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Adapter course plugin based on student's learning styles for Moodle

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Abstract

Moodle is a free open-source popular Learning Management System (LMS), extensible with new functionalities by adding plugins. In this article we present a new plugin for Moodle, Adapter course plugin, that adapts course materials based on student's learning styles. The adaptive Moodle system that we aim to construct contains these main modules: Student Model that contains information about student's learning styles, Activities Data module that contains student's log data from their activity, and the Adaptive Content Presentation module which is responsible for choosing the appropriate materials from the Learning Objects according to the detected learning style. Adapter course plugin is the core component of the Adaptive Content Presentation module of the adaptive extended Moodle system. Instructors will add materials and annotate them with metadata related to learning styles and the user interface will be adapted with the appropriate materials for the logged in student.

Keywords: *Moodle, Learning Styles, Plugins, Adaptation, LMS.*

1. Introduction

Building a full adaptive LMS is very challenging. LMS nowadays are becoming very popular in education especially in universities, where different types of materials and user interactions are included. Learning styles are important because students tend to achieve better results when they learn according to their learning styles. It has been demonstrated that adaptive learning systems improve student commitment and learning outcomes [1] and pedagogical strategies related to the learner's learning style influence on making learning easier [2]. We have chosen Moodle as the basis for the adaptive system into which we will integrate learning styles because it is an open source LMS. We will extend it with plugins to add the adaptation features. The adaptation will be based on different learning styles of the students. In [3] we have proposed an adaptive system architecture which has these modules: Student Model, generated from the ILS Questionnaire [4], Activities Data which collects data from student's activity and Adaptive Content Presentation module which will be responsible for choosing the appropriate materials based on detected learning style.

As part of this work in progress, in our previous article [5] we have proposed and implemented three plugins for Moodle. The first one is the Learning Style plugin that calculates a student's learning style based on ILS Questionnaire and stores it in the Moodle database. The two other plugins are report plugins that help teachers by showing distribution of learning styles, and student's activity data. In this article we propose a new plugin, Adapter course plugin, that shows materials based on the stored learning style value for each student. In this plugin we have implemented the main functionalities of the Adaptive Content Presentation module in system architecture to provide content based on learning styles for each student. In this way, the system supports individual learning and provides customized learning paths, which improves the process.

The next section will provide a short overview of the works related to this research. The third section will present the learning objects according to the students learning styles followed by our work for the implementation of the adapter course plugin. Conclusions and the work for the future will close the paper.

2. Related work

The main approaches used for automatic adaptation based on learning styles are data-driven approach and literature-based approach using a simple rule-based method. Data driven approach uses data to train a model. Data is split into training data and test data [6]. The advantage of this approach is that the model can be very accurate due to the use of real data. However, the approach strictly depends on the available data. Therefore, it may be difficult to have a good data set used for detecting learning styles because the data are scattered on different courses. The idea of the literature-based approach is to use the behavior of students to get hints about their learning style preferences and then apply a simple rule-based method to calculate learning styles from the number of matching hints [7].

Adaptation of user interface is how the system can automatically adjust the content presented on each page of the adaptive system based on student's preferences. There are two main techniques to achieve this: the adaptive presentation and adaptive navigation. Adaptive presentation includes adaptation features based on content. Adaptive navigation is based on links and includes features such as direct guidance, map adaptation, adaptive sorting, hiding, annotating, and link generation [6].

One of the challenges for building this plugin is the identification of rules for content adaptation. In [12] a rule-based adaptive user interface is proposed. Initially some predefined rules are applied for each learning style, related to types of materials. As the learner progresses in the course the learning styles of the learners may change and hence the rules are designed to handle the dynamically changing learning styles. All learning objects are defined as flag variables in the rules which have been set. Based on the learning categories, flags will be enabled or disabled, and the learning objects are popped up on the portal for the enabled objects [12]. In [8] another similar approach is explained. The system contains the adaptive content presentation and interface enhancement agent (AIA). AIA module generates learning materials once it gets a profile for the learner. This is done by mapping learning styles with learning objects for each dimension.

3. Learning objects and styles

"A learning object is a representation designed to afford uses in different educational contexts" [9]. It can be used or reused during the learning process supported by technology. They can be tagged with metadata that can be used to integrate them into the adaptive system based on the learning styles.
According to FLMS student's learning styles are divided into these groups: active/reflective, visual/verbal, intuitive/sensing, sequential/global. From the literature, we have seen that active learners are more enthusiastic and participative in the learning process. They understand the information best by doing something, by sharing, applying, or by explaining to others. Reflective learners prefer to think and analyze the information quietly [10]. We therefore think that for active students' exercises are more effective whereas reflective ones prefer examples. Visual learners best understand the concepts with pictures, diagrams, flow charts, and demonstrations. Verbal learners understand better by reading more text material and listening to more spoken explanations [10]. For visual/verbal aspects we will focus on Type metadata. We will offer more text materials to verbal students whereas more photos, videos, presentations, and diagrams for visual ones. Sensing learners are interested in learning basic facts and concepts, whereas intuitive learners are more interested in applying basic concepts to discover possible outcomes. For intuitive/sensing dimension we will focus on Category metadata. Intuitive students prefer lectures, summary, exercises. Sensing students prefer examples. Sequential

learners prefer to understand concepts in linear steps and provide links between all the steps. Global learners tend to jump between the steps and randomly understand the information without providing links.

For the Sequential/Global dimension we will focus on the order of materials. For sequential ones we will show materials in this order: lecture, examples, exercises, summary whereas for global ones we will show materials in this order: summary, examples, exercises. In the table below a summary of these rules for each dimension is shown:

Table 1: Learning styles dimensions/rules

	Active	Reflective	Visual	Verbal	Intuitive	Sensing	Sequential	Global
Category					Lectures, Summary, Exercises	Examples		
Type	Exercises	Examples	Pictures, Diagrams etc	Text				
Order							Lectures, Examples, Exercises, Summary	Summary, Examples, Exercises

3. Adapter course plugin

The plugin we will implement in Moodle is called “Adapter course plugin”. Its functionality is to format the course. Course format plugins are used to show materials and blocks in a course in different layouts. They are in the “/course/format” folder in the project. Course formats are specified for each course by the creator or teacher of the course. We chose this type of plugin because we want to show materials differently for each student. In the following paragraph we will explain the algorithm we will implement in this plugin.

We are going to use the literature-based approach with a rule-based method for the implementation of this plugin and the adaptive presentation technique with both media and learning objects adaptation techniques for the adaptation of user interface. For adaptive presentation we can focus on media types or on learning objects. For example, we can include different types of media such as pictures, diagrams, flowcharts, videos, text, audio. We can also choose to present the information in different learning objects, for example some students may prefer examples rather than through definition [11].

Teacher/instructor will annotate each material with metadata when they add it in the course. For each material we will add three types of metadata: “Category” metadata which can have one of these values: lecture, summary, example, exercise, exam, “Type” metadata which can be: photo, video, presentation, link, diagram, and the last metadata field we will add is “Semantic” which will have a value indicating the logical relation of materials with each other. For example, if a teacher/instructor adds two different types of materials (text/video) for the same concept they will have to annotate them with the same value of field Semantic. In the figure 1 we show the metadata fields we have added to materials. Instructor/Teacher will have to fill them in when they add the material.

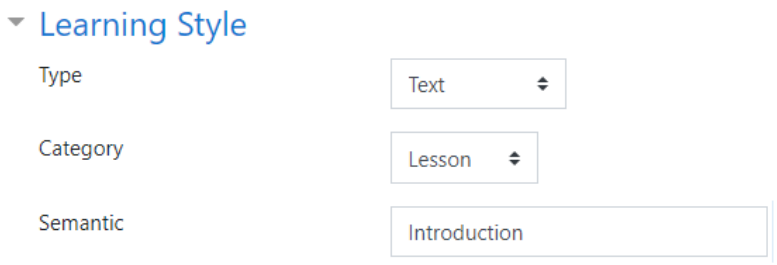

Fig. 1 Metadata fields for materials

The course user interface will be adapted only if they choose the Adapter course plugin format in course settings. For the adaptation of the user interface, we will use the algorithm described above. Materials will first be grouped by semantics so students can find them easier. For each semantic, suggested materials will first be displayed to students, based on their learning style. Students can choose between these suggested materials as well as the other ones that do not match their learning style. We will let them choose materials because we will use data from logs to recalculate their learning style, so the system will be more accurate. In the figure 2 a graphical representation of a more detailed architecture of Adaptive Content Presentation is described.

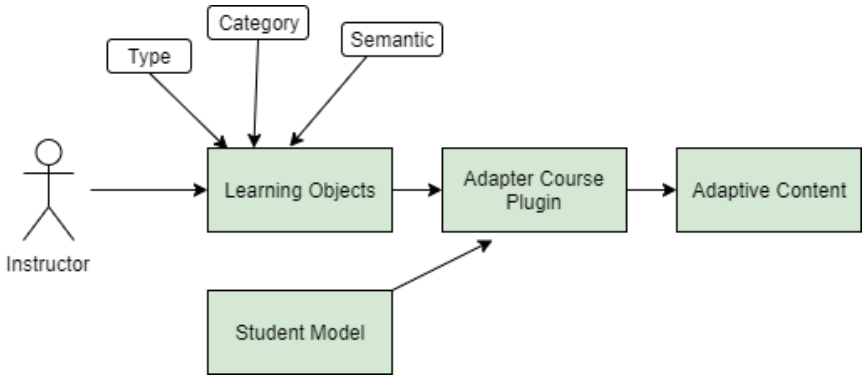

Fig. 2 Adaptive Content Presentation Module

The Adapter course plugin will get data from Student Model and Learning Objects and use annotations to generate Adaptive Content.

4. Conclusions

Building an adaptive LMS based on learning styles requires complex work on different modules. We are working on building an adaptive LMS based on Moodle, by adding plugins. The architecture we have proposed contains these modules: Student Model, Activities Data and Adaptive Content Presentation module. In this article we propose a new plugin for Moodle, Adapter course plugin, for providing the functionalities needed for the implementation of the Adaptive Content Presentation module. This plugin will get data from Student Model, and Learning Objects, and with generate the Adaptive Content. To achieve this, we added metadata to learning objects in Moodle. Each learning object will be annotated with metadata by teachers/instructors and the plugin

will find the suitable material based on annotations and student's calculated learning style. For this calculation, we have previously added another plugin in Moodle, that calculates and stores learning styles in Moodle database, based on student's responses to the ILS questionnaire.

In the future, we aim to improve this adaptive system with automatic recalculation of student's learning style based on their interaction with the system. Following this mixed approach, the identification of learning styles will not depend only on the result of the questionnaire but on student's behavior and preferences, making the adaptive system more accurate.

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