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INTEGRATING AN INTERACTIVE ONLINE PROGRAM ON REPORT WRITING INTO A CHEMICAL ENGINEERING LABORATORY COURSE: WHAT HAS BEEN THE IMPACT?

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Abstract

As the emphasis in engineering education has changed to focus more on the social and professional context of engineering, students are expected not only to develop the necessary technical skills but also the so-called 'softer skills', most importantly, effective communication skills. Effective communication is rated highly by prospective employers and is seen by recent graduates to be critical for success and advancement in the profession (Sageev and Romanowski, 2001). Although the laboratory report has traditionally been part of the laboratory course, this has generally not involved explicit teaching of the language features of the report genre in this context. Collaboration between subject area specialists and writing specialists led to the development of a face-to face program on report writing integrated into the third-year laboratory course and this has formed the basis for the online program. In transferring to an online environment, the interactive and integrated nature of the face-to face program has been maintained. The program has been well-used and positively evaluated by students in the process of writing their reports, while its integration into a report writing feedback cycle has led to improvements in student writing.

Keywords

laboratory report writing, chemical engineering, genre, online learning, integrated course

Introduction

One of the contexts in which engineering students have traditionally developed their communication skills is in their laboratory work, where a written report is an integral part of the laboratory course and is typically used as an assessment tool to evaluate learning outcomes. However, report writing is often seen as only one of the skills, and not the most important, to acquire during laboratory training (Owens, 1992, Schmahl, 1999). Although the need for explicit attention to report-writing skills in engineering has been highlighted (Friday,1986; Nutman, 1987; Miller, Ely, Baldwin & Olds, 1998), many subject area specialists feel they lack the knowledge and skills to teach students the written genres of their discipline. Through collaboration with writing specialists, a number of integrated courses have been developed to improve students' writing skills in different discipline contexts (Taylor & Drury, 1996, Walker, 1999) one of which has been the third-year laboratory course in chemical engineering at Sydney University which typically involves a cohort of 52 students. In the initial face-to-face course, the genre of the laboratory

report was taught collaboratively by the chemical engineering lecturer and the writing lecturer. Students worked through exercises and example report texts from previous laboratory classes so that the structure, content and language choices for the genre in this context were made clear. At the same time students were engaging in their own laboratory work and drafting their own reports. Drafts were then submitted into a feedback cycle where students could use the initial assessment and feedback on their work to improve their writing for final submission and grading. This course formed the basis for the design of the online integrated report writing program.

The potential of using the web to develop professional skills, provide virtual laboratory and project experiences and deliver course content has been documented as has its use in the teaching of skills, such as numerical analysis of laboratory results (Lozano-Nieto, 1999; Daku, 2001; Christie, Jaun & Jonsson, 2002). Student benefits include practical real-life experiences, better motivation, and good professional skills development (Baillie & Percoco, 2001). Other advantages such as self-paced instruction, flexibility and ease of access have been widely documented. Although there are many web sites which provide advice on report writing or sample reports (Bissell, 2002; Kett & Turnbull, 2003) few offer students interactive activities or integrate programs closely with the curriculum. Both of these aspects were considered essential to achieve successful learning outcomes for students writing their reports in the third-year chemical engineering course.

Approach, Implementation and Integration

The report writing program aims to make explicit to students the genre and discourse requirements of the laboratory report in the context of their own discipline as a way of helping students to improve their report writing skills. The typical stages of a chemical engineering laboratory report are used to create the macro-design of the progam as well as the hyperlinks to different parts of the program. Within each stage, explanations, examples and interactive exercises followed by feedback are used to help students understand the appropriate content, structure and language features of that stage. Although the program has been designed to stand-alone for self-directed learning, the integration of the program into the first laboratory task of the third-year chemical engineering laboratory course means that students can see its immediate relevance to their present learning situation and are highly motivated to use it to guide the writing of their reports.

The program was introduced to students in their course introduction where the role of the program in improving student report writing and marks was emphasized. Before using the program, students worked through multiple choice exercise extracts from each part not only to provide a pre-test for evaluation of the program but also to increase their awareness of their strengths and weaknesses in the different parts. Although students received no feedback on this exercise, they did receive general feedback on a piece of their extended writing - a results and discussion section of a report - which they also completed as a pre-test. Feedback on this exercise was given jointly by the the chemical engineering and the writing lecturer so that both aspects of content and language could be addressed. Students then began their laboratory work and wrote their draft report, while accessing the online report writing program. They submitted their draft for individual feedback on both content and language from their engineering lecturer before submitting their final draft. The multiple choice pre-test was then used as a post-test and students also completed questionnaires and contributed to focus groups.

Outcomes and Student Feedback

Quantitative Feedback

Overall, the integrated program improved student performance. There was a significant difference between students' multiple choice pre and post test marks (95% confidence level, n = 20) and between their marks for their draft report and their final report (95% confidence level, n = 41). However, sample sizes are too small to make generalisations, particularly about the impact of the online program, since only 20 students did both a pre and post test. Also, the overall improvement in student marks is more likely to be a result of individual feedback on student drafts rather than the impact of the online program.

However, an integrated program can lead to a more effective feedback cycle, if students consult the online program prior to submission of their draft reports. Questionnaire data (n=26) was collected on program design and content and students' perceptions of their learning from the program. Feedback on design and content was very positive, with generally 75% of students or more rating the program highly in terms of design (user-friendliness, ease of use etc.) and content (exercises, interactivity, feedback, example texts etc.) However, students requested more example texts and a feature to print out the content and structure guidelines for each part of the report. As can be seen from Figure 1, positive student ratings were given on all aspects of learning from the program. Overall, the program had helped students to learn more about writing a laboratory report in chemical engineering, to know where to put information and how to structure each part. However, only average ratings were given for learning about language and understanding chemical engineering topics, indicating that few students saw any connection between the program and their learning of chemical engineering content, although they appreciated a writing program that used examples from their discipline. The program was rated highly for making students more aware of their problem areas and clearer about the purpose of laboratory reports in chemical engineering. However, ratings for increasing student confidence in writing reports were lower, with only a third of respondents giving strong positive ratings in this area. Nevertheless, this is not an unreasonable impact from a single type of intervention such as this which was evaluated over a short period of time.

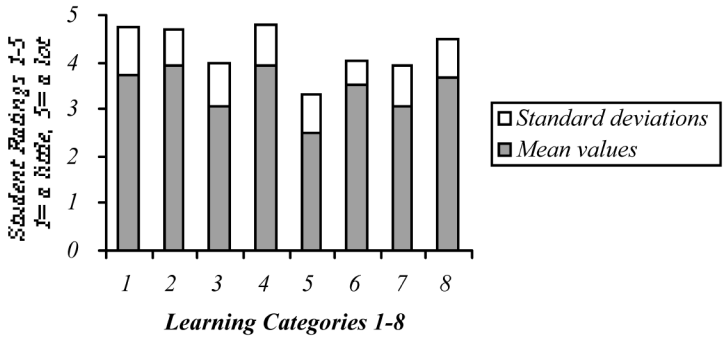

Figure 1: Student ratings of their perceptions of learning about report writing after using the online program in the following categories: 1. Knowledge about writing a laboratory report. 2. Where to put content in each part of a report. 3. Kinds of language appropriate for each part. 4. Structuring the information in each part. 5. Understanding chemical engineering topics. 6. Awareness of problem areas in report writing. 7. Confidence in report writing. 8. Awareness of the purpose of laboratory reports in chemical engineering

Qualitative Feedback

Qualitative feedback was sought through open-ended questionnaire and focus group. This feedback generally supported the quantitative feedback in that students were positive about the programs' contribution to their learning, particularly for learning about the structure and the appropriate content at each stage of a report ("The program has made report writing easier for me as it gives a solid structure to use to write reports";"It showed me how chemical engineers pay attention to detail without waffling on about unimportant information"). NESB (non-English speaking background) students found the sections on appropriate language for report writing particularly useful, ("They guided me where I was really weak.") but felt that the program needed a glossary/data base for words/phrases, for example phrases for describing graphs in the text.

Feedback has led to closer integration with course content so that the link between writing in the discipline and learning and understanding content is emphasized, while at the same time the online program goals have been further clarified so that students do not have unrealistic expectations of gaining better marks simply from doing the program. Students can now print out key sections of the program to refer to while writing. Other recommendations such as including more example texts, extending the language sections for NESB students and creating programs to address other report genres in engineering await further funding. However, university wide, online learning materials for the laboratory report genre have been further extended this year with the implementation of two new programs in biochemistry.

The Impact

The impact of the program has spread beyond its immediate context. Within the Department of Chemical Engineering, the web site has acted as a tool to integrate and guide laboratory training at different year levels (vertical integration), while it has also provided generic guidance in report writing across third-year units of study, where reports are frequent items of assessment. Students studying Mechanical and Civil Engineering have also been referred to the site since the broad expectations of their laboratory reports are similar.

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