

# Construction and Inspection of Learner Models

Juan-Diego Zapata-Rivera, Jim Greer

ARIES Laboratory. Department of Computer Science. University of Saskatchewan, Canada  
{Diego.Zapata, Jim.Greer}@usask.ca

## ABSTRACT

Learners working on the creation of conceptual maps become involved in a creative learning activity that involves “making sense” of new concepts and their relationships through modelling. These models can be seen as representations of the learners’ understanding of a particular topic domain. During subsequent learning activities, students can reflect upon the models they have built. In addition to domain knowledge, models can contain information about learners’ knowledge profiles and social aspects of learning. This paper explores different ways to interact with models in order to support reflection, negotiated assessment, and knowledge awareness. We have developed ConceptLab, a knowledge construction and navigation system that uses XML-based conceptual maps to represent the learner’s view of the domain. ConceptLab has been used by students and teachers as part of an exploratory study carried out in a Colombian elementary school.

## Keywords

Conceptual maps, Learner models, Collaborative and Negotiated Assessment.

## INTRODUCTION

Constructivist environments promote reflection and meaningful learning. Computers should be used as cognitive tools helping learners to acquire responsibility for their planning, decision-making, and self-regulation (Lajoie, 1993). We claim that inspectable learner models can be constructed collaboratively or individually. Learners and teachers can inspect their models in order to support reflection and knowledge awareness. Learners can benefit by constructing models of the domain and later by looking inside these models and reflecting upon their content. Tools that make the learner model inspectable to learners and teachers promote reflection and interactive assessment. Teachers can use such tools to help students model their own understanding of the domain and also as assessment tools. One such tool, ConceptLab has been used by students and teachers as part of an exploratory study carried out in a Colombian elementary school. This paper presents ConceptLab as well as some preliminary results obtained from this study.

## CONCEPTLAB

ConceptLab (Zapata-Rivera et al. 2000, Zapata-Rivera & Greer 2001), is a knowledge construction and navigation system that allows students to engage in collaborative construction of conceptual maps. These maps represent the learner’s view about of the domain. ConceptLab considers the object resulting from the learner’s work as his/her domain representation. Learner models in ConceptLab maintain basic learner information (i.e. preferences and personal information), the learner’s current level of knowledge on every concept, social aspects of learning (i.e. helpfulness, eagerness, assertiveness, etc.), and the XML representation of the map (map structure, links, and presentation preferences).

Students and teachers can create their own maps collaboratively or individually. Students working in groups assume different collaborative roles (i.e. leader, speaker, resource manager, critic, and time vigilant) in order to co-ordinate their interaction. Students can use a predefined list of concepts (common vocabulary given by the teacher) or their own new concepts (in case they discover some original concept that is important and should be included in the system). We have experimented with students creating their models using paper, markers of different colours, and labels. A digital photograph of the paper model was used to integrate the model within ConceptLab as a conceptual “map”.

Once the map is imported into ConceptLab, learning resources can be linked to the concepts in the map. Students can use their own map to access these resources. These resources can be suggested by the teacher (initial links) or by classmates. Students can use an existing map as a guide to study the content, or use ConceptLab as a learning tool to facilitate remembering, to create maps collaboratively, to share their maps, and to encourage discussions about a particular topic. Maps in ConceptLab can be overlaid with the knowledge profile of a particular student or group of students, integrating the system’s or the teacher’s view of the student’s knowledge. In addition teachers can visualize how social aspects, such as: eagerness, helpfulness, assertiveness and self-confidence are taken into account in the overall assessment. Initial knowledge values are obtained from an initial pre-assessment quiz that feeds a Bayesian model that integrates information about the domain, self-assessment and social aspects of learning into a Bayesian network.

Through accumulation of evidence and Bayesian propagation, an estimate of the student’s knowledge on every concept is available to be used within ConceptLab. Special interfaces have been designed to allow students and teachers to interact with the model. Students interacting with the model may realise what they really know or do not know and perhaps use this information to focus their learning activities. Learners and teachers use the model to engage in discussions that support knowledge reflection. We are interested in knowing how students and teachers will react to the model. What kind of

support is needed in order to promote learners' reflection? What should be the teacher's role in this process? and how teacher and learners interact with the model during the creation, reflection, and negotiating based on the model.

## EXPLORATORY STUDY

An exploratory study was conducted in May, 2001 in a classroom at the Joaquin Aristizabal, a Colombian public elementary school. Participants were eighty fifth grade students and six teachers. Students in a science class were introduced to the cell, were told about conceptual maps, ConceptLab, and learner models. Students were asked to create a map of a cell using paper, markers, and labels. They were prompted with some of the main concepts but were free to include some extra ones. Students worked in groups, dyads, or individually. The maps were fed into ConceptLab and students and teachers interacted with the graphical maps.

## SOME PRELIMINARY RESULTS

Based on an initial analysis of the information gathered during the study, we report some general findings.

- *Students became engaged in learning while creating the map using these new and different kinds of media.*
- *Students understood their roles and were able to create group or individual representations of a cell.*
- *Students successfully explained their work as a group or individually.*
- *Student used books and asked questions more frequently than in traditional learning settings..*
- *Teachers were greatly surprised by students' participation during the whole experiment.*
- *Reflecting upon the model facilitates a new learning process.*
- *Explaining why (justifying learners' claims about their knowledge) facilitates learning.*
- *Dialogue between teacher and students was enhanced by ConceptLab.*
- *Evidence about students' social aspects of learning was useful to teachers.*
- *Teachers valued ConceptLab as a tool that supports negotiated assessment*

## CONCLUSIONS

ConceptLab combines a knowledge construction tool and inspectable learners models. It has been interesting to begin to investigate the advantages of using these technologies to support learning and reflection. Different learning outcomes can be observed at different stages of the experiment. Support is needed to help groups to interact with a group knowledge profile. ConceptLab integrates constructivist and cognitive approaches by providing a set of tools that emphasises reflection and collaboration. More information about ConceptLab can be found on-line: [www.cs.usask.ca/~rjz896](http://www.cs.usask.ca/~rjz896)

## ACKNOWLEDGMENTS

We wish to recognise both the Natural Science and Engineering Research Council of Canada and COLCIENCIAS - Colombia for financial support of this research. We would like to thank teachers, observers and students at Joaquin Aristizabal Colombian elementary school especially Norelia Rivera for their participation in this exploratory study.

## REFERENCES

- Lajoie, S.P. & Derry, S.J. (Eds.). (1993) Computers as cognitive tools. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Zapata-Rivera, J.D., & Greer, J.E. (2001) Externalising Learner Modelling Representations. *Proceedings of the Workshop on External Representations of AIED: Multiple Forms and Multiple Roles. AIED2001*. 71-76.
- Zapata-Rivera, J.D., Greer, J.E., & Cooke, J. (2000) An XML-Based Tool for Building and Using Conceptual Maps in Education and Training Environments. *ICCE 2000*. 755-762.