Innovative teaching of the experimental sciences in regional Queensland

Robert Newby
School of Biological and Environmental Sciences, Central Queensland University

Abstract

Central Queensland University offers a range of experimental science courses both by distance education and by 'face to face' teaching. The latter is spread over four regional campuses using various technology. In recent years there has been a blurring of the boundaries between full-time, part-time and distance education. More significantly the increasing use of technology has seen a blending of the styles and modes of delivery so that all the traditional terms are in need of redefinition (or perhaps abandonment). The actual teaching practice behind terms such as 'mixed mode' and 'flexible delivery' is starting to make a real difference for students. Despite the plethora of acronyms, e.g. VAL (Video Assisted Learning), ISL (Integrated System-wide Learning), students now have access to a range of technology based resources and we can cater for a range of learning styles (and lifestyles).

This paper outlines briefly the innovative technology being used and its influence on teaching techniques. At CQU courses are not evaluated systematically by the University but individual lecturers are encouraged to survey students in their courses. The results from these surveys are allowing us to optimise the flexible delivery models for teaching science in regional areas. The influence of factors such as class size, communication medium, student age, course level and support mechanisms are now reasonably well documented. The limitations of different models as perceived by staff and students are briefly explored.

Introduction

The experimental science departments at Central Queensland University have been at the forefront in developing a range of innovative teaching methods for students in regional areas. Students and staff now have considerable choice and flexibility in their mode of interaction. While there is little systematic institutional evaluation, surveys by individual lecturers have provided data for demonstrating the strengths and weaknesses of the different modes of delivery. The new flexibility is having a considerable impact on teaching styles and learning styles (particularly at first year level).

The nature and impact of technology in distance education has been discussed in numerous papers (see for example, Comeauux, 1995; Daunt, 1997; Kampmueller, 1996; Knox, 1997). Similarly there are a number of papers on the evaluation of academic performance (see for example, Binner et al., 1997; Burke et al., 1997). Many of these relate to the use of technology to teach smaller classes of later year students. It is not my intent to review the field but rather to provide an account of our experience with new technology in teaching first year experimental science at a widely distributed regional university.

Evaluation policies and procedures

Despite years of talk (some at senior levels) Central Queensland University does not have an institution-wide policy on evaluation. Some faculties (e.g. Business and Law) have a common evaluation instrument but these are the exceptions rather than the rule (see Appendix 1). Within Science, only the School of Biology and Environmental Sciences has a single evaluation instrument which is applied across all courses (see Appendix 2). This is a minimum set of questions and lecturers may add additional questions (usually selected from an extensive question bank). In addition, individual lecturers may from time to time use special questionnaires for promotion purposes or to investigate a particular issue. For example I always carry out a student survey if I have a new course or if I have changed a course significantly (see Appendix 3). One of the studies upon which I will comment shortly, was undertaken specifically to evaluate the relative advantages and disadvantages of VAL and ISL in a service course to health science students (McKillup and Dalton, 1999) (see Appendix 4). In addition to surveys, information has been gathered by various ad hoc or semi-formal means. For example, I have held a number of positions in the Faculty which have allowed me to interact extensively with students in individual interviews. This has allowed me to solicit comments and feedback on the different teaching modes. In some cases this has been akin to an action research model.

Brief historical context

Central Queensland University is headquartered in Rockhampton and began life in the 1970s as a fairly typical College of Advanced Education. The original name was Capricornia Institute of Technology and until recently there was a significant commitment to making science education accessible to people in regional Queensland. In the mid seventies there was a move into distance education by the science faculty (and later by others) and by the mid eighties we had a reasonably sophisticated and efficient system of distance education operating for several disciplines. This expertise was reflected in our designation as one of a relatively few Distance Education Centres. This mode of teaching was supported by traditional print-based study guides and a commitment to residential schools (typically 4 or 5 days of intensive practical work per course (subject) held during the school holidays. Physics and Computing moved early to incorporate kits and on-line teaching. Biology and Chemistry trialled kits but these were largely abandoned because of legal and logistic problems. (Some introductory courses still use kits).

In the late 80s under the influence of the Dawkin's reforms, CQU moved to establish campuses at a number of regional locations. The distances involved are quite large and the centres included Gladstone (1 hour's drive south), Mackay (3 hours to the north), Bundaberg (4 hours to the south) and Emerald (4 hours to the west). For a variety of social and political reasons, a full range of first year science was only seriously developed at Mackay and Bundaberg. A small computing and physics presence was established in Gladstone but this has struggled to maintain viable enrolments. More recently experimental science 'lectures' for health science students have been available at Gladstone but students must travel to Rockhampton weekly to do practicals. The main mode of teaching delivery developed during this period was VAL (Video Assisted Learning). In essence the lectures in Rockhampton were video taped live and sent overnight to the regional campuses. The local tutor added value to the tapes by providing additional commentary and running practical sessions. We had the advantage in science of having well

developed sets of study guides to supplement lectures. The lecturer was not responsible for camera work and the taped lectures were dispatched unedited. Throughout this period information technology played an increasing role (although there were some notable failures such as Aragon and KeyLink).

The late 90s saw a move to other campuses including fee paying ventures in capital cities and overseas. The advent of the so called 'quality funds' from the Federal Government in the late 1990s assisted a move to exploit new technology for delivery to the regional campuses. In particular, microwave links were used to establish what is called ISL (Integrated System-wide Learning) networks. In essence this is videoconferencing with all the frills. Teaching sessions (lectures) are transmitted live and the teacher (lecturer) is responsible for driving the system and in fact for the whole production. The teacher can use a touch pad to switch between the following:

- class camera;
- lecturer camera;
- document camera;
- video recorder;
- computer;
- web links; and
- others.

The teacher also has control of camera angles and focal lengths (if they choose to over-ride the pre-sets). The remote cameras are voice activated and the remote sites are equipped with document cameras. Not all remote sites have a full range of accessories. With the new wider bandwidth and generally improved technology, immediate and meaningful interaction between teacher and learner is reasonably effective. The main limitation is the need to recognise that at any instant there is a single channel of information (plus sound). The move towards ISL has seen a move away from traditional lecturing (and hence the switch in usage from 'lecturer' to 'teacher' in this paragraph).

Current status

A wide range of experimental science courses are now offered in the regional campuses. They are taught using various delivery models. In fact some courses mix the mode of delivery and may rely on any or all of the following:

- external study guides (only);
- VAL tapes (with tutor and/or study guides);
- ISL (with study guides and/or tutor);
- face to face lectures (from any site); and
- WWW/CD-ROM.

A summary of the delivery modes for science courses appears in Appendix 5.

Even where the mode of delivery is constant within a course, a full-time student in any one term may do one course involving face to face delivery, one which relies on study guides alone, one course delivered by VAL and one delivered by ISL.

More recently we have been developing courses using team teaching involving regional tutors for some of the delivery. Some courses are effectively delivered from one of the regional campuses to the rest of the network. For example, environmental science students in Rockhampton take a course called Environmental Economics which originates out of Emerald (even though there are no environmental science students in Emerald).

This comment is also true for Rockhampton based students. We no longer necessarily have face to face lectures from the on-site lecturer. I run a third year course in insect biology where the mode of delivery changes as the term progresses. By the end of term the students are working quite independently with minimal supervision. (I note parenthetically that there is some student resistance to this; many students actually like lectures).

The old dichotomies of 'full-time' or 'part-time', and 'internal' or 'external' are losing their meaning (much to the chagrin of our administrators). Instead we talk in terms of mixed mode enrolments and flexible delivery. The way students get information is changing and the notion of independent learning is being practiced as well as preached. In addition the way we teach is changing. There is less emphasis on chalk and talk and more on genuine dialogue with students. The University has made a considerable investment in staff development to support these changes.

The experimental science courses are distinctive in that they have retained traditional practical sessions, which on the regional campuses are run by a local tutor. This provides a common contact point that is not necessarily available in other disciplines. The need for practicals has also limited the extent to which advanced level science can be offered to regional students. There have been some schemes developed within chemistry to bring advanced instrumentation to this group. In non-experimental courses there is emphasis on email and chat lists but for many experimental courses these are little used by students. This is presumed to be due to ready access to the regional tutors.

Evaluation outcomes

Rather than present a raft of tables and statistical summaries I would like to draw together some of our experiences and some of the feedback from our evaluations of the different teaching modes.

To a large extent we have avoided looking for correlations based on academic performance and other variables. We know that regional students do as well as (or better than) main campus students but we recognise that there are numerous uncontrolled variables (class size, tutor access, etc.). Similarly with distance students, those that remain in the course tend to do better on average than full-time students (but there is a well documented high initial attrition).

If we consider the different media we can make the following comments based on our evaluations.

Study Guides - there are no surprises here except that the responses lack symmetry. To a large extent, a well structured study guide will be well received by students but they often give it a middle ranking score. By contrast students will quickly let you know if a set of study guides is not up to standard by ranking it very severely. Our students have become quite discriminating (and expect high quality study guides).

From the point of view of academic performance (including attrition) we find school leavers cope poorly with this mode of learning. For mature aged students or later year students, the academic results are comparable (or better) than for the internal students. School leavers who attempt full-time distance study almost invariably fail some of their courses. This appears to be due to poor study skills and time management. In academic advising we usually advise such students to attempt no more than a 75% load in their first year. It was for this sort of reason that we avoided a traditional distance education model when setting up at the regional campuses.

VAL - the main feature about VAL that students appreciate is the flexibility with respect to time. They can watch the tapes at any time (and can of course review them later in term). This feature makes the courses available to part-time students who might not be able to attend lectures because of work commitments.

In some surveys, VAL lectures are ranked equally highly with face to face lectures. We have had some deserved criticism from students where there were technology deficiencies (e.g. small screen, poor sound or narrow bandwidth) but generally these are beyond the control of the lecturer.

The main criticism from students arises from poor camera work and a feeling of exclusion. If the camera lingers on a wide angle shot for too long or fails to switch to the document camera in a timely fashion, then the students become quite frustrated. From a teaching point of view the best technique is to develop a good relationship with the camera person and anticipate your moves. Simple leaders like 'We will now have a look at this simplified diagram on the document camera' allows both the technician (and the students) to anticipate what is about to happen.

Similarly, students at remote campuses comment favourably on even small gestures that recognise their existence. Because there is no feedback in VAL, the students can easily become passive and it is difficult to enliven lectures beyond putting on a stimulating performance with variety and some rhetorical questions directed at the remote campuses.

ISL - we have less data on evaluation of this mode of teaching but some of the preliminary student feedback is useful. Students appreciate the immediate feedback and life-like lectures but they miss the loss of flexibility with respect to time. Since ISL sessions are not taped by the University, a missed session is a lost opportunity.

Local tutors have commented that they now feel excluded to a degree since they are no longer involved in the minute by minute progress of the lecture. By contrast there are quite enormous demands on the teacher/director who must hold the entire performance together.

Many people indicate that videoconferencing should be limited to 20 persons per site and six sites per session. Our experience is that this can be extended, particularly where the delivery is coming from the main campus and/or is well executed. In making this comment I also recognise that quite often in science we still spend quite a bit of time on content. There is generally less interaction than in a humanities course. For more interactive sessions the limits of 20 x 6 are probably optimistic.

Students on the main campus comment unfavourably where there are substantial amounts of lecture content coming from a remote site. It would appear that this is based partly on expectations in that main campus students (in a large class) expect the delivery to originate from there. A recent student comment drew our attention to the fact that large main campus lecture theatres are often not equipped to facilitate student participation that can be relayed to the remote campuses. For example in smaller lecture theatres, students may have individual microphones but large lecture theatres may have only four microphone sites for 120 students.

It is of course quite possible to structure a lesson so that there are breaks for discussion at each campus (and perhaps reporting back responses). By the end of each term in first year environmental science we have students making a presentation by ISL. Science lecturers report that the greatest limitation in terms of a well structured ISL lesson is the loss of 'teaching time'. The content has to be reviewed thoroughly in moving from a conventional lecture to ISL.

In general the use of technology has enabled CQU to widen the study options of science students on regional campuses. We have evaluated the different models and refined them progressively. In terms of change models it is probably true that the 'early adoption phase' is coming to an end and that the 'late adopters' are now beginning to use the systems available.

Conclusion

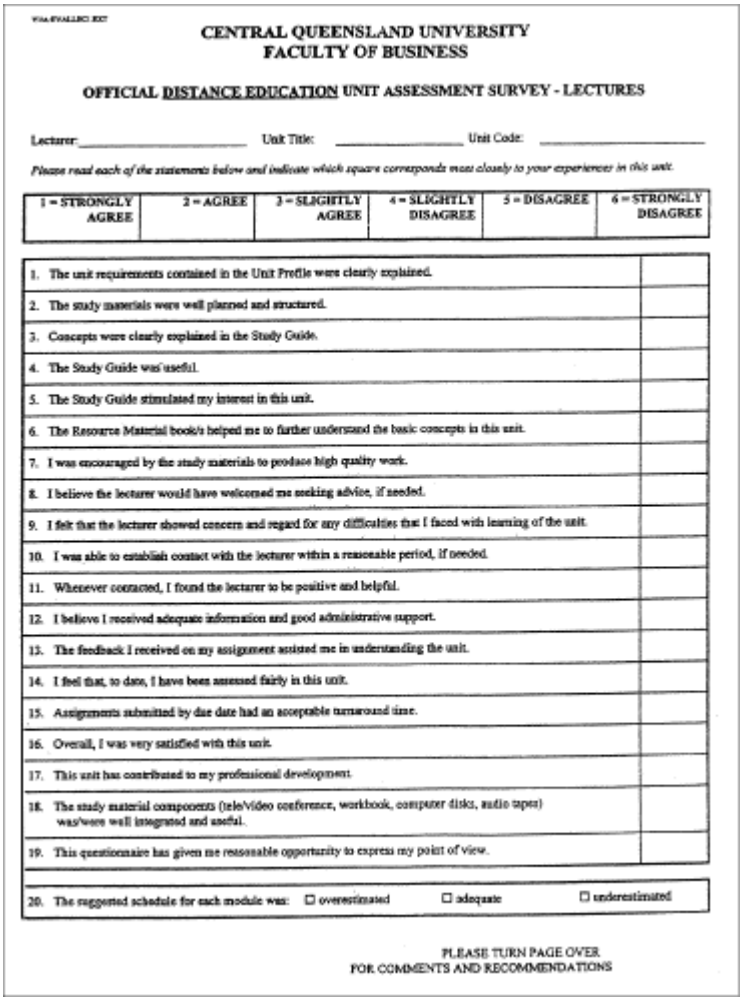
Central Queensland University science courses are taught across multiple campuses using a variety of modern technology. Evaluation by students and staff has allowed us to optimise our teaching models. Flexible delivery and mixed mode enrolment are making significant changes to the way we teach and the way students learn. Time and space are no longer limitations but there is a need to consider carefully the advantages and disadvantages of the different systems.

References

Binner, P., Barone, N., Welsh, K. and Dean, R. (1997) Relative academic performance and its relation to facet and overall satisfaction with interactive telecourses. *Distance Education*, **18**(2), 318-326.
Burke, C., Lundin, R. and Daunt, C. (1997) Pushing the boundaries of interaction in videoconferencing: A dialogical approach. *Distance Education*, **18**(2), 350-361.
Comeauux, P. (1995) The impact of an interactive distance learning network on classroom

communication. *Communication Education*, **44**, 353-361.
Daunt, C. (1997) *Is teleteaching different?* ODLAA Conference Paper, Launceston.
Kampmueller, G. G. (1996) Two-way video distance education: Ten misconceptions about teaching and learning via interactive television. *Action in Teacher Education*, **17**(4), 28-36.
Knox, D. M. (1997) A review of the use of video-conferencing for actuarial education - a three year case study. *Distance Education*, **18**(2), 225-235.
McKillup, S. and Dalton, S. (1999) *Successful VAL for Human Functioning units*. CQU internal report to ECAB.

Appendix 1. Sample Questionnaire



CENTRAL QUEENSLAND UNIVERSITY
FACULTY OF BUSINESS

OFFICIAL DISTANCE EDUCATION UNIT ASSESSMENT SURVEY - LECTURES

Lecturer:_____ Unit Title: _____ Unit Code: _____

Please read each of the statements below and indicate which square corresponds most closely to your experiences in this unit.

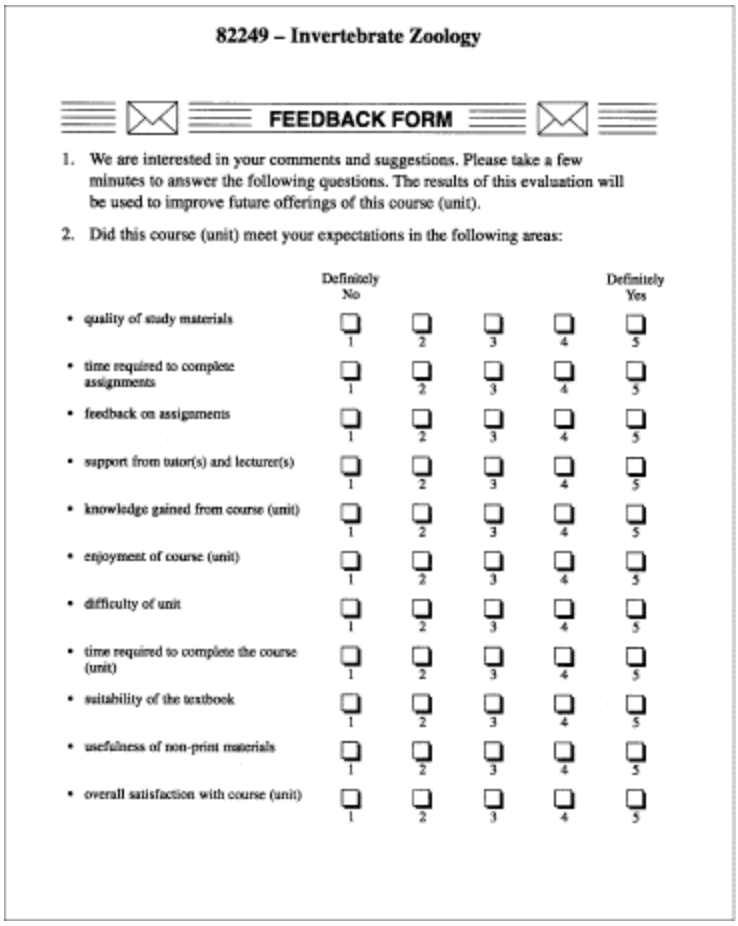
1 = STRONGLY AGREE	2 = AGREE	3 = SLIGHTLY AGREE	4 = SLIGHTLY DISAGREE	5 = DISAGREE	6 = STRONGLY DISAGREE

1. The unit requirements contained in the Unit Profile were clearly explained.	
2. The study materials were well planned and structured.	
3. Concepts were clearly explained in the Study Guide.	
4. The Study Guide was useful.	
5. The Study Guide stimulated my interest in this unit.	
6. The Resource Material book/s helped me to further understand the basic concepts in this unit.	
7. I was encouraged by the study materials to produce high quality work.	
8. I believe the lecturer would have welcomed me seeking advice, if needed.	
9. I felt that the lecturer showed concern and regard for any difficulties that I faced with learning of the unit.	
10. I was able to establish contact with the lecturer within a reasonable period, if needed.	
11. Whenever contacted, I found the lecturer to be positive and helpful.	
12. I believe I received adequate information and good administrative support.	
13. The feedback I received on my assignment assisted me in understanding the unit.	
14. I feel that, to date, I have been assessed fairly in this unit.	
15. Assignments submitted by due date had an acceptable turnaround time.	
16. Overall, I was very satisfied with this unit.	
17. This unit has contributed to my professional development.	
18. The study material components (tele/video conference, workbook, computer disks, audio tapes) was/were well integrated and useful.	
19. This questionnaire has given me reasonable opportunity to express my point of view.	

20. The suggested schedule for each module was: ☐ overestimated ☐ adequate ☐ underestimated

PLEASE TURN PAGE OVER
FOR COMMENTS AND RECOMMENDATIONS

Appendix 2. Sample Questionnaire



82249 – Invertebrate Zoology

FEEDBACK FORM

1. We are interested in your comments and suggestions. Please take a few minutes to answer the following questions. The results of this evaluation will be used to improve future offerings of this course (unit).
2. Did this course (unit) meet your expectations in the following areas:

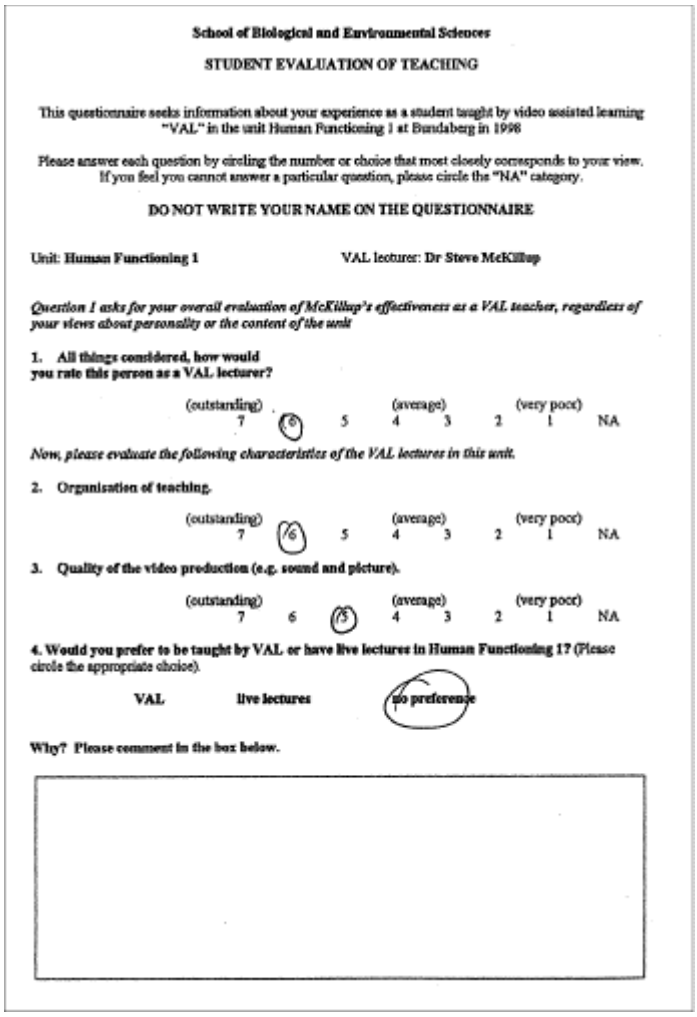
	Definitely No				Definitely Yes
• quality of study materials	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
• time required to complete assignments	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
• feedback on assignments	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
• support from tutor(s) and lecturer(s)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
• knowledge gained from course (unit)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
• enjoyment of course (unit)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
• difficulty of unit	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
• time required to complete the course (unit)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
• suitability of the textbook	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
• usefulness of non-print materials	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
• overall satisfaction with course (unit)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

Appendix 3. Sample questionnaire

82928 Aquatic Physiology					
	Course.....				
Introduction					
The unit 82928 was offered for the first time in 1999. The target audience was primarily BTech and BEnvSc students in the second and third year of their course. The purpose of this questionnaire is to provide feedback for the progressive improvement of this unit.					
Responses					
Please respond to each statement on the scale provided where 1= strongly disagree, 2=disagree, 3=neutral, 4= agree, 5= strongly agree.					
	S/Disagree			S/Agree	
1. The unit profile accurately described the requirements of the	1	2	3	4	5

unit.					
2. The content/curriculum of the unit was appropriate.	1	2	3	4	5
3. The study notes provided for the unit by the lecturers were useful.	1	2	3	4	5
4. The practicals were relevant.	1	2	3	4	5
5. The amount of work expected in the unit was appropriate.	1	2	3	4	5
6. The assignment (essay on topic of choice) was a useful exercise.	1	2	3	4	5
7. The practical write-ups were appropriate	1	2	3	4	5
8. This unit has extended my understanding of aquatic animals.	1	2	3	4	5
9. The unit was too theoretical.	1	2	3	4	5
10. The unit required more tutorials (needs to be 2L+1T/week).	1	2	3	4	5
11. The prerequisite (82249/82925) adequately prepared me for this unit	1	2	3	4	5
12. There was adequate emphasis on ecological topics.	1	2	3	4	5
13. The unit content was too similar to other units.	1	2	3	4	5
14. The lectures/lecturers were well organised.	1	2	3	4	5
15. The lecturers were adequately prepared.	1	2	3	4	5
16. The unit presumed too much biochemistry knowledge.	1	2	3	4	5
17. The unit requires a textbook in future years.	1	2	3	4	5
18. I would prefer more readings from scientific papers.	1	2	3	4	5
19. I would prefer fewer lectures.	1	2	3	4	5
20. The unit fitted in with the overall aims of my course.	1	2	3	4	5

Appendix 4. Sample Questionnaire



School of Biological and Environmental Sciences

STUDENT EVALUATION OF TEACHING

This questionnaire seeks information about your experience as a student taught by video assisted learning "VAL" in the unit Human Functioning 1 at Bundaberg in 1998

Please answer each question by circling the number or choice that most closely corresponds to your view. If you feel you cannot answer a particular question, please circle the "NA" category.

DO NOT WRITE YOUR NAME ON THE QUESTIONNAIRE

Unit: **Human Functioning 1** VAL lecturer: **Dr Steve McKillup**

Question 1 asks for your overall evaluation of McKillup's effectiveness as a VAL teacher, regardless of your views about personality or the content of the unit

1. **All things considered, how would you rate this person as a VAL lecturer?**

(outstanding) 7 (6) 5 4 3 2 (average) 1 (very poor) NA

Now, please evaluate the following characteristics of the VAL lectures in this unit.

2. **Organisation of teaching.**

(outstanding) 7 (6) 5 4 3 2 (average) 1 (very poor) NA

3. **Quality of the video production (e.g. sound and picture).**

(outstanding) 7 6 (5) 4 3 2 (average) 1 (very poor) NA

4. **Would you prefer to be taught by VAL or have live lectures in Human Functioning 1?** (Please circle the appropriate choice).

VAL **live lectures** **(no preference)**

Why? Please comment in the box below.

Appendix 5. Diversity of Regional Campus Delivery Modes

Course	Distance Education Material	VAL	ISL	Other	Team Teach *
First Year Biology	Y		Y		
First Year Chemistry	Y	Y	Y		Y
Environmental Science	Y		Y		
First Year Physics	Y		Y		Y
Fundamentals of Computer Technology				WWW	
Human Functioning I	LN	Y			

Human Functioning II	LN	Y			
Human Functioning III	LN	Y			
Intro Science (Health Science)	LN	Y			
Concepts of Science (Education)	LN	Y			
Introduction to Biomedical Science		Y	Y	CD	
Human Anatomy				CD	
Introbiol/Introchem (bridging)	Y				

* Indicates at least some delivery from regional campus