Analysis of Feedback Authoring Possibilities in Web-based Learning Systems

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Abstract: This paper surveys and analyses the feedback authoring possibilities in online assessment modules of the most popular Learning Management Systems (LMS) including: Moodle, Sakai, and Blackboard. We consider the problem of authoring and supporting of tailored and personalized feedback and demonstrate how it has been (or could be potentially) addressed in these systems.

Introduction

Developers of modern WBLs put a lot of effort in the creation of user-friendly and effective authoring tools. Their main intentions are to enhance the teacher's work in managing e-learning applications and to produce useful and efficient learning materials. The WBLs authoring tools are aimed at helping: (1) to decrease the effort (time, cost, and effort) for making learning courses, (2) to decrease the skill threshold for designing learning applications, (3) to help the teacher to articulate or organize his/her domain or pedagogical knowledge, (4) to support good design principles (in pedagogy, user interfaces, etc), and (5) to enable rapid prototyping of learning course design (Murray, 1999).

Among the whole learning management functionality feedback is the one that gives the student the response from the system. It occurs during interaction with different components of WBLs (assessment, navigation through the learning materials, communication and collaboration, etc.) and performs many functions – feedback informs, motivates, corrects, evaluates the student, keeps his/her attention, and provides additional comments and explanations. Therefore, the study and design of feedback provided by the system and feedback authoring tools are crucial aspects of the educational applications development. In (Vasilyeva et al., 2007) we overviewed state-of-the-art of feedback in WBLs and outlined the main problems of the feedback design in WBLs.

In this paper we focus on analysis of the feedback that is presented during online assessment in WBLs. Online assessment components of LMS are actively used nowadays not only in e-learning, but also within blended learning, as part of the learning process for self-evaluation and for "real" exams. Authoring and delivering of feedback is one of the important tasks of the online assessment components.

The increasing number of uses of WBLs as well as the existence of different types of feedback and the ways of its presentation emphasizes the necessity of the feedback personalization. The same feedback could be very different for different students. Tailoring of feedback offers possibilities to deliver feedback that is most effective for the student and is the most appropriate for the user's expertise and cognitive abilities in general and, in particular, adapted to the user's performance, current mood and attentiveness. In our recent research we experimentally demonstrated feasibility and effectiveness of Immediate feedback personalization during online assessment in WBLs (Vasilyeva et al., 2008a; Vasilyeva et al., 2008b).

To the best of our knowledge none of the existing WBLs currently supports possibilities for tailoring of feedback in online assessment (except the possibility of tailoring of feedback to the response context). In this paper we analyze how this limitation can be overcome and present our approach of introducing feedback tailoring functionality to WBLs which was implemented as a proof of concept in the Moodie LMS.

The remainder of this paper is organized as follows. First, we review and summarize feedback authoring possibilities supported by three most popular WBLs: Moodle, Sakai and Blackboard. Then we focus on the issues related to feedback tailoring in WBLs. After that we discuss possible modification of Moodle on the example of Moodie to support feedback personalization during online assessment. We conclude the paper with a summary and outline the directions for further research.

Feedback Authoring Possibilities in major WBLs

In this section we present an overview of the functional possibilities of the most popular WBLs such as Moodle, Sakai, and Blackboard with regard to feedback authoring in their assessment modules. Moodle, Sakai and Blackboard are designed using sound pedagogical principles and support online individual and collaborative learning through a number of features and activities including course management, creating and learning content and document distribution, forums, chats, wikis, online testing, etc. We focus our analysis on the feedback that is supported by online assessment components of these systems.

Moodle (http://www.moodle.org) is a free, open-source WBL used in more than 180 countries. Besides the powerful course management system, Moodle includes a quizz module that allows the teacher to design and implement quizzes, tests, consisting of multiple-choice, true/false, short answer questions etc.

Moodle supports the following types of feedback in its assessment module: immediate, summative and delayed feedback. Immediate feedback may include knowledge of the response (KCR), knowledge of correct (KCR) and/or elaborated feedback (EF) to the question as a whole, to the variant of the answers, to the multiple-choice questions being answered correctly, incorrectly, or partially correctly. Summative feedback can include the grade for the test and general comments on the student's performance based on his/her score. Delayed (until all after all questions have been answered) feedback may include an overview of all the questions, the student's response to those questions, highlighted correct responses and EF (explanations). Delayed feedback could be presented either directly after answering to the whole test or when the test is closed (typically when the end-time of the exam is reached). Moodle's quiz authoring tools allows setting the listed above types of feedback presentation.

Sakai (http://www.sakaiproject.org) is actively developing WBL that has been recently becoming widely used. It is also a free, open-source educational software platform used for teaching, research and collaboration. Sakai is currently being used at over 150 institutions and being piloted by over 100 more. Sakai includes an assessment manager (SAMiGo) that supports online assessment through online tests/quizzes, homework questions, problem sets, self-study exercises, compositions, projects, language drills, and surveys. SAMiGo assessment tasks can include the following types of questions: multiple choice, survey, short answer/essay, true/false, fill in the blank, file upload, and audio recording.

The types of feedback which can be presented in SAMiGo are: immediate and delayed feedback (the time when feedback should be presented can be set), KCR, KCR and EF to the question, to the variants of answers. The EF can be separately specified for the question in case it is answered correctly and in case it is answered incorrectly. The feedback can also include the statistics of answering to the questions of the certain test.

Blackboard (http://www.blackboard.com) is the popular commercial WBL which is being used in over 2200 education institutions in more than 60 countries. Its features include course management, a customizable open architecture, and a scalable design. Blackboard has an online assessment unit that allows creating tests and surveys and supports different types of questions (multiple-choice, true/false, matching, ordering, etc).

For each of the questions the author can specify the necessity of providing the KCR and/or KCR feedback. Blackboard also gives instructors the possibilities to specify different types of formative instruclational feedback for multiple-choice questions. The authors can specify EF for the each possible variant of the answer, for the correct response, and for the incorrect response to the question.

In Table 1 we present a summary of the feedback functionality supported by Moodle, Sakai and Blackboard. For this analysis we used the taxonomy of feedback suggested in (Vasilyeva et al., 2007).

<table>
<thead>
<tr>
<th>Time of occurrence</th>
<th>Moodle</th>
<th>Sakai</th>
<th>Blackboard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate feedback</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>* possibility to specify what to include to the immediate feedback: responses, correct answers, scores, elaborated feedback</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Delayed Feedback</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>* After completing the attempt</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>* After the quiz is closed</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>* At the specific date</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>* possibility to specify what to include to the delayed feedback: responses, correct answers, scores, elaborated feedback</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>
In the next section we describe a technical changes that we introduced to Moodle LMS to facilitate feedback personalization personality.

Feedback Personalization in Moodle

The Moodle Quiz Module allows authoring of different types of feedback (Tab. 1). This allows introducing the possibilities of feedback tailoring without developing feedback functionality itself. We have introduced a number of changes to Moodle Quiz module and Moodle’s database architecture throughout the series of experiments to support discrimination between several types of feedback (KR, KCR and several types of SF) and personalization/recommendation of feedback. Our approach is based on the traditional user modeling approach in adaptive hypermedia (Brazovskiy, 2001). In our study we used a simple user model that includes information about student’s L,S certainty and correctness of the current response. Other individual characteristics can be added easily of course, however we tried to focus our study on a particular set of characteristics that allows us to verify our findings from preceding experiments as well as to verify the feasibility of the RS adaptation approaches and to make some new observations. Besides the user model, another important component is a feedback adaptation unit that has to include a knowledge base containing the adaptation rules that associate user (task, environment) characteristics with certain feedback parameters from the feedback repository.

In the Appendix we present the list of changes introduced to Moodle database and quiz module to support feedback personalization functionality.

Conclusions

Feedback is an important feature of the online assessment components of WBLs. In this paper we overviewed feedback-related functionality of the most popular WBLs – Moodle, Jukai and Blackboard. Our analysis demonstrated that although a wide range of the types and ways of feedback presentations are supported, authoring and presentation of the personalized feedback is still not possible. Tailoring of feedback to the individual characteristics of students and their learning needs is a promising direction of WBLs development that can be beneficial for enhancement of WBLs in terms of efficiency and effectiveness of interaction and learning processes.

In this paper we also stressed that it is relatively easy to extend the WBLs functionality by altering the code and introducing some changes into the database on example of the Moodle LMS. In our work feedback personalization was hard-coded. However, there are no serious obstacles in providing authoring tools for adaptation within WBLs. Authoring of personalization rules is supported in existing adaptive systems. For example, AHA! provides both high-level (Graph Editor) and low-level (Concept Editor) authoring tools which can be used for creation and editing of the personalization rules (De Bra et al, 2007).

Our ongoing and future research is focused on incorporating adaptation (including feedback adaptation) supported by AHA! adaptive system into existing LMS. This is one of the main goals of the EU FP7 STREP project ORAPPLE.

Acknowledgements

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References

Appendix

Moodle Database Modification

The Moodle database was modified in order to store (1) additional information in the user profile, (2) personalization/recommendation rules, and (3) additional systems settings. We introduce the following main changes to the database architecture of Moodle:

1. The field “adaptive_feedback_flag” was added to the quiz properties table (mdl_quiz) to enable/disable feedback personalization in the certain quiz.
2. Additional fields for the multiple-choice questions table (mdl_question_mchoice) were added:
   - question_concept – to store information about the concept studied by the certain question;
   - question_adapttype – to store the information about the feedback adaptation strategy used for EF personalization/recommendation;
   - feedback_theory – to store theory-based EF for the question;
   - feedback_example – to store example-based EF for the question;
   - feedback_url – to store “pointing” EF for the question.
3. Fields to store feedback-related events and more data about the test were added to Moodle question states table (mdl_question_states table):
   - ansr_cer – to store student’s certainty in the response for each response;
   - ansr_check – to store information about requests of KR feedback;
   - ansr_check_time – to store the time of KR feedback request;
   - time_start – to record the time when the student receives a new question;
   - time_feedback1_start – to record the time when the student start reviewing first type of EF;
   - time_feedback2_start – to record the time when the student start reviewing second type of EF;
   - feedback_pref – to store information about immediate and/or delayed feedback requests;
   - feedback_pref_type – to record types of EF visited by the student.
4. A new table to store user’s ratings of the feedback usefulness and student’s comments about the questions and explanations was added (mdl_feedback_rating) (Fig 1a.)
5. New tables to store feedback recommendation/personalization rules were introduced (mdl_feedback_recom, mdl_feedback):
   a. feedback_recom: feedback recommendation/personalization rules based on certainty in the concept, response certainty and response correctness (Fig 1b.).
   b. feedback_recom: feedback recommendation/personalization rules based on active/reflective and sensitive/intuitive LS, response certainty and response Correctness (Fig 1c.).

1 In case you plan to introduce the similar changes to your Moodle server, please request more details from the first author of this paper. A script to automatic update of the Moodle server can be also made available on request.

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