Feasibility Analysis Test of Computer Based Testing (CBT) System for General Physics Exam

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Abstract. This study aims to develop and to test the feasibility of Computer Based Testing (CBT) system for General Physics courses that can be used as a media to measure the ability of student. This research involves a part of Research and Development (R & D) for developing CBT product and also descriptive research for qualitative and quantitative data processing. The collected data as a result of assessment are validated by a team who are experts in analyzing qualitatively and quantitatively. The procedure of implementation consists of three stages, namely preparation, implementation and final stages. In the preparation stage, the CBT system is accommodated in preparing application and all items. In the implementation stage, the feasibility test is conducted through an assessment supported by IT Expert Team. In the final stage, the assessment results of the IT Expert Team are used as a basis for evaluating the CBT system. As result, the Computer Based Testing (CBT) system has fulfilled the criteria of question eligibility through content validity testing with aspects of matter, construction and language. The average value is 75.6 that satisfy valid criteria with minor revisions as well as satisfy eligibility system which includes Content, Interface, Navigation and Security indicators with the percentage is 86.6% involving the category of the level of eligibility which is in very good level. Thus, it can be used as a medium for student exams in the General Physics course.

1. Introduction

The General Physics course is one of compulsory subjects in the Physics Department which requires conceptual understanding associated with daily physics phenomena. Students can apply physics in their daily life if they understand the concept of physics clearly. The mastery of physics concept will reduce misconceptions. One of method to be master in physics concept is using test based on a conceptual knowledge as routine assignments or question exercises. The habit of doing tests can help students understand physics clearly and this can indirectly build their conceptual knowledge.

The results of the conceptual knowledge-based test for 65 students in Department of Physics FMIPA Unimed, academic year 2018/2019 described that only 27 % of students got score 68 while 83% of students got score less than 65. This means that students' conceptual knowledge is still low. One of the reasons may come that they are rarely trained to work on conceptual knowledge-based questions. In addition, learning process is only focus in solving of calculation problems and memorizing formulas without interpreting the meaning and function of formulas so that the ability of students only relies on memorization. In terms of solving physics problems students use a plug and chug and memory-based approach [1-3]. Because of lack of understanding physics concept, students think that physics subject is difficult [4-5]
In line with the results of the conceptual knowledge-based test, the results of interviews with the lecturer who teaches the General Physics course show that students cannot solve conceptual questions because the lecturer rarely gives these types of questions. There are several problems associated with the result of observations on the test instruments used by the lecturer that are described in the following statements: i) the test has not focused on mastering physics concepts and even though the test has a grid and an assessment rubric; ii) the test does not fulfill the process of compiling tests that meet the eligibility criteria for good instruments including validity and reliability; iii) the test instrument used for assessing learning achievement is not in accordance with the measured realm of knowledge. In theory, the test instrument must be adapted to the characteristics and objectives of the learning material. The conceptual knowledge-based test must be developed that meets the test eligibility criteria [6].

Basically, the test is available in two forms, namely paper-based testing (PBT) and Computer-Based Testing (CBT). During the time, the test in the Department of Physics is conducted by using paper-based test that have weaknesses such as: the test takers are possible to cheat; takes longer time to get the results; ineffective and efficient in terms of test implementation and the use of test time is difficult to control properly. In addition, the used of paper makes that the PBT test is not environmentally friendly and less up to date at present. While according to Himah, Sudarti and Subiki [7], the conventional test format such as PBT have several weaknesses namely: the assessment process becomes less inaccurate so that there is possible an error of assessment; the instrument is less effective and efficient and not up to date. Moreover, Samson &Oluwatosin [8] states that the PBT method can cause irrelevance in the individual character values both of educators and students involving dishonest in doing examination and the possibility of giving or offering of a bribe in solving of questions during examination.

The advance of Information and Technology influences the education system particularly for the developed of test that must be able to adapt the application of computer-based tests or Computerized Based Testing (CBT). The developed of teaching materials and computer-based tests that utilize computers provides more flexibility to solve problems and it can be used as evaluation of learning process [9-11]. In addition, the form of test that is packaged by utilizing computer technology and internet networks can be used to familiarize students using e-learning-based evaluations so that students will be easily in doing examination using the CBT.

The implementation of CBT changes the aspects of learning and curriculum in the world of education [12] which has developed rapidly, especially in educational assessment [13]. The use of CBT instruments have positive values [14] that are described as follows: i) using CBT is more effective and efficient compared to the PBT; ii) reducing in cost because of paperless; iii) doing examination in strict time according to the test design; iv) resulting of test can be known quickly and objectively according to the ability of the test takers; v) being able to train honesty and persistency of test takers; vi) training student in terms of basic technology skills. The use of computers as a media in carrying out assignments and exams are inteded in familiarizing students to interact with technology, utilizing Information and Communication Technology (ICT) to carry out self-assessment, improving ICT-literacy and ICT-usability and strengthening in learning process through exam practice (learn by the test) [15-16].

2. Method

This research is part of Research and Development (R & D) type which is focusing in developing of CBT product. This research also is part of descriptive research in terms of qualitative and quantitative data processing. In education area, the development research is oriented in developing and validating the products used in education through several stages. Meanwhile, the descriptive research reveals an analytical research study of documentation that collects data using written sources such as academic journals or text books related to the research problem. The collected data is in the form of the results of the assessment from the validation sheet which is handled by an expert team. Then, the data are analyzed qualitatively and quantitatively by the team. The procedure of implementation consists of
three stages, namely the preparation stage, the implementation stage and the final stage. In the preparation stage, the CBT application is designed which is started from the preparation of items and tools that provide in the application system. While in the implementation stage, a system feasibility test is conducted by the IT team through an assessment. In the final stage, the results of assessment conducted by the IT team are used as a basis for evaluating the CBT system. The used instrument research consist of a content validation test sheet including the aspects of the assessment of material, construction and languages, system evaluation. This system evaluation accommodates content, interface, navigation, configuration, and security indicators. The obtained data in the validation test and CBT system assessment from the validator are quantitative data. The data are analyzed using a Likert scale score of 1, 2, 3, 4, and 5 that can be obtained by dividing the total score of validators with the expected score. Then, the result of the validation of the test instrument is categorized according to the evaluation results criteria in Table 1 [17]. While for testing the feasibility of the CBT system is analyzed by the evaluation results criteria in Table 2 [18].

| Tabel 1. Validity Score Conversion |
|-----------------------------------|
| Average Value | Criteria |
|----------------|----------|
| 25.00-40.00    | Invalid (not be used) |
| 41.00-55.00    | Less Valid (not be used) |
| 56.00-70.00    | Quite Valid (be used after major revision) |
| 71.00-85.00    | Valid (be used after minor revision) |
| 86.00-100.00   | Very Valid (very good to be used) |

| Tabel 2. Conversion Score Assessment of Eligibility |
|---------------------------------------------------|
| Level Of Eligibility | Percentage Score |
|----------------------|-------------------|
| Very Good            | 76% - 100%        |
| Good                 | 51% - 75%         |
| Enough               | 26% - 50%         |
| Not Good             | 0% - 25%          |

3. Results and Discussion

The computer-based test system in the General Physics course has been developed based on the preparation, implementation and final stages. In the preparation stage, the items and the design of the CBT system are prepared. The validation process in this stage got 25 test items which were validated based on material, construction and language aspects. The average validator score is 75.6 that fulfill valid criteria with minor revisions as shown in Table 1. The results of the validator assessment are presented in Table 3.
Tabel 3. The Result of Expert Validation

| Score                           | Validator 1 | Validator 2 |
|---------------------------------|-------------|-------------|
| The Average value for the 25 item test | 73,15       | 78,1        |
| Conclusion                      | Valid (be used after minor revision) |             |

Description from validator assessment in the material aspect focus on the following criteria: 1) the suitability of the questions with the indicators; 2) the accordance between the content of questions and the objectives of learning process. From the construction aspect, it focuses on the following criteria: 1) the display of images such as graphs, diagrams, and tables that are inserted in the questions should be clearly illustrated and they have functions; 2) the subject matter is formulated clearly and firmly. While in the language aspect focus on the improvements of words that are ambiguous and ineffective.

After validation process, the third aspects showed the validity in the category of small revisions. Previous researchers namely, Nova, et al., [19] have also involved 35 items that are valid but need improvement in order to be used in the future test. Test instruments that have fulfilled content validity and validity testing are appropriate for future tests [20]. Test instruments that have met the eligibility are used in the CBT application for system testing in the implementation stage. The display of start menu of the CBT is user friendly that be shown in the following Figure 1 and Figure 2.

**Figure 1.** The display of start menu of the CBT

**Figure 2.** The display of testing
In the implementation stage, an IT expert team will test the application of system to determine the feasibility of the application that has been developed. Besides focus on the content component of assessment, the team also provides comments and suggestions to improve the product that has been developed. The comments and suggestions from the IT expert team are shown in Table 4.

Table 4. Comments and Suggestions from The IT Team

| No. | Validator   | Comments and Suggestion |
|-----|-------------|-------------------------|
| 1   | Expert IT 1 | The maximum number of participants should be targeted for large classes |
|     |             | Add participant data button |
|     |             | Make the overall score display |
| 2   | Expert IT 2 | Initial display, reflects test activities |
|     |             | Exit button is not maximized |
|     |             | Admin and lecturer login pages are put together |

Table 4 provides improvement descriptions from the two IT experts in terms of several indicators started from the initial display that does not accordance with the test activity indicator, the display of final score has not been read, the interface display is less attractive and less interactive. In the content indicator, there are several syntax errors for instance: 1) typing errors in the system; 2) navigation layout, content and functions have not been placed correctly so that it can be difficult for users. According to these suggestions, the developer makes improvements to the test system. Further, this improved system has been tested again by IT experts covering the following aspects: content, interface, navigation, configuration, and security. All of aspects have been listed in the assessment category and these are provided in Table 5:

Table 5. Assessment data by IT experts

| No. | Assessment Component | Validator Expert 1 | Validator Expert 2 | Average Number of Scores | Maximum Number of Scores | Percentage (%) | Category |
|-----|----------------------|--------------------|--------------------|--------------------------|--------------------------|----------------|----------|
| 1   | Content              | 16                 | 18                 | 17                       | 24                       | 70.8           | Good     |
| 2   | Interface            | 41                 | 44                 | 42.5                     | 44                       | 96.6           | Very Good |
| 3   | Navigation           | 16                 | 19                 | 17.5                     | 20                       | 87.5           | Very Good |
| 4   | Configuration        | 10                 | 8                  | 9                        | 12                       | 75             | Good     |
| 5   | Security             | 12                 | 10                 | 11                       | 12                       | 91.7           | Very Good |
|     | Average total        | 95                 | 99                 | 97                       | 112                      | **86.6**       | Very Good |

Table 5 provides the information of the average percentage of two IT experts covering the following aspects: 1) the content aspect is 70.8% which is in the good feasibility category; 2) the Interface aspect is 96.6% which is in the excellent category; 3) the navigation aspect is 87.5% which is in the excellent category; 4) the configuration aspect is 75% which is in the good category; 5) the security aspect is 91.7% which is in the very good category. Thus, based on the average value of all aspects, it can be conclude that the feasibility level of the CBT system is 86.6% which is in the excellent category. From this result, the developed system has been feasible to be used because it has satisfied requirements of test conducted by IT experts. Further step, it can be used web application testing that is important to find errors in the content, function, capacity, and security of web applications [21]. The final stage of this research is the revision process of the final product started.
from the use of the application system and the overall appearance of the system. The final product is in the form of a web-based computerized test system that has been listed in the General Physics course. This product has satisfy the standard of eligibility through validity testing and system testing. Furthermore, this system can be run and installed in a network server. This system can be used as a media examination for General Physics courses.

4. Conclusions
The Computer Based Testing (CBT) system has fulfilled the requirement of eligibility criteria through validation process. The validation process covers the following aspects: 1) the content validity including material, construction and language aspects has average value 75.6 fulfilling valid criteria with minor revisions; 2) the system eligibility including indicators of Content, Interface, Navigation and Security has percentage 86.6% which is in the very good level category. From those results, this CBT system can be used as a media for student examinations in the General Physics course.

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