

# The Development of an Adaptive E-Learning System by Customizing an LMS Moodle

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**Abstract—** This paper discusses the development of an adaptive e-learning system based on student's learning styles by customizing an LMS Moodle. Two popular models of learning styles used are VAK and Felder. The VAK learning styles include visual, auditory, and kinesthetic, while the Felder learning styles include global and sequential. In order to accommodate the system adaptivity, some modules are created within the Moodle.

**Keywords—** adaptive, e-learning, learning styles

## I. INTRODUCTION

Nowadays, the development of Information and Communication Technology (ICT) especially the Internet has brought the opportunity to share information globally. It has raised new learning experience for students. E-learning is one example of internet applications used to deliver learning materials. E-learning is a hypermedia-based instructional application that uses the attributes and resources of the Web to provide a relevant learning environment [1]. E-learning becomes popular research topics and development. The advantages of e-learning include classroom and platform independence.

There are many e-learning systems existing on the web today, however they commonly provide the same learning resources to all students without considering individual differences. They assume that all students are homogeneous, highly prepared and motivated. It could be a problem, if the e-learning systems are used by more diversity of students. These students may have very different learning aims, backgrounds, knowledge levels, learning styles, and competencies. These kinds of e-learning systems may not be suitable for varieties of students. Therefore a flexible e-learning is urgent to be developed so that different students obtain different learning resources and mode of presentations.

Adaptive e-learning systems (AES) answer these problems by modifying the presentation of materials to adjust each individual student [2]. The AES combines two technologies that are hypermedia systems and intelligent tutoring systems to adapt the systems to the individual student. The AES uses a user model to gather information about his or her learning aims, preferences and knowledge, and uses it in order to adapt to the student's needs [3].

This paper discusses the development of an adaptive e-learning system based on student's learning styles by customizing an LMS Moodle. Two popular learning styles will be explored and used as basis for implementing the adaptation mechanism. Some modules will be created within the LMS Moodle to accommodate the system adaptivity.

## II. ADAPTIVE E-LEARNING

As the use of Internet for delivering learning materials is increasing, the term of e-learning is becoming popular among teachers and educators. In general term, e-learning is a short of electronic learning [4]. The definition of an e-learning is a delivery of learning materials through any electronic media including the Internet, intranet/extranet, satellite broadcast, audio/video tape, CD-ROM, and computer-based training (CBT) [5]. Another definition suggested by the Australian National Training Authority includes applications and processes using all available electronic media such as Internet, audio/video tape, and CD-ROM to distribute instruction more flexible. The ILRT of Bristol University defines e-learning as the use of electronic means to deliver, and enhance teaching, learning, and assessment.

In more comprehensive meaning, Khan [6] defined e-learning as a delivery of learning resources using web technologies in an open, flexible, and distributed learning atmosphere. The learning resources are delivered to anyone, at anyplace, and anytime. In his definition, Khan focuses the use of the terms: open, flexible and distributed. Furthermore, open or flexible learning means giving students the freedom to choose time, place, pace, content, learning style, assessment types, and collaborative or independent learning [7]. The meaning of a distributed learning environment is one where teachers, students, and the materials are in different places so that students can access whenever and wherever [8].

Among many different types of individualized online learning, an adaptive e-learning system is considered as one of the most recent variants. This system attempts to adapt to each user by offering learning resources in accordance with one or several characteristics of the user. It is possible that the adaptive e-learning system has to be developed because the existing e-learning systems are not capable of providing an individualized learning. The conventional e-learning systems present the same learning resources for all students [2,3]. Limitations of the conventional systems become apparent when such systems are used in institutions where the student demographic is diverse; the student prior knowledge is wide ranging, with different learning styles and other preferences.

Other benefits of using the adaptive e-learning systems are possibilities to resolve the problems of "cognitive overhead" and "lost in hyperspace" mainly when scopes of the learning resources are huge. Miles-Board [9] said that the problem of "cognitive overhead" occurs because of the extra effort and attention needed to retain many tasks at one time, while the problem of "lost in hyperspace" indicates to

the propensity to lose one's awareness of place and focus in an e-learning system.

There are two kinds of adaptation in the adaptive e-learning system depending on who takes the initiatives: the system or the student [10]. If the system which initiates, it is called adaptivity and if the student who initiates, it is called adaptability. Adaptivity means the capability of a system to adjust its presentation according to the student characteristics automatically, while adaptability means the capability of the system to support user adjustment.

Adaptive and adaptable are two words that often confusing. Systems that can adapt automatically to the user based on the system's assumptions about user characteristics are called adaptive. Systems that allow the user to change certain aspects and adapt their behaviour accordingly are called adaptable [11]. In developing an adaptive e-learning system, it is important to balance between these two levels of adaptation [12].

### III. LEARNINGS STYLES

There are various definitions of learning style from the literature. Bennet [13] made a definition of learning style as the way a student prefers to learn. According to James and Blank [14] learning style can be defined as the complex manner in which learners most efficiently and most effectively perceive, process, store and recall what they are trying to learn. McLoughlin [15] summarizes the term of learning style as referring to adopting a habitual and distinct mode of acquiring knowledge. In addition, Honey and Mumford [16] have defined learning style as the attitudes and behaviours that determine an individual's preferred way of learning. Learning style influences the effectiveness of training, whether that training is provided on-line or in more traditional ways [17].

Riding and Cheema [18] surveyed a number of learning style constructs and classified them into two broad categories: *wholist-analytical* and *verbaliser-imager*. The wholist-analytical category describes how individuals process information. Wholists prefer to learn material globally, while analysts are likely to process information in details. The verbaliser-imager describes how individuals represent information. Verbalisers prefer to present information in words, while imagers tend to present information in pictorial form [15]. Pask [19] referred to wholist-analytical as holist-serialist.

According to Pask, holists prefer to begin with an overview of material and then proceed to details, while serialists tend to follow step-by-step instruction. According to Felder et al. [20], wholist and serialist are known as global and sequential; while verbalise and imager are known as verbal and visual. Sequential Learners: These learners tend to learn in linear steps following logical step-by-step paths. Global Learners: These learners prefer to learn in large jumps.

Sarasin [21] said that most learners can be classified as Visual, Auditory or Kinesthetic learners depending on how they prefer to obtain and handle information. Visual learners can learn effectively when they see the materials, Auditory learners like to hear the material, while Kinesthetic learners are those who learn best by doing. These three classifications are known as VAK learning

styles. The VAK learning styles refer to human observation channels: vision, hearing and feeling. It suggests that learners can be divided into one of three preferred learning styles, i.e. Visual, Auditory or Kinesthetic.

**Auditory Learners:** These learners prefer to absorb information by listening. They learn best from listening to lectures, participating in discussions and talking things out. When they recall information, they will remember the way they heard it.

**Visual Learners:** These learners learn best when information is presented in pictures, tables, charts, maps or diagrams. Seeing and reading are important activities for visual learners.

**Kinesthetic Learners:** These learners learn best through feeling and doing. They prefer lab activities or field trips over classroom lectures. They like to be involved with physical experiences; touching, feeling, holding, doing, and practical hands-on experiences.

Each learning style model has its own instrument for measuring the learners that is usually in the form of questionnaires. The questionnaire comprises several questions about learner personality, attitude, and behaviour. In this paper, the VAK learning styles will be combined with Felder learning styles of global and sequential.

The questionnaire includes indicators to measure the learner preferred learning styles of Visual, Auditory or Kinesthetic and Global or Sequential. Based on the scores the learners obtain, they can be classified into one of these categories (known as learning modes):

- Global-Visual
- Global-Auditory
- Global-Kinesthetic
- Sequential-Visual
- Sequential-Auditory
- Sequential-Kinesthetic

The term of learning mode used in this system refers to a combination of presentation mode Global-Sequential with variations of VAK. Because there are six types of learning modes that must be accommodated, then the system must provide six kinds of presentations. Learning mode of "Global-Visual" means the material is presented globally by focusing on the visual aspect. Learning mode of "Global-Auditory" means the material is presented globally with major elements of the audio aspect. Learning mode of "Global-Kinesthetic" means the material is presented globally with emphasis on the kinesthetic aspect. For the other three learning modes that are "Sequential-Visual", "Auditory-Sequential," "Sequential-Kinesthetic", the learning materials are the same as the three previous modes, but they are presented sequentially.

### IV. CUSTOMIZING MOODLE

An adaptivity mechanism that is used to decide whether a student will get a certain mode of learning is very simple. As it was described in the system design [22], students have to fill out the questionnaires when the first time accessing the adaptive course. The questionnaire contains questions that ask the tendency of learning styles in which the answers are grouped into two, the first group: visual, auditory, kinesthetic and second group: global, sequential.

For example if a student obtains the highest score on the visual aspect of the first group and highest score on the global aspect of the second group, then students will continue with the learning mode of "Global-Visual". Another example, a student will continue with a learning mode of "Sequential-Auditory", if she or he gets the highest score on the auditory aspect of the first group and highest score on the sequential aspect of the second group.

In order to customize the list of questions within the questionnaire, teachers are allowed to edit the questionnaires. Figure 1 shows a list of questions edited by teacher.

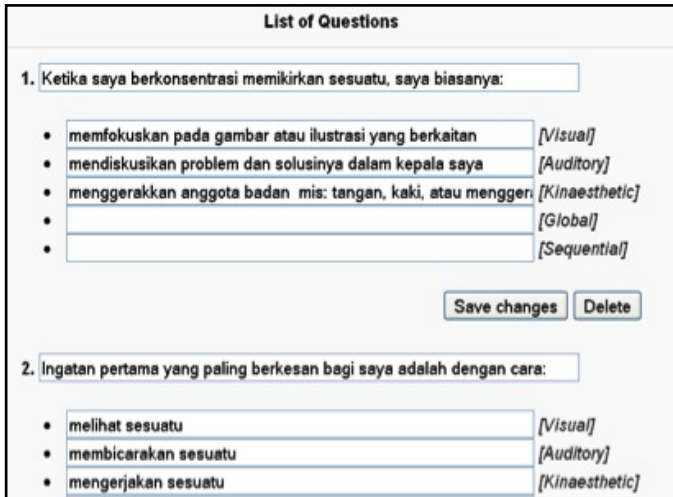


Fig. 1 List of questions edited by teacher

The number of questions in the questionnaires must be odd or cannot be divided by 3 for the first group and cannot be divided by 2 for the second group. The disadvantage of this mechanism, among others, although the number of questions is not divisible by 3, but there is still a possibility that the two aspects got the same score. If this happens, then the system will choose the one that may not match the student's learning styles. In addition, when filling out the questionnaire for the second chance, students may still remember some of the questions, if this happens then the score may not reflect their actual learning styles.

The adaptivity mechanism described above can be implemented using a Learning Management System of Moodle. As a standard Moodle does not consider individual differences of learners and treat all learners equally, in order to accommodate the learners' learning styles of Visual, Auditory or Kinesthetic and of Global or Sequential; it needs to be customized. Customizing Moodle to implement the system design includes creating some modules, blocks, and course format within the Moodle. In order to serve the adaptivity mechanism, it has been created within the Moodle three modules of assignment, quiz and resource, four blocks of adaptive and one course format. The customized Moodle file structure can be seen in figure 2.



Fig. 2 The customized Moodle file structure

Teachers are responsible for devising and editing all the learning materials. When teachers want to make one topic of learning materials, they have to make the topic for all six types of learning mode accordingly. There is one additional section categorized as common that can be seen by all students. The common section may contain information such as course schedule, syllabus, discussion forum, etc. Figure 3 shows a teacher's view when they are editing a course page.

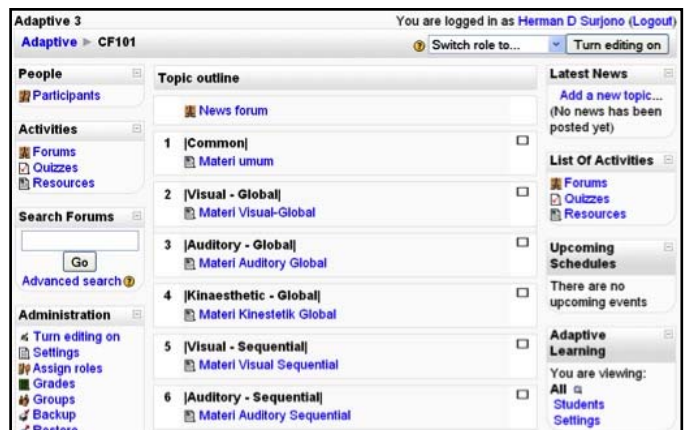


Fig. 3 Teacher's view of a course page

When a student that has a certain learning style see the course page, all the materials will not be presented, but only one material will show. Figure 4 shows a student's view when he/she has a learning mode of auditory-global.

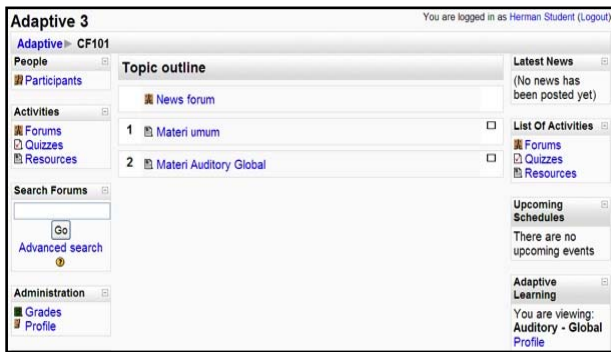


Fig. 4 Student's view of a course page

## V. CONCLUSIONS

The adaptive e-learning system that is developed in this paper presents learning resources that match students' learning styles i.e. visual, auditory and kinesthetic either globally or sequentially. The system identifies the student's learning styles tendency through a set of questionnaire. The questionnaire scores are used by the system as basis to provide the student a presentation of learning resources differently.

The system is implemented by customizing the LMS of Moodle. It has been created within the Moodle three modules of assignment, quiz and resource, four blocks of adaptive and one course format.

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