LEARNING SCIENCE USING QUALITATIVE MODELING INTERACTIVE ENVIRONMENT

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Introduction

- Adequate scientific knowledge is crucial for understanding the complex environment and reality within which we live.
- Constructing conceptual interpretations of system's behavior (White & Frederiksen, 1998) requires ICT software supporting learners in actively dealing with the theoretical concepts such as visualization and diagrammatic techniques, creation of models and concept prediction and explanation (Niedderer et al., 2002).

Qualitative Modelling

- A qualitative model of a device or system is an abstraction that captures ordinal knowledge and predicts the set of qualitatively possible behaviors of the system, given a qualitative description of its structure and initial state.
- Qualitative reasoning is the area of AI which creates representations for continuous aspects of the world, both quantitative and temporal, supporting reasoning with little or not accurately defined information.

DynaLearn - the modeling Environment

The DynaLearn project aims to develop and implement effective educational tools for learning about complex systems using a qualitative modeling approach. Dynalearn project is funded by the European Union's 7th framework programme and carried by a consortium of eight participant partners. The main components of the DynaLearn Environment are Conceptual Modeling (CM), Semantic Technology (ST) and Virtual Characters (VC). The CM component is used for learners to articulate, analyze and communicate ideas, and thereby construct their conceptual knowledge (Figure 1 and Figure 2). The VC component is used to generate meaningful feedback of various types, and make the interaction engaging and motivating. The ST component is used to deliver semantically appropriate feedback.

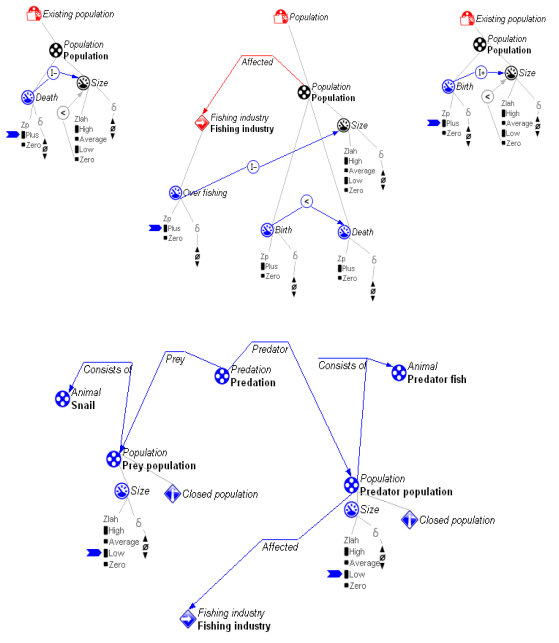

Figure1. Predation and over fishing model

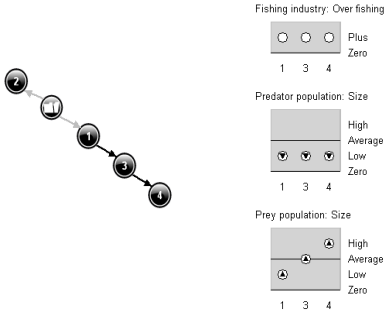

Figure2. Predation ad over fishing simulation results

Research

- "Marine Biology – Qualitative models" pilot course was administered at the Faculty of Life Sciences in Tel Aviv University (2009/2010).
- A group of 10 undergraduate students (third year) attended a 7 lessons (2 hours each) exercise using the modelling environment with the purpose of constructing models related to the course syllabus.
- The students worked in pairs from the beginning of the exercise.
- They were asked to choose a scientific paper related to the course syllabus.
- Each couple presented their scientific paper, QR model and the results of the simulation. In a 20 minutes presentation.
- A formative evaluation (pilot research) was conducted during the exercise.
- Each meeting was accompanied by an evaluation task, observational notes, unstructured open-ended interviews, participants' journal and thinking-aloud process.
- These were conducted in order to follow and analyze the students' active construction of their models, their ability to interpret given states of a model, their abilities to adapt a model to given data and scenarios or assessing their ability to tailor a model from already existing fragments in accordance with a given environmental phenomena or text.

Preliminary Results

- A preliminary account indicate that the students found the "Learning by Modelling" approach engaging and motivating (even if more time consuming than regular classes).
- Several insights were obtained during the pilot study concerning the students' conceptual understanding, their acquisition of the qualitative modelling language and skills, their ability to move among representations (text, models, report and presentation) while working on a scientific problem.
- A substantial insight, expressed at the end of the learning cycle by the students, indicated that the modelling experience and the systemic perspective on the scientific topic they were working on, generated the need to integrate several pieces of knowledge from different domains, including knowledge from previous courses that until its use here remained separately "classed" with the corresponding course.

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