'OZ SOILS' - A LEARNING TOOL TO FOSTER A BETTER UNDERSTANDING OF IMPORTANT SOIL PROCESSES

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Abstract

Educational research suggests that multimedia programs could be of value in more effectively teaching the concepts and processes of fundamental soil science to students because of the medium's combination of interactivity and the dynamic visual information with text. At the University of New England an instructional multimedia program (called "Oz Soils") is being developed, and has been used by students of an introductory soil science unit as an additional learning aid since 1995. The program was evaluated by means of student questionnaires. The response to the program was very positive, with students reporting it to be easy and enjoyable to use, and believing it to be educationally effective.

Key words: Soil science teaching, computer-assisted learning, multimedia teaching package.

Traditional soil science teaching is in a process of change. This is driven by a demand for greater flexibility in the delivery of education and new develop-ments in educational technology. In addition, there is increased interest in the soil by students from a wide range of disciplines and increased teaching through distance education (3). Computers now offer the opport-unity to present educational material in multimedia teaching packages which combine the use of text, graphics, pictures, animations, digital video and sound. Such packages can be made interactive, so that students can test themselves and get immediate feedback on their performance. In her book on the future of tertiary educational technology, Laurillard (4) argues that multimedia resources containing self-assessment questions can address most the requirements for effective learning, and are a substantial improvement over sole reliance on lectures and printed material. University education generally contains a combination of interactive (*eg.* tutorials, formative assessment, discussion with peers) and non-interactive components (*eg.* textbooks, paper-based notes, lectures to large groups). Quality interaction is of great benefit in the learning process (1), and interactive multimedia presents an opportunity to improve educat-ion. For example, the computer can be used to examine a range of soil sites, particular soil profile characteristics and associated land use, to expand the student's understanding of soils and landscape. This can be likened to a "virtual soils excursion", in which the knowledge of students is broaden by "visiting" sites too distant to be reached on a real excursion. Although interactive multi-media is still in its infancy, it is highly likely that such teaching programs will become increasingly comprehensive and sophisticated over the next few years.

Results

At the University of New England an instructional multimedia program called "Oz Soils" is being develop-ed (2), and has been used by students as an additional learning aid to an introductory soil science unit since 1995. Oz Soils introduces the core concepts and pro-cesses of soil science including soil structure, nutrient cycles, the hydrological cycle, and soils and the land-scape. Students can learn about micro-scale processes and their place in the larger natural cycles. The program includes interactive animations of many soil processes, Australian soil and land-scape examples, and revision exercises. The aim of using interactive multimedia in teaching soil science is to improve the quality of learn-ing so that through the use of Oz Soils, students will take a less superficial approach to the subject matter. The desirable outcome is for students to develop understand-ing of basic concepts to enable them to apply their knowledge to environmental systems, problems, and laboratory exercises.

As the program is aimed at the novice learner of soil science, a basic content structure is incorporated into the interface design. The partitioning of the content material into major sections guides the learner in constructing a conceptual framework of what is an otherwise complex multi-disciplinary subject. From the main menu screen that briefly explains the aim and major components of the program, the four main

sections of the program can be accessed. Subsequent section menus then lead to a number of activity modules. Navigation is achieved by simple mouse-clicks on the menu buttons or icons.

The following example illustrates how Oz Soils integrates with the soil science teaching curriculum at UNE. After attending lectures on the nature and behaviour of soil organic matter, students are directed to Oz Soils for further study. Each student navigates, by pointing and clicking on hypertext links from the Oz Soils opening screen to the organic matter module that is contained within the nutrient cycling section. Once inside the module, the student finds several screens, each addressing a different aspect of the topic and demanding an appropriate activity. For example, one screen contains animations illustrating the processes of crop residue decomposition at a microscopic scale. By clicking the appropriate button, the student can run scenarios for residues of different nitrogen (N) content and see how these affect available soil N levels.

Students can explore screens in any order, but at the end will be presented with a series of revision questions. The answers entered by students elicit a response from the program in the form of praise or an admonition coupled with an informative comment. This enables students to quickly assess whether they have satisfactorily understood the material, and if not, they are encouraged to return for further study. Finally, armed with a conceptual understanding of how organic matter can influence soil nutrient cycling, students then attend a laboratory practical class where they carry out chemical analyses for soil organic matter and an experiment on the influence of residue type on soil N availability.

Oz Soils was evaluated in 1995 and 1996 by Lockwood and Daniel (5). Students completed questionnaires designed to assess the students' use and reaction to Oz Soils, and to ask about the perceived learning outcomes. The response to Oz Soils was very positive, with more than 90% of student respondents reporting that it was easy and enjoyable to use as well as being educationally effective. There was no difference in response pattern between female and male students. The minority of students in the sample who identified themselves as either not enjoying using computers or finding them hard to use were slightly less positive about Oz Soils. However, even in these groups a large majority gave favourable responses to the evaluation questions. The evaluation results provide encouragement for further development of multimedia programs to assist in teaching soil science as well as other sciences.

Large, good quality multimedia programs are costly to develop. For the material to be effective, it needs to be developed as an integral part of the teaching course with the development driven by the teachers and content experts rather than multimedia experts (5). Access to the appropriate technology alone, without having the necessary expertise and skills to develop effective complex interactive multimedia packages, can result in products that do not promote effective learning. Formative evaluation by teachers and students is an essential part of the development process. Therefore, it must be emphasised that essential components of the development process of high-quality multimedia programs are research-based design, formative evaluation, and the implementation of effective learning strategies.

Conclusion

Multimedia teaching programs can improve the student learning environment if they are appropriately integrated with the teaching curriculum. However, it is important that the development of multimedia teaching packages draws on sound educational theory and has formative evaluation as an essential part of the develop-ment process.

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