Enhancing Moodle to adapt to students different learning styles

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Abstract

The e-learning management systems are gaining popularity in the academic community offering many benefits for better and easier learning. Although there exist many e-learning management systems almost all of them do not offer adaptivity features that would made the system adapt to the need and learning styles of the students. This paper focuses on the need to enhance an existing open source e-learning management system, Moodle, by building an adaptive module to meet students different learning styles. The aim is to create an adaptive module and integrate it to Moodle system. In this paper we review the most relevent studies related to this subject, analyze the techniques they have used to detect learning styles and provide different content. Based on these results and our previous work, we propose the architecture for this adaptation module.

1 Introduction

Learning management systems(LMS) are very useful to every type of corporation or education institution whose aim is to help the employees or students to learn better and easier. E-learning can be defined as learning using electronic means. With the massive use of internet, e-learning management systems are implemented by using modern technologies for the construction of web systems. The students like to learn using e-learning management systems because of many benefits that it offers like the possibility to access the information anyplace and anytime. There are different popular LMS used nowadays even in education system.

A very well known LMS is Moodle (Modular Object Oriented Developmental Learning Environment). It is very popular because it is open source and also can run on different platforms. In Moodle it is also possible to add modules[LGH14]. Despite these advantages, Moodle also has some limitations. The same content is offered to all the students despite their differences. It does not have the ability to adapt to their knowledge level, preference of learning styles, cognitive ability, goals etc. Learning styles are considered to be an important aspect that affects the process of learning. Therefore, adapting to them could also make this process more efficient. There are various attempts done in order to build an adaptive e-learning system based on learning styles. Some have built new systems, whereas some have used a LMS, and extended them to be adaptive. LMSs provide a great variety of features which can be included in the courses such as quizzes, forums, chats, assignments, wikis, and so on. As such, they have become very successful and are commonly used by educational institutions, but they provide very little or, in most cases, no adaptivity[Gra07]. In this paper we are going to make a review of various techniques used for building adaptive systems based on learning styles , and propose to build a new module for Moodle system, that will be able to identify students learning styles and deliver content based on their style. This system will be used and tested with students at our department with the aim to analyse the result and improve in the future. The rest of the paper is structured in the following way. In the second section some of the most relevant studies and technologies that are used are analysed. In the third section the architecture of the adaptation module of moodle will be presented. In the last section we summarize our results and future work.

2 Related work

Extending a LMS to be adaptive can be beneficial, because it will provide users with all the functionalities that LMS-s have, and also add the adaptive functionality. This would require less time, by avoiding programming the whole system and focusing on the adaptive module. To provide adaptivity with respect to learning styles, the learning styles of the learners need to be first known by the system. In this section we are going to make a general review of some adaptive e-learning systems from the literature and the techniques they have used to detect learning styles.There are two main approaches used for detecting learning styles, based on the literature : explicit and implicit. In the first one, instructors provide students with a questionnaire that will calculate their learning style. There are many questionnaires available by the learning style model creators. One of them is the ILS(Index of Learning Styles) questionnaire based on the Felder-Silverman model. For example, this explicit method is used in [Sur14], where students have to fill out the questionnaires when they accessed for the first time the adaptive course. After determining their learning style, the system adapts the material according to that. CS383 (Carver, Howard, and Lane, 1999) is another system that uses this technique. It incorporates Felder-Silverman Learning Style Model(FSLSM). The system provides adaptivity based on the sensing/intuitive, visual/verbal, and sequential/global dimensions of FSLSM. The learning styles of the students are calculated based on their answers and stored in the student model. The adaptation is done at the presentation level by showing different types of media elements according to learning styles[Gra07]. This technique has some disadvantages, students learning style can change during time and the system does not adapt at real time, because the questionnaire is only in the beginning. Moreover, filling a questionnaire requires an additional amount of work from the students, and they may not be interested. Sometimes their answers can be arbitrarily and can mislead the adaptation process. In the second approach the system does the automatic detection of learning styles. It analyses students behavior from the interactivity with the system, without the need of any questionnaire. Automatic detection techniques can be divided into two subcategories: data-driven and literature-based [Gra07]. In the first one, a classifier is built that classifies students in one dimension of their learning styles. This is done by applying a data mining algorithm on data from students activity and build student models. In the second approach a literature approach is used. Based on the literature, learners with a preference for a specific learning style behave

in a specific way. The idea of the literature-based approach is to use the behavior of students in order 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 [Gra07]. From the literature, we can see that data-driven approaches are more widely used. One reason can be that it is more familiar to computer science researchers because they require gathering relevant information for the user model and then use an AI classification algorithm to automatically detect the learning style preferences. Whereas the literature based approach requires having some knowledge of psychology and cognitive science to correctly estimate the importance of the hints [JAA14]. Some of the artificial intelligence techniques used in data driven approach are: Bayesian networks, Decision trees, neural networks etc. Below, there are a few adaptive systems and the technique they use. Cha et al. (2006) derived relevant patterns for detecting learning styles from the literature and then used Decision Trees and Hidden Markov Models to learn the parameters of the model from data about the behaviour of students and from reference data including the learning style preferences identified by the ILS questionnaire[Gra07]. Another approach for automatic student modelling was investigated by Garca et al. (Garca et al., 2005, 2007). They observed the behaviour of learners during an online course in the system SAVER and used Bayesian networks for identifying learning styles based on the behaviour of students[Gra07]. Sometimes, a mixed approach is used. An explicit model is used for the initialization of user model, and then it is updated using an implicit model. For example, this technique is used in TANGOW system. Adaptation in this system is based on two dimensions of FSLSM: sensing/intuitive and sequential/global. After initializing the student model by filling the ILS questionnaire, it is automatically updated by observing the learners actions in the course. When learners behave contrary to the determined learning style, preference stored in the student model is updated [Gra07]. In a study by (Graf, 2007) , Moodle is used as a LMS to extent with the capability of identifying student learning style. A mixed model is also used here. After the user model initialization based on ILS questionnaire, the model is updated based on the analysis of user data. The time spent in the system, the number of logins and the number of visited learning requests for additional learning objects were recorded and analyzed[MAl16].For this analysis two approaches were used: a Bayesian Network approach as well as a rule-based approach. Since the accuracy of the results was better in the latter case, the rule-based approach was implemented into a tool called DeLeS, which can be used to identify the

learning style of the students in any LMS [Elv09]. Another approach is used in a study in [Des+12].In this study, for creating an adaptive system based on Moodle, a data mining clustering technique is used. After collecting initial data based on a questionnaire and an introductory course, they apply the clustering algorithm to divide students into some groups, based on their learning style. This technique is more efficient especially for courses with large group of students, where adapting courses for a group of student is less difficult and also less time consuming for teachers, who need to adapt learning materials for group of students instead to each student [Des+12].

3 Proposed Solution

As we can see from the literature, FSLSM is the most often used learning style model in these adaptive systems, where some systems incorporate the whole model and some systems include only some dimensions of FSLSM. We aim to build an adaptive system using adaptation based on FSLSM learning styles. We have also chosen to build this adaptive module, as an extension to Moodle LMS. Moodle can be seen as the best LMS concerning adaptation issues. In a study in [SB05]nine platforms were analysed in detail, regarding their adaptability, personalization, extensibility and adaptivity. Moodle obtained the best results in the general as well as in the adaptation evaluation. Moodle provides an adaptive feature called lesson where learners can be routed automatically through pages depending on their answer to a question after each page. Furthermore, the extensibility is supported very well by a documented API, detailed guidelines, and templates for programming. Being an open source product, Moodle also enables third-party enhancement of its functionality by the addition of modules. In[LA18] we have investigated students learning style in a group of students at our department based on the ILS questionnaire which uses Felder-Silverman learning style model. This study revealed that a considerable amount of students were balanced on the learning styles dimensions. One of the reasons for that, can be that students do not have stable learning styles and they can change during time or depending from the course. Sometimes they can also give arbitrary answers which lead to wrong calculations. We came to the conclusion that relying only on the questionnaires to identify learning styles is not a good approach. On the other hand, using only an automatic approach would take more time and would also need a lot of initial data in order to be accurate. We therefore suggest to build an adaptive system based on learning styles using a mixed approach. We will enhance Moodle, and build a new module for this. Students will fill in the questionnaire in the beginning. This will help in building their initial user model. We will provide adaptive content for the users with the identified learning style and provide a default content for the balanced one. This user model will be updated on regular basis. We will decide on the technique of the model adaptation in the future, after studying and testing them with the initial dataset. The time of adaptation could be a configurable parameter in the system. The system will be able to identify students learning styles by exploring their activity using system logs, such as time spent in an activity or lesson, the frequency of accessing certain type of materials, how much they like to use forums, chats etc. According to learning styles, the system should be able to provide different content.In 1an overview of the proposed systems architecture is presented. Student Model is generated from the ILS Questionnaire as well as the Dynamic Student Modeling Module. Activities Data represents the module that will collect students data from their activity. The Adaptive Content Presentation module will be responsible for choosing the appropriate materials from the Learning Objects Module according to the detected learning style. Instructors will add materials and annotate them according to learning styles.
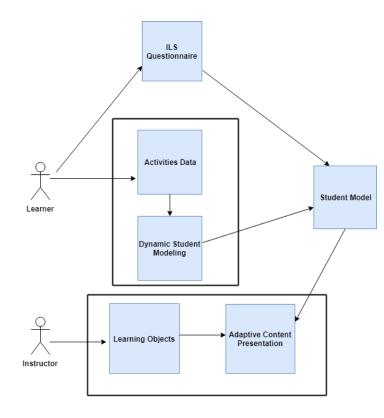

Figure 1: System architecture

4 Conclusion and future work

In this paper we proposed to build a module for making Moodle an adaptive e-learning system based on learning styles. We investigated some of the most common techniques used in similar systems, from the literature. There are two main techniques used for building the student model: explicit and implicit. Explicit model is based only on a questionnaire, whereas the implicit method is based on automatic learning style detection. In the implicit model, two main techniques were used: data driven model and literature based model. The first one includes the use of data mining algorithms to analyze students data, and classify students to different student models. The second one uses a simple rule based method, based on students activity. In the first model, data mining algorithms as Bayesian Networks, Decision Trees, Clustering algorithm, etc. are used. We analysed some of the systems and the technique they use. Based on the studies that we have analysed and Moodle capabilities we defined and presented the architecture for our adaptation module. We will integrate the questionnaire in Moodle system, and decide about the algorithm that we will use to automatically detect students learning styles. As mentioned in this paper, different solutions use different data mining algorithms for this reason. We will make an analyses about their performance and choose one to implement. In this paper, we have proposed that the adaptation will be done at specific intervals of time. After the implementation, we aim to test this technique and better analyze this solution.

References

[SB05]   Graf Sabine and List Beate. "An Evaluation of Open Source E-Learning Platforms Stressing Adaptation Issues". In: *Advanced Learning Technologies* (2005).

[Gra07]   Graf. *Adaptivity in Learning Management Systems Focussing on Learning Styles*. Vienna University of Technology, 2007.

[Elv09]   Popescu Elvira. *Diagnosing Students's Learning Style in an Educational Hypermedia System*. Cognitive, Emotional Processes in Web-based Education: Integrating Human Factors, and Personalization. Advances in Web-Based Learning Book Series, IGI Global, 2009.

[Des+12]   Despotović-Zrakić et al. "Providing Adaptivity in Moodle LMS Courses". In: *Educational Technology Society* 15 (2012).

[JAA14]   Feldman Juan, Monteserin Ariel, and Amandi Analía. "Automatic detection of learning styles: state of the art". In: *Artificial Intelligence Review* (2014).

[LGH14]   Prabhani Pitigala Liyanage, Lasith Gunawardena, and Masahito Hirakawa. "Using Learning Styles to Enhance Learning Management Systems". In: *International Journal on Advances in ICT for Emerging Regions* (2014).

[Sur14]   Herman Dwi Surjono. "The Evaluation of a Moodle Based Adaptive e-Learning System". In: *International Journal of Information and Education Technology* 4 (2014).

[MAl16]   Samar M.Alkhuraiji. *Dynamic adaptive e-learning mechanism Based on learning style*. A thesis submitted to the University of Manchester, 2016.

[LA18]   Leka Loreta and Kika Alda. "A study on student's learning styles using Felder-Silverman Model". In: *KNOWLEDGE, International Journal Budva, Montenegro* 23.1 (2018).