MOT 2.0: A Case Study on the Usefuleness of Social Modeling for Personalized E-Learning Systems

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Abstract. In this paper, we report on our findings from the first evaluation of MOT 2.0, an Adaptive Web 2.0 e-learning tool, which supports: 1) *collaborative authoring* (i.e. editing content of other users, describing content using tags, rating, commenting on the content, etc); 2) *authoring for collaboration* (i.e., adding author activities, such as defining groups of authors, subscribing to other authors, communication between authors, etc); 3) *group-based adaptive authoring* via group-based privileges; 4) *social annotation* i.e., tagging, rating, and feedback on the content via group-based privileges; 5) *adaptive authoring*, by recommending related content and/or other authors; *adaptive delivery* based on users' activities. Our main contributions are: 1) defining a new social layer in LAOS, a five-layer model for generic adaptive hypermedia authoring; 2) removing the barrier between tutors, learners and authors, which all become authors, with different sets of privileges; 3) adding the power of group-based authoring to the course creating.

Keywords. MOT 2.0, social LAOS, adaptive hypermedia

Introduction

E-learning 2.0 [16] is a term referring to the next generation of e-learning using Web 2.0 [11]. It implies social annotation and collaborative *authoring* facilities, where students and teachers are all involved in the content creation process, and the strict delimitations between authors and students disappear. By means of Web 2.0, every web page can be considered as the focus of a community, and each member of this community can evaluate, edit and share content with others [7].

When it comes to authoring of e-content for adaptation and personalization, however, prior research shows that it is a traditionally difficult task, both for authoring of intelligent tutoring systems [17], [12], and adaptive educational hypermedia [15] especially when performed in the form of '*one author does it all*' [15]. Adaptive lessons are normally a great deal more complex than their non-adaptive counterparts, requiring more time and expertise to be authored.[4].

Transferring the success of Web 2.0 collaborative authoring onto authoring for adaptive e-content seems thus a promising solution, which can provide the means of generating richer authored materials, and sharing good practice.

In this paper, we describe a new e-learning 2.0 system, MOT 2.0 (My Online Teacher 2.0), focused on including *collaborative authoring* and *social annotation* for communities of authors, as well as applying adaptivity based on users' activities. In this way, information collected from social annotation can be used to recommend adaptive materials for the delivering/authoring process. The aim behind including collaborative authoring and social annotation within MOT 2.0 is to define improved adaptive materials based on communities of practice [6]. Authors who belong to the same community can cooperate in providing more valuable adaptive content within the community, based on their different backgrounds and knowledge. The collaborative facilities in MOT 2.0 rely on Web 2.0 techniques, such as collaboration in creating the courses, tagging the content, rating it, and commenting on it. The collective content works as a *state-based system*, as each particular instance of it can be used to improve the authoring process, by recommending related content from it to authors, which then can decide on the next state of the collective content based on these recommendations. Moreover, in MOT 2.0, teachers are no longer the only authors of the content; students are also considered authors, as they too can add their contributions, as determined by a controlled set of privileges determined by the teachers.

1. Tutors versus Learners collaborative Scenarios

In the following, we illustrate the idea of collaborative adaptation in authoring and delivery via two scenarios.

1.1. Authoring Scenario

Mike and Mary teach a course on "Web programming". Mike has experience with 'AJAX' and Mary has experience with 'PHP'. They want to author a joint course that covers 'AJAX' and 'PHP'. They aim to develop a collaborative course, which will be delivered to students in an adaptive manner (providing recommended/ alternative paths through the course for different users based on users' activities). Mike initially creates a group called "Web programming". Mike initializes the privileges for this group, by enabling all privileges for himself and Mary; therefore, they can collaborate in authoring, editing, tagging, commenting, rating, etc. of lessons. Mike also sets the default privileges, for new users joining the group to read, tag, comment, rate (vote) the content, and flag inappropriate content. Mike starts creating items that cover the topic 'AJAX'; for each item Mike adds tags that describe it. At the same time, Mary also creates items for 'PHP' and she applies a set of tags on them. Mike notices that one of Mary's items is not fully described, so he edits this item, and the system records the update. Mary also notices that one of Mike's items is missing the appropriate tags, so she applies the suitable tags for it. During item creation, Mike and Mary try to categorize the items for better adaptation; by determining the type of each item (text, image, video, audio, or other metadata for adaptation).

1.2. Learning Scenario

Joanna and Jeremy are students in the "Web programming" course. Their teachers are Mike and Mary. The first step is for the students join the "Web programming" group,

where they receive basic privileges: *read the actual content/module, tag its items, vote (rate), comment on items, flag inappropriate content*. Joanna and Jeremy have different background and skills, as well as preferences. MOT 2.0 suggests an initial evaluation for both of them to indentify their knowledge gaps, as well as their prior knowledge and the prerequisites needed. Then, MOT 2.0 uses Joanna and Jeremy's user models, the current context, and the current adaptive strategy, to deliver adaptive modules. MOT 2.0 records all their activities, including how many time items have been read. Based on these activities, MOT 2.0 can recommend other materials. Joanna has a good knowledge of 'AJAX', thus she can tag the 'AJAX' items with more precise keywords. She can also rate the items describing 'AJAX'. Jeremy has a basic knowledge of 'PHP', so he adds questions on the complex items, so that teacher Mike (or any other user) can answer them. Alternatively, the system can trigger an adaptation strategy based on the fact that Jeremy has a question on that item (e.g., suggesting visiting prerequisite items, other adaptive material, contacting appropriate users, or just waiting for an answer). Jeremy also notices an inappropriate comment on one of the items, so he flags it and thus reports it to Mike and Mary. Mike and Mary need to check all flagged activities within the "Web programming" course when they have the time. Because teacher Mary has experience with 'AJAX', she can be confident to confirm or reject Joanna's activities. Once these activities are committed, MOT can update Joanna's user model, and recommend related course materials. Mike notices Jeremy's questions about a specific item. So, he answers the question and gives him some recommendations. Because Joanna is interested in 'AJAX', she subscribes to material created by the teacher Mary; thus Joanna can have updates of the new items posted by Mary.

2. System Design and Architecture

Based on these scenarios, specific requirements have been extracted, as follows. The ***authoring scenario*** leads to the following requirements:

R1. Groups should be able to be created.

R1.1. Group privileges can be set for specific types of users (e.g., new users).

R2. Lessons should be possible to be created.

R.2.1 Lessons should belong to either an individual author, or a group (the latter thus permitting collaborative authoring).

R2.2 Lessons should be formed of items.

R2.2.1 Each item can have tags applied to it.

R2.2.1.1 Specific tags exist, such as type and adaptation metadata.

R2.4 collaboration on a lesson or item should be permitted in the form of any subset from {*collaborative editing of items or tags, tagging, commenting, rating*}.

The ***learning scenario*** leads to the following additional requirements (please note that some of them just refine major requirements above):

R3. User profile can be stored (including such items as background, skills, preferences, read items, undertaken activities, etc.).

R4. Adaptive strategies can be stored (for personalized delivery).

R1.1.1. Students are authors with basic privileges (read, tag, rate, comment, flag).

R2.2.1.2 Specific tags exist, such as *questions*, *answers* and *recommendations*; as well as *activities*, and *rejection*/ *acceptance* of activities.

R1.2 Subscriptions should be possible to groups.

R3.1 Subscriptions should be possible to users.

The above requirements have been implemented, and are reflected in the four modules of MOT 2.0: 1) *user module*; 2) *content module*; 3) *group module*; and 4) *adaptation module* (Figure. 1). Each module contains entities to capture the required information, which are fully described in previous work [8] and thus not repeated here.

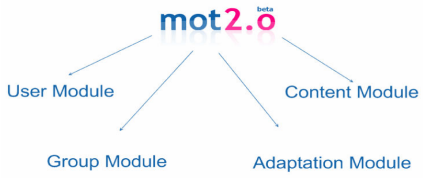

Figure 1. MOT 2.0 main modules.

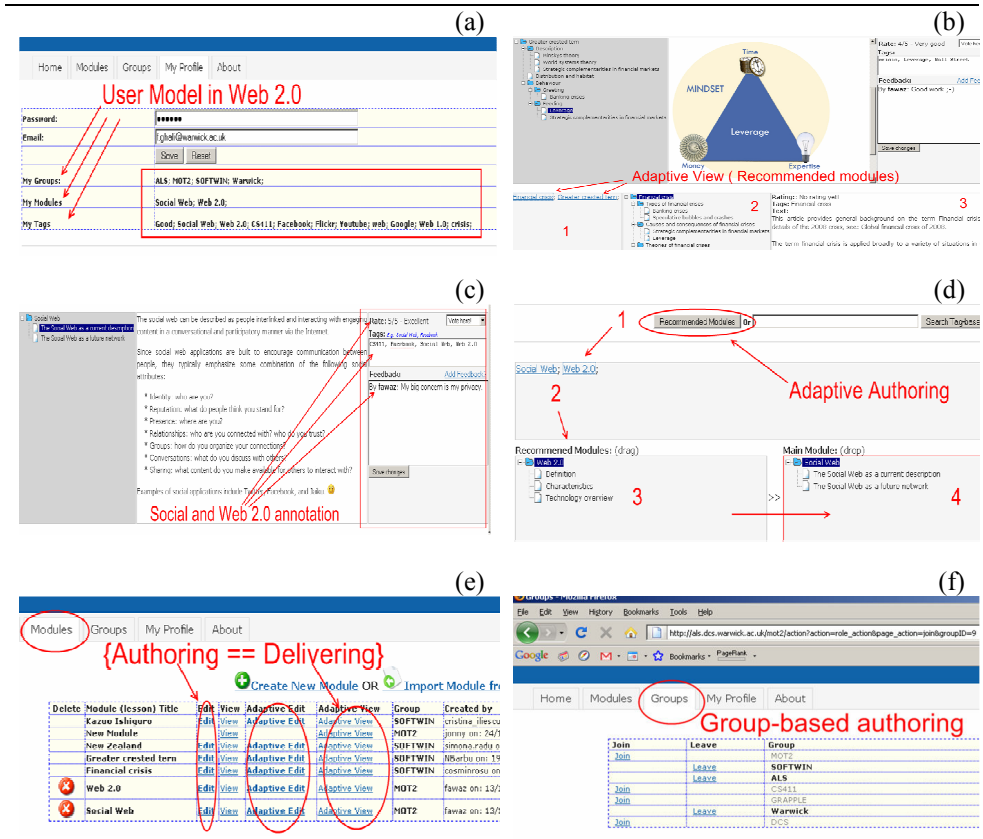

Figure 2. MOT 2.0 Screenshots.

The screenshots provided above illustrate different functions and capabilities of MOT 2.0, starting from Figure 2 (a): the user module captures the results of all actions the users make using the system, which helps to create the user model in Web 2.0; these action results include which groups the user has already subscribed to, what modules the user has created/edited, what tags the user has already used and for which module. Figure 2 (b) demonstrates the adaptive view of the lesson, which shows other related recommended materials for further reading; at this stage, in the following implementation round, we plan to apply other adaptive strategies. Figure 2 (c) shows

social annotations for the actual lesson based on the user's privileges for the selected group/course. These social activities include: rating the content of the item, feedback, and tag items with a set of keywords. Figure 2 (d) explains how the adaptive authoring works, by displaying other related recommended courses which can be used in creating the course. Figure 2 (e) is about the blending of the authoring and the delivering (view) process, as the users may still change the content of the course during or after the delivery, or they may annotate it during its creation. Figure 2 (f) shows the group-based authoring concept, where users can create groups, and have different privileges on different groups. This setup allows the definition of advanced levels of the relation between tutors and learners based on their user model.

3. Evaluation

The system as presented above has been evaluated with the help of a group of 11 students studying 'Dynamic Web-based systems', a 4th year module at the department of Computer Science at the University of Warwick. The students were introduced to the system after they had some lectures on adaptive hypermedia, user modeling, semantic web and social web. Prior to this experiment, they were required for an assignment to produce a whole adaptive lecture in groups of up to five students, with a different system (MOT 1.0 [1], which allows a modicum of collaborative authoring without its social and community aspects). Thus, the students could be considered as having some designer and authoring experience, as well as being involved in the learning process. This fitted well with our image of blurring the edges between authoring and learning. Students were asked to perform some specific tasks with the MOT 2.0 system, which highlighted the new features introduced. These tasks involved also reusing the adaptive lectures that they had created previously, as well as creating material from scratch, and, of course, using the social tools (rating, tagging, feedback, etc.). After performing these tasks, they were asked to respond to especially neutralized[1] questions as shown in Table 1. The table also shows the mean value of their response on the scale of 1-5 (*(not at all useful) 1 2 3 4 5 (very useful)*), as well as the variance of the results. The scale was kept numerical for further interval processing.

Table 1. Evaluation of MOT 2.0

What do you think about …	**Mean (1-5)**	**Variance**
Q1. browsing other author's modules?	4.45	0.47
Q2. the keyword-based access for other authors' tags (keywords)?	4.27	1.02
Q3. copying item(s) across from other authors' modules/items?	3.82	1.76
Q4. creating a module based on someone else's modules/items?	4	0.6
Q5. allowing the students to help the teachers in creating (editing) the content of the course?	3.64	1.65
Q6. the similarity between the authoring (creating and tagging the module) and the delivering (reading the module) in MOT 2.0?	3.55	1.47
Q7. collaborative authoring techniques in MOT 2.0 (i.e. editing the content of other users, tagging and rating the content, commenting)?	4.09	1.29
Q8. authoring for collaboration techniques in MOT 2.0 (i.e., defining groups of authors, subscribing to other authors, communications, etc)?	4.73	0.22
Q9. grouping the authors in groups?	4.18	0.96

[1] 'especially neutralized' here means avoiding leading questions, such as 'Did you like …' or 'Did you dislike …'. We preferred here thus questions starting with 'What do you think of …'. Moreover, students were also told that the experiment had no bearing on their marks, in order not to skew results.

Q10. adapting authoring by recommending related modules/items?	4.27	0.62
Q11. recommending modules / users / groups?	4.18	0.56

As the table shows, the mean of all questions was above 3. This leads to the conclusion that the students considered the possibility to browse other author's modules useful (Q1), that they considered the creation of a module based on someone else's module beneficial (Q4), that they liked the addition of collaborative techniques on MOT 2.0 (Q8) such as defining author groups, subscribing, communications, etc. Specifically, they liked the grouping of authors into groups (Q9).

From a point of view of *adaptation*, students like the process of adaptive the authoring process by recommending related modules or items (Q10). They also saw room for extension in adding adaptive delivery based on groups, users, modules, etc. (Q11), which is the development direction that we were planning to take but wished to have confirmed as being necessary. The results above are taken from questions with variance below 1, where thus the opinions were strong and with minimal spread.

The rest of the questions, whilst still showing an average positive result, have a higher variance. The second lowest score combined with the second largest variance was obtained when we asked them about having students helping teachers in the authoring process of courses (Q5). The majority thinks this is useful, but some skepticism remains. Looking at their qualitative feedback, the reason was related to security concerns i.e.: "I chose to answer 3, because of security concerns to prevent the abuse use of the system" The lowest score was obtained when we asked them their opinion about the similar representation of authoring and delivery (Q6). Whilst the average is still high, the variance is also high, showing that some students may have either had or seen potential problems with this mixture. It is clear that we need to continue researching into how to seamlessly introduce authoring and delivery in the same environment. Copying items across from other authors was perceived as useful, but the variance was also quite large there (Q3); by looking at the qualitative feedback, the concern was about the copyrights of the copied materials, which we should include in the next version. Another concern was about the ease of copying, it is possible that a simple answer here would be to improve upon the function allowing the drag and drop between modules. Collaborative authoring, in the form of editing, tags, etc. (Q7) was considered useful, and, whilst the spread was high, so was the overall value, thus compensating for the spread. Similarly, despite the relatively high variance, the keyword access to other authors' material was considered beneficial (Q2).

4. Discussion

Overall, the experiment that we run on MOT 2.0 showed that the newly introduced facilities of Web 2.0 were perceived as being useful in the creation of adaptive, personalized courses, in addition of the usefulness of Web 2.0 concepts in e-learning. Some activities, such as grouping, subscriptions, communications, recommendations, accessing other people's material, were considered of higher use than others, such as tagging, copying of items, etc. More research is necessary after the functionality of the tool is improved to find out if this was due to some tool restrictions, or some deeper issues. However, as the general feeling is positive, we feel that continuing in this direction is justified. Another issue that needs attention is the apparent lack of distinction between authoring and delivery views. We had expected that students, accustomed to Wikipedia and other Web 2.0 software, to be taking quicker to this

approach, but it seems that some worries may remain, when these concepts are translated onto an adaptive, personalized environment. Again, some more intuitive interfacing might lessen such worries; in the current implementation, the views were kept separate so that the students were made aware of using the different parts of the system, but in the future, the intention is to merge these.

5. Related Work

Recommended content has been studied extensively in the adaptive hypermedia community. According to Brusilovsky [15], there are two levels of adaptation: adaptive navigation (link level e.g., [9]) and adaptive presentation (content level adaptation). Other researchers have also added that learners' web learning activities should be utilized [5]. We followed both approaches to help learners to find recommended courses, as well as recommended collaborators.

Such recommender systems as the one we envisage are now-a-days slowly starting to be interesting not only to research communities, but also for the commercial realm. E.g., [14], 'in June' 2008 'the social ad firm SocialMedia Networks has invented an algorithm called FriendRank'. The name seems to imply that a similar algorithm as the one originally deployed for Google search, PageRank[18], is to be used for recommendations in a friend's network. MOT 2.0 is aiming at applying such concepts in the world of adaptive e-content and authoring.

On the other hand, collaborative filtering in e-learning has been used in many researches. E.g., in CoFIND [10], a web-based n-dimensional collaborative filtering system seeks to guide learners to relevant resources based upon not only the content of the resources but the qualities exhibited by those resources, that make them useful learning material. Our prototype focuses on the users activities in the collaborative filtering process; i.e., recommended courses can be displayed based on the relevance of the course to the user, as well as to the user's current activity. Moreover, collaborative filtering has been also used in intelligent tutoring system[13]; however, our approach goes beyond simple, scripted collaborative filtering to include external adaptation strategies[3], which can be created at a later stage by the tutors or administrator, and can affect both students and tutors. Finally, our approach also extends the traditional authoring for e-learning, as we include learners in group-based authoring.

6. Conclusion and Future Work

In this paper, we have presented the theoretical fundaments of combining authoring of e-Learning with social networking concepts, discussed in general the implications, as well as highlighted this merge with the help of two specific scenarios. These scenarios were then converted into a list of requirements, which guided us in the implementation of MOT 2.0. The remainder of the paper presented the evaluation of MOT 2.0, which confirmed, overall, that this merger is of value and interest.

Our main contributions are: 1) defining a new social layer in LAOS [2], a five-layer model for generic adaptive hypermedia authoring; 2) removing the barrier

between tutors, learners and authors, which all become authors, with different sets of privileges; 3) adding the power of group-based authoring to the course creating.

For future work we shall take on board the students' questionnaire results, and their more informal, qualitative feedback. A simple solution to issues highlighted would be some improvements of the interface. Another direction of future work is to incorporate more adaptation strategies into MOT 2.0. For the current implementation, for simplifying the experiment, we only based recommendations on similar tags between modules. As the focus was on the added value of social interactions and grouping, this was enough for the proof of concept. For the future, we want to connect to prior research, where we have developed a specific portable language for adaptation strategies [3]; and either extend it for social interactions, or create a new, dedicated one. In this way, interactions and adaptive behavior can be specified independent on the content or the people involved, and reuse of adaptive behavior is possible.

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