ISEI 7
7th International Conference on Ecological Informatics
13 – 16 December 2010
Ghent University
Ghent, Belgium

The use of the DynaLearn learning environment to construct qualitative models of fundamental concepts in ecological sciences.

R. A. A. Noble

The University of Hull, Hull, UK

Email corresponding author: R.A.Noble@hull.ac.uk

Session: Qualitative reasoning (Chair: B. Bredeweg (The Netherlands)

Timing: 14 December 2010, *Blancquaert room*, 10h20-10h40 (Code QR 2)

Abstract

Qualitative conceptual modelling, a computer-based Artificial Intelligence approach, has been promoted as modelling approach that could be applied in an educational setting to develop students understanding about ecological systems. The qualitative modelling approach enables modellers to build mechanistic models and develop explanatory and predictive reasoning about systems behaviour without the need for numerical or empirical models. The EU-funded FP7 project DynaLearn is developing a learning environment and curricula that both furthers the technological capabilities of conceptual qualitative modelling and explores the requirements and opportunities for learning by modelling within the domain of environmental sciences. Within the DynaLearn system a number of learning spaces are available for students to develop models and model expressions at different levels of complexity using different modelling primitives. The software enables students to build models ranging from traditional concept maps, through formalised representations of systems structures and basic notions of causal relations, to qualitative models that utilise hierarchies of re-usable knowledge fragments and multiple scenarios.

This paper presents a number of qualitative models (or model expressions) highlighting how the qualitative modelling approach can be used to develop students' understanding of fundamental concepts and topics in ecological systems. The models presented highlight that qualitative models can be used to represent both domain specific knowledge and ecological concepts that can be observed in many systems.

Example models are shown relating to the topics of photosynthesis and respiration. The model expressions show how the different learning spaces of DynaLearn can be used to represent different views and levels of complexity for the same topic. Furthermore, the models show how qualitative modelling can be used to build mechanistic explanations for the phenomena of diel fluctuations in dissolved oxygen concentrations in shallow lakes related to the fluctuations in the rates of photosynthesis by aquatic plants. This model shows how qualitative models can be used to develop causal explanations and predictive reasoning for systems behaviours that are regulated by a number of different processes.

A second suite of model expressions are presented for the topic of cellular osmosis and diffusion. The models highlight how qualitative representations of osmotic flows can be used to

address common misconceptions regarding the exchange of water and solutes across semi-permeable membranes along concentration and water potential gradients.
The topics and models here highlight the flexibility and range of possibilities available for qualitative reasoning modelling available within the DynaLearn learning environment. In particular the models highlight how qualitative reasoning models provide a framework for developing mechanistic models explaining aspects of causality in ecological systems, develop predictive capabilities based on simulation of scenarios and enable modellers to explore ambiguity in systems behaviour.