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Evaluating the effects of a new qualitative simulation software (DynaLearn) on learning behavior, factual and causal understanding

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Introduction

The DynaLearn software, a new intelligent learning environment aimed at supporting at better *conceptual and causal understanding* of environmental sciences was evaluated. Based on promising results of introducing Qualitative Reasoning [1], System Dynamics [2] and Animated Teachable Agents [3] into classrooms for a better, more structured and engaging learning, the DynaLearn projects targets at the development of an individualized and engaging cognitive software tool for acquiring conceptual knowledge in environmental science in 6 Learning Spaces (LSs, see Fig. 2) to explore and build models of increasing complexity (see an example in Fig. 1).

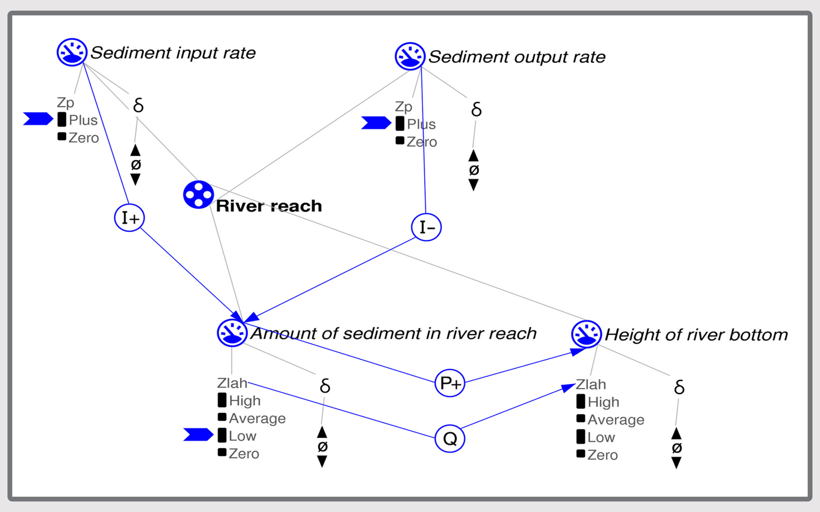


Fig. 1: Example for a model in LS 4.

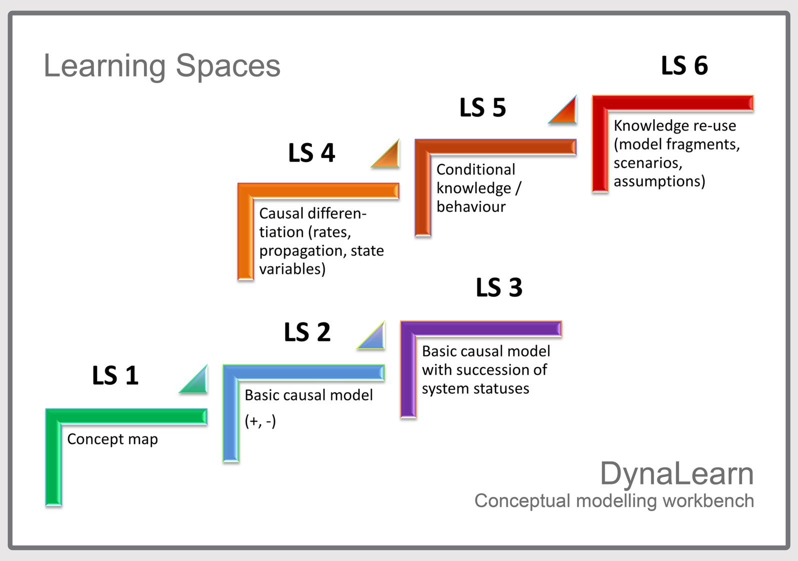


Fig. 2: Learning Spaces 1 - 6 of the DynaLearn software.

Evaluation methodology

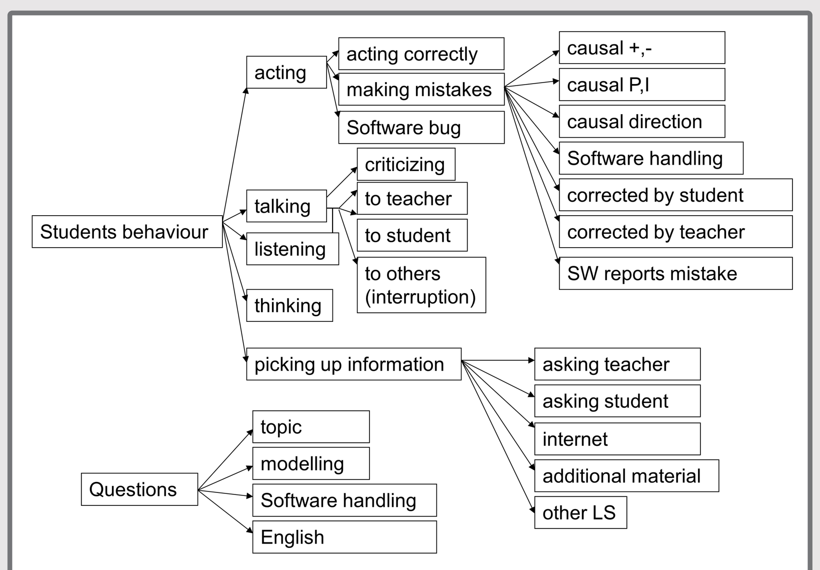
In Austria we had two evaluation sessions 2010 with students of a secondary high school (i:HTL) and on Boku University mostly with master students (see Tab. 1).

Tab. 1: DynaLearn Evaluation activities in Austria 2010

Evaluations of DynaLearn in Austria 2010

where	students	age	gender	duration and content
Secondary high school	2	16	f, m	3 days of modelling in LS1, LS2, LS4
Boku University, Vienna	29	22-39	12 f, 17 m	1 day of modelling in LS1, LS2, LS4

The *data gathered* during the pilot evaluations consisted of three components: (1) Video recordings capturing the modelling activities of two i:HTL students, their social interactions, questions and answers, analysed by using Transana (see Fig. 3 and 4); (2) Textual data, gathered by pre- and post-tests (to prove the change in content knowledge, Tab. 2) and analysed with the Atlas.ti (Fig. 5); (3) Motivation questionnaires (to collect attitudes, impressions and ideas).



The Transana software allowed for a transcription of the video tapes (9 hours in total). The transcript-based analysis allowed us to elaborate:

- Conversation Analysis: about talks and questions/answers between students and between students and teacher.
- Action Analysis: about student modelling activities visible on their screens.

27 main keywords concerning students' behaviour and questions with regard to the DL software and the domain knowledge (topic) during the modelling processes were identified and used as codes in the video analysis.

Fig. 4: Hierachical structure of keywords used in Transana for video analyses.

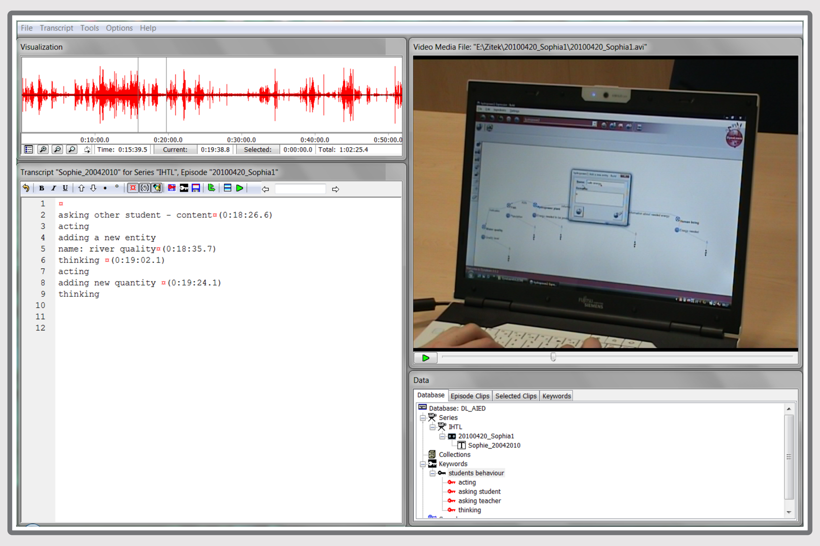


Fig. 3: Screenshot of the Transana software.

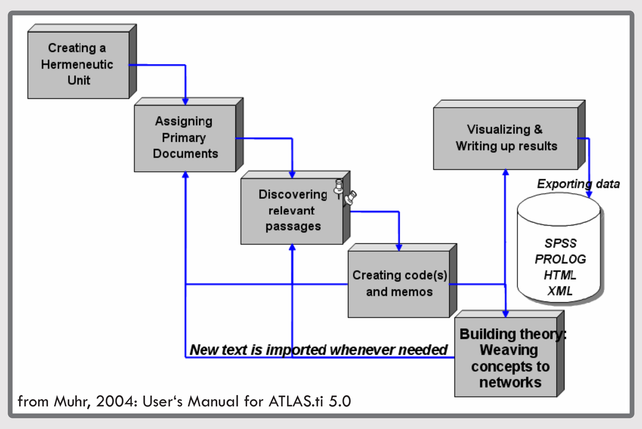
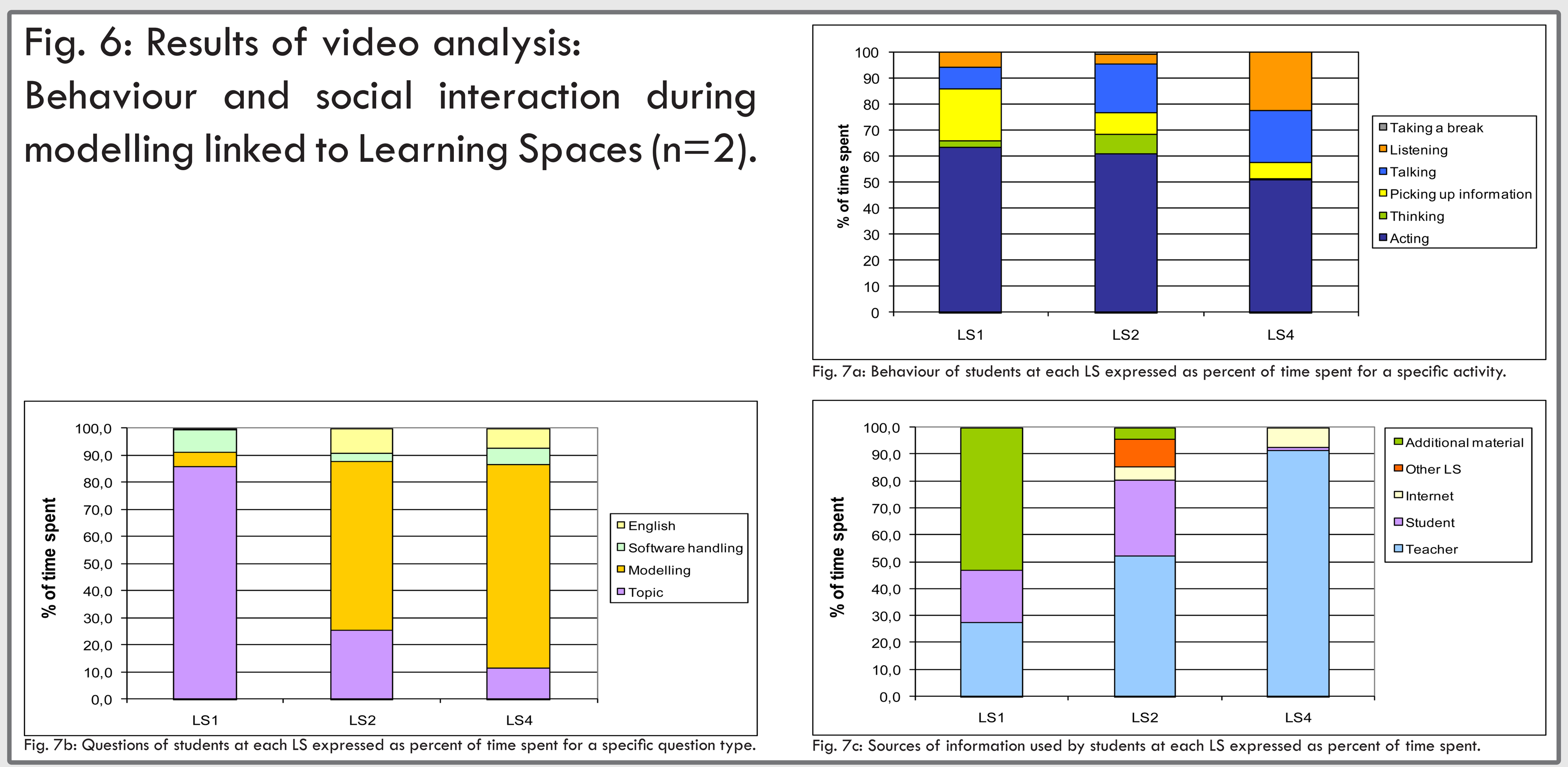


Fig. 5: Workflow of Atlas.ti, a workbench for qualitative analysis of texts, graphics, audio or video data.

Evaluation results

The *overall feedback* to the DynaLearn approach was rated from neutral to very positive, very interesting and very easy etc. and never negative. There was a high agreement, that the software could also be applied to other fields of science and the model based learning activity as a whole was liked very much. The questions 'Using the software provides a very comfortable way of learning', 'The software is easy to use' and 'The software and its features motivated me to build the model' were rated only slightly above neutral, indicating the need for help functions and other motivating features planned to be available for the next releases.

Fig. 6: Results of video analysis: Behaviour and social interaction during modelling linked to Learning Spaces (n=2).



Behaviour of students differed per LS. At LS1 most time was spent for picking up information (asking teacher/student, additional material) (Fig. 6). At LS2 there was more conversation among students, and at LS4 most time was spent communicating with and listening to the teacher. Conversation increased from LS1 to LS4, focusing on modelling issues.

Comparison pre- and post-tests

	pre-tests	post-tests	change (in %)
concepts, total	36,5	46,5	27,4
causal rel_direct	5,5	10,5	90,9
causal rel_graphic	0,0	1,0	100,0
causal rel_wrong	1,0	0,0	-100,0
number of words	157,5	183,0	16,2

Tab. 2: The amount of scientific concepts mentioned and causal verbal expressions used increased significantly, whereas wrong causal notations did not appear at the post test (i:HTL, n=2). Similar results were documented at the BOKU evaluation (n=29).

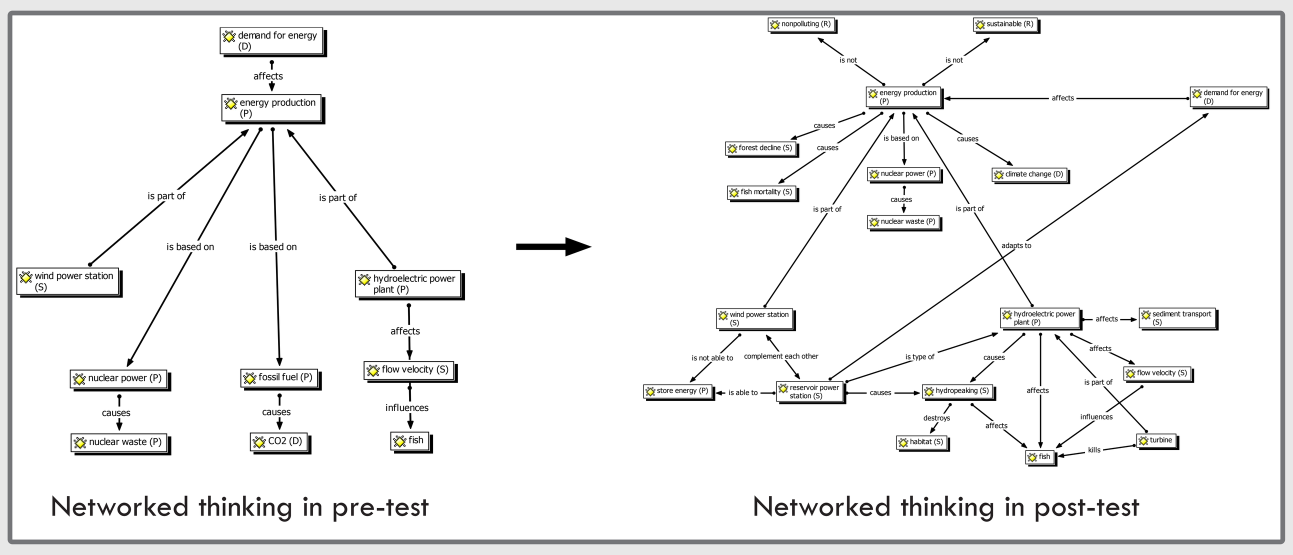


Fig. 7: Change of knowledge structure and content after DynaLearn activities, in the pre- and post-tests of an i:HTL student (analysed with Atlas.ti).

The use of DynaLearn leads to

- a significant increase in conceptual knowledge,
- a significant increase in the use of causal expressions (verbal and graphical),
- a decrease of wrong causal expressions and
- an increase need for initial scaffolding from LS1 to LS4.

References

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