MyExperiences: Visualizing Evidence in an Open Learner Model

Barbara Kump[1], Christin Seifert[2], Günter Beham[2], Stefanie Lindstaedt[1,2], Tobias Ley[2]

[1] Knowledge-Management Institute, TU Graz, Inffeldgasse 21a, 8010 Graz, Austria
[2] Know Center, Inffeldgasse 21a, 8010 Graz, Austria
bkump@tugraz.at;
{cseifert, gbeham, slind, tley}@know-center.at

Abstract. When inferring a user's knowledge state from naturally occurring interactions in adaptive learning systems, one has to makes complex assumptions that may be hard to understand for users. We suggest MyExperiences, an open learner model designed for these specific requirements. MyExperiences is based on some of the key design principles of information visualization to help users understand the complex information in the learner model. It further allows users to edit their learner models in order to improve the accuracy of the information represented there.

Introduction

Knowledge Indicating Events (KIEs) [1] have been suggested for diagnosing user knowledge in an adaptive learning system. Similar approaches to assessing user knowledge from different sources of evidence have been proposed (e.g., [2, 3]). KIEs are naturally occurring actions from which evidence for a user's knowledge level for a concept is inferred. Because no additional interaction with the users is needed to diagnose knowledge levels, the KIE approach is especially useful e.g., for work-integrated learning. However, employing KIEs is based on assumptions which may not be valid in all cases (e.g., "a user who reads a text has learned about the underlying concept"). Moreover, the diagnosis of user knowledge based on KIEs is not necessarily understandable for users.

Open learner models (OLMs) [4] enable users of adaptive learning systems to see the details of the information held about them as well as the processes used to gather this information. Thus, we regard OLMs as powerful means to enhance understandability and accuracy of knowledge assessment based on KIEs. We present *MyExperiences*, the OLM of the adaptive learning system *APOSDLE*. Because in OLMs the way the information is displayed to the user is critical, the design of MyExperiences is based on the principles of information visualization condensed in Shneiderman's well-known mantra *Overview first, zoom and filter, then details-on-demand* [5].

MyExperiences: The Open Learner Model of APOSDLE

APOSDLE's open learner model, MyExperiences (Fig. 1), allows users to access their learner model in order to understand how their knowledge level in certain concepts was diagnosed, and to change its content, if necessary. Typically, ~100 concepts are represented in the learner model. For each concept, one of three knowledge levels is automatically diagnosed with KIEs: *learner* (e.g., asking for a learning hint), *worker* (e.g., performing a task related to the concept), and *supporter* (e.g., being contacted).

In terms of data structures, the APOSDLE learner model is a forest of trees with the knowledge levels being the roots of the trees. The children of each root (knowledge level) are all concepts for which the corresponding knowledge level was diagnosed. The children of each concept again are the KIEs that occurred for the respective concept. Due to the large amount of data (number of knowledge levels, concepts, and KIEs), we chose the tree map [6], a space-filling approach, as the core technique. By combining the tree map (right part of Fig. 1) with the familiar tree view (left part of Fig. 1) as coordinated multiple views, the user can get a quick overview (tree map) and browse to details in a familiar way of interaction (tree view).
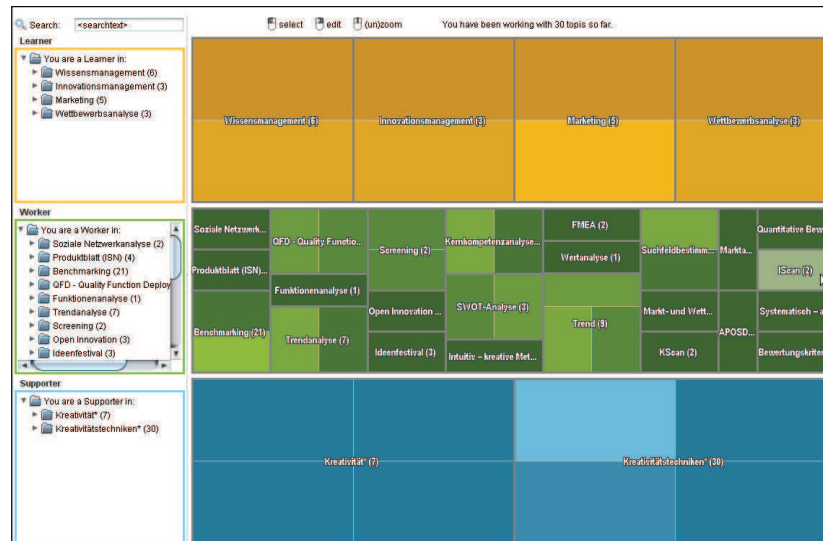

Fig. 1. **The tree map-based open learner model of APOSDLE**

This is how MyExperiences relates to the principles of information visualization overview, zoom and filter, and details-on-demand: MyExperiences is divided into three rows (with different colors), one for each knowledge level. Each row in MyExperiences consists of the tree view (left) and the tree map view (right). Each tree map gives an *overview* of all the concepts for the specific knowledge level. For a concept, the number in brackets indicates the number of related evidences (KIEs). The lighter the color of such a sub-rectangle, the higher is the relative occurrence of this event for the concept. The aspect of *filtering* is realized with the search

functionality on the top left. The user has several possibilities to interact with MyExperiences. Common interaction techniques like *selection* and *zooming* enable the user to investigate the OLM, either as an overview or in detail. Zooming one step into the tree map allows the user to understand why the specific knowledge level was inferred for this concept. In this zoomed view, the user is provided with the additional information about which evidences (KIEs) occurred how often for this specific concept (*details-on-demand*). The user also can alter the knowledge level for any concept and resets its own changes to the system's decisions.

Discussion and Future Work

Outcomes of informal interviews with APOSDLE users indicate that MyExperiences improves understandability and accuracy of the APOSDLE learner model. Still, this needs to be evaluated systematically in usability studies. Concerning the visualization, we see two main avenues for follow-up. First, we plan to provide users with visual clues about uncertainty in automatically diagnosed knowledge levels. Second, users should be able to see the development of their knowledge levels over time. One possible disadvantage of the current realization of MyExperiences is that concepts without KIEs do not appear in the visualization and thus cannot be altered by the users. This may be overcome in a future version.

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