

# The Adaptive eLearning System Design

## Student Learning Style Trend Analysis

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**Abstract** — This study aimed to analyze the trend of student learning styles that are used as a basis for designing an adaptive eLearning system, as one of the solutions to improve the quality of learning. In the long run, adaptive eLearning system is expected to overcome the problems in conventional eLearning, which assumes all users' characteristics are homogeneous. In the realization of this system required several stages namely (i) analysis, (ii) design, (iii) development, (iv) implementation and (v) evaluation. In addition, at this stage the preparation of learning materials will be incorporated into adaptive eLearning. Results at this stage is identified, analyzed, and designed as a system for the trend of student learning styles through questionnaires. The score of the questionnaire results will be used as a basis for providing different materials according to the students learning style i.e. visual, audio, and kinesthetic (VAK).

**Keywords**— *adaptive elearning system, student learning style, trend analysis, questionnaire.*

### I. INTRODUCTION

eLearning trend is now growing rapidly and has managed to steal the attention of many parties both in education and industry. The benefits of eLearning have also been felt in the education world in Indonesia, as support of the implementation of the 2013 curriculum that requires students to always participate actively in learning. This is in accordance with the nature of eLearning that is individual learning and habit to learn, where the most important role lies in the students. The main aspect into consideration in the design of learning and eLearning development is student behavior[1]. It provides assurance that eLearning can provide a maximum learning experience for students, improve student retention ensure that each related component supports the achievement of learning objectives and matches the characteristics of the student.

However, the existing eLearning has not fully implemented the eLearning system as a model of Learning Management System (LMS). E-learning is applied still in the

narrow sense that is only using information and communication technology, especially the Internet, Such as e-mail communication, learning through blogs, and other Internet-based applications. All learning resources are not well managed so that sometimes at risk of lost in space in learning the material and still oriented class. Besides, eLearning is also less focused on the characteristics of students. The role of eLearning still only prioritizes the content delivery of learning by assuming all users are equal, regardless of cognitive aspect (knowledge ability), motivation gained from the individual learning experience and learning style. In most eLearning systems (conventional), presented only suitable materials for homogeneous students, very ready and motivated, but when the system is presented to diverse students it will be a problem. As stated by[2] that e-Learning mostly provide web-based learning in order to make students can access the same courses through internet easily. In an e-Learning system, one course will not suitable for all users' ability. The content that is shown for certain group students will not be suitable for other students because each student has different learning motivation, knowledge level, learning style, and competence. Thus, the existing eLearning cannot guarantee the transformation of learning or the smooth implementation of the learning itself, and the effectiveness of learning will not run optimally

The presence of learning system that is expected to increase the intensity of self-learning cannot yet show its important role. For that, we need a dynamic eLearning system based on model characteristics of students in accordance with the scientific field. In this paper, we will discuss the trend analysis of student learning styles that are used as a basis for designing the adaptive eLearning (AdeLe) system as one of the solutions to make the learning process more optimal and meaningful.

Adaptive eLearning or often referred to as personalization learning into a solution that is right against the limitations of learning that exist today. Adaptive eLearning is a new approach that will become trends and fashion as an innovative eLearning method in the years to come, as revealed by[3] that "Adaptive e-Learning is a new approach that can make an e-Learning system More effective by adapting the presentation

of information and overall linkage structure to individual users in accordance with their knowledge and behavior".

Some studies mention that the characteristic factors that influence students' success are learning style, motivation and knowledge ability [1][2][4][5]. These three characteristic factors (Triple-characteristic models/TCM) are inherent structures that can improve learning and outcomes in individual learning [4]. Therefore, an e-Learning system will be built that can encourage students to play an active role, emphasizing on personalization that includes adaptability (adaptive) oriented to learning styles, motivation and student ability level. This system can detect the characteristics and needs of individual students. The system has an algorithm that can determine the type of learning materials that can be in accordance with the Triple-characteristic Model (TCM) of the students and is also equipped with a scoring system. This system is expected to make learning becomes meaningful and fun for students so that the learning objectives become more optimal. This is in line with [6] that the use of technology in education has promising potential in the internalization process.

#### **A. The Adaptive eLearning (AdeLe) System**

The Adaptive eLearning system will address the issues of current eLearning (i) show the same web page to all users regardless of student characteristics, (ii) class-oriented ie material intended for a specific target audience, so that the different user groups will be difficult to understand the material, (iii) the risk of lost in space in the learning material. This is lowers the effectiveness of learning so that it becomes less than optimal.

The advantages of the adaptive eLearning system are (1) well managed as LMS capable of displaying alternative learning pages according to individual characteristics, (2) oriented to broader user groups, (3) provide navigation to limit the flexibility of users in finding information. For work like that, the adaptive eLearning system has the main components, among others, *domain model*, *user model* and *adaptation model* [7][8][9], And has the same advantages as in Web Based Instruction that can be accessed anywhere anytime, not limited to a particular platform, easy to access and updated, faster distribution to users and more users who can access.

Therefore, it is essential for vocational schools that have implemented eLearning system although it is still conventional to update the system. So this research has a high urgency because through this research will be developed the adaptive eLearning system oriented to characteristic and requirement of student that is learning style, an ability of knowledge and student motivation (triple-characteristic model / TCM). This designed activity can involve students actively in learning so that learning becomes fun and meaningful. This condition is expected to improve the quality of learning in vocational schools.

#### **B. Preliminary Study**

Adaptive elearning or personalized elearning has been studied by several researchers. For example Personalization elearning system based ontology [10], And Development of personalized learning styles on elearning by using Felder Silverman Learning Style Model, which in this system has an algorithm that can determine the type of learning materials (visual/verbal) that can and in accordance with student learning styles [5].

The Developed an adaptive eLearning system that emphasizes key adaptive features based on student models. The proposed system can initialize the student model to determine the level of student cognitive when the student enrolls for the lecture. After the student begins the learning process and performs many activities, the system can keep track of the information from the students until he takes the exam. The level of student knowledge, determined based on the test scores, is updated into the system for use in the adaptation process, which combines the model of the student with the domain model to provide the lecture content according to the student's wishes. In this research, eLearning adaptive system is implemented in the lecture "Introduction to Java Programming Language". Once the system is tested, the results show a positive response to the proposed system, especially on its adaptive capabilities [2].

Further research conducted by [11], examines the design of adaptive elearning system based on student learning styles. The adaptivity system is based on two learning style models, namely VAK and Felder. VAK learning styles include visual, Audio, and kinesthetic, while Felder's learning style is global and sequential. This system combines both learning styles to change the presentation of each student.

[4] have developed personalization in the eLearning environment based on three parameters/factors (triple factor) behavioral patterns that affect performance and facilitate student learning that is learning style, motivation and ability of student knowledge. Student behavior patterns are observed through student activity log data where each log data provides an indication related to triple-factor identification in the eLearning system.

The Research by [7] which is basic research offers an architectural model for adaptive eLearning system automatically based on student learning style. The concept of this model is that the system will automatically adapt to the user's wishes and learning styles. The system will learn about the user when the user learns, and when selecting the content material so it is said to learn in two paths ie the students to the system and the system to the students. The researcher recommends applying this model concept to an applied research.

II. METHODOLOGY

Research at this stage is a development research that has only reached some stages, using stages of identification, analysis, and design with an engineering approach. Research steps as in figure 1.

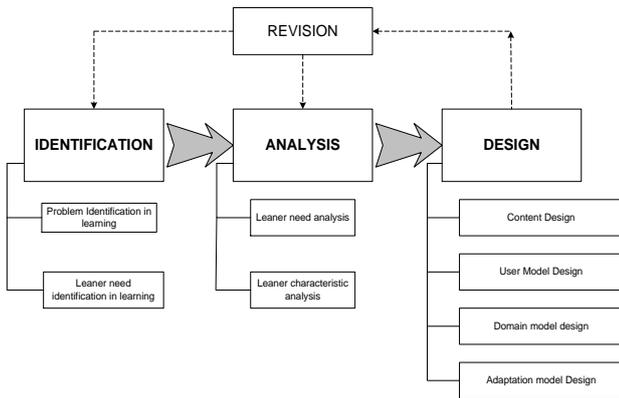


Fig. 1. Research Steps

- 1) Identification: The first step in developing an adaptive eLearning system is to identify the problems and needs of the students that appear in the lesson.
- 2) Analysis: The second step, after identifying the needs of students and problems in learning, conducted needs analysis, analysis of student characteristics and system requirements analysis. In the analysis of student, characteristics generated a questionnaire grid that will determine the trend of learning styles of students. Needs analysis is conducted to make sure that the system will be developed based on what is needed. System requirements analysis is the determination of overall system functions including expected performance and system technical requirements.
- 3) Design: The program design will be based on the obtained results in the analysis phase. This program design will include:
  - a) System architecture, i.e. content design, user model design, domain model design, and system model adaptation design such as Figure 2 and Figure 3.
  - b) Use of case diagrams, lecturer flow diagrams, and student flow diagrams

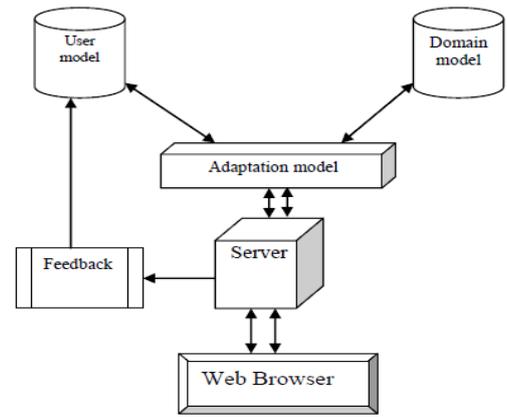


Fig. 2. AdeLe System Architecture

VAK modality consists of three layers, as in Figure 3, the learning layer, characteristic layer and personalization layer. The relationship of the three layers is, in the learning layer, will be obtained information of related patterns from student learning behavior to support the identification of the characteristic layer. Then the characteristic layer will be the basis for personalized functionality on the personalization layer.

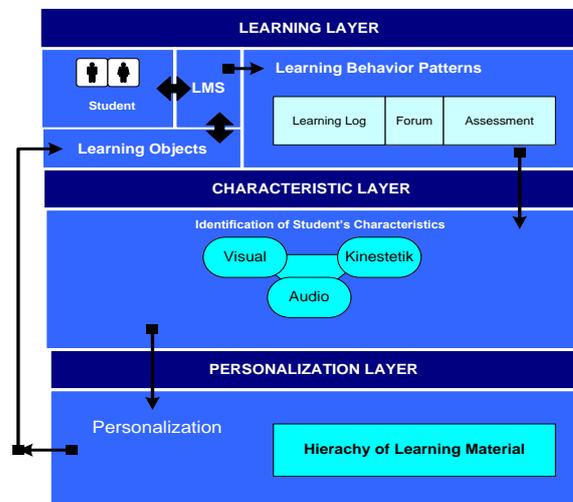


Fig. 3. VAK user Model design

While the learning layer consists of four components, namely student, LMS, Learning object and Learning behavior patterns. Students will react with the system through the LMS to get the required learning materials, forums for discussion, test and other activities. The LMS itself is eLearning software that will manage learning objects (materials, forums, tests etc.) and tools to provide information regarding patterns of student learning behaviors in online learning situations

### III. RESULT

The analysis is a step that is done after identification and done in the development of AdeLe system. At this stage of the analysis, generated a description of system requirements, description of system functions and the main features of the expected system. The AdeLe system is expected to provide different material presentations according to the user's learning style trend. Thus the system should be able to identify the diversity of user learning styles and utilize the user data as a consideration in delivering material presentations. Users get learning materials in accordance with their learning styles, so that the learning process becomes effective and more optimal. Learning styles are a learning habit whereby a person feels most efficient and effective at receiving, treating, storing and removing something learned [1] [4][10][5].

To identify the trend of user learning style, questionnaires were used. The learning style model adopted in this AdeLe is Visual-Auditory-Kinesthetic (VAK). This VAK model is simple and easy to be implemented. In this model, students' learning style tendencies are identified through visual aspects (eg, drawings, diagrams, graphs, etc.), audio aspects (eg, narration, sound effects, etc.) and kinesthetic or motion aspects (eg, holding, committing, etc.).

### IV. DISCUSSION

The elearning system is called adaptive when the system is able to automatically adjust to the user based on assumptions about the user [12].

The ability of adaptive elearning system to be able to adjust automatically to user condition obtained from user model. Besides being adaptive, adaptive elearning systems need to be adaptable, allowing users to change the system behavior according to the user's wishes.

Adaptive e-learning technology (hypermedia) is basically a merger between hypermedia technology and adaptive system. Adaptive elearning systems need to accommodate user conditions or characteristics and store all this information in the user model and then the system will utilize this information as a basis for delivering learning materials. The user model gets information about the user interaction by monitoring, browsing behavior, and testing.

The AdeLe system is developed on the basis of the fact that conventional e-learning has the limitations of being able to provide only the same learning material presentations for all users. The limitations of conventional e-learning systems become a critical issue when e-learning systems are applied to a wide range of users in terms of demographics, learning styles, as well as knowledge levels e.g. for distance education, as well as the level of motivation.

In a hypermedia system that is adaptive, a learner can be given a presentation tailored to his or her level of knowledge[13], with his learning style and with other preferences[14]. In this eLearning system model that is being developed, the learning presentation material is adapted to the student's learning style tendency as measured by the VAK

learning style instrument (visual, auditory, kinesthetic). Thus each student will get a presentation of learning materials in accordance with the tendency of his learning style. Besides, another advantage of the AdeLe system is to overcome the problems of "*cognitive overhead*" and "*lost in hyperspace*" attached to conventional e-learning systems. The problem of "*cognitive overhead*" occurs because of additional effort and concentration in browsing activities on conventional e-learning[8].

While the problem of "*lost in hyperspace*" occurs because someone who is exposed to many links in non-linear documents tends to be lost direction. In the AdeLe system, there are two levels of adaptation depending on who started to adapt in this regard whether the system or the user. This term leads to two kinds of adaptations: adaptivity and adaptability[15][9]. Adaptivity is related to the ability of the system to represent the user characteristics. While adaptability refers to the capacity of the system to support users who will make modifications. In designing an adaptive system, the issue to consider is how to balance between the two adaptation levels.

The AdeLe model developed in this study will implement the two levels of adaptation. Implemented adaptivity functions include the presentation of learning materials according to user learning styles. While the adaptability functions that are implemented include: changes in user profiles, changes in learning style modes when the user has completed the test questions. In the process of developing, AdeLe system is always done a continuous evaluation or ongoing evaluation. The point is that evaluation activities can be done either at the stages of analysis, design, or implementation. With evaluation expected improvement can be done at every stage of system development.

### V. CONCLUSION

AdeLe's system design of the diversity of learning styles is done following a engineering approach with stages: identification, analysis, and design. In the analysis phase, the questionnaire gratings were generated which determined the student's learning style trend and became the foothold in designing the AdeLe system. Furthermore, it is necessary to implement the implementation stage to generate programming code, web page display, eLearning system as a whole, and alpha and beta testing evaluation phase. Meanwhile, to know the effectiveness of the system in learning, it is necessary to conduct experimental research involving the real users.

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