USING COMPUTER TECHNOLOGY TO INTEGRATE INSTRUCTION IN DISCIPLINE-SPECIFIC LITERACY SKILLS INTO THE CURRICULUM: A CASE STUDY

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ABSTRACT

An innovative model of Learning Development that assists students in the transition from secondary to tertiary study is being implemented within a number of faculties at the University of Wollongong. This model centres on the integration of instruction in generic and discipline-specific tertiary literacy skills into subject curricula because such integration is able to deliver relevant, cost-effective and equitable support to whole cohorts of students. This paper reports on the use of technology to supply instruction in skills, and to supply feedback to students about their development of skills, in one of the subjects on offer at Wollongong: a first year core Biology subject.

KEY WORDS

Tertiary literacy skills, integration, discipline-specific skills, generic skills, curriculum development.

1. INTRODUCTION

Students new to the university context, with its plethora of separate disciplines each with its own set of language and literacy conventions, often lack the language and literacy skills necessary for successful study. Universities have responded to this lack of skills by appointing literacy specialists, or Learning Development lecturers, to provide students with assistance in the transition from the secondary to the tertiary context. This learning assistance or learning development has been provided within a number of models in the Australian higher education sector over the last twenty-five to thirty years. The models range from an early 'do nothing' model to a later 'integrated' model and reflect both the student populations of their time and the level of responsibility taken by institutions for the development of students' skills (Skillen & Mahony, 1997; McLean, Surtie, Elphinstone & Devlin, 1993). During this time there has been an increasing diversity in student populations and a growing sense of the need for institutional cost-effectiveness and accountability.

The early 'do nothing' model was a 'sink or swim' model in which responsibility for students' acquisition of skills necessary for the academic and disciplinary context was the student's, not the institution's. At this time, in fact, institutions expected students to already have the necessary skills for the academic setting (Baldauf, 1997). They didn't expect to have to teach those skills or assist students' development in any formal way.

Such a model did not:

- offer equity because it failed to take account of an increasing student diversity;
- recognise the need for all students to acquire new skills suitable for discipline-specific contexts; and
- capitalise on students' intellectual potential, by teaching skills as well as content.

A later model adopted a 'remedial' approach. While this approach, which is still in operation in many universities today, recognises the need for assistance in an increasingly diverse student population, it operates with an underlying 'remedial' ideology which sees those students who lack the requisite skills as deficient and in need of remedial assistance.[2] Assistance in this approach is usually offered by Learning Centres that operate outside of the curriculum and is offered only to the most needy of students on an individual basis. The approach fails to recognise that *all* students need to develop specific skills for operating effectively in new tertiary and disciplinary contexts. It also fails to offer support that is:

- offered efficiently (achieving maximum development for maximum numbers of students with minimal cost to the institution);
- offered equitably (to all students);
- relevant to students' needs within the course being studied; and
- discipline-specific, rather than generic in content.

A new model of learning development, which is being increasingly adopted in various versions in a number of institutions, has adopted an integrated approach. This model rests on the belief that all students need to acquire new sets of literacy and learning skills pertinent to their fields of study, and that the acquisition of such skills is most effective when instruction is embedded within the context of study.[3] Thus, in this model instruction in relevant generic and discipline-specific literacy and learning skills is integrated into curricula at times when skills are required by curricula. This instruction provides students with the opportunity to capitalise on their intellectual potential and discourages situations in which a lack of skills impedes students' capacity to learn or to convey the results of their learning in appropriate ways. An example of such integration is the provision of instruction in the specific reading and writing skills required within a particular discipline. Instruction in such skills may be in the form of face-to-face workshops team-taught by both Learning Development and discipline staff or written resources that form part of the learning materials of the subject being studied/taught. Such a model of learning development is a major improvement on older models because it:

- is unobtrusively offered to students in a way which does not signal a 'deficiency' in their level of skills;
- is efficiently offered to maximum numbers of students;
- occurs at times required by students and by the curriculum; and
- achieves greater levels of student development in required skills than is achieved in a regular curriculum or 'do nothing' model of learning development.

It is this model which is being vigorously implemented throughout first-year core curricula at the University of Wollongong. The benefits of using such a model have been quantified in detail in an earlier paper. The most important of these is that a higher level of students' skills can be achieved than is possible in curricula in which no integration is carried out (Skillen, Percy, Merten and Trivett, 1998). One example of this integration is a first year core subject in Biology: *Molecules, Cells and Organisms.* In this subject, the provision of instruction and feedback occurred not only in face-to-face and written mode but also via the use of computer technology. This paper will present a case study of this integration and will show how computer technology has been used to provide and enhance instruction and feedback to students.

2. INTEGRATION OF DISCIPLINE-SPECIFIC SKILLS INTO FIRST YEAR BIOLOGY: A CASE STUDY

The integration of instruction in generic and discipline-specific skills into a one-semester, first year Biology subject (*Molecules, Cells and Organisms*) was carried out by the subject lecturers and two learning development lecturers (the authors). Integration into a subject (*Evolution, Biodiversity and Environment*) in the previous semester had focussed on discipline-specific reading, writing and study skills, while integration in this subject focussed only on generic and discipline-specific *writing* skills because of the report-writing requirements of its assessment schedule. The following table (Table 1) summarises the steps that were taken to prepare for and to carry out this integration in *Molecules, Cells and Organisms.*

Table 1

TITLE

Students	Staff
Assessment One	
	• Collaborative identification of required skills • Collaborative design of curriculum assessments • Development of staff resources • Marking workshop/planning session
• Submission of first assessment task	
	• Marking of first assessment
• Face-to-face feedback from Learning Development and faculty staff	
	• Collaborative development of student resources
• Follow-up instruction provided on-line	
	• Analysis of first assessment
Assessment Two	
	• Modification of criteria for assessment two
• Submission of draft of second assessment task • Instruction and peer assessment • Re-submission of second assessment task	
	• Marking of second assessment
• Feedback and follow-up instruction on-line	

An initial skills inventory was undertaken by both Learning Development and the first year Biology lecturers to determine the range of skills required for writing effective Biology reports. This inventory identified the following macro skills that students would require to write effectively and competently in the genre and to be successful in the course:

- proper use of data provided (Criterion A);
- suitable structure and development of answer/text (Criterion B);
- control of scientific language and writing style (Criterion C);
- grammatical correctness (Criterion D); and
- suitable data analysis and presentation (Criterion E).

On the basis of this inventory, a collaborative re-design of curriculum assessments was carried out to ensure that assignment tasks allowed for assessment of these skills as well as assessment of content. To assist in assessment, Learning Development produced a set of resources for staff that explained the criteria and sub-criteria and gave examples of texts in which the criteria were met and examples in which they were not met. Immediately prior to the students' submission of the first assignment task, Learning Development and Biology staff met to discuss criteria and to ensure parity between markers.

After subject lecturers had marked the assignments, Learning Development entered assignment results into a database that was used to provide marking and feedback sheets to students and to analyse results across the whole cohort[4]. The database allowed students to be given extremely detailed feedback sheets that displayed the rating they were given for each sub-criterion and an overall rating for each criterion. An overall average mark was also recorded which was arrived at on the basis of differential weighting across criteria. The weighted average score was used only for assessment purposes, while ratings for sub-criteria and criterion averages were intended to assist student development. This development was assisted by directing students, via their feedback sheets, to on-line resources that were specially developed as integrated resources for this curriculum[5].

The on-line resources focussed on detailed information about the criteria and sub-criteria used in the assessment. This information consisted of anonymous answers from the assignment that provided both good and poor examples; each of these were annotated to explain the sub-criteria in question in a way which might allow students to 'see' and understand how to construct the style of writing appropriate for the genre. Hypertext links were included to emphasise connections between and within criteria; and to emphasise connections between these resources and more generic learning resources. In addition to this on-line support, a one hour face-to-face feedback session from Learning Development and faculty staff was provided in tutorial time. Student responses and queries during this session informed further development of the on-line resources.

Stage two of the integration began with a collaborative modification of the assessment criteria for assignment two to suit the different requirements of that assignment task. After students submitted a first draft of this report assignment, they peer-marked each other's reports during a peer-assessment tutorial that was conducted by Biology and Learning Development staff. During this class, the knowledge that students had gained from the previous assignment, from the feedback and from the on-line resources was supplemented with further instruction in how to assess assignments on both literacy and content criteria.

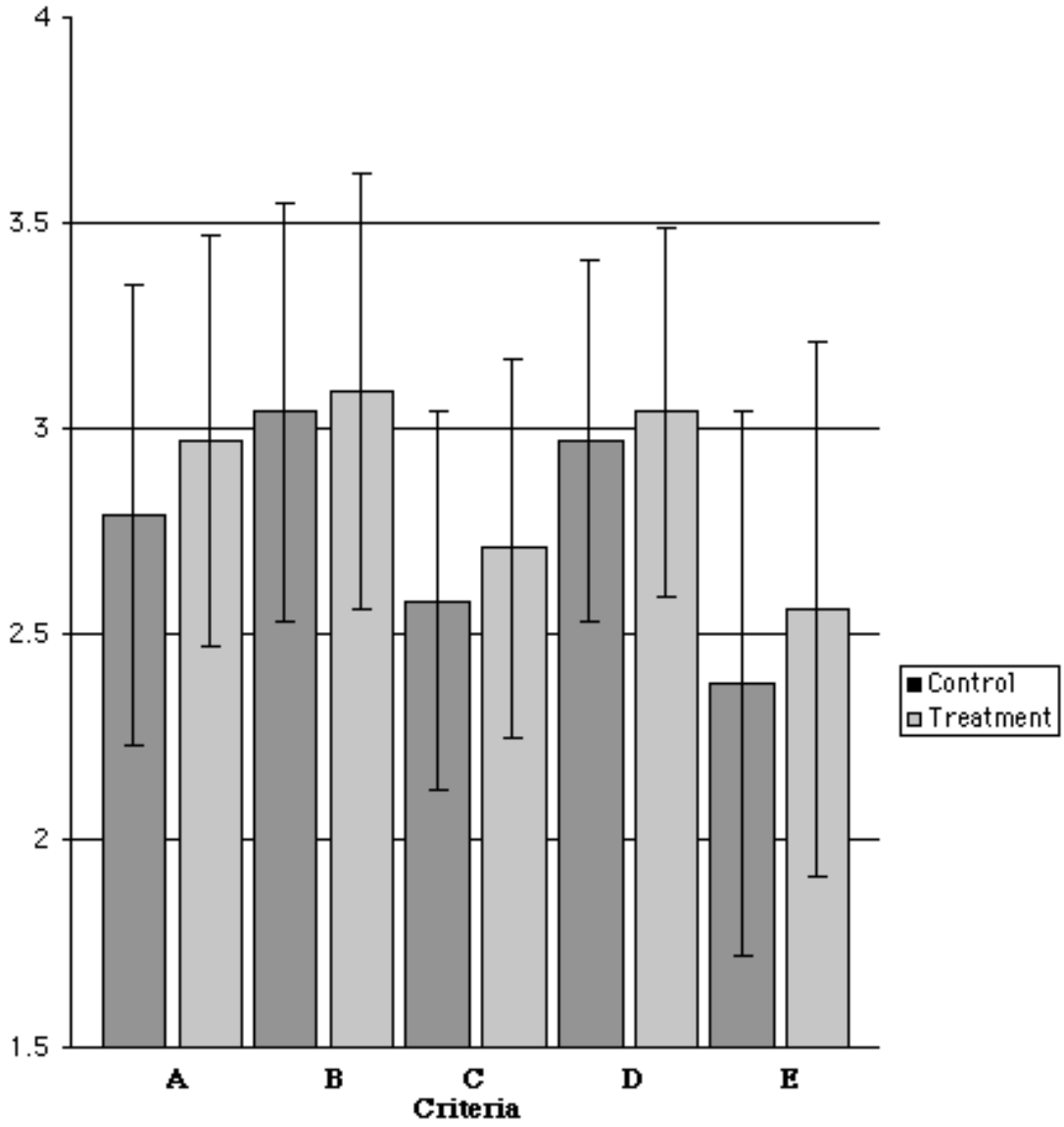
After a two-week mid-session break, students submitted a revised version of this second assignment that took into account the comments made by peer markers. This re-submission was assessed by faculty staff and again directed students to relevant on-line resources, where necessary.

3. ADVANTAGES OF USING COMPUTER TECHNOLOGY IN AN INTEGRATED MODEL

Overall, the provision of instruction in an integrated model such as this produces significant benefits in terms of student learning. An analysis of data showed that there was a statistically significant difference in three criteria between those students who had been previously exposed to integration in the subject *Evolution, Biodiversity and Environment* and those who had not been exposed to such integration[6]. The means and standard deviations for both groups in each criterion area are shown in Figure 1. It should be noted that minimal instruction was given in Criterion B and no instruction was given in Criterion D. Overall, the students exposed to integration achieved at a higher level than those who were not.

Figure 1:

Means (± SD) of Control and Treatment Groups on each Criteria



The use of computer technology to provide student feedback and instruction within an integrated model of learning development such as this has a number of advantages. Table 2 summarises both its advantages and its disadvantages. The major advantages of using such technology in an integrated model are an improved quality of instruction and of feedback. The use of a database allowed a systematic and standardised method of collecting information and providing feedback.

Table 2

Merits of using Computer Technology to Integrate Instruction into First Year Biology

	Advantages	Disadvantages
Database	• enables individualised detailed feedback	• printed feedback may appear impersonal
	• time and resource effective to maintain	• time and resource intensive to establish
	• enables immediate student access to individual and overall results	• can potentially delay feedback to students
	• facilitates informed teaching	
WWW	• time and resource effective to maintain	• potentially time and resource intensive to establish
	• changeable	• dependent on technical skills of staff
	• responsive to changing needs	• dependent on technical skills of students
	• able to show linkages between and within criteria	• less effective than face-to-face instruction
	• able to include more feedback to students about their skills	• dependent on student motivation
	• allows Learning Development staff to maintain a level of quality control	
	• a central repository of instructional material increases the likelihood of transference to other subjects	

The use of detailed feedback to students is an essential part of an integrated model because of the pedagogical power of explicit feedback. Students are better able to learn from their mistakes when they see exactly where and what their mistakes are, when they are provided with a model of the genre that they are to achieve and when they are given explicit instruction on how to achieve that genre. In our past efforts at integration, feedback was provided to each student via a one-sheet form filled out by a marker that detailed the rating each student had achieved in each of the literacy criterion areas as well as a rating for each of the sub-criteria within each criterion; for example, in Criterion E students received a rating for their attempts to meet each of the following sub-criteria:

- data correctly calculated and expressed as a mean (±sd);
- appropriate presentation of data;
- appropriate figure legend which stands alone, gives values for plotted data and explains error bars;
- axes appropriately labelled; and
- data appropriately summarised in text.

Students also received another standard one-sheet form that detailed the ways in which writers might construct genre-appropriate text. For the subject *Molecules, Cells and Organisms*, feedback to students depended more heavily on technology. The ratings achieved by each student were entered into a database which generated more appropriate and detailed results for students and which also allowed statistical information about the cohort to be generated, giving information about which literacy issues needed the most, or least, development. Overall, the use of a database allowed a systematic and standardised method of collecting information, providing feedback and planning future teaching strategies.

Instruction (and feedback) about genre-appropriate text was also provided via technology. In previous integration work, detailed instruction and feedback about genre-appropriate text was provided via paper-based resources while in this subject, web-based resources were chosen as the most efficient and appropriate medium to deliver instruction to large numbers of students. We found that the web was not only more cost-effective and efficient in delivering instruction to such large numbers, but that the quality of instruction was also improved.

This improvement was achieved on the basis of the quantity of instructional material we were able to deliver, as more useful and in-depth resources were delivered at a cheaper cost than was previously the case. Improvement was also achieved on the basis of the characteristics of the medium. Because the WWW lends itself well to the use of colour as a way to highlight information it allowed a substantial improvement in dealing with language, both generic and discipline specific. Using colour obviated the need for large blocks of text to explain concepts that could be explained more effectively through the combined use of colour and text; for example, providing instruction in the use of the passive voice in scientific writing was enhanced by being able to use colour to highlight the passive constructions in sample Biology texts.

The quality of instruction has also been enhanced by the ability to adapt and update web resources in response to new student needs. In response to feedback from students that suggested they needed more assistance with understanding and using discipline-specific terminology; an additional resource was added to the web-site after a delay of only 24 hours.

Although resource-intensive to establish, the WWW site has enabled a greater depth of instruction than would have otherwise been possible. In the past, economic considerations limited the amount of resource-based instruction that Learning Development could provide within an integrated curriculum to only the most pressing instructional needs. The WWW site has opened up the possibility to deal with a greater range of issues in more suitable depth, a range and depth that would once have been possible in face-to-face mode with only small groups of students.

4. CONCLUSION

This innovative model of learning development is successful in assisting students with the transition into tertiary study and into specific disciplines. By integrating instruction in generic and discipline-specific skills into curricula the model achieves a substantial improvement in the level of student skills in a range of literacy criteria. The use of computer technology in this integration process assists in the supply of more detailed and standardised feedback to students about their level of skills and in the provision of a higher quality and quantity of instructional resources. It also allows for more cost-effective and efficient delivery to large numbers of students.

5. REFERENCES

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6. ENDNOTES

[1] Evidence suggests that limited support was given informally by some lecturers to students in the form of classroom or one-to-one talks about essay writing (personal communication, MacNeil, 1998)

[2] The earliest proponent of this approach was ANU where a Learning Centre began operating 28 years ago.

[3] Ramsden (1992) has shown that teaching is effective if students see the direct relevance of what is being taught/studied and if they have some extrinsic motivation for that learning .

[4] This analysis of results will be discussed in the next section of this paper.

[5] Students identified as being in extreme need were also referred to the Learning Resource Centre for individual consultations.

[6] One group of students entered the subject *Molecules, Cells and Organisms* from the Faculty of Health and Behavioural Science without having studied the subject *Evolution, Biodiversity and Environment* and had thus not been exposed to discipline-specific instruction inside an integrated curriculum.