

Chapter 14. Learning Human Biology: Student Views on the Usefulness of IT Materials in an Integrated Curriculum

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Abstract

This paper reports on the outcomes of a study on the use and perceived usefulness of educational multimedia resources and communications technologies within the context of a single course in a first-year biology program. A major focus of the research, as reported in this paper, was the extent to which the computer-based resources made available to the students were utilised, and the students' perceptions of the usefulness of these resources to their learning. Data of expected and actual use and usefulness of these resources were collected from the students using surveys and focus groups within an action-research model. While the majority of students found the multimedia resources to be of use for their learning activities through providing off-campus access to supplementary and relevant materials, it is of interest that some did not find them useful and some did not use them at all. In addition the use of communications technologies was greatest for social interactions rather than course specific needs. The data indicated that these levels of use were not a function of access to computers or the Internet. These findings suggest that the provision of online resources will not necessarily generate value-added learning and reinforces the need to offer a variety of learning experiences that target different learning styles and enable a mix of off-campus and on-campus opportunities.

1. Introduction

First year science courses at The University of Sydney have high student numbers. As well as servicing many degree programs in Science, they also service other faculties such as Agriculture, Education, Arts and Engineering. This large group of students is very

heterogeneous, characterised by varied educational and academic backgrounds with a broad range of incoming entry grades, and a range of incoming generic skills (writing, computer, team work, etc.). Many of the students in specialist Science degrees are highly motivated and know where they are going, but a large proportion are enrolled in the straight Science degree which allows the students a wide choice of subjects, but often means they are unsure of their future directions. In addition, many students arrive at university with an expectation of being spoon-fed (McInnis, 1995), having been conditioned to using a surface approach to learning in high school, whereas, at university, they need to focus more on deep learning strategies to succeed within their chosen degree programs. It is recognised that active involvement in the learning scenario can lead to the use of deep learning strategies (Sutcliffe, 1999). Computer-based activities offer learning experiences that are under the control of the individual learner, that may better suit individual needs and offer active involvement by way of interactivity. Increasingly the Web is being used to create a better learning environment that is more independent of teacher interaction, is sustainable in the current economic climate and encourages the development of lifelong learning strategies. To provide this type of learning environment, the School of Biological Sciences at The University of Sydney set up a virtual learning environment (VLE at <http://fybio.bio.usyd.edu.au/vle/L1/>), allowing students to access resources any-where/any-time. The development of this resource, and preliminary evaluations of its use by students, are discussed elsewhere (Peat, 2000b).

The current study examined one of the first year courses, Human Biology, which integrates a range of computer-based learning modules, online materials and communications

strategies with more traditional learning resources such as lectures and practical sessions. The aims of the course include helping the students develop a familiarity with foundation issues in human biology with the ability to relate learning to real life and to enhance the development of those life skills required of a science graduate. The teaching methods use lectures, practical classes in which the students are encouraged to work in small peer groups to foster collaborative learning strategies and good inter-group communication, and independent study opportunities which can be done at a time to suit the student and do not require attendance on campus. Within the teaching format educational multimedia resources, including in-house computer-based modules, have been integrated into the curriculum. It is recognised that the incorporation of information technology can change the roles of students and teachers, facilitate more student-centred learning and expand the scope and content of the curriculum (Horgan, 1998). Given the current environment, the learning paradigm is one where students are provided with a range of resources to cover the curriculum of the course and this range has been designed to cater for a variety of learning styles. The purpose of this study was to provide both a reflective and analytical assessment of a broad range of learning resources integrated through web-based technology. Three specific factors led to the adoption of this approach.

First, the students enrolling in the course constitute an heterogeneous group with widely varying academic backgrounds and interests in biology, a situation that now appears to be the norm for large first year science classes. Over the last ten years the increasing heterogeneity of the student group and an increasing awareness of animal rights issues has led to potential problems with the performance of some ethnic/cultural groups with respect to some biological procedures (e.g. dissections of animals and animal parts). During this period some changes in the practical structure have been implemented to take this into account, such as replacing animal dissections with computer-based simulation ("virtual" dissections).

Second, the computer-based modules used within this course have already been demonstrated as effective (Peat, 1999; Peat, 2000a; Peat, Franklin and Mackay-Wood,

1997). They have been developed over a number of years and formative evaluation enabled each resource to be enhanced as it was being integrated into the curriculum. Students (and staff) were asked such questions such as "Was it easy to use?", "...accessible?", "...enjoyable" and "Were there any bugs?". Individual resources were modified according to student and staff feedback. Many of these products were developed initially for use on the University Intranet but have now been launched on the Internet. Part of this current project is to determine the accessibility of these Internet resources to the students and when and how they are being used. Use of these resources within the learning process has been investigated by asking students for what purpose (tutorial, remedial learning, self-assessment) they are using the materials, and how the materials help them in their learning. For this investigation it was considered more important to focus on the overall teaching and learning process rather than the effectiveness of individual resources.

Third, the research agenda within instructional technology has gone beyond that of comparing resources to one of making them work better (Reeves, 1999). Over the past 25 years a vast quantity of research has been conducted to assess the comparative benefits of computer-based learning, with ambivalent results (cf Reeves, 1993; Russell, 1999). For this project the focus was not on the individual resources as effective learning tools, but on the perceptions of both students and teaching staff as to their importance in the overall teaching and learning process; this is particularly significant with the increased emphasis by tertiary institutions on online learning. Within this context, the project emphasised the student perceptions of their learning experiences as advocated by (Prosser, 2000) and so the focus was on the ways in which resources, based on information and communications technologies (email, discussion groups, computer-based learning), had been effectively integrated into the curriculum.

Given the amount of time and money that had been spent on the development of all the teaching and learning resources and within the context of the three issues identified (increased heterogeneity of users, accepted mature materials, and making the resources work better), the aim of this project was to determine how the computer-based modules and

information and communications technologies influence the learning process. The resources in question are being sustained within the curriculum and have been used by more than 800 students each year for several years, and while this has been accepted as cost effective, the effectiveness of the materials has not been sufficiently demonstrated with respect to student learning outcomes.

This paper examines the role of computer-based modules and communications technologies on the learning opportunities for a large group of first year students as viewed from the student perspective. In general terms it was found that a substantial proportion of students used the computer-based resources and reported that they were useful in their learning, although some resources were not actually used as much as students themselves expected to use them.

2. Available Online Resources

Since 1992 computer-based modules have been introduced into all the first year biology courses at The University of Sydney. There is a suite of modules used for a variety of teaching and learning scenarios: modules to be completed pre-lecture and pre-practical class; modules to be used within a practical class; and modules enabling revision, and self-assessment. Students are directed to particular modules at given times during the course and many of these are accompanied by paper-based resources. Some of these modules are primary or core resources for the students, replacing other materials, whilst some modules are additional to help support the students in the absence of extensive face-to-face contact. Tutorial modules provide a large amount of information for students to explore, at a variety of depths, to complete projects and laboratory exercises, and contain a quiz section for students to assess their understanding of the material. Tutorial modules enable biological processes to be illustrated in an animated manner not otherwise available. Pre-lab modules are introductions to the use of laboratory equipment and they allow the students to gain an understanding about how the equipment works before meeting up with it in the laboratory session. This has proved an effective way to help students learn to use equipment and one that is now used extensively in Chemistry classes around the higher education sector (Wilson, 1996; Wilson

and Cavallari, 1995). Self-assessment modules allow students to take a series of formative tests and exercises aimed at helping them monitor their level of understanding of major biological concepts. Further descriptions of design and evaluations of all the modules can be found at

<http://fybio.bio.usyd.edu.au/SOBSFYB/fyb/tdg/FYBTDGhome.html> and in Peat (2000a), and Franklin & Peat (2001). It is considered that the use of these resources will possibly vary depending on the students' perceptions of the usefulness of each resource.

In 1997, communications technologies in the form of email and chat were introduced as a resource for learning, enabling asynchronous electronic student/staff and student/student contact. These resources are available via the CyberTutor and discussion links from the first year biology Virtual Learning Environment (VLE). The use of communications technologies as a resource was enhanced in 1999 when The University of Sydney provided all students with a free email account. The current communications links available via CyberTutor, CyberAdmin and CyberTechSupport through the VLE allow students to contact staff about academic, administrative and technical matters.

3. The Students

The target population of students (n=800) is typically recent high school leavers enrolled in science-based degree programs. As noted earlier, the student body has become increasingly diverse over the years, with respect to academic achievements, literacy and science backgrounds and extra-curricular activities such as paid employment. A recent survey (Peat and Franklin, 2000) indicates that the majority of first year biology (full-time) students are undertaking a significant amount of paid casual employment to support their lifestyle (67% are in paid employment from 5-15 hours a week). For many students this increasing demand by part-time work is making it difficult for them to fulfil on-campus course expectations and is one of our reasons for developing online resources available any-time, anywhere. McInnis, *et al.* (2000) indicate that this is common to all first year students Australia-wide.

4. Method

The research model used was based on the more recent arguments of Reeves (1993) and Alexander and Hedberg (1994) which have led to a model involving a mixed approach to data production and analysis, with both quantitative and qualitative information obtained in the evaluation process. Described as the Eclectic-Mixed Methods-Pragmatic Paradigm (Phillips, *et al* 2000) this approach is considered more capable of handling the complexity of modern society and technology with a focus on practical problems rather than on issues, whilst acknowledging the weaknesses of current evaluation tools.

The overall study was based on the dynamic state of the perceptions of the major stakeholders involved in the course, but this paper focuses on the students' perceptions of their use of computer-based modules and communications technologies within an integrated curriculum. Data were collected from all stakeholders at four separate intervals, using surveys, interviews and/or focus groups. The first data collection point (DC₁) was at the commencement of the course and consisted of surveys of students and laboratory teaching staff, and interviews of lecturers, courseware developers and technical staff. This established a benchmark of understanding and perceptions prior to any teaching and learning influences. A separate instrument was designed for each of the stakeholder groups such that the questions focused on similar course delivery issues and all stakeholder perceptions of learning resources and how they would be used. This will enable alignment of responses and the derivation of common themes in terms of the understanding, potential and use of learning resources within the program. It asked all stakeholders for their expectations of the use of different learning resources (including educational multimedia).

Figure 14.1 shows the relationship between the data gathering activities from DC₁ to DC₄ associated with investigating the **students'** views of the computer-based modules and communications technologies.

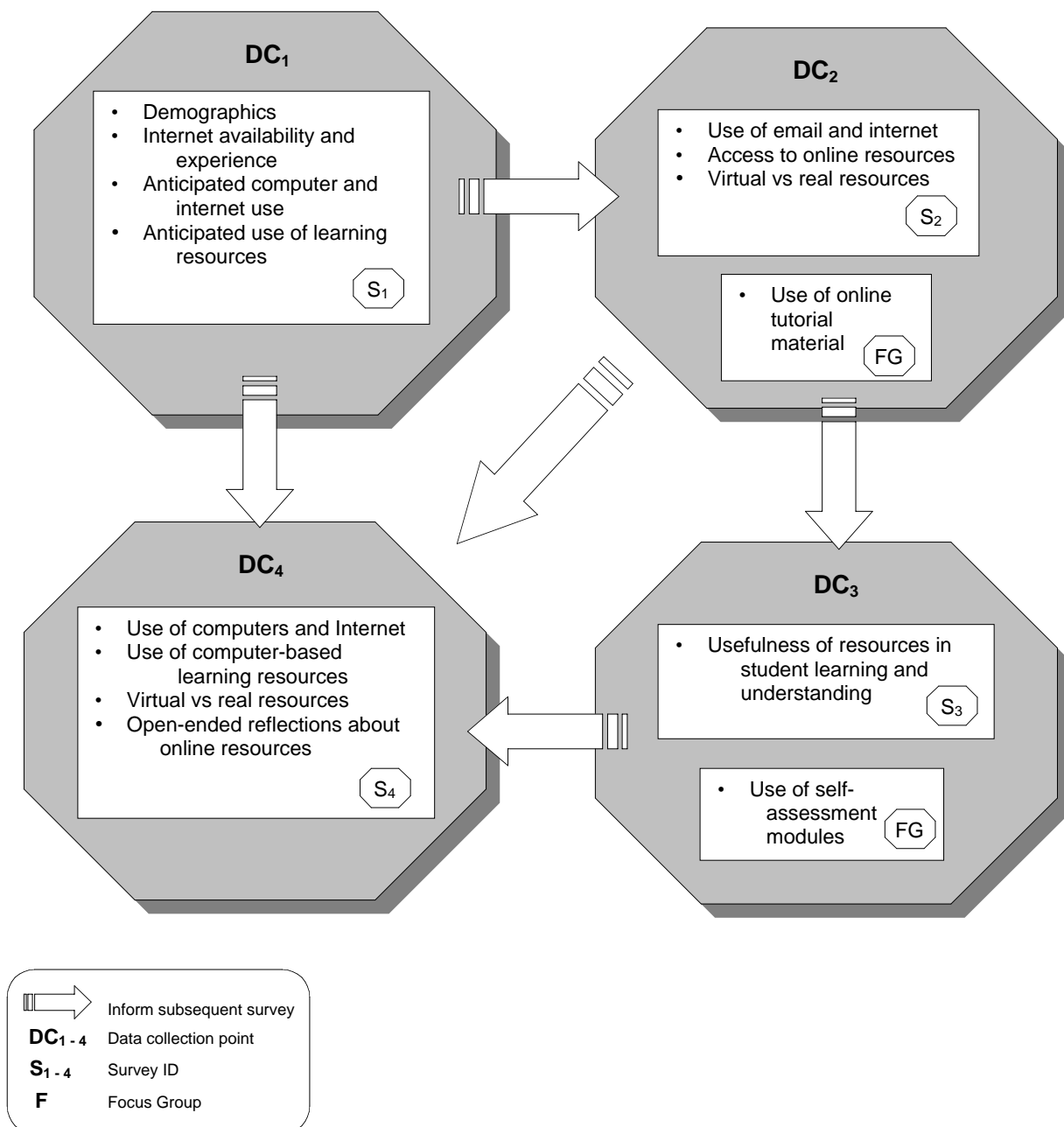
Student surveys, using both qualitative and quantitative instruments, were conducted at each of the data collection points (DC₁-DC₄). Student survey S₁ provided benchmark information about the student cohort, including

demographic data and learning style, as well as students' expectations of learning resource usage. At S₁ all students were surveyed, during the fourteen laboratory sessions of one week that accommodate this large group of students and the data collected are from this entire stakeholder group. Subsequent data collection by survey was of a subset of this stakeholder group with S₂, S₃ and S₄ each surveying half the total number of students but chosen at random. The information from S₁ helped inform both S₂ and the focus group. In particular students were asked further questions in S₂ about their use of email and the Internet in their learning, and ease of access to first year online modules. In addition S₂ targeted their perceptions of the use of virtual versus real dissections in enhancing learning. The focus group questions, relevant to this paper, concentrated on the use of online tutorial material. On the basis of the focus group material the third survey (S₃) revisited some of the material from the second survey as it was felt that some of the S₂ questions had been ambiguous and the data collected were not easy to interpret. It also focused specifically on students' perceptions of the usefulness of the resources to their learning and understanding. Whilst survey S₄ repeated much of the ground covered in the initial survey (S₁), it did so by asking students what resources they had actually used and how useful they had found these resources. A focus group was asked to comment specifically on the use of the self-assessment modules.

5. Results and Discussion

This section reports on the major factors emerging from this research process and examines student:

- demographics;
- use and perceptions of the Internet;
- access to online materials;
- views of communications technologies; and
- perceptions about using online tutorials in general.

Figure 14.1. Student data collection chart at DC₁ – DC₄.

5.1 Student Demographics

The demographic information provided from the first survey (S₁), whilst dynamic, represents a snapshot in time of the first year biology students taking Human Biology at The University of Sydney in 2000. The analysis describes the student group in terms of gender, age, schooling and family educational background. The student group taking this course was predominantly female (65.5%), full-time enrolled (98.5%), within the school leaver age range (91.5%), and having attended school in Australia (95% - Catholic 24%, Government 40% and Independent/Private

31%). The students came from predominantly university oriented backgrounds (40% of students have both parents with degrees, 30% have one parent with a degree). Most of them were enrolled in the Faculties of Science and Pharmacy (83%) and most reported that they had completed the previous semester's biology course (92%) and this previous experience of the learning environment within first year biology gave them an informed perspective on the way in which the unit would be presented, in particular the use of computer-based resources.

In addition the demographic information

identifies the general access by students to computers and the Internet. Nearly all students in this course (99.5%) have access to a computer, with 98.5% of all students indicating access to the Internet (84% access at home). An interesting issue is that there is now significant competition within the home for the Internet line (36.5% of students indicating competition from siblings or parents). These data are comparable to a University of Sydney survey of computing experience and skill development needs of all incoming first year students (UniServe Science, 2000) in which 87% of students have access to a computer at home (for the sciences and technology students this figure is higher) and is in comparison with the equivalent 1995 University survey (not published) which showed that only 66% had access. It can be argued that universities can justify the provision of online materials/courses if students have access to them.

5.2 Student Use and Perceptions of the Internet

The demographic analysis from S_1 indicates that students have good access to the Internet. However it was important to know whether the students used the Internet for their learning in Human Biology and if they perceived these resources to be useful to their learning, in order to justify the provision of these web-based first year biology resources. At the commencement of the semester, 54% of students expected it to be necessary to have access to a computer weekly, and 33% expected a daily need in

order to participate in, and successfully complete, the Human Biology course (see Table 14.1). During the course 71% of students used a computer weekly for Human Biology and 13% accessed one daily (ie 84% used a computer at least weekly). The results were similar for Internet access as also shown in Table 14.1. Weekly use of a computer for human biology-related activities appeared to be sufficient.

The majority of students (81%) had a preconception that they would use the Internet to support their learning during the course but only 76% actually used the Internet to support their learning (Table 14.2). With 99.5% of students indicating access to a computer but in fact 20% not accessing the Internet at all during this course, the implication for universities considering putting more materials online is one of caution. We need to be aware that students will continue to require a diverse range of learning resources both online and off-line. Given these data we might want to investigate further the reasons for non usage and whether this relates to access issues and competitive access at home, or whether there are issues with learning styles and learning preferences or maybe an interrelationship between how people wish to learn and how the material is presented.

Students found the Internet as a resource to support learning was as they expected, but 24% of them were not using it as a resource (Table 14.2) Again these data indicate that a considerable number of the students (200) are

Table 14.1. Student use and perceptions of the Internet.

		Expectation (S_1)	Actual (S_4)
Access computer	- never/rarely	13%	16%
	- weekly	54%	71%
	- daily	33%	13%
Access Internet	- never/rarely	11%	20%
	- weekly	55%	64%
	- daily	34%	16%

Table 14.2. Student use of and perceptions of the usefulness of the Internet to support learning in Human Biology.

	Expectation (S_1)	Actual (S_4)	
		Use	Do not use
Use of Internet to support learning	81%	76%	24%
Usefulness of Internet in supporting learning	- not useful	9%	11%
	- useful	58%	55%
	- extremely useful	33%	34%

not using the Internet as a resource and those that do use it indicate it is useful (55%) but not extremely useful. This reinforces the idea that within the student cohort there are a variety of learning styles which require the provision of a variety of resources, and not necessarily computer-based. Half the students who used the Internet perceived that it was useful in supporting their learning, and this encourages us to continue to provide web-based resources. Similar data for lack of uptake of web-based teaching has been reported by Oliver & Omari (2001) who found that 20% of students were not comfortable with using the Web as their learning environment and suggested that this number of students (50 in their cohort) is too big to be ignored when making decisions on delivery of materials.

5.3 Student Access to Biology Online Materials

The biology web-based resources, accessed via a Virtual Learning Environment (VLE at <http://fybio.bio.usyd.edu.au/vle/L1/>), offer both educational multimedia materials and communications technologies, and students are encouraged to use it as the principal web-site for the course. Thus, it would be expected, as a result of student experience in the previous semester's biology course, that there would be no difference between students' perceptions of their use of the VLE to support their learning and their actual use, and this was found to be the case (Table 14.3). A few students (15%) did not actually use the VLE at all during the course, which corresponds to the 16% of students who, at the end of the semester, responded that they rarely or never accessed a computer to support their learning in Human Biology (Table 14.1). Students' perceptions of the usefulness of the VLE did not change over the semester, with 94% of students who used the resource perceiving it would be useful/extremely useful and reporting it to be

so (Table 14.3). It is interesting to note that, while 76% of students reported they had used the Internet to support their learning (Table 2), in fact, 85% reported they had used the VLE which is a web-based resource. There may be a misconception by students of what the VLE is, and this may be because many of them use the materials available on computers in the (first year biology) Resource Centre, and thus perhaps do not realise that they are on the Internet.

Whilst general access to computers and the Internet is good, there is some concern within the student body about access to the special materials made available via the VLE on the Internet for this course. A number of students (16%) indicated they had difficulties in accessing these materials and open-ended question methodology was used to find out why. In response to the question "Do you have any difficulties accessing First Year Biology Internet resources? If, yes, please indicate why?" there were 50 responses and these were categorised within themes. The major difficulties identified were difficulties with software (28% of all responses), insufficient RAM (22%) and download times (18%). The most frequently stated comment was about the difficulties with the "plugins" needed to view the educational multimedia modules online. The remaining 32% of responses covered competition for access, navigation and hardware problems.

We can provide the technology but we need to be careful that we match this with student abilities and experiences. Some universities provide all students with electronic toolkits to help them in using the Internet but this is only of use if the students are able to access the toolkit materials and use them. We are considering providing the students with our tutorial and self-assessment modules on a CD.

Table 14.3. Student use of and perceptions of the usefulness of the biology virtual learning environment.

	Expectation (S ₁)	Actual (S ₄)	
		Use	Do not use
Use of VLE to support learning	85%	85%	15%
Usefulness of VLE in supporting learning			
- not useful	6%	6%	
- useful	47%	44%	
- extremely useful	47%	50%	

5.4 Student Use and Perceptions of Communication Technologies

The facility for both chat groups and email were provided to students via the VLE and usage of these is summarised in Table 14.4. Web-based chat groups were initially not considered by many students to be a resource that they would use to support learning (16%) and even fewer (5%) used chat groups during the semester to support their learning in Human Biology.

On the other hand, email, as a form of asynchronous communication, was considered to be a more useful resource to support learning in Human Biology. The student expectation of their probable use of email and its potential usefulness was however greater than the reality. At the commencement of the course 59% of students expected to have access to email at least weekly in order to participate in and successfully complete the course, whereas only 29% actually used email weekly. Interestingly, 22% (about 160 students) initially expected to be in daily email contact but only 5% (40 students) actually used email daily, with the majority of students only using email weekly. Similarly 41% of students expected email to support their learning in Human Biology but in reality only 22% used it for this purpose. Of those students who did use email, 57% found it useful/extremely useful in supporting their learning. This means that approximately 10% of the entire cohort found email useful in supporting student learning (only 80 students).

The student expectation for using email was much higher than the reality of using it and this needs to be viewed in the light of the other

stakeholders' perceptions (which will be reported in a future paper). It may be that, as teachers, we have unrealistic expectations and that there is a mismatch between what we think as providers and how the students perceive the provisions. It may be that the students, whilst expecting to use the technology, find they do not like using it, do not know how to use it or that they do not see the purpose in using it for course-related matters. Students need a purpose for using a resource and this needs to be made clearer to them.

Whilst Table 14.4 reports on expectations of use (from S_1) and actual use (from S_4) of email to support learning in the Human Biology course, a mid-course survey (S_2) indicated that the overall student use of email was high, with 97% of all students surveyed indicating some use. Most of this use (75%) was for other than course-related activities. This was further investigated within focus group discussions where students indicated that they appreciated and expected information to be sent to them via email but that they would rather talk face-to-face with staff as this gives immediate feedback and allows for follow-up questions. Students found email responses to be "not fast enough", expecting immediate responses to their questions.

5.5 Student Use and Perceptions of Computer-based Online Tutorials

At the start of the course students' expectation of the use of computer-based online tutorials was high (73%) (Table 14.5), matching their expectation of Internet use. Approximately a third of the way into the course students were asked (S_2) about their use, in general, of the

Table 14.4. Student use of and perceptions of the usefulness of communication technologies in support of their learning.

		Expectation (S_1)	Actual (S_4)	
Access to email	- never/rarely	41%	71%	
	- weekly	37%	24%	
	- daily	22%	5%	
			Use	Do not use
Use of Email to support learning		41%	22%	78%
Usefulness of Email in supporting learning				
	- not useful	41%	43%	
	- useful	48%	47%	
	- extremely useful	11%	10%	
Use of chat groups to support learning		16%	5%	

Table 14.5. Student use of and perceptions of the usefulness of computer-based online tutorials (CBT).

	Expectation (S ₁)	Actual (S ₄)	
		Use	Did not use
Use of CBT to support learning	73%	75%	25%
Usefulness of CBT in supporting learning			
- not useful	9%	9%	
- useful	60%	53%	
- extremely useful	31%	38%	

various computer-based learning materials. At that time only 50% of students had used any of the materials and of those students, the majority (60%) used them on their own and with a preference for using the materials at home rather than on-campus. By the end of the course computer-based tutorials had been used by 75% of the students (Table 14.5).

There was no difference in the students' expectations of the use of computer-based tutorials and their actual final use to support their learning. There was a match of students' initial expectations (91%) of the usefulness of the computer-based tutorials with actual usefulness (91%). However, it is important to note that 25% of students did not use the computer-based tutorials to support their learning, and we need to investigate the reasons why. These results mirror the recent work of Oliver and Omari (2001).

The data indicate that there are 200 students not using the educational multimedia materials. Given that 91% of those students that did use the materials found them useful, it is important to explore why the group of non-users do not avail themselves of these learning resources. They may be computer-phobic

(although our anecdotal and survey data suggest that all students can use a computer), or it may be that this is not a good learning experience for them. Core resource material should be emphasised both to the students and the laboratory teaching staff; additional/remedial/revision materials should also be suitably identified so that students (and staff) are aware of the purpose of the materials.

The focus group at DC₃, which investigated student perceptions of the online self-assessment modules, revealed that the students were using them as a learning tool as well as for the original purpose.

".. get to know what you understand not just rote learn"
"...probable use more as a learning tool but also for revision at the end".

Survey S₃, two thirds of the way through the semester, provided data on students' perceptions of the usefulness of computer-based online tutorials to their learning and understanding. With respect to skills development, 80% of the students who used these tutorials perceived them as being at least useful for developing an independent approach

Table 14.6. Students ratings of the usefulness of the computer-based online tutorials in their learning.

Type of understanding/learning	Usefulness (%)				
	Of no use	Of some use	Useful	Very useful	Essential
Developing an independent approach to learning	7	14	33	29	17
Developing discipline-based research skills	11	19	32	27	11
Understanding the structure of body systems	5	17	33	31	14
Understanding the functions of body systems	5	18	28	33	16

to learning, and for the development of discipline-based research skills (eg finding, assessing, summarising, organising information), 70% perceived the tutorials as at least useful. With respect to content 78% of students found the computer-based online tutorials to be at least useful for understanding structure of body systems. The data for understanding the functions of body systems were similar (Table 14.6).

The results in Table 14.6 have a bell-shaped distribution with some students perceiving the materials as of no use while others found them essential, indicative of the use of different learning strategies by students and the need for a variety of learning resources. This is the same theme as before, where some students will benefit from this type of material, whilst others will not, and this is probably true for all the different learning experiences. This will be the subject of further investigations.

As part of Survey 4, students were given the opportunity to comment on the Computer Based Learning resources via a number of open-ended questions. Some responses to the question: "Explain how you think the CBLs help in your learning, understanding and revising" are seen below, indicating students appreciate the interactive nature of the modules and the ability for self-assessing.

CBL allows interactive study from home, which certainly assists in learning, understanding and revising.

They clearly explain and demonstrate principles otherwise confusing and vaguely explained (if at all) in the textbook.

Allow visual reinforcement. Visual aids/animation helps clarify and understanding. Self-tests at end helpful.

Allow problem-based learning and to learn interactively.

However not all students find computer based learning suits their learning style.

I don't believe they do. The information is much more successfully provided elsewhere, as it is more organised and direct. These are only

useful once everything else has been memorised to ensure everything has been covered.

The responses to the question "Do you have any other comments to make about the use of CBL resources in Human Biology?" highlight some of the specific advantages of the resource materials, in terms of factors critical to the student in 21st century tertiary education. These are the need for supplementary and relevant materials, off-campus access and balancing study with other important activities.

It is a useful tool for reinforcement of lecture material.

It is a huge help with personal study that can be conducted at home.

Yes, it allows me to further understand the topic, but sometimes, it involves you spending a lot of time for it.

It is a very effective method of independent study and is very helpful in being another complement to lectures and the text.

Excellent idea - step by step demonstration, explains material carefully and thoroughly - great way to learn.

However the responses below illustrate that this style of learning may not suit all students.

I'm not good with computers, don't find it useful.

Don't use computers.

I don't agree with putting all important information on the web, it was difficult for me to access the internet, hence I miss out on a lot of learning material.

As we might expect after 20 years of the use of computer-based teaching resources there is some level of acceptance of the value of these within the tertiary teaching curriculum. However, there remains the issue that some students do not find them useful and this reinforces the need for the variety of materials on offer. It reminds us that we cannot use online as a replacement, but we can use it effectively in the teaching program.

6. Discussion

The message coming out of this study is that there are students who embrace educational multimedia and information and communications technologies and who will find these learning experiences valuable. However, there is a proportion of the cohort (15-20% of 800 in the current study) that, for whatever reason, are not taking up the challenge of these new(er) technologies. Maybe there is a mismatch between us as providers of the resources and students as users of these resources. The data yet to be analysed will provide information on alignment on student and staff perceptions of the importance of these resources in the learning process. Questions yet to be explored include: "Did the students not like the resources?", "Were the resources hard to use?", "Did the resources offer little perceived benefit over those available in other forms?", "Were the resources perceived as core or additional?" and "What additional help is required to enable students to use the proffered materials?" In addition, there is a substantial number of students, although in the minority, who, whilst using the materials, do not find them particularly useful.

We should take care when replacing viable (traditional) resources with computer-based ones that the replacement will be just as acceptable. In addition, more investigation needs to be done to understand which computer-based resources are viable within a student learning framework and which are not. It is important to evaluate the computer-based/Internet-based materials in the context of the curriculum and to remember that the students require a variety of learning experiences that not only embrace the electronic world but are also anchored in the more traditional offerings.

The outcomes of this current study will inform other curriculum developments within first year biology courses. Ongoing work will consider the views of the other stakeholders - lecturers, laboratory teaching staff, technical staff and multimedia courseware developers.

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