Collaborative Adaptation Authoring and Social Annotation in MOT

Fawaz Ghali[1], Alexandra I. Cristea[1], Craig Stewart[2] and Maurice Hendrix[1]

[1] Department of Computer Science, University of Warwick,
Coventry, CV4 7AL, United Kingdom
{F.Ghali, A.I.Cristea, M.Hendrix}@warwick.ac.uk
[2] Department of Electronic Engineering, Queen Mary University of London,
Mile End Road, London, E1 4NS, United Kingdom
Craig.Stewart@elec.qmul.ac.uk

Abstract. The Web is constantly evolving, in fundamental and innovative ways. Social annotation and collaborative authoring facilitate and change the process of creating and sharing information. In this paper, we propose a new design of the authoring system MOT (*My Online Teacher*), focusing on *collaborative* authoring and *social* annotation. The goal behind this is to define improved adaptive materials based on personalization and recommendation. We start the collaboration design process by discussing its features, characteristics and creating a survey with a group of third-year students in a "Web Programming" course at the University "Politehnica" of Bucharest. Results confirm a consistent association between the authors and the students in the proposed prototype; the key elements of the collaboration are rating and tagging the attributes, in addition to feedback the content in the *domain model*; moreover, the privileges are defined at the level of the lesson and the link in the *goal model*.

Keywords: Collaboration design, social annotations, collaborative authoring, Web 2.0, adaptive hypermedia, MOT.

1 Introduction

Collaborative authoring and social annotation are two faces of same coin: both rely on cooperation, but in different ways. Whilst *collaborative authoring* (annotation and editing during writing [8]) creates/modifies the actual web resources, *social annotation* (or annotation during reading [8]) facilitates the adding/editing/modifying of information in a web resource, without changing the resource itself [10]. The main goal for defining cooperation (collaborative authoring and social annotation) in MOT [3] is to allow multiple authors to contribute in the authoring process. Thus, the authored materials foster a new level of knowledge (both of creation and of use) by aggregating information from many users. In principle, the more users that contribute to the authoring process, the more valuable the final *stable* material is. Stability is important to reach, as systems such as Wikipedia show, because only then a

consensus of the community is certain. Whilst a resource is still changing, its value is less certain to that community.

2 MOT and CAF

MOT [3] is an authoring tool that can be used for authoring adaptive hypermedia courses. MOT is based on the LAOS (*Layered WWW AHS Authoring Model and their corresponding Algebraic Operators*) framework [4], and consists of: 1) *Domain layer*: defining the conceptual domain model (DM), built of atomic and composite concepts, where each concept has a set of attributes. 2) *Lesson layer*: defines multiple flexible lessons from a given domain map or combination of domain maps. 3) *User - adaptation - and presentation layer*: described by adaptation strategies. In MOT, the contents (Conceptual and Lesson layers) can be exported into Common Adaptation Format (CAF) xml files [5] (Figure 1).

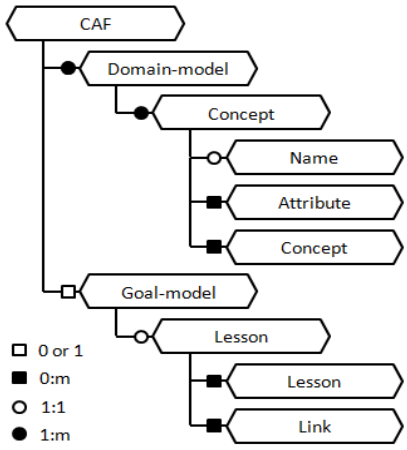

Fig 1. CAF XML structure; where 'x:y' means 'the range x to y'; 'm' stands for 'more'.

CAF represents the actual data structure of the domain and lesson part of the MOT database by using XML, which is more suitable for conversions. A CAF XML file has: 1) a *Domain model*: consisting of one or more domain maps, each with a set of concept(s); and each concept with a set of attribute(s) that describes related domain data (and link to the actual content). A concept may have sub-concept(s) and associations to other concepts. An attribute has a name and contents. 2) a *Goal model*: consisting of a single goal map, representing the actual lesson, which may have a set of sub-lesson(s). Each lesson has a set of link(s), where each link points to an attribute in the domain model. The link has two attributes: weight and label, which are used to determine the adaptive requirements via adaptation strategies.

3 Extending Collaboration in MOT

MOT is an adaptation authoring tool, which already supports some basic collaboration activities such as: 1). General access (visualization) to other author's domain maps, as well as lessons. 2). Keyword-based access (visualization) of existing domain concepts, created by the current author or by other authors. 3). The possibility of copying a domain concept across from another of the author's own domain map(s), which allows reuse of previously created materials. 4). The possibility of linking to concepts from someone else's domain map(s), which corresponds to referring in one's own book to someone else's book (e.g., adding a full quote). 5). Semi-automatic search and linking function (with weights and labels) to link domain concepts from any domain map, be they authored by the same author or not, to another (related) domain concept, which helps the author in finding related domain concepts to the one they are currently authoring, so they can reuse material, or refer to it, as necessary. 6). The possibility of creating a lesson based on someone else's domain map(s): this is similar to creating a lesson based on someone else's book(s). 7). The possibility of creating a lesson including other lesson(s) created by other authors, which corresponds to reusing the lesson materials of other teachers on the web, as long as they post it and allow such reuse.

On top of the above, the design, as initially proposed in this paper, is focusing on utilizing two aspects:

1) *Collaborative authoring*: where multiple authors can contribute in the authoring process. The question here is at what level in the CAF structure as shown in Figure 1 this collaboration should be. Possible options are, e.g., collaboration at the level of a domain concept, domain attribute, lesson, link, whole domain map, whole lesson map, etc. E.g., collaboration at the level of a concept in the CAF file would allow a user to edit previous concepts or create new ones (and/or sub concepts).

2) *Social annotations*: where multiple users (authors and/or students) can annotate the content of the attribute (tag/rate/feedback) and share this annotation with other users. A similar question appears as in the collaboration: which level of granularity is needed for social annotations? For instance, students rating at the level of the attribute in the CAF file would mean that an author could get feedback of the usefulness of each of the attributes he/she created.

Both collaborative authoring and social annotation will require the introduction of a more refined system of authorization (level of privileges). The question here is at which level of granularity privileges should be defined at. For instance, if privileges for authoring can be only at the level of whole domain maps, then it means that different authors have full editing rights over the whole contents of a domain map. If, however, such privilege is granted at a lower level of granularity, e.g., at the level of a link or lesson in CAF, then this would correspond to one domain attribute. In such a way, for each domain attribute, different accesses can be set. E.g., user A can grant user B editing rights over the 'keyword' attribute of a specific concept, say 'German pronouns', but not over the 'text' attribute, which contains the main text of this concept. User A could however at the same time grant editing rights to user C for the 'text' attribute, as well as, for instance, the 'keyword' attribute – but not over the 'video' attribute. This allows for an appropriate use of specialists, who can receive specific rights for the concepts and attributes they are specializing on, and nothing

else. Thus, it seems appropriate to define users and groups at the level of links and lesson in the CAF file (as explained in detail in section 5). These design ideas and initial mental speculations were further transformed into design hypotheses and then tested, as explained further in the paper

4 Hypotheses of the Collaboration MOT System Extensions

The study of related research, as shown in section 6, generated a number of design hypotheses on social annotation, collaboration and roles, and the required granularity:
H1. Adding collaborative facilities via social annotation (rating/feedback/tags – e.g., keywords) is useful for both authors and students.
H2. The tools to realize collaborative authoring should be based on a combination of semantic web (ontology-based structures) and social web techniques (Web 2.0: 'free' tags and annotation).
H3. Specifically, social annotation should be performed at the level of domain concept attributes in MOT.
H4. Social collaborative tools should support both author-author and author-student collaboration.
H5. Collaboration is needed at the level of both users and groups.
H6. Users and group privileges should be defined at the level of links or lessons.
Thirty 3rd year students contributed to this design stage of Collaboration MOT, by answering a questionnaire and reflecting refined hypotheses.

4.1 Testing the Hypotheses

We prepared a questionnaire (see the ANNEX) based on our hypotheses, in which we asked eight questions about the design of Collaboration MOT. A group of thirty students studying in a "Web Programming" course, partially delivered via distance learning, collaborated in the creation of new content in MOT and answered our questionnaire. The students were enrolled in the 3rd year of Computer Science at the Politehnica University of Bucharest, Romania. As their own course is partially delivered online, students can be expected to act as social annotators, and also to participate in the collaborative authoring process. Thus, the study performed can be considered real inquiry into what users need (e.g. supporting them in accomplishing a particular task, such as creating a part of a course description). Moreover, by being computer science students, the chosen group could be considered computer and software applications savvy and thus able to have the expertise or foresight to choose software features appropriately. Before the students had to fill the questionnaire, they were made familiar, via lectures, with Semantic Web concepts and technology (e.g., XML, XPath, RDF), Social Web concepts and technology (folksonomies, Web 2.0 concepts, etc.), and via hands-on experiments, with authoring environments (MOT) and learning environments (Sakai , AHA!). The questions that they were asked focused on our two principles of collaboration: collaborative authoring and social annotation.

Summarizing the results, we can say that 15 out of 30 respondents believed that collaboration should use both Web 2.0 as well as Semantic Web (Ontology/RDF/OWL) techniques; 26 respondents believed authoring should use social annotation techniques (such as tagging, rating, and feedback mechanisms); 24 answered that collaboration (social annotation and collaborative authoring) should be done by students and authors together; 21 responded that collaboration must be defined using users and groups; whereas 10 thought that the privileges should be defined at the level of lesson as well as with links to the goal model.

We applied a Chi-square test to verify if our observations match our hypotheses. We chose the chi-square test because our questionnaire used categorical data. The degrees of freedom associated with our data is calculated as follows: Df = number of categories – 1 As shown in Table 1, all results are statistically significant, as tested with the help of the Chi-Square test (with significance level $p <= 0.05$).

Table 1. Questionnaire statistics

Question	Chi-Square	Df	p	Hypotheses
Q1	11.862	2	.003	H2
Q2	41.448	2	.000	H1
Q3	26.034	3	.000	H3
Q4	24.069	2	.000	H4
Q5	12.448	1	.001	H4
Q6	19.931	2	.000	H5
Q7	11.345	5	.047	H6
Q8	11.345	5	.047	H6

Thus, our hypotheses are confirmed (Table 1), and we conclude that the groups of users of MOT would like to see the type of collaboration as described by our hypotheses. We also performed some more detailed analyses of the data. For example, for question 1, concerning the best application of collaborative authoring in MOT, the four answers (social web, semantic web, both, none), are selected with frequencies (14, 1, 15, 0), respectively. Beside the clear preference of both social and semantic web application together ($p=.003 <.05$, based on Chi-Square), we can also pairwise compare the two answers, separately. We notice a clear preference of social web techniques ($p=.049<.05$ as per a Binomial Test).

5 Design of Collaborative Authoring and Social Annotation

The proposed inclusion of collaborative authoring in MOT is focused on allowing groups of authors to contribute in the authoring process by providing editing facilities at the level of domain model concepts. After authoring the course, we propose another level of collaboration among students/authors, to interact with the authored material, by utilizing social annotation techniques, such as tagging, rating, and feedback. Thus, collaboration can be presented as collaborative authoring (create/edit) which can occur at the creation stage of the authored material (authors only), or at the usage stage (authors and students) or as social annotation (describe/evaluate/opinion).

The new Collaboration MOT DTD of the CAF file is extended, as shown below (extensions shown in bold). The domain concept is extended, allowing an arbitrary number of tags. For backwards compatibility purposes, zero tags are also allowed.

```
<!ELEMENT concept  (name, attribute*, concept*, tag*)>
```

The attribute is also extended, to allow for evaluation, and a list of tags and opinions. Evaluation can utilize a rating or voting system, whereas the opinion refers to the feedback or the comment created/edited by the annotator (student and/or author).

```
<!ELEMENT attribute (name, contents, tag*, evaluation?
opinion*)>
<!ELEMENT tag (user, keyword) >
<!ELEMENT opinion (user, feedback)>
```

The lesson element is extended to allow annotation by individual users that access this lesson, as well as by groups of users. Both authors and students can annotate the lesson. Despite the fact that user annotations appear in the DM, the privileges of the users (as well as the groups) are defined in the GM (at the level of the links and lessons), because the GM is used to point to the actual domain content (concepts), it is therefore more appropriate to define privileges at this level.

```
<!ELEMENT lesson  (link*, lesson*, user*, group*)>
```

The elements of the tagging mechanism are shown below, and are also added to the collaboration DTD. Users can tag data with their own keywords, evaluate resources, and give feedback.

```
<!ELEMENT keyword (#PCDATA)>
<!ELEMENT evaluation (#PCDATA)>
<!ELEMENT feedback (#PCDATA)>
```

The new DTD defines privileges based on individuals or groups:

```
<!ELEMENT user (#PCDATA)>
<!ELEMENT group (#PCDATA)>
```

The use of this new DTD extension is shown below, where one of the content concepts and attributes is commented upon and evaluated by students:

```
<CAF>
 <domainmodel>
  <concept>
    <name>Collaboration</name>
    <tag>
     <user>Jessica</user>
     <keyword>Social annotation</keyword>
    </tag>
    <attribute>
     <name>Introduction</name>
     <tag>
       <user>Rachel</user>
       <keyword> Relative </keyword>
     </tag>
     <evaluation>80%</evaluation>
     <opinion>
       <user> Jessica </user>
       < feedback >
            I understood it.
        </ feedback >
     </ opinion >
     < opinion >
```

```
      <user>Rachel</user>
      <feedback>
            Excellent work.
        </feedback>
    </ opinion >
     <contents> Information about collaboration.<contents>
    </attribute>
  </concept>
 </domainmodel>
 <goalmodel>
  <lesson weight= "" label= "beginners" >
    <user>Jessica</user>
    <group>Group 1</group>
    <link weight= "" label= "beginners" >
       Collaboration\Introduction
    </link>
  </lesson>
 </goalmodel>
</CAF>
```

5.1 Screenshots of Collaborative MOT

The general overview of the system is shown in Figure 2. *Collaborative MOT* will display the concept at the top, tags under the concepts, and the rating of the concept under the tags. Feedback from the users will be displayed at the bottom.

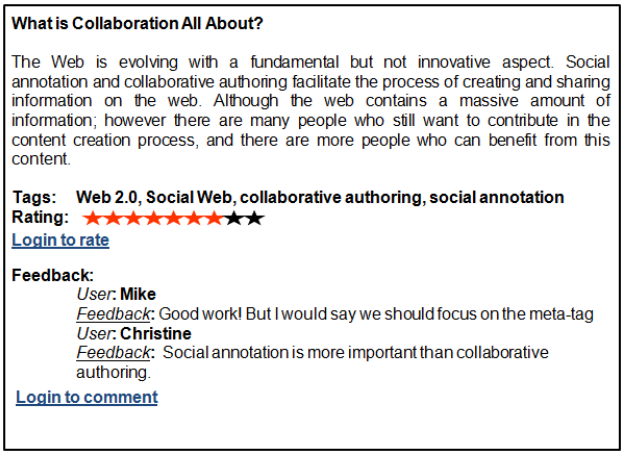

Fig 2. Social annotation in MOT

The author screen is shown in Figure 3. When the author logs into the system, a set of collaborative options will be displayed (add a concept, add a sub-concept, add an attribute), in addition to editing the current concept/tag , such as tracing the changes made by users as well as their contributions. A list of others contributors (authors who contributed to the concept) is displayed, to allow for communication between authors.

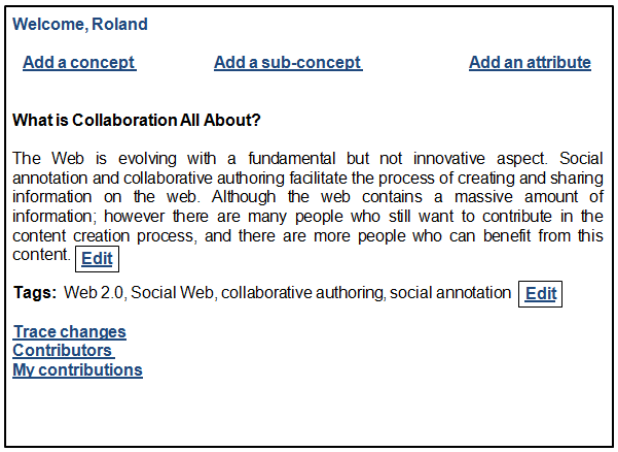

Fig 3. Collaborative authoring in MOT

The student screen is shown in Figure 4: When a student logs into MOS (My Online Student), she can tag the concept, or evaluate it by a rating shown below the concept. Moreover, she can comment on the course, which allows her to ask/answer questions. The user has the option to see all her contributions in addition to all messages sent by her.

Fig 4. Student screen in MOS

6 Related Work

A variety of researches have been done on social annotation in multiple areas such as: folksonomy [11] which we used to define tags as a part of our research; visualization

[7], which we used to visualize the collaboration design; web search [6], which we plan to use as a feature of Collaboration MOT based on the tags; adaptation [1], where Collaboration MOT will "adapt" adaptive materials based on social annotation.

On the other hand, Ahn et al [1] used social annotation to enhance information visualization by defining visual pointers that grant information about a users' (and a groups') annotations to web resources; whereas in our work, the system will make recommendations on related materials based on social annotation. For example, if a user annotates a concept then the system will record this annotation and suggest related materials to the user based on this annotation; another example is to display recommendations based on the user's group interactions, if the user's group annotates (or contributes in the collaborative authoring) of a concept, then the system will store these collaborations and suggested related materials for all users who belong to that group. Moreover, Bateman et al [2] proposed a structure for combining social annotations (tagging) with natural language ontologies. We argue however, that the tagging system should be based on freely chosen tags rather than applying a pre-defined ontology. However we argue that the best use of co-occurrence values will be covered by evaluating the concepts as described in the new DTD presented in section 5. Finally, Marshall & Brush [9] studied the link between personal and shared annotations, defining the user and group aspects of a system. Therefore, based on such studies, Collaboration MOT will be enriched by adaptation materials based on collaboration between the users.

6 Conclusion and Future Work

In this paper we propose a collaborative design process for authoring of adaptive hypermedia by applying our solutions to the adaptation authoring tool, MOT. We distinguish between two components of collaboration: collaborative authoring (which modifies the actual web resource, i.e., concept in the domain model by multiple authors) and social annotation (which lets the users - adaptive hypermedia authors as well as students - add/edit information without modifying the actual resource). Our basic hypotheses for designing collaboration in adaptive hypermedia, at the levels of authoring and delivery, are confirmed via statistical analysis on a first set of questionnaires with potential users.

Of course, the real challenge is to perform similar studies on the proposed implementation. Users may report wanting one thing in a survey, but behave differently in the actual system. For example, one could expect that unless the ratings are anonymous, or the authors entirely separate from the consumers, the consumers would not want to place honest comments or ratings. It is also not always clear whether students learning material are in the best position to evaluate it; they may mislabel content. Or they may not recognize the utility of the material.

As a next step, the social annotations generated can be exploited by adaptive hypermedia, by reusing this information as possible recommendations for authors and students alike. Therefore, we want to explore the various ways these new annotations can be applied in the adaptation process. Simple pseudo-rules of this kind would be, an adaptation rule that shows students concepts related to the current concept, e.g,:

```
IF (user_accesses_concept)
          THEN (show_other_concepts_with_similar_tags)
```

In this way, the newly contributed, inexpensive content and annotations can be utilized to generate new forms of adaptation and reasoning, thus enriching both authoring and learning experience.

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ANNEX: Questionnaire and Responses

1. Collaborative Authoring in MOT should be designed in such a way that it uses (standards, where applicable) and technologies from:
    a. 14 Responses: Social Web/ Web 2.0.
    b. 1 Response: Semantic Web.
    c. 15 Responses: Both.
    d. 0 Responses: None of the above (it should be proprietary systems only).
2. Social Authoring facilities in MOT is useful if we use annotations in the form of:
    a. 0 Responses: Rating.
    b. 1 Response: Feedback.
    c. 3 Responses: Tags (keywords).
    d. 0 Responses: Editing content.
    e. 26 Responses: All of the above.
3. Collaborative Authoring facilities in MOT via Social annotation should be done by:
    a. 2 Responses: Feedback at the level of the concept.
    b. 3 Responses: Rating at the level of the concept.
    c. 4 Responses: Tagging at the level of content of attributes.
    d. 20 Responses: All of the above.
4. Social annotation: Feedback, rating & tagging should be applied by
    a. 5 Responses: Student
    b. 1 Response: Authors
    c. 24 Responses: Both.
5. Collaborative Authoring in MOT is important for:
    a. 0 Responses: Collaboration between authors.
    b. 0 Responses: Collaboration between students.
    c. 5 Responses: Collaboration between students and authors.
    d. 24 Responses: All of the above.
6. For collaborative authoring, interaction is needed at the level of:
    a. 4 Responses: users.
    b. 4 Responses: groups.
    c. 21 Responses: Both.
7. User privileges should be defined at the level of:
    a. 1 Response: attribute.
    b. 5 Responses: concept.
    c. 5 Responses: domain model.
    d. 7 Responses: lesson.
    e. 2 Responses: link.
    f. 10 Responses: lesson and link.
    g. 0 All of the above.
8. Group privileges should be defined at the level of:
    a. 1 Response: attribute.
    b. 6 Responses: concept.
    c. 4 Responses: domain model.
    d. 7 Responses: lesson.
    e. 2 Responses: link.
    f. 10 Responses: lesson and link.
    g. 0 All of the above.