ISEI 7
7th International Conference on Ecological Informatics
13 – 16 December 2010

Ghent University
Ghent, Belgium

EDUCATION ABOUT THE EU WATER FRAMEWORK DIRECTIVE USING QUALITIVE MODELS

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Abstract

The main objective of the European Water Framework Directive 2000/60/EC (WFD) is the protection, restoration and improvement of the ecological state of water bodies. The general environmental objective of the WFD is achieving good ecological status of all natural water bodies and good ecological potential of artificial or modified water bodies through development and implementation of River Basin Management Plans by the year 2015. These plans provide solutions for a set of problems related with water quantity and quality, and in general – with the ecological status. One of these problems is increasing water use, which leads to a decline of the river runoff, habitats and species diversity. Solving this problem is important not only to meet the people water needs, but also to support the various services provided by riverine ecosystems to the humans. However, for many students and stakeholders this is difficult to understand. Therefore, conceptual knowledge of system's behaviour is crucial for society to understand and successfully interact with its environment.

Educators experience educating students and stakeholders about the effects of ratifying and implementing legislation on the natural world as a difficult task. Particularly for environmental science students, who are taught to view the world as natural processes, law does not fit their learned perspective. Furthermore, teaching about the processes occurring in the natural world is already challenging without the added complexity of legislation. An added complication is that the environmental science and law disciplines are not well integrated. We argue that qualitative conceptual models can contribute to the education about legislation and environmental science due to their unique features. Conceptual models primary purpose is to capture a person's understanding about the natural world and allow it to be communicated. As such, conceptual models are useful to use in educational settings. Such models encompass both the structure of the system and behavior of the system, and these features are neatly separated within the models. Conceptually relevant values of quantities are explicitly modeled in favor numerical details that do not contribute to understanding. The explicit causal relationships between the

quantities not only allows learners to understand the underlying processes of the system, but also allows running simulations that predict the effects of implementing certain kinds of legislation. Furthermore, the representation allows environmental science and law to be integrated in a single representation, which allows showing a holistic view of water quality. This is a fundamental approach proposed by the WFD.

This paper presents qualitative models that capture both the effects of water use on aquatic species and their habitats, and the role that legislative regulation (such as the WFD) has on both water use and river runoff. Such legislative actions can lead to an improvement of the ecological state of water bodies. The models show that increasing governmental pressure and decreasing economical pressure (both in the form of legislation) can be a good solution to the problem of water use.

The models shown in this paper have been implemented using software developed in the DynaLearn EC project. Models have been developed in different Learning Spaces (LSs), allowing each of them to emphasize specific details of the system behavior. The objectives of the models are to demonstrate the main effects of an increase of governmental pressure (by means of water legislation and standards) and protection actions on water quality. The models give answer of the following questions: (1) How do the protection actions and their consequences affect the water bodies? (2) What happens if the governmental pressure increases? (3) What happens if economic pressure increases? The answers of these questions should give students and stakeholders a better understanding about the interaction between law and water management.