

Externalising Learner Modelling Representations

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Abstract. Research on inspectable learner models involves the study of representational aspects of the profile that systems maintain about learners. When learners and teachers interact with inspectable learner models several questions arise, such as: What kind of representation is most appropriate for learners and teachers?; How will students and teachers react to different representations?; How should learners and teachers interact with the model?; In order to answer these and other questions, we have developed ViSMod, an interactive visualization tool for Bayesian learner models and ConceptLab, a knowledge construction and navigation system that uses XML-based conceptual maps to represent the learner's view of the domain.

INTRODUCTION

In order to provide individualised instruction, educational systems maintain a representation of the learner (learner model). By making the learner model inspectable to students and/or teachers, it is possible to promote reflection, interactive assessment, and collaborative creation of learner models. These provide the teacher with a powerful assessment tool. In order to determine how learners will react to the learner model, it is necessary to consider representational, and visualization issues. Several authors have explored the use of different media in presenting the learner model to students and teachers [Bull & Shurville 1999, Morales et al. 1999, Dimitrova et al. 1999, Muehlenbrock et al. 1998, Paiva et al. 1995]. How to present the model to the students and teachers basically depends on three factors: the domain target, the students' and teachers' preferences, and the goals of the learning environment.

Supporting reflection can be done by simply exposing learners to a simple textual description of the content of the model, to a 2D or 3D graphical model or even a virtual space in which students can interact with abstract representations of their cognitive states. Should this reflection process be an individual activity, a group based activity, or a guided activity (by a teacher or an artificial agent)? In order to explore these questions, we have developed ViSMod [Zapata-Rivera & Greer 2000], an interactive visualization tool for Bayesian learner models and ConceptLab [Zapata-Rivera et al. 2000], a knowledge construction and navigation system that uses XML-based conceptual maps to represent the learner's view of the domain.

VISMOD

Our experience with ViSMod has shown that learners and teachers can visualize the Bayesian learner model using various visualization techniques, such as: colour, size, proximity (closeness), link thickness, and animation. Using ViSMod it is possible to inspect the model of a single learner, and compare several learners by comparing their models, navigate throughout the model changing focus according to learners' and teachers' interests, and use several sources of evidence to animate the evolution of a new model.

Learner models in ViSMod capture information about learner's knowledge, learning preferences, and social aspects of learning. By allowing inspection of student models and the creation of what-if scenarios, ViSMod aims to support students' reflection, knowledge awareness, and refining of learner models. Figure 2 shows a screenshot of ViSMod. Both student beliefs and system beliefs have been associated to each concept of the model. Thus, marginal probability of a student knowing a particular domain concept is the result of considering the learner's opinion, the system's/teacher's opinion and the influence of social aspects of learning on each concept. Figure 3 shows how the node "GeneralAspects" (social aspects of learning) influences every domain concept.

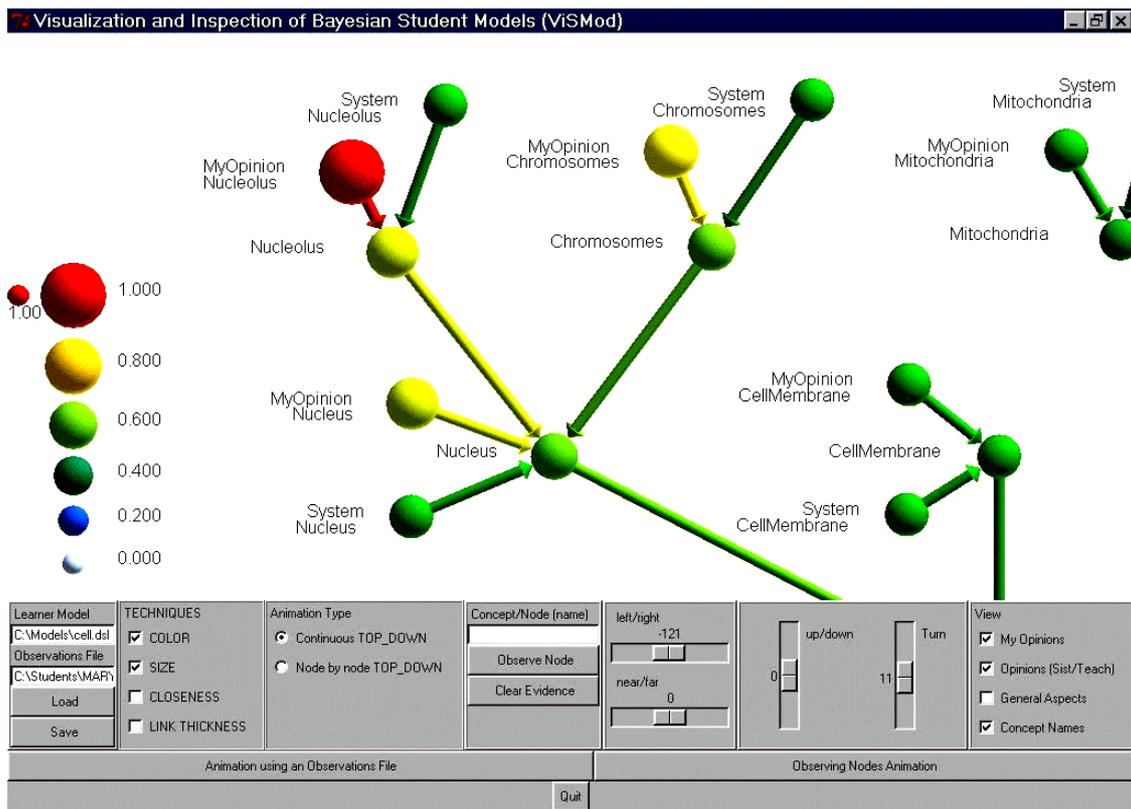


Figure 2. A screenshot of ViSMod showing a fragment of a Bayesian student model in the area of biology cell. It shows how students' and systems'/teachers' opinions are taken into account to assess the overall belief of a student knowing a particular concept. The control panel in the lower part of the window shows the set of widgets available to interact with the model.

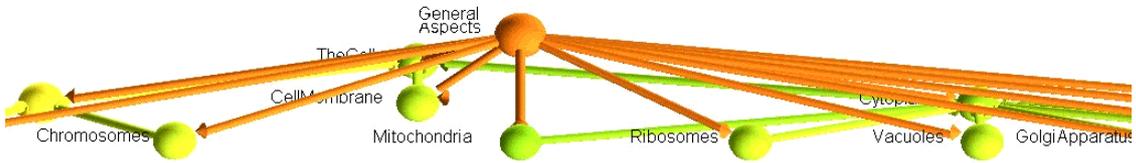


Figure 3. In this screenshot of ViSMod, it is possible to visualise the influence of “GeneralAspects” (social aspects of learning) on each and every node in the model. To get this view of the model, it is necessary to check on the general aspects checkbox on the right part of the control panel (see figure 2) and rotate the visual representation of the model as desired.

CONCEPTLAB

Considering the learner as a part of a learning community in which situational factors play an important role on the learning process, we have developed a knowledge construction and navigation system called ConceptLab. ConceptLab allows students to engage in collaborative construction of conceptual maps. These maps represent the learner’s view about the domain.

ConceptLab provides the possibility to link different kinds of resources to specific nodes. Learners can create their own knowledge structure using a set of predefined concepts (common vocabulary given by the teacher) and use their own map to access class resources. These resources are suggested by the teacher (initial links) or by his/her classmates during the creation of their maps (collaborative browsing). As it is done with some constructivist tools, ConceptLab considers the object resulting from the learner’s work as his/her representation.

The learner module in ConceptLab maintains basic learner information as well as the XML representation of the maps (map structure, links, and preferences). In addition, learners can use an existing map as a guide to study the content, or use this system as a learning tool to facilitate remembering, create maps collaboratively, share their maps, and engage in discussions about a particular topic.

Teachers can use ConceptLab maps to assess the learner’s knowledge. This can be done by comparing different maps (visually or through queries) to determine problems in the learning process for a particular learner or groups of them. Finally, teachers can use this system as an environment to promote reflection among learners on a specific topic. Figure 4 shows how collaboratively or individually created conceptual maps can be used to support a collaborative navigation system. By clicking on a particular concept, it is possible to access a variety of links, added by the teacher or classmates, related to the concept of interest.

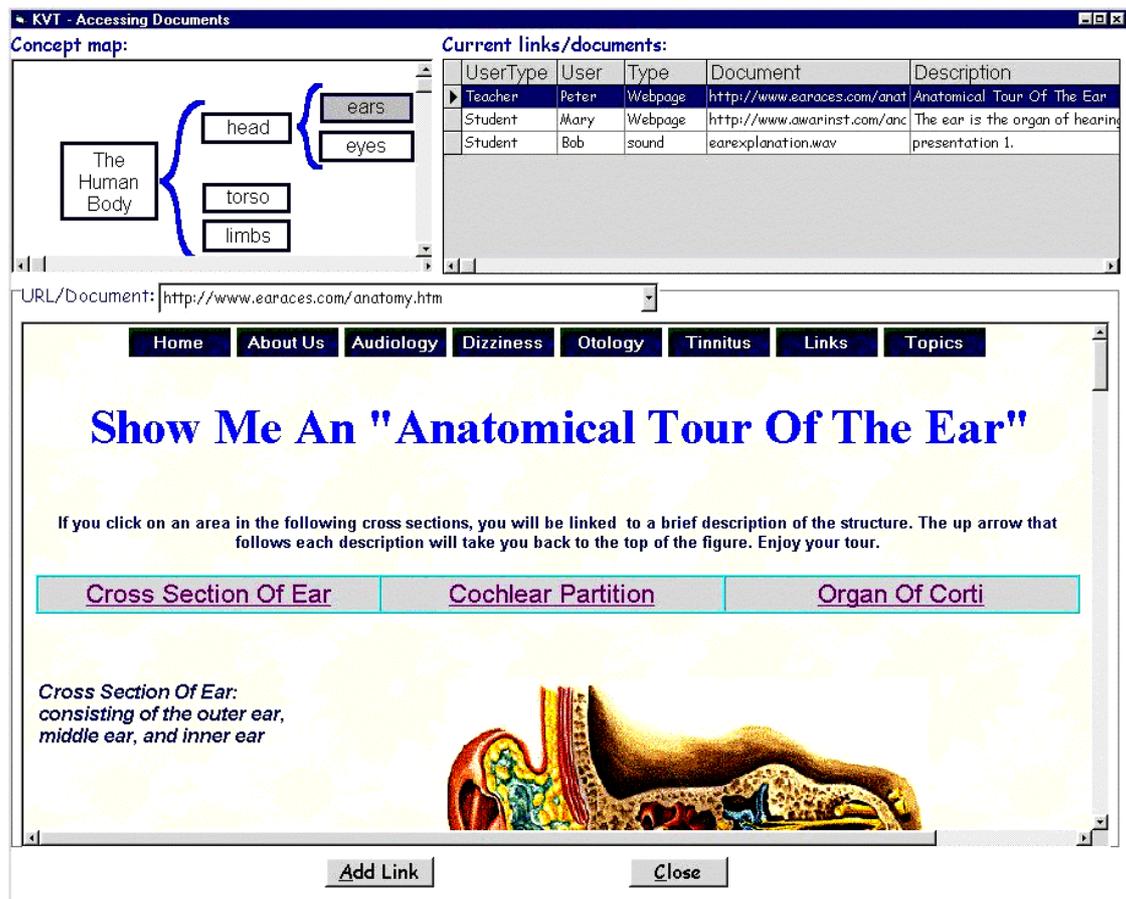


Figure 4. A screenshot of ConceptLab showing how a concept map is used to support a collaborative navigation system for an anatomy class.

SUPPORTING REFLECTION

ViSMod provides a way for students and teachers to interact through the creation of different views of a Bayesian student model. Each view could have different nodes and evidence. Students and teachers experiment with their views in order to create a model that reflects their own perception of their learning process with high fidelity. Learner modelling views in the case of ViSMod and ConceptLab maps in the case of ConceptLab become key elements to engage learners and teachers in discussions that support knowledge reflection.

We are interested in knowing how students and teachers will react to different learner modelling representations; how situational factors affect the learner's reflection process when interacting with the model; how is the teacher's role in this process; and how teacher and learners interact with the model. We have defined a set of experiments that will help us to find answers to these questions.

Special interfaces have been designed to allow students and teachers to interact with the Bayesian student model. Students interacting with the model may realize what they really know and perhaps use this information to focus their learning process. Figures 5, 6 and 7 show how learners and teachers can interact with some particular nodes. Learners cannot change the

system's view information nor the general aspects' (Figures 6 and 7), but teachers can change these values.

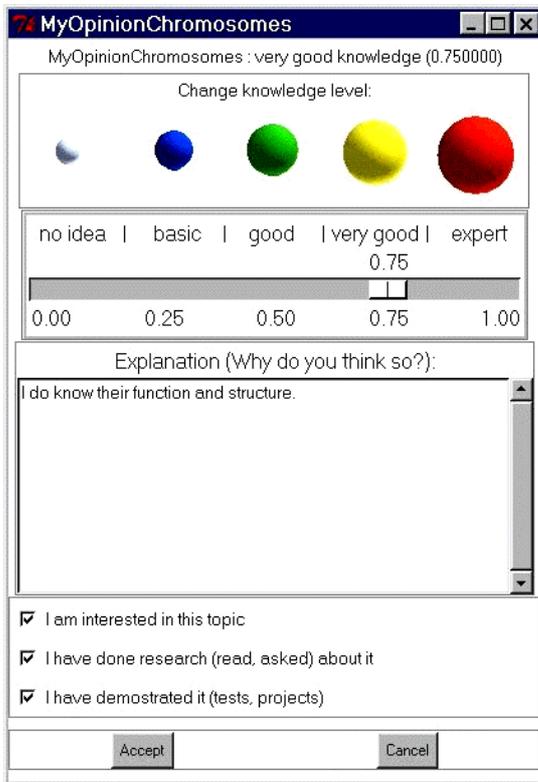


Figure 5. The learner's opinion about his/her knowledge on Chromosomes

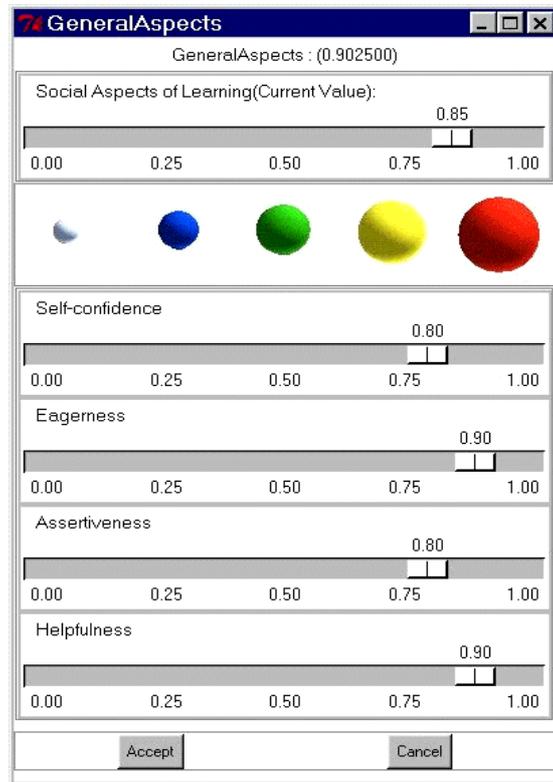


Figure 6. Social aspects of learning

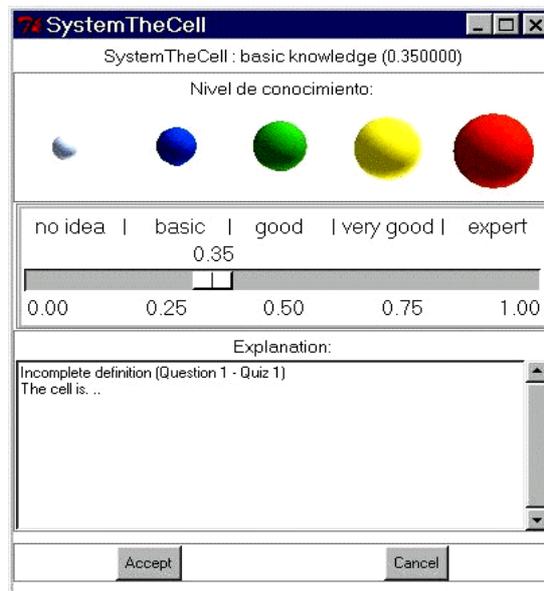


Figure 7. The system's view of the learner on a particular concept

FUTURE WORK

Future work will be focused on testing ViSMod and ConcepLab in a classroom making use of different learner modelling representations. These educational applications will be tested as part of a guided activity in which the teacher (or an artificial agent) will help students to interact with the model. Learners will be working in groups and individually.

A first exploratory study will have place in a Colombian school during the next month. Several scenarios involving the use of ViSMod and ConcepLab have been designed. Learners and teachers will have the opportunity to interact with learner models and use the model to support a negotiated assessment process.

The results of these experiments will be useful to analyse the implications of using each tool in a particular environment. Future research will lead us to a clearer understanding of the use of learner models, considering the advantages and disadvantages of externalizing the learner model to learners and teachers in real environments.

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