules and revision materials designed to support student learning. 20% of students did not use any IT or communications technologies to support their learning, even though they had access to computers and the Internet (Franklin et al. 2002). Within the subset of students who used the on-line learning materials, 90% ranked them as useful or extremely useful (on a five-point Likert scale).

To what extent should we be concerned that a significant group of students are not using IT learning resources? The provision of online resources can be costly and time-consuming and the assumption is that all students will benefit from their implementation. Peat, Franklin, Lewis and Sims (2001b) surveyed staff and student expectations of student IT usage and found that staff consistently over-estimated the use students would make of the computer-based resources. It should be expected that different students have different preferred modes of learning. Oliver and Omari (2001), for example, report that while many students saw value in learning on a web-based, student-centred, collaborative setting, many expressed a preference for learning in a teacher-directed mode.

The aim of the present study was to quantify the use of different teaching and learning resources in a mixed learning environment and evaluate whether students had different preferences for ICT and traditional modes of delivery to support specific aspects of their learning. We were interested in determining the extent to which students were using traditional learning resources, on-line modules and communications technologies, such as peer collaboration by email, and whether these differing resources were being used by students to learn new knowledge, to consolidate their knowledge, for exam revision and/or for personal interest.

Materials and Methods

We surveyed students in three intermediate (second year) units of study (Botany, Pharmacology and Zoology) within Faculty of Science degree programs at the end of Semester 2, 2002. The survey instrument asked students to indicate whether they use traditional and/or non-traditional learning resources and to specify the learning purpose for which each resource was used. Traditional resources included attendance at lectures, attendance at practical classes, personal lecture notes, practical notes, text books, library and collaboration with student peers. Non-traditional (ICT) resources included email contact with peers, web lecture notes, *WebCT* learning environment and computer-based tutorial modules. Students were not required to access all of these resources specifically but were encouraged to do so to supplement their learning. Certain tutorial computer modules were used in timetabled classes in Pharmacology and Zoology units of study. The categories of learning purpose offered were 'did not use', 'learning new knowledge', 'consolidating existing knowledge', 'background information', 'exam revision', and 'personal interest'. Students were asked to nominate all relevant categories.

The numbers of returned responses were n = 39 for PCOL2002 Pharmacology Fundamentals (26% return rate), n = 19 for BIOL2003 Plant Anatomy and Physiology (61% return rate) and n = 20 for BIOL2002 Animals B (26% return rate). Chi-squared analysis was used to determine if a significant number of students used a specific resource for specific learning purposes.

Results and Discussion

A comparison of traditional and ICT usage patterns, over the three cohorts, showed that students used traditional learning resources to a greater extent than they did ICT-based resources (Figure 1, with data in Appendix 1). The categories of learning for which there was a significant difference were acquiring new knowledge, background information, and personal interest. There was no significant difference between students' use of traditional *vs* ICT resources for consolidating existing knowledge and exam revision. Statistical analysis of differences between cohorts (Figure 1) indicated that Zoology students were not discriminating between traditional and ICT resources when it came to learning new knowledge; Zoology and Botany students were not discriminating between traditional and ICT resources when it came to using these resources for background information or for personal interest.

Traditional teaching modes (attendance at lectures and practical classes) were the major resources students used to learn new knowledge (Table 1, significant χ^2 values in Bold). This reflects, most likely, the traditional way most units of study are delivered at university level in the Life Sciences. Both traditional (personal lecture notes, practical notes, attendance at practical classes, peer collaboration) and ICT resources (emailing peers, *WebCT*, online learning modules) were identified as contributing factors in the consolidation of knowledge. There was no significant difference found between the usage of specific learning resources for the purpose of acquiring background information. The best resources for exam revision were personal lecture notes and online lecture notes, which were also used for personal interest along with the practical notes, *WebCT* learning environment and the online learning modules.

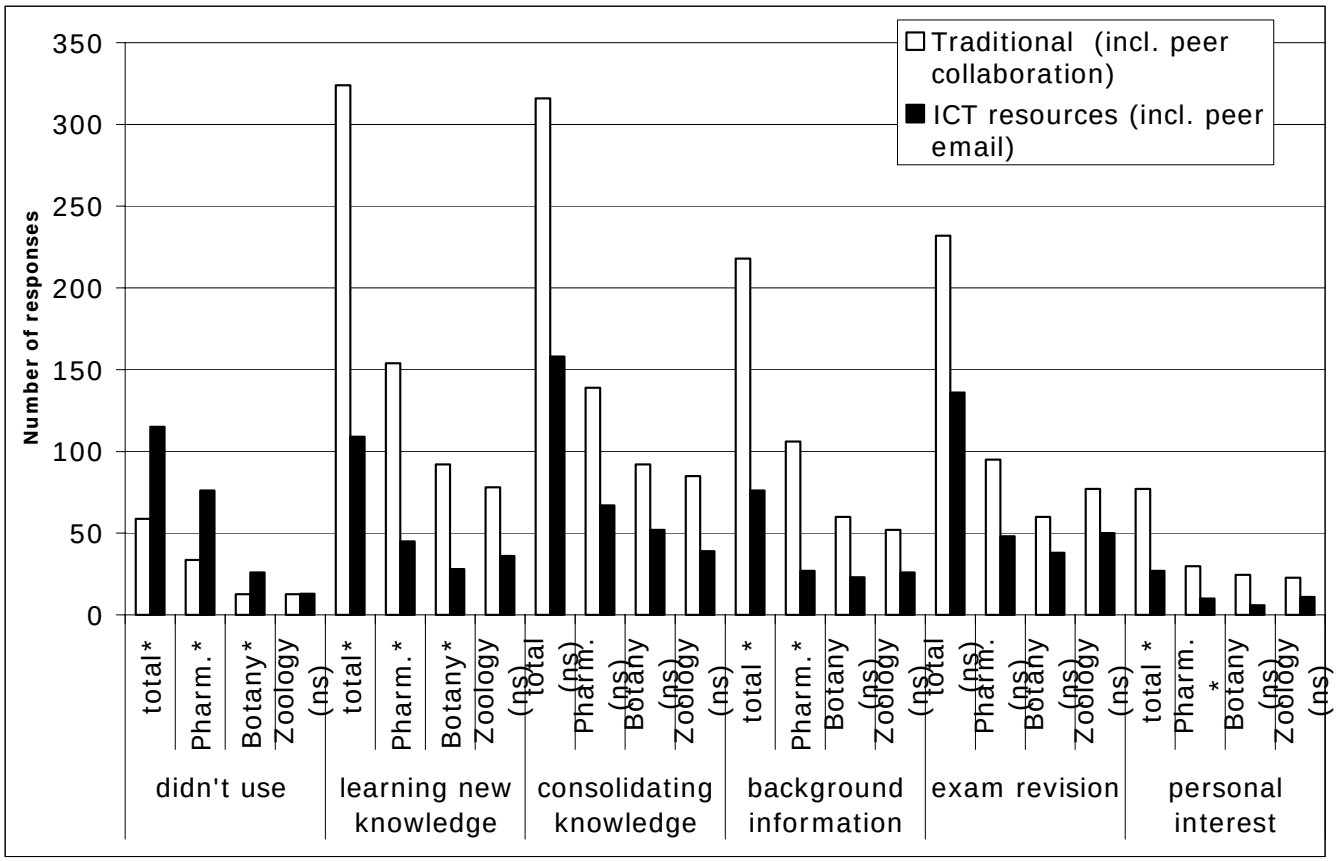

Figure 1. Numbers of students in Intermediate Life Sciences units of study that use traditional and ICT learning resources for specific learning purposes. For each category of learning purpose the total responses across the three unit of study cohorts, and the responses for each individual cohort, are plotted. The 'did not use' values are the sums of all 'did not use' responses within traditional (open) and ICT (closed) categories. Significant differences are indicated by an asterisk. (Critical $\chi 2 = 3.84$; df = 1; p = 0.05)

Table 1. Do students use specific learning resources equally for each learning purpose?

	Learning resource	learning new knowledge	consolidating knowledge	background information	exam revision	personal interest
Traditional resources	attendance at lectures	**39**	4	0	2	7
	attendance at practical classes	**10**	**10**	2	5	6
	personal lecture notes	2	**10**	5	**19**	**14**
	practical notes	0	**11**	0	0	**17**
	text books	1	1	0	0	9
	library	0	0	5	0	7
	collaboration with peers	7	**39**	8	1	4
ICT-based resources	email contact with peers for studying purposes	5	**25**	2	1	5
	web lecture notes	1	2	5	**13**	**16**
	WebCT learning environment	0	**13**	2	4	**20**
	biology content on the Internet	1	0	1	0	2
	computer-based tutorial modules	0	**13**	1	1	**16**

Values are the calculated χ^2 values for data across the three cohorts. Values in **Bold** indicate a significant usage of each specific resource for the specific learning purpose. (Critical $\chi^2 = 9.49$; df = 4; p = 0.05.)

Student peer collaboration was a significant factor that contributed to consolidating existing knowledge, but face-to-face peer contact was preferred over collaboration by email. Students used face-to-face peer collaboration (78% of all students) approximately twice as much as student email (46% of all students) to support their learning. This difference was significant for the learning category 'consolidating existing knowledge' ($\chi^2 = 8$, $p < 0.05$). The teaching environment in Life Sciences provides for high levels of student-student contact, as students spend extended periods of time working in groups (in practical classes), and our results could be a reflection of their familiarity with this particular learning style and environment.

A preference for 'live' peer collaboration is reflected by literature accounts of students' preference for face-to-face instruction from teachers rather than online instruction (e.g., Oliver and Omari 2001; Kenny 2003). While there appears to be a clear role for ICT in supporting student preparation for assessment tasks (examinations, assignments), students rate traditional modes of delivery more highly for the acquisition of new knowledge. Meanwhile, governing bodies and funding crises in universities argue for reducing face-to-face teaching time and increasing reliance on ICT-based delivery. If student satisfaction with courses is of any concern, our results suggest we proceed with caution in the current rush to get away from giving lectures. Instead, we should perhaps be orchestrating more opportunities in our curricula for students to participate in peer collaboration; it would be interesting to find out the existing mechanisms students use to collaborate and if new ICT could be introduced to better support this collaboration. It can be argued that such provision would enhance the vocational training of our graduates, as teamwork and collaboration aligns more closely with authentic practices of professional scientists.

Previous studies have related peer interactions to a variety of positive learning outcomes, e.g., students' academic achievement, development and satisfaction with their university experience (McInnis and James 1995; Krause, McInnis and Welle 2003). Twale and Sanders (1999) found the only non-classroom variable that was significantly correlated with critical thinking ability (as measured by the critical thinking section of the US Collegiate Assessment of Academic Proficiency Test) was hours spent outside class talking to peers about current issues. Even within a totally web-based learning environment, the amount of perceived human interaction with staff and peers was a strong predictor of student satisfaction with a course (Pérez-Prado and Thirunarayanan 2002).

Students in the present study used essentially non-ICT modes, such as lectures and practical classes, as the main mechanisms to learn new knowledge; however, in all units of study students were using computer tutorial modules and peer collaboration, as well as the traditional resources, to consolidate knowledge. The strategy of students appears to be incorporation of all means available to consolidate knowledge. This learning strategy seems to be linked primarily to the short-term goal of examination performance, rather than the more enduring motivator of personal interest. Indeed, Krause et al. (2003) reported that the most common reason for peer interaction between students at the University of Melbourne was to discuss assignments.

The current findings have implications for the designers of online learning resources, in terms of alignment between design objectives, student learning preference and staff expectation of student usage for all types of learning resources. If student learning preferences influence learning outcomes, as suggested by Franklin et al. (2002), then student preference for face-to-face rather than ICT learning resources should be taken into account when designing curricula. A variety of learning experiences that target different learning preferences need to be offered to enable a mix of traditional and non-traditional learning modes, including effective student interactions with peers as well as teachers.

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Appendix

Table 2. Use of traditional and non-traditional (ICT) learning resources for specific learning purposes available to intermediate level students in Pharmacology (P), Botany (B), Zoology (Z). Data are % response (based on number of surveys returned per unit of study).

		did not use			learning new knowledge			consolidating knowledge			background information			exam revision			personal interest		
	Unit of study	**P**	**B**	**Z**	**P**	**B**	**Z**	**P**	**B**	**Z**	**P**	**B**	**Z**	**P**	**B**	**Z**	**P**	**B**	**Z**
traditional resources	attendance at lectures	3	0	0	**85**	**100**	**95**	26	32	35	33	53	50	36	26	35	**26**	16	30
	attendance at practical classes	0	0	0	46	**84**	**70**	67	47	65	33	37	15	8	32	45	21	11	**35**
	personal lecture notes	8	5	5	26	16	30	46	79	50	21	21	15	51	**79**	**70**	8	11	10
	practical notes	3	0	0	28	63	45	62	68	50	**46**	37	30	28	58	40	8	5	15
	text books	0	11	20	**67**	63	30	54	**74**	45	**49**	**53**	**55**	**59**	37	50	23	32	20
	library	46	11	5	13	63	40	10	63	50	23	**63**	**65**	18	21	50	5	26	20
	peer collaboration	**26**	**21**	**15**	13	11	10	**56**	**74**	**65**	5	16	15	26	32	50	13	11	20
ICT resources	email peers	**62**	**47**	**45**	3	5	5	23	58	25	5	11	5	10	16	25	3	5	5
	web lecture notes	5	21	0	**49**	32	**55**	41	63	45	23	16	25	**56**	**63**	**75**	**10**	11	10
	WebCT environment	44	11	0	15	**53**	40	44	63	50	8	32	30	18	58	65	0	0	5
	biology content on the Internet	59	42	10	21	16	35	13	21	25	10	32	45	8	32	25	8	**11**	**25**
	computer tutorial modules	26	16	10	28	42	45	**51**	**68**	**50**	23	32	25	31	32	60	5	5	10