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A new curriculum for teaching conceptual systems understanding of river catchments.

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Abstract

Humans have changed riverine landscapes all over the world in a way that their natural ecological functions are critically impaired. Integrated river basin management is therefore one of the biggest challenges of the 21st century (UNESCO IHE). Achieving the Millennium Development goals and the goals of the EU Water Framework Directive of coupling human welfare with healthy riverine environments is only possible when the co-dependence of people and of ecosystems are acknowledged and physical, chemical, biological, social, economic and political issues are adequately considered.

To achieve understanding of the highly complex interactions between humans and the biophysical properties of catchments, particularly under the current global change scenarios, an ecosystem approach has to be taken. Interlinked models at different scales tackling across a wide variety of scientific disciplines including human behaviour and social sciences are needed. Furthermore, education represents a crucial part in integrated management and sustainable development. But environmental education in secondary schools in Europe increasingly fails to attract students, as environmental issues are perceived as too complex. Within the DynaLearn (DL) project (http://www.dynalearn.eu), an interactive, hierarchically structured learning environment able to capture and simulate causal relationships across disciplines and scales is being developed. The DL software is based on qualitative reasoning, a research area within artificial intelligence (AI), and as such it provides means to integrate knowledge of different grain and extent without using numerical information.

Six Learning Spaces (LS) including concept maps, generic causal reasoning, qualitative system dynamics simulations based on rates, state variables, assumptions and agents allow for a cross disciplinary exploration of practically every topic at different levels of complexity. Another important feature of the software is the potential to simulate non-linear dynamics and emergent properties of systems. Accompanying the DL software a new curriculum based on a constructivist and hierarchical ecosystem approach including thermodynamics and archetypical system patterns is being developed.

The basic structure of the new curriculum and selected models integrating biological and physical processes in river catchments will be presented.