Concept Tagging in Moodle

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Abstract

The Moodle learning management system (LMS) is becoming increasingly widespread due to its adoption by education providers at all levels. The system however does not provide educators with the ability to create connections between online course material and domain concepts easily and visibly. We chose concept tagging as the method for allowing teachers to provide these links in a new concept tags plug-in for Moodle. Our concept tagging plug-in allows the creation, management and application of concept tags to course content. Students and teachers will mutually benefit from the use of such a mechanism, as it would aid information location in and retrieval from course content. An initial evaluation of the plug-in showed that teachers find the concept tagging of course modules to be a desirable and usable functionality that Moodle lacks. The work in this paper describes the first prototype of the plug-in, the aim of which is provide the first step in contributing to the addition of basic student modelling functionality to Moodle as part of a wider project. By continually keeping track of a student's progress on each concept tag, Moodle will be able to suggest appropriate course modules for further study based on this progress.

Keywords

Concept tagging, Moodle plug-in, metadata

Introduction

Moodle does not currently associate a course's resources and activities with its domain concepts, as it has no knowledge of what domain concepts any particular resource or activity covers. For example, Moodle can identify a 'quiz' but lacks a mechanism, at present, to link it to a concept in the domain covered by a course. We believe that a feature allowing the 'tagging' of resources and activities in online courses with 'concept tags' would address this absence of domain knowledge.

In fact, despite the overall success of tagging due to its flexibility, extensibility and simplicity (Smith G. , 2008), tagging remains absent in E- learning (Bateman S, 2007). Furthermore, an easy-to-use system promotes its adoption and usage as well as motivating users to tag because it helps them manage and retrieve their information (Smith G. , 2008). This is the concept tags plug-in's aim. Using this plug-in, teachers have the ability to create, manage and apply concepts to course modules. Consequently, the system becomes more 'intelligent' and is able to communicate to students, via the plug-in, a list of which course modules cover which concepts. The concept tags plug-in essentially adds a missing metadata layer to a course's contents, aiding students in the location and retrieval of information from course content by providing a more structured environment for students when exploring course materials.

The concept tags plug-in is a part of a larger project aimed at adding basic student modelling functionality to Moodle to enable it to provide adaptive assistance to students. By continually keeping track of a student's progress on each concept tag, Moodle will be able to suggest appropriate course modules for further study. In addition, students will be able to view their progress on each domain concept and make decisions about which resource or activity to view next.

Background Information

Moodle roles and capabilities

Moodle defines 'roles' for users of its system, which offer varying degrees of control over course contents and participants depending on 'permissions' given for 'capabilities' in a 'context' (Roles and capabilities: Moodle.org). A 'context' is an 'area' of Moodle, such as a course, which in turn can contain more contexts, such as plug-ins like the forum module. We are interested in the 'teacher' and 'student' roles for this plug-in. Teachers belong to a specific course (Features: Moodle.org) and add and manage course modules within it. Students participate in a course and make use of its resources and activities.

Tagging

A tagging system enables the application of a 'tag' to a 'resource' within the system. Users are the individuals who create and apply tags and, in our case, add resources, such as a PowerPoint presentation. The tags themselves are metadata, or "structured information", describing, explaining or otherwise facilitating the retrieval, use or management of an information source (NISO Press). We deal with 'concept tags', where each tag is the name of a concept in a course's domain. The teacher decides on the tags' granularity. Concept tags are essentially 'descriptive' metadata, which, when applied to course modules, will better describe course content to aid discovery and identification (NISO Press).

Related Work

Tagging in Moodle

At the time of development, Moodle's tagging system allowed users to tag blog entries while creating the new entry. The author of the entry can add new tags and delete or modify existing tags after publication. Each tag appears as clickable links at the bottom of published blog entries, which displays a page listing related tags and recent blog entries and users tagged with the tag. This occurs as a user's 'interests', as described in their profile, makes use of the same tagging infrastructure. Moodle 2.0 extended tagging to courses (Moodle.org Tracker, 2010) and questions (Moodle.org Tracker, 2010).

There is a Moodle Social Bookmarking activity that allows students to share links to online content (Piguillem, 2008). The links can be tagged and organised similarly to the service offered by 'delicious'[1], allowing inquiry-based activities known as WebQuests to be created for Moodle courses for example. Although we could have made use of this through using the internal Moodle link to a resource or activity, our idea is to eventually allow tagging at a finer-grained level (for example a specific slide in a slideshow).

General Tagging Work

FreeTag is a free of charge, open source plug-in that allows users to add tagging to existing applications that use PHP and MySQL (Smith D. H., 2012). After downloading FreeTag, the application developer simply runs the provided script to add a new table to an existing database schema that has unique, integer keys for the 'users' table and the 'objects-to-be- tagged' table (Luk, 2005). The application programming interface (API) then becomes available for use with the system. In theory, the concept tags plug-in can use the FreeTag API but we did not at this stage as we did not come across this code until we were carrying out our evaluation study.

The Semantic Hacker API is available for free, unlicensed use if fewer than 20 000 queries occur per day, at a rate of less than five per second (Forum: Sematic Hacker). It includes a 'Concept Tags' feature, which generates tags from text-based content (API Overview: Semantic Hacker, 2012). Using the online demo, we generated concept tags (see Figure 1) for the sample resource used in our evaluation[1]. The article introduces data trees in an Artificial Intelligence (AI) setting, so all the generated tags are relevant. A teacher for an introductory course to AI may decide that 'ai' is too coarse-grained because it would apply to the majority of course modules,

Figure 1 Concept tags for an article about data trees[2], generated using the Semantic Hacker API demo. Each tag's 'weight', indicated by its size, shows its importance in relation to the topics contained in the content (API Overview: Semantic Hacker, 2012)

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[1] http://www.delicious.com/

[2] http://www.aihorizon.com/essays/basiccs/trees/index.htm

Concept Tags (6)
Binary tree
Graph theory
Binary search tree
Tree
Tree
Tree structure

Figure 2 Concept tags for the same article about data trees[3], generated using AlchemyAPI demo

diminishing its value as descriptor of the modules' contents. In another course however, it may be important to point out that this article is one of a subset of course modules about AI.

Moodle caters for many types of course modules, not all of which are text-based, so the Semantic Hacker API could provide a method of initially populating a course's list of concept tags solely from its text-based resources. Another potential way of creating an initial list of concept tags for a course using its existing "Internet-accessible URLs and posted HTML files or text content" is the AlchemyAPI (AlchemyAPI, 2012). AlchemyAPI generated a different set of relevant concept tags (see Figure 2). We can explore the option of pre-populating the tags list in the future, including using one or both of these APIs, but this project explores giving teachers the ability to tag course modules and leaves the creation of concept tags to the teacher.

Design and Implementation

Extend Moodle's tagging system to tag course modules

Although the ideal solution in terms of direct input to Moodle, we did not want to set about extending and modifying the Moodle core code due to our inexperience with Moodle development and time restrictions. In addition, the project aims to explore concept tagging in Moodle, so creating an independent block allows us to focus on exposing potential users to the idea of concept tagging and analysing their feedback, rather than attempting to add functionality to multiple, existing sections of the Moodle code straight away.

At the time of development, the 'mdl_tags' table did not store any data about the course to which each tag belongs. We initially thought that as tags are thus not local to a course so that clicking on a tag would list all course modules tagged with it, regardless of the user's enrolment in the course. Hence, the modules displayed may not be viewable or irrelevant to the course. It later became apparent that it is possible to create course-specific views. There was no ability to maintain a course-specific list of concept tags we required however.

Develop a new and independent concept tags block

Implementation of the concept tags plug-in as a block means that there are some limitations in usability as the tagging of course modules is separate from their addition to a course. Due to time constraints and the exploratory nature of the project, this solution best allows us to focus on concept tagging in Moodle. Re-implementation and improvements can now occur more quickly and effectively due to the experience gained.

The Glossary module is an activity module allowing participants to create and maintain a list of definitions, like a dictionary (Features: Moodle.org). Using this module as a beginning point for a concept tags module means that any occurrence of a tag in the course could provide an automatic link back to its page in the 'glossary' (Features: Moodle.org). This page can display a list of course modules tagged with that concept tag. The tags would also be searchable. Using the infrastructure of the glossary module, we can consider student contributions to the creation and application of concept tags as it includes a feature allowing entries made by students to be approved by teachers prior to becoming visible to others. We still need to provide a tagging and managing tags interface, which we decided to focus on first.

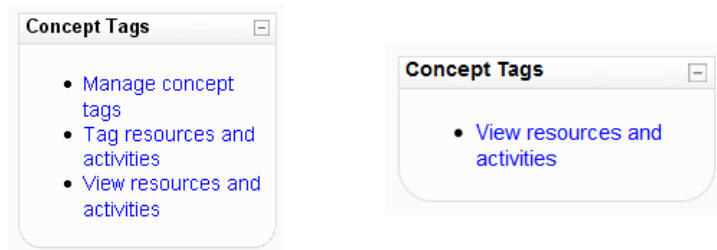[3] http://www.aihorizon.com/essays/basiccs/trees/index.htm

Figure 3 The concept tags block as seen by teachers (left) and students (right) - students will only be able to request a list of course modules alongside applied concept tags to eliminate the need for moderation and censorship should students add and manage concept tags themselves

The concept tags plug-in will therefore be a block that allows teachers to create new concept tags, rename/delete/apply concept tags to course modules and view modules alongside their tags. Once the plug-in is at a stable and reliable stage, we would like to consider its inclusion in and/or integration with the Moodle core.

Solution Design

The plug-in is a Moodle block (see Figure 3), essentially serving as a starting point from which to access and use the actual tagging and management features. An administrator would need to install the block in the Moodle system prior to teachers being able to add it to their course. There is no configuration necessary for this block to function however, so teachers are able to start using it as soon as they add it to their online course. The only knowledge required to use the plug-in is a basic idea of how tagging works.

All data related to the concept tags block is stored in the 'mdl_concept_tags' database table, automatically created during the installation of the concept tags block and added to the existing Moodle database. The 'id' attribute is an integer primary key used to differentiate between different records, which all Moodle database tables require. The foreign key 'courseid' references the 'id' attribute of the 'mdl_course' table, which lists all courses in a Moodle installation. Similarly, 'moduleid' references the 'id' attribute of the 'mdl_course_modules', which contains all resources and activities in a course. Lastly, the 'tag' attribute is the 'normalised' concept tag: the user-specified tag stripped of extra whitespace and in lowercase characters. No user data is stored when a user creates or applies a tag, as there is no value obtained from knowing who created or applied a tag because only teachers are able to do so. We have made this decision because we assume that teachers will be uploading the course materials and as domain experts would know which concepts are covered by each resource or activity. In addition, there is a separation between tags for each course because we would like to keep the system's monitoring of progress on a domain concept in the context of a course.

Managing concept tags

Teachers can manage a course's concept tags by creating new tags and viewing a list of existing tags allowing the deletion and renaming of concepts as necessary (see Figure 4). They can also choose to populate or extend the list by importing terms previously exported from a Moodle course glossary as an Extensible Markup Language (XML) file. The placement of the importing link is in the same place as the export glossary entries link for familiarity and easier access. In addition, the plug-in's glossary entry importing function is an adaptation of the Glossary module's equivalent functionality in order to provide greater reliability when dealing with glossary export files.

Tagging resources and activities

In the tagging view, the page displays a list of all course modules in a list box. Teachers cannot tag certain modules like labels due to their use for the organisation of groups of course modules on a page. The selection of an item from the list, followed by the clicking of "select" displays a list of all concept tags in the current course alongside a list of concept tags applied to the selected course module (see Figure 5). These list boxes are initially empty.

Creation and applying multiple tags to the selected course module involves typing a comma-separated list of concepts into the "create new tag(s)" text field and clicking the "+" button. Alternatively, selecting a tag from the "all course concept tags" list box and clicking the ">>" button applies it to the selected course module. Removing a tag similarly involves selecting it from the "applied concept tags" list and clicking the "<<" button.
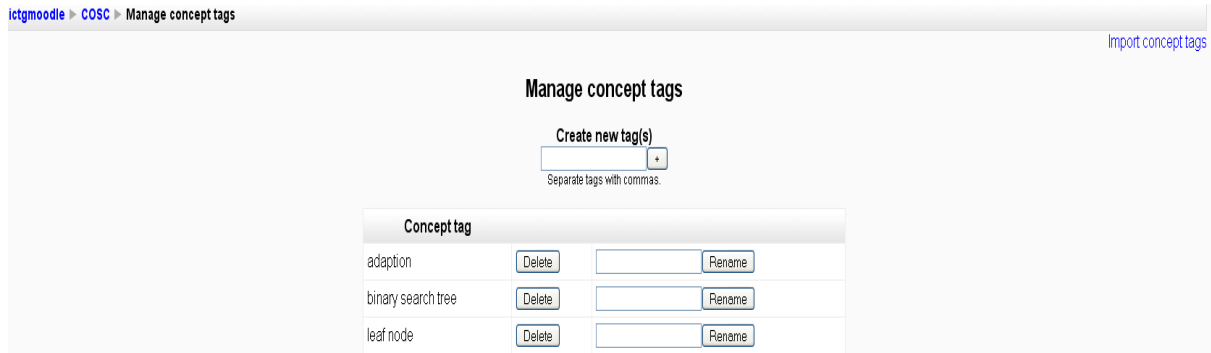
Figure 4 Managing course concept tags – teachers can add, delete or modify concept tags as well as import glossary entries as a starting point for a course's list of concept tags that they can then modify

Viewing resources and activities

When viewing a course's resources and activities, the modules will be clearly visible as hyperlinks with their tags, in alphabetical order, and type next to them (see Figure 6). Clicking on any of the module instances will take the viewer to the resource or activity of interest. This view is available to both teachers and students. The concept tags themselves are not searchable or navigable from within the plug-in, which may limit its benefits until this is done.

Evaluation

An evaluation study was carried out with five University of Canterbury and Lincoln University lecturers (one female). Participants were from different backgrounds: namely Education, Computer Science and Accounting. The purpose of the study was to receive feedback on the concept tags plug-in from teachers, its primary users, regarding its adoption and usage by them as well as highlighting strengths and weaknesses of the system.

Prior to each evaluation session, the participant read a short, online article, varying depending on his or her area of expertise. In addition, lecturers provided an electronic copy of a resource from one of his or her Moodle courses and, if possible, an XML file containing entries exported from a Moodle glossary. A course was set up
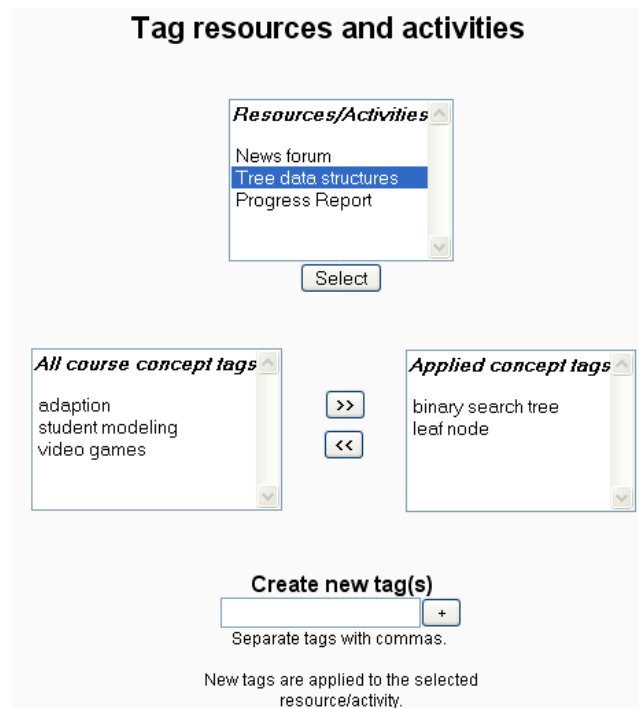

Figure 5 The tagging of course resources and activities occurs via this interface

View resources and activities		
Name	**Type**	**Concept tags**
News forum	Forum	
Tree data structures	Resource	binary search tree, leaf node,
Progress Report	Resource	adaption, student modeling, video games,

Figure 6 The viewing of course resources and activities occurs via this interface - clicking on a course module's name takes the user to the resource or activity

for each participant on a local installation of the Moodle system so that data for each lecturer would remain separate. All courses had the same layout, the only difference being the previously uploaded resource.

Participants read an information sheet describing the project and evaluation session, signed a consent form and filled in the first part of the questionnaire prior to beginning. While working through the tasks, participants described their actions and thoughts 'out-loud'. The rest of the questionnaire was then filled out. Tasks included creating new tags for an existing resource, uploading and tagging a resource and importing tags from a Moodle glossary. All features of the plug-in were used at least once. We took the screen recording and a video of each session.

Overall, the questionnaire consists of eighteen questions, including both open-ended and close-ended questions. Some questions require the participant to decide on a position on a 5-point Likert scale and comment on their choice. The success of the plug-in depends on the responses to two particular statements in the questionnaire: "I would use the concept tags plug-in in my Moodle course(s)" and "I would recommend the concept tags plug-in to my colleagues." A response higher than '3' for both statements would indicate that this plug-in is successful as the participant is willing to use it and encourage their colleagues to use it as well.

Major Findings

There were varying levels of familiarity with Moodle among participants in the study, ranging from lecturers who had recently set up an online course to one who had developed seven courses. In addition, only one participant was already familiar with 'tagging' prior to using the plug-in and thought that it was "useful for showing key topics."

In response 'having the ability to tag resources and activities would be useful', one participant strongly agreed, as "tagging seems to get an excellent balance between effort and benefit." Two other participants chose '4', one because the "the idea of concept tagging can assist my students to enhance their ability to be able to master key concepts in the ... curriculum", the other interested "to try this new means for [their] students." The rest were neutral, citing "no experience of tagging" and lack of "understand[ing of] their utility." Three out of the five participants felt neutral to the statement 'I would use this feature for all my courses'. One teacher indicated that the plug-in's adoption "would ultimately depend on the amount of time and work it would take to set up." Similarly, the participant who strongly agreed admitted that it would "depend... on experience with trial courses." The remaining participant chose '4' as they were "not sure how effective it will be, but [thought that it] seems like a good idea."

One lecturer was neutral and one strongly agreed that it was enjoyable to use the plug-in as "it was easy to implement and relatively straight forward." The rest chose '4', stating that using the plug-in was an "interesting exercise" and the concept tagging functionality "uncommon" and "difficult to rate... without knowing more about concept tagging – what it does, its utility and what a student would see and get out of it." Four participants also found it easy to use and picked '4'. As intended, the plug-in is "very straight forward to ... use once [it is] understood what tagging involve[s]" and it "will get easier with repeated use." Participants spent an average of 8.36 minutes (s.d. 2.88 minutes) using the concept tags plug-in during evaluation sessions, which indicates that a basic familiarity can be obtained in a short time. Moreover, two lecturers strongly disagreed with the statement 'I found the concept tags plug-in frustrating to use' as it was "not at all difficult [to use] once a purpose was established." The others chose '2', one commenting on the "usual minor Moodle frustrations [like] finding blocks/buttons."

Participants liked that the plug-in is "reliable", "simple", and "easy to use." Although one participant found concept tagging to be "an interesting idea", they decided that they "would need more use/familiarity of it to be convinced." In contrast, one participant "likes the ability to be able to link ... core concepts to each resource in order to display such information to [their] student and then they [the student] can develop their level of understanding at their own pace." Dislikes about the plug-in include the "lack of detail", in the form of onscreen instructions and help documentation, and being "unsure about the benefits for students [and] their dislikes." Further improvements need to be made to the tagging interface, for example, the use of the word 'applied' in "Applied concept tags" was found to be confusing as it suggested that this was a category of tags of which another would be "theoretical concept tags." A participant also made the recommendation of a "larger scroll window for [the lists] of tags." In addition, it "would [be easier if the resource or activity were] visible [while tagging]." This lecturer overcame this obstacle by opening the resource in a new tab in the same web browser they were using. Evidently, while improvements need to be made to the interface, teachers only require an understanding of the idea behind and purpose of tagging in order to begin using this plug-in.

Two participants strongly agree that students will benefit from being able to view concept tags and click on them to find all the associated resources and activities. One is neutral and the remaining two chose '4', one because "this creates a very succinct chronological order of learning material for [the students'] understanding", the other that although they agree, it "depends on [the] interface and [the] effort out into tagging by [the] teacher." Although the plug-in calls for extra effort from teachers, where a Moodle course glossary already exists, it can be used to create a list of concept tags that may be altered as required. A participant who tried the 'import concept tags' feature expressed approval at the ease with which a glossary can be used as a starting point for a concept tags list. It was also recognised that tagging "is an excellent means for students to be able to gain assistance when the teaching staff may not be available", which may result in less direct enquiries being made to the teacher about which course modules to use to learn more about which concepts. This needs further investigation however.

Two out of five participants answered '4' to the statement 'I would use the concept tags plug-in in my Moodle course(s)'. One strongly agreed while the other two were 'neutral', a lecturer indicating that they might but that they "would need to know more about the utility of tagging first." After using the concept tags plug-in, no lecturer decided that they would like to use the plug-in in their Moodle course(s) less than they initially indicated. Three out of five participants chose '4' on the Likert scale in response to 'I would recommend the concept tags plug-in to my colleagues' and another strongly agreed; with one indicating that the plug-in provides an "easy way to make material more useful." The other participant was neutral. Since it is clear that three or more participants chose either a '4' or '5' for both statements, the evaluation study shows that the concept tags is a successful idea and should be further developed for future installation in 'real' Moodle systems.

Once participants were informed that the concept tags plug-in is a part of a larger project aimed at ultimately providing adaptive assistance to students, all opinions about the plug-in became positive. The idea that Moodle will keep track of a student's progress on each concept tag and suggest appropriate resources/activities for further study was described as providing "very valuable feedback for [the] teacher [and] worth the extra effort." Given this background information, one lecturer "can see now better the idea behind tagging" and another thought this was "an excellent idea [as the concept tags plug-in and student model together] would become an invaluable tool."

Conclusions and Future Work

Moodle is missing a mechanism that allows teachers to add metadata to their online course resources and activities. The concept tags plug-in allows the 'tagging' of resources and activities with 'concept tags' created, managed and applied to them. An evaluation study showed that concept tagging is a desirable and usable functionality that Moodle lacks. Most notably, the plug-in was described as useful as it would assist "students to enhance their ability to be able to master key concepts... [, e]specially when [the] discipline requires the mastery of its own terminology." This is the concept plug-in's goal: to add a layer of metadata to course content to provide a more structured environment to aid users in the navigation and retrieval of information from course modules. Ultimately, this will allow students to locate and focus on specific content to better understand concepts. The concept tags plug-in is a part of a larger project aimed at adding basic student modelling functionality to Moodle so that it can provide adaptive assistance to students. Moodle will continually keep track of a student's progress on each concept tag and suggest appropriate course modules for further study.

Most notably, the concept tags plug-in lacks a "pivot browsing" feature, whereby a tag, resource or user is a vantage point for viewing particular slices of data in the tagging system in order to explore the tag space (Smith G. , 2008). To maximise the value of concept tagging, the concept tags should be clearly visible as hyperlinks on course module pages. Clicking any concept tag can open a webpage with all the resources tagged with it, allowing the student to focus on that concept for example. In addition, concept tags are currently specific to a course, which means that teachers are not aware of what tags have been used in other courses. This is not a major issue however because it is possible to generate lists of concept tags as a starting point for teachers while maintaining course privacy.

Improvements to the existing plug-in include more onscreen help and instructions. In addition, changes need to be made to some of the terms used in the interface to improve usability and remove some of the confusion. The interface has therefore been redesigned to be simpler and so should be more intuitive to use. Greater value would be obtained if teachers were able to tag specific sections of course modules, making tagging finer-grained. For example, a teacher may decide to tag an overall PowerPoint presentation as well as specific slides in order to better direct students to relevant information. We would like also to look at re-implementing the concept tags plug-in with the FreeTag API for improved reliability and even extending Moodle's tagging infrastructure following the seeking of feedback from the Moodle development community.

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