



2016 International Conference on Smart Green Technology in Electrical and Information Systems (ICSGTEIS)



CONFERENCE PROCEEDINGS

Advancing Smart and Green Technology to Build Smart Society

6 - 8 October 2016

Bali, Indonesia

Organized by



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Adaptive Online Learning Design Using Moodle

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Abstract—The paper proposed adaptive learning design using LMS Moodle with eliminating complexity for technical works. The selection of Moodle was done based on its features and it has been utilized in Udayana University. Therefore the usage of Moodle will achieve effectiveness of adaptive online learning system. The proposed approach combines two evaluations and two testing, in order to improve its adaptive capability to accommodate various type of learners' style.

Keywords— *adaptive learning system, Moodle, formative evaluation, summative evaluation*

I. INTRODUCTION

No doubt that Internet has become basic need in daily life which changes people way of life. Rapid development of Internet has become global and interactive media for information sharing. Additionally it is happen in learning process that push many education institutions to implement e-learning, online learning, or web based learning for their learning activity. Then many open course wares (OCWs) have been developed which trigger development of MOOCS, Coursera, Khan Academy, etc.

Due to swift technology development, e-learning is required to be more effective and efficient by satisfying individual style and capability. The learning process and its technology usage should fulfil various type of students, and could operate on various devices, networks, learning activities, and in any environment. Therefore adaptive online learning could be one of the solutions. In addition, for instance many MOOCs have to enhance their learning models to boost adaptive and personalized learning [1], if they want to be more influential both in developed countries and developing countries. The Authors [1] suggested to approach teaching strategies of MOOCs from five dimensions, i.e. model of teaching, adaptive learning, certification, monetization, and the strategy model for developing countries. Then MOOCs should offer various type of accreditation. However these modification are still an open area to explore.

Traditional e-learning has been implemented in Udayana University since year 2008. However its implementation target is under expectation. In fact most of lecturers in the University understand the important of e-learning [2]. However there are less than 10% of courses in Udayana University in the form of e-learning.

Udayana University has the most number of international students among universities in Indonesia. However there are no e-learning course developed for international students.

Therefore Udayana University is very keen to design and implement adaptive online learning especially for international students. The University has enough units and capacity to boost the development, such as Udayana Center for Learning Innovation and Institution of Academic Quality Development or LP3M. By improving e-learning strategy to be adaptive e-learning, Udayana University will have more online courses that meet various type of learners. Hence in this paper will propose adaptive online learning design by using LMS Moodle for international students in Udayana University.

II. ADAPTIVE LEARNING CONCEPT

According to [3] that adaptive learning is a capability of learning system to change its process automatically according to users or students based on the students' assumptions. The capability of the system to adjust itself automatically can be developed if user model has been portrayed [4]. Adaptive learning system should have adaptable characteristic which give students opportunity to modify the system. Then adaptive e-learning has three main components, i.e. domain model, user model, and adaption model [5]. Adaptive e-learning technology basically is a mix of hypermedia technology and adaptive system. An adaptive system should accommodate user characteristics and then are stored into a user model. After that the information will be used by the system as a basis information for course delivering. The user model is developed by monitoring and analyzing their interaction, the way their browsing, and their assessment results [6].

User model is claimed to be the most important component in an adaptive e-learning system. The user model function is to capture and store user information and user profile [7]. There are six functions of user model that identified by [8], i.e. Corrective, Elaborative, Strategic, Diagnostic, Predictive, and Evaluative function. Generally, there are two methods to represent user information. The methods are overlays model and Bayesian network model. In term of the method approach, for long-term approach are stereotypes, overlays and perturbation models. Then for short-term approach, there are model tracing and CBM model.

III. ADAPTIVE ONLINE LEARNING IMPLEMENTATION

Many researches have analysis on affectivity of elearning. Implementation of adaptive e-learning results better academic achievements of students than non-adaptive e-learning [9]. The same results have been shown by Triantafillou, et.al [10] and Bajraktarevic, et.al [11]. On the other hand, in [12] and [13] showed that online learning produced negative results,

especially for post-graduate students. For learning concept or theory, online learning had better result than offline learning. On the contrary, offline learning had better results than online learning for laboratory or experiment activity.

In general, adaptive learning implementation can be categorized into two groups, i.e. an adaptive presentation and an adaptive navigation support or link [5]. Adaptive presentation is a tailored of web content such as adaptive text and adaptive multimedia. In Addition adaptive navigation support is a technique to modify web link by users in certain time [14].

Adaptive online learning has been hard to implement by teachers who have not enough technical skill [15]. It is challenging to develop adaptive learning system for teachers or instructors with no technical background. The authors have proposed IMS-LD with five phases as a solution of the learning system, i.e. (1). Diagnostic evaluation concerning prior knowledge and learning style; (2). Presentation of the new knowledge; (3). Test new knowledge; (4). Synthesize knowledge and reflect; and (5). Apply knowledge. An adaptive instruction model and adaptability according to a learning style were proposed by [16]. In this model the learning content was categorized into conceptual knowledge, principal knowledge, and procedural knowledge. The instruction model and the learner's learning style was merged.

Research on efficiency of adaptive online learning has been carried out by [17]. The research combined two algorithms which are adaptive online learning algorithm and algorithm of efficiency seeking of learning system. The first algorithm was to enhance the ability to select dynamically an appropriate learning object for various type of learners. Then the second algorithm was to choose a learning path with saving costs, time and effort. Representative approaches to combine two algorithms were implemented. An adaptive environment creation for online learners become research focus of [18]. They recognized key steps and requirements in applying business intelligence techniques in process of personalization. Effect Size (ES) tool was applied to analyze effectiveness of Intelligent Tutoring System (ITS) and Adaptive Hypermedia Systems (AHS) in [19]. ES was a tool to compare the output of pedagogical experiment of the systems with the purpose of showing a significant improvement in the learning process of students when adaptive learning was implemented.

A custom of LMS Moodle was used in an adaptive e-learning implementation [20] and then the implementation was evaluated its performance in term of its all adaptation functionalities. The Author [20] utilized VAK (Visual, Auditory, and Kinesthetic) and Felder learning styles included global and sequential in the implementation. A set of questionnaire was filled in by the students to identify their learning style preferences. Then the scores were applied the system as basis of types of learning materials presentation. Authors [21] proposed theoretical framework ALMS-Adaptive Learning management System which stressed on three points. The first point was extracting the knowledge from the use's interaction, behavior and actions and translate them into

semantics which are represented as Ontologies. The second point was to find the Learner style from the knowledge base. The final point was deriving and composing the workflow depending upon the learner style. All framework modules have beneficial from the intelligent agents' application. Next research is a usage of an ontology based approach to augment adaptive e-learning system based on the semantic content design, learner and domain models to accommodate various type of learners [22]. They chose ontology model, as its capability developed content design and learner models needed to establish adaptive e-learning system. The key focus was to propose new adaptive e-learning with its ability to accommodate various characteristics of learner's ability, learning style, preferences, and knowledge levels. The ontology model through its ontology user profile can be updated automatically based on increase of learner's abilities. Different approach for dynamic and adaptive learning system utilization was offered by [23]. A multi-agent architecture that provides the key functions of the learning system was recommended. It has five agents, i.e. the Student Agent, Record Agent, Modelling Agent, Learning Object Agent, and Evaluation Agent. Each agent was meet a certain functional requirement that contributes to overall learning system. The uniqueness of each agent was autonomous and has its own social ability.

WELSA - Web-based Educational system with Learning Style Adaptation was investigated in [24] in building adaptive learning system. It consist of three key modules. Firstly, an authoring tool for the teachers that providing them to create courses conforming to the internal format. Secondly, a tool to analyze data was used to analyze the behavior of the students and consequently building and updating the learner model, as well as providing various aggregated information about the learners. Finally a course player that was basic learning management system for the students. Other scheme that included Learner state, the Educational Activity state, the Infrastructure state and the Environment state was explored in [25] to formulate an adaptive context-aware pervasive and ubiquitous learning system as a system of an adaptation engine with input and output. All the states were input to adaptation engine which was applied deterministic or probabilistic adaptation decisions. Then the output was the adapted educational activity and/or infrastructure, such as learner's position and its available network. Additional investigation of comparisons on three adaptive learning style scenarios, namely matching, compensating and monitoring is presented by [26]. Different modes were operated for the scenarios. Design-time mode was used for matching and compensating scenarios. Meanwhile a run-time adaptation mode was implemented for monitoring scenario. All scenarios were investigated in term of their effectiveness in adaptive learning styles. They found that the monitoring adaptation produced higher learning achievements when compared to other adaptation, although no significant effect was found. Design research or process research method and experimental research method were adopted in the paper as a research design. Finally, Paper [27] analyzed metadata standards to reuse of learning objects in the educational domain. Adaptive content with its management and reuse was explored using the

metadata standards. The schemas were designed to be independent of the pedagogical model underlying the adaptively.

IV. PROPOSED ADAPTIVE LEARNING DESIGN USING LMS MOODLE

Adaptive learning using LMS Moodle will be implemented for one or two courses for international students in Udayana University. Two evaluation steps are going to apply, i.e. formative evaluation and summative evaluation. The formative evaluation will be done at developing process of the course. In addition the summative evaluation will be used at the end of the course. Both evaluation aim to improve the course and to measure its affectivity. Figure 1 display research steps.



Fig. 1. Adaptive Learning Design Steps

Analyze step is required to identify the system need and its performance. Then design step which includes system's architecture, use case diagram, teacher case diagram, and student case diagram, is analyzed. Next step is to custom LMS Moodle during implementation step by adopting investigation of Moodle suitability for adaptive learning system [18]. Table 1 shows the adoption. Both evaluation are applied using two testing models, i.e. alpha testing and beta testing. The alpha testing is performed by experts or teachers, and beta testing is accomplished by users or learners. Revision or modification step is executed starting from design step until implementation step that are based on evaluation results.

Alpha testing will involve application developer, instructional designer, content developer, and media expert. A set of questionnaire will be designed to be used in alpha testing that will analyze content, interface, media selection, pedagogy, hidden feature, navigation, and performance. Formative or on-going evaluation is implemented in combination with alpha testing and beta testing. Then beta testing is implemented together with summative evaluation. All evaluations and testing are mainly focused on learning style of students.

LMS Moodle has been installed and used since 2008 in Udayana University. It can be accessed in <http://elearning.unud.ac.id>. In this learning design, four Moodle features will be activated, i.e. resource, forum activity, assignment activity, and survey. Next a use case diagram which presents access role of students, teachers, and system administrator as shown in Figure 2, is outlined to be implemented and evaluated.

TABLE I. MOODLE SUITABILITY FOR ADAPTATION [18]

	Active	Reflexive	Visual	Verbal	Sequential	Global	Sensitive	Intuitive
Forum	Concrete problems	Topics for thinking	No	Yes	Yes	Global topics	Facts, examples	Abstract topics
Chat	Yes	No	No	Yes	Frequent	No	Yes	No
Glossary	Many terms	Concepts	No	Yes	Yes	No	Yes	No
Workshop	Experiment	Unexplored topics	Yes	Yes	Yes	Yes	Practical examples	Unexplored topics
Survey	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Choice	Yes	Yes	Yes	Yes	Yes	Rarely	Yes	No
Lesson	Problems examples	Provided topics	Illustration	Written, multimedia	Yes	Rarely	Facts, algorithm	Rarely
Comm.	Face-to-Face	Email	Combined	Combined	Combined	Combined	Combined	Combined

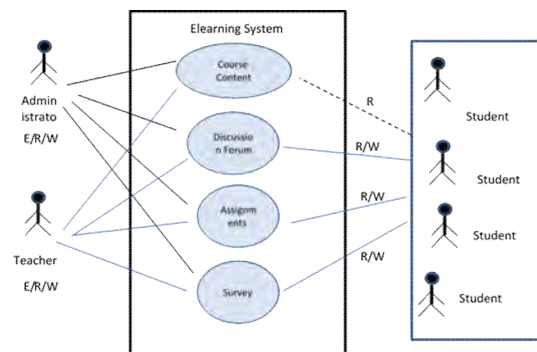


Fig. 2. Use Case Diagram

Note:
E: edit; R: Read; W: Write

The administrator has privileges to modify the system, however has no capability as a content provider. On the other hand the teacher has to provide course content, assignments, and to use all learning features of LMS Moodle. Then the students has limited access to the system. They only could read the contents, to participate in discussion forum, to submit the assignments, and to fill all questionnaires. Finally guest has no access to the system.

V. CONCLUSIONS

Adaptive learning design using LMS Moodle has been presented. Such proposed design and approaches are simple to be implemented without involving complexity for technical works. LMS Moodle has been applied in Udayana University, thus by using LMS Moodle will improve the system in term of effectiveness. The proposed approach consists of two evaluations and two testing, in order to improve its adaptive capability to accommodate various type of learners' style.

The implementation will be our next research focus. Thus the affectivity of the system would be found and analyzed after the implementation phase.

ACKNOWLEDGMENT

The research project was funded by the Indonesian Government through LPPM of Udayana University under Hibah Unggulan Udayana. Therefore Authors would like to express their gratitude to the LPPM.

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