Enhancing student learning using Decision Support Tools

J.M. Scott[1], H.G. Daily[1], A.D. Moore[2], E.M. Salmon[2], J.R. Donnelly[2], R. McCook[3]

[1]University of New England, Armidale, NSW.
[2] CSIRO Plant Industry, Black Mountain, Canberra, ACT.
[3] Horizon Technology, PO Box 598, Roseville, NSW.

ABSTRACT

A Decision Support tool (GrassGro™) has been used as a teaching and learning framework to enhance student understanding of complex ecosystem functions, especially relating to the climatic, soil, pasture and animal components of grazed pasture systems across southern Australia. The software is served from a central location to any computer on campus thus facilitating student access. By releasing constraints on the functionality of the program as students gain more experience, the learning process is made easier for students whilst allowing lecturers to have some control over which features are explored in particular classes. Early feedback suggests a need for a clear structure to assist students' learning if the great potential of such tools is to be realised.

KEY WORDS

Model, teaching, ecosystem.

INTRODUCTION

The complex interactions among climate, soils, plants, livestock, markets and risk in managed and natural ecosystems can be difficult concepts for anyone to learn, understand and appreciate. Following pioneer work by Bellotti *et al*. (1), and with the support of a CUTSD National Teaching Grant, CSIRO and Horizon Technology, a Decision Support tool (DS tool) is being used to enhance learning across the curriculum at the University of New England. The software used is GrassGro (developed by CSIRO and licensed to Horizon Technology Pty Ltd), as described by Moore *et al*. (3). One of the main attractions for using this software is the breadth of published literature upon which the model is based and which can be used to help explain scientific concepts. Other features are the numerous queries that can be made of climate, soil, plant, animal and economic changes over time, and the ability of the software to simulate for numerous locations, especially across southern Australia.

The diverse range of topics that can be illustrated using this single software program has enabled the incorporation of this DS tool into the curriculum of the Bachelor of Natural Resources, Agriculture and Rural Science degrees at the University of New England. It is well suited for demonstrating the variability of climatic events, as well as demonstrating a wide array of biological principles relevant to pastures (including some weeds and herbs), animals and economic outputs over time. There is sufficient detail in the DS tool to permit the investigation of plant ecophysiological principles as well as production of wool and meat by ruminants. Both biophysical and economic risk can also be evaluated. Use of GrassGro familiarises students with decision support software in commercial use by agricultural advisers.

METHODS AND MATERIALS

To date, 14 academic staff have been trained in the use of the software. The software has been modified under licence and a single installation is now distributed from a secure central server over the University network to any computer on campus. The feasibility of serving the software over the Internet has been demonstrated although this has not yet been implemented for students.

The options available to individual classes of students are controlled by the lecturer for specific learning objectives by modifying the initialisation files. Each student logs on to the server using a password and thereafter each is able to save his or her individual simulations without compromising the original files or other students' work. Graphical and tabular output from GrassGro simulations can be readily copied to word processing or spreadsheet software to enable reports to be written.

RESULTS

Students have used GrassGro to learn, test, evaluate and modify their decision-making skills as well as to learn how various elements of ecosystems are inter-related in a wide range of units (2). Continued exposure at increasing levels of complexity appears to have enhanced the quality of students' experience of and confidence with the program.

To date, the project has led to more staff interaction and coordination between different units, whilst more interest is being shown in computer use by students. At this early stage of implementation, there is no indication that learning outcomes related to complex systems are being met more effectively than with other learning methodologies. Nevertheless, the response of both students and staff to individual practical experiences has been enthusiastic. After experiencing one or two sessions, students require little introduction to new aspects of the DS tool before they are keen to explore it themselves with little direction from a lecturer.

During the second year of implementation of this project, most students have been introduced to the use of GrassGro in at least two units. Typically, learning exercises are set within practical sessions requiring a brief report on the findings from the practical. To date, some 200 students have each experienced up to three different learning experiences using GrassGro with up to five different experiences planned within their undergraduate years. Examples of the objectives of some of the classes taught so far (2) include:

1st year: Climatic variation between sites and years

2nd year: Pasture plant adaptation differences between annuals and perennials.

3rd year: Pasture and animal growth over seasons and years.

4th year: Investigating risk in agricultural systems using an unconstrained version of the software.

DISCUSSION AND CONCLUSIONS

To date, surveys of staff and students involved in the project confirm the great potential many see for a deeper approach to learning about complex system interactions and to enhance computer competencies in graduates. However, it is clear that more work is needed to realise the potential for greater integration between units and to ensure that students can readily see the linkages between those units.

It is expected that much of the gain from this project will not be realised until the full suite of practical experiences is available over the full length of the degrees. It is hoped that this will then create a synergistic effect leading to enhanced student understanding of how complex ecosystems function.

ACKNOWLEDGMENTS

The financial support from the Committee for University Teaching and Staff Development is gratefully acknowledged. The cooperation of staff and students is also appreciated as is the excellent computer support of Jim Reid and Noni Wells.

REFERENCES

1. Bellotti, W.D., Daily, H.G., Kiley, M., Mullins, G., Peterson, R. and Tivey, D. 1998. Integrating a computer simulation into the curriculum: a teachers guide. The Advisory Centre for University Education, The University of Adelaide.

2. Daily, H.G., Hinch, G.N, Scott J.M. and Nolan, J.V. 2000. The use of a decision support program to facilitate the teaching of biological principles in the context of agricultural systems. http://www.tedi.uq.edu.au/conferences/teach_conference00/abstractsA-H.html#Daily

3. Moore, A.D., Donnelly, J.R. and Freer, M. 1997. "GRAZPLAN: decision support systems for Australian grazing enterprises. III. Growth and soil moisture submodels, and the GrassGro DSS" *Agric. Sys.* 55, 535-582.