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Item Selection on The Moodle-Based Computerized Adaptive Test

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Abstract. In this industrial era, all areas of life have been entered. There are five central issues that support performance, namely numerical physical devices, production tools, programs, interfaces, and networks. The Modular Object-Oriented Dynamic Learning Environment (Moodle) in order to support Industrial technology has been equipped with adaptive test facilities. Adaptive Moodle can be used to organize a communicative and interactive test process because of the communication features (chat, messaging, or forum). In addition, Adaptive Moodle can be used to administer online tests. Adaptive tests are tests whose quiz presentations will adjust to the user's abilities. The results of the research that has been carried out regarding the selection of items on the Moodle-based computerized adaptive test (CAT) were obtained: (1) The Moodle adaptive test worked successfully in accordance with the research objectives, (2) Based on user responses, the selection of items on the Moodle adaptive test items had worked well for the exam, (3) The Moodle adaptive test can run according to its function, namely adaptive to the user's ability.

1. Introduction

In this industrial era, all areas of life have been entered. There are five central issues that support performance, namely numerical physical devices, production tools, programs, interfaces, and networks. [5]. Utilization of Industry 4.0 technology for testing purposes in various fields can be done by applying the Adaptive module in the Modular Object-Oriented Dynamic Learning Environment (Moodle). Adaptive Moodle can be used to organize a communicative and interactive test process because of the communication features (chat, messaging, or forum). In addition, Adaptive Moodle can be used to administer online tests [1]. Adaptive tests are tests whose quiz presentations will adjust to the user's abilities [2][4].

The development of the Moodle adaptive test program is to utilize at least four of the five industrial 4.0 technology centers. Four technologies that can be utilized for this include numerical physical devices, production tools, programs, interfaces, and networks. The four technologies have been integrated into one device called a smartphone, computer and Wide Fidelity. [5]. In this article the use of industrial technology is applied in exam management. With the help of Moodle which has the capability to be used for network-based exam management. Moodle was chosen because it is an open source and free tool. Moodle users to date have recorded 104,361 websites, 21,000,000 administrators, and 179,000,000 users, spread across 232 countries. The use of Moodle shows an increasing trend, due to the addition of new features including the computerized adaptive test library (CAT).

Moodle software has several advantages. First, the features are complete. Moodle can be used for communication (chat, messaging, or forums), document creation and administration, data tracking, and plugin extensibility capabilities. Second, ease of use. This is because Moodle can be adjusted flexibly according to the policies and needs of each user institution [1].



The superior features, ease of use, and nature of Moodle as open source should make us a reason to abandon the traditional test process management model. For that, we can develop and design a Moodle adaptive test process. With the Moodle Test, the presentation of quizzes can be more interesting because it utilizes multimedia. The test process does not need to be face-to-face, because users can work anywhere according to a predetermined schedule [2].

The Adaptive Moodle test has a quiz feature that can be used to measure the user's ability. This is a series of activities that aim to measure the level of mastery of a material. This activity is a process of measuring and evaluating abilities. For this purpose, a measuring instrument is needed, which in the test process is often referred to as a test or assignment tool [2][6].

The change in the way of testing in this industrial era is the use of internet-based test applications [5]. The ability to present test items with a level of difficulty according to the user's ability is an advantage of internet-based test applications. Such abilities are called adaptive tests. The test items in the question bank, which have been standardized according to content parameters and level of difficulty, are the main source for the Moodle adaptive test [4]. In its use, the measurement of the user's ability by the Moodle adaptive test can be carried out better and more accurately, although between users varies in the number of items obtained and the time of the test. With certain analysis through a program, the user's ability is estimated and the score is known immediately after the test is finished. All estimated scores are provided to the system administrator. These adaptive tests can be done well by the Adaptive Quiz module installed into Moodle [1]. This study was conducted to determine the ability of the Moodle adaptive test which has not been widely used. In detail, this research article discusses Moodle's adaptive test ability, item selection based on user responses, and the function of measuring user abilities.

Adaptive test-based on Moodle is different from computer-based testing (CBT). The difference between CBT and Adaptive tests-based on Moodle lies in the algorithm approach used to select a set of quizzes that are given to the user during the test process [2]. Adaptive tests-based on Moodle is software that contains content and/or quiz sequences that will automatically adapt to the abilities of each user's abilities. The term Adaptive Moodle-based test is commonly used to describe Computer Assisted Assessment (CAA) software [3]. In terms of adaptive, Item Response Theory (IRT) is used to estimate user capabilities. After that, based on these estimates, the user will be given the next quiz with the level of difficulty according to the results of the estimated ability [2][6].

Adaptive tests based on Moodle center on classifying users into one of a number of discrete categories, such as pass or fail. An adaptive test based on Moodle in which a set of If-then rules that are created are then used to select the next given quiz. In other words, the Adaptive test system based on Moodle will classify the user's abilities [3]. Based on the ability classification, the user will be taken to an advanced quiz according to the ability of each user.

There are four components of the Moodle-based Adaptive test, namely the item bank, item selection procedure, ability estimation and termination rules. Another component of the Moodle-based Adaptive test that is often considered is the content balance and control items that often appear (exposure control items) [8].

The concept of the algorithm used by the Adaptive test-based on Moodle is that if the user cannot answer correctly on a given quiz, the system will give a quiz that has a lower level of difficulty. Conversely, if the user can answer correctly, then the next quiz given is a quiz with a higher difficulty level. The chart of the Adaptive test process based on Moodle can be seen in Figure 1 [8].

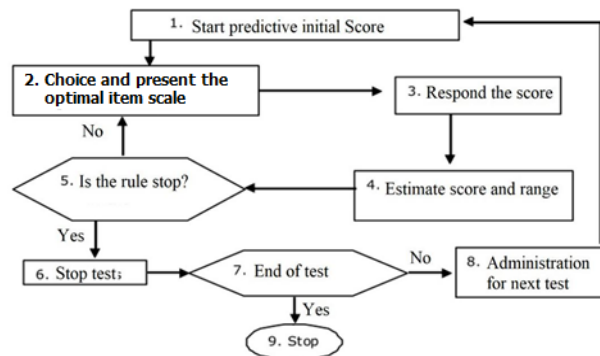


Figure 1 Adaptive test-based on Moodle process chart [8]

In the Adaptive test-based on Moodle, quiz item difficulty is estimated using the Rasch model or item response theory. The Rasch model was developed by a Danish mathematician named George Rasch. The Rasch model is mathematically written as follows:

$$P_i(\theta) = \frac{e^{D(\theta-b_i)}}{1 + e^{D(\theta-b_i)}} \quad (1)$$

$P_i(\theta)$ = probability that the user's ability with the level of ability θ answered item i correctly, $e = 2.7183$; $D = 1.7$, and b_i = item difficulty level [2][6].

Moodle is a software package produced for internet-based managerial activities and websites using social construction principles. Instructor assignments will change from being a source of information to being an influencer. The instructor's role in the Moodle system includes: connecting with individual users to understand their needs and moderating discussions and activities that lead users to achieve capability goals [1].

Moodle is a description of the application of concepts and mechanisms of the testing process electronically by utilizing information technology. Moodle under the GNU license can be used freely as an open source product. The advantage of Moodle is that it can be installed on any computer and operating system as long as it can run PHP and supports SQL databases. Some of the features that Moodle has include task submission, discussion forums, download archives, ratings, chat, online calendar, news, online quizzes, and Wiki. By installing the Adaptive Quiz plugin, Moodle's online quiz capabilities are even better [1].

2. Method

This study uses a research and development approach. The development research model used is a scale construction process [4]. After that proceed with the installation of the Adaptive Quiz plugin in Moodle, user testing, data analysis and reporting [1][3].

The adaptive test-based on Moodle grade test tools in this study consisted of the test of knowledge aspects. The test tool to assess the knowledge aspect is made in the form of multiple choice which is equipped with a level of difficulty for each item. The test tools for aspects of knowledge is filled in by users, while the skills test tools are filled by the observer. MCQs are chosen in the assessment of aspects of knowledge because this model can cover a wide range of material, the test is objective so it is suitable for use in the adaptive test-based on Moodle.

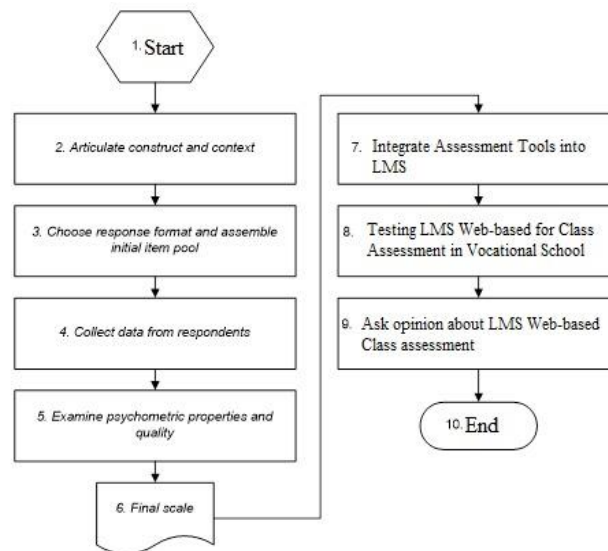


Figure 2 Research process [3][4]

There are two types of research population. First is the expertise competency of the users to be chosen. The second population is the name of the subject to be developed in the test tool. The sample of expertise competency and the name of the subjects in this study will be chosen purposively. The sample of users where the data will be collected will be determined randomly in Yunlin University, Taiwan (sample 1) and Yogyakarta (sample 2). Data collection techniques in this study used instruments in the form of multiple choice online tests to assess aspects of knowledge.

The quality of instruments for a number of quizzes in the question bank will be analyzed based on item response theory. In addition, the item items will also be analyzed with the Rasch model to obtain the level of difficulty that will be used as the basis for item selection in CAT.

To determine eligibility, estimate user's ability, research data will be analyzed using descriptive statistics. Descriptive statistics will display data trends and data variability. Trending data will also be displayed in tabular or graphical form.

3. Results and Discussion

Based on the results of research and development, the result in the first stage is to install a Moodle-based adaptive test. The following is a display of the start page, which contains information in two languages, namely Indonesian and Taiwanese (System View in link address <https://catpkln.com>).

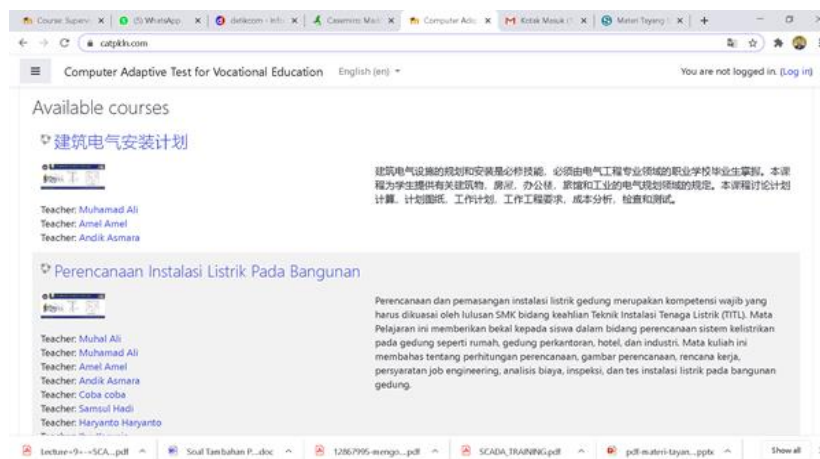


Figure 3 The start page is Indonesian and Taiwanese.

Before entering the system to start the test, the user first logs in. The purpose of the login system is for data security, because only registered users can enter the system. By logging in, the observer knows the number of users who took the test. The following illustrates how to login to the system and the pages of the system Figure 4.

Figure 4 User login page

Based on the test results, the Maximum value data for the 1st sample is 37.78, for the 2nd sample, it is 69.30. The minimum value for the 1st sample is 20.00, while for the 2nd sample it is 23.00. The average value for the 1st sample is 26.59 for the 2nd sample, it is 49.26. The materials tested for both countries are the same. The language used in the exam questions for both countries has been translated into their respective languages. The test material tested has been selected for the generally accepted international Electrical Installation Engineering competency. From these results, there is a clear difference, that the competence of the 2nd sample is higher than that of the 1st sample.

Based on the results of observations of the data on the test items received by the user, it has varied according to the correct and incorrect responses of the user's answers. Users also said that the adaptive test model was good for the test. This shows that the test items given to students are different and adaptive according to the student's ability level (Figure 5).

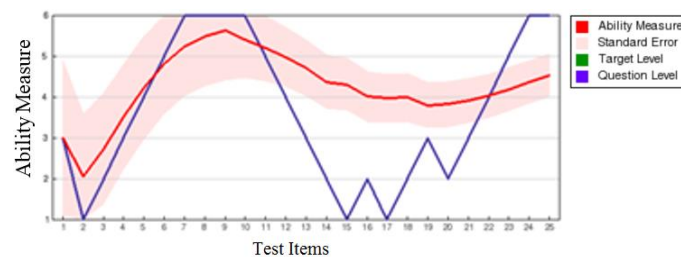


Figure 5 Result page

Figure 5 above shows that the selection of test items is indicated by a blue line. The user's abilities are indicated by a red line. While the standard error is described by a pattern of pink areas. Based on these results (blue line) it can be seen that the rise and fall of the line depends on the right and wrong of the user's response. The user's ability can be directly seen from the red line. The same thing was also obtained by other users immediately after the exam was over, namely getting different images according to the user's answers correctly or wrongly. This shows that the Moodle adaptive test is able to choose the test items given to the user, adaptive according to the user's ability level.

4. Conclusion

The user responses that were collected using a questionnaire generally stated that the Moodle-based adaptive test was good. This is because the test questions from the computer that are given to be done to the user are different and adaptive, according to the level of the user's ability.

The conclusions from the results obtained are: (1) The Moodle-based adaptive test has succeeded in working and functioning properly according to the user's response, (2) The Moodle-based adaptive

test has been able to work on choosing the right questions according to the right and wrong user responses. (3) Moodle-based adaptive test is good enough to be used for the test in order to measure the ability of the user's cognitive level.

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