DEVELOPMENT OF TWO-TIER DIAGNOSTIC TEST BASED ON E-LEARNING

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Abstrak. The weakness of the two-tier, three-tier or four-tier paper-pencil diagnostic tests is that it takes a long time for results and feedback analysis and remediation. This paper presents the results of an initial review of the technique of developing a two-tier diagnostic test using e-learning facilities. By using e-learning based diagnostic tests at the same time students will get the results of answers, explanation of answers and also explanation of the reasons for each answer choice. Development of two-tier diagnostic tests based on e-learning (E-TesMis) using the ADDIE model, starting from the initial analysis to evaluation. The results of the initial (A) analysis include IT facilities, student IT skills, availability of other supporting media. The design stage (D) starts from the preparation / writing of two-tier diagnostic tests manually to the explanation of the concept of each answer. The development phase (D) of the tests that have been designed is applied or moved on the e-learning page and revised several parts after the expert gives input. The Implementation Phase (I) is the test phase or test pilot. The last stage of Evaluation (E) includes the analysis of the results of trials on several (limited) respondents and also on the expanded respondents.

Kata kunci: Two-tier, tes diagnostik, konsep listrik, model ADDIE

1. Introduction
The rapid technological development in all aspects of human life, from the macro-scale industry to life in the family requires a touch of technology. In the world of education, several terms have been known before the term e-learning appears related to distance education, among which there are terms (i) open distance learning, (ii) web base training, (iii) computer base training, (iv) technology base learning, and (v) online learning [1]. The term e-learning is often exchanged with the term distance education or with the term web-based education. Actually education with e-learning systems is wider than the education system [1]. Learning with e-learning as a process of expanding learning or transferring lecture material to students through the internet, intranet, audio, interactive TV, video and CD-ROM networks [2].

The use of e-learning has been felt in various fields, including continuing professional improvement [3]. Accessible to learning at any time and every place, independent and more flexible teaching [4]. There is an increase in the attractiveness of students towards foreign languages [5]. Students can easily access course material [6]. Several other studies say that the internet is a perfect learning tool, more flexible, and can develop teaching materials [7, 8, 9, 10, 11, 12].

However, in the application of learning with e-learning there are several obstacles, as faced by the State of Kuwait, including lack of management support, language barriers, IT problems, and lack of
time [13]. Tanzania in the application of learning with e-learning faces several problems including low infrastructure, financial challenges, inadequate IT support, lack of knowledge about e-learning and barriers to change in teachers [14].

Efforts to overcome the shortcomings in the application of the learning process with e-learning, especially in higher education, have been carried out by several researchers from various countries. For example, in the education administration department, the University of Emirates has developed a “hybrid” e-learning diagnostic test aimed at developing students’ learning experiences [15]. In the fields of informatics, optics and engineering, mechatronic, the University of Budapest has developed two diagnostic tests to teach Sustainability Energy, namely “Solar Powered Electric” and “Luminous Efficacy of Modern Light Sources” [16]. At the Department of Education, Padova University, has developed an e-learning diagnostic test to enhance collaboration between students with different educational backgrounds [17]. Diagnostic tests have also been developed to overcome difficulties in learning modern physics [18, 19].

Based on the results of the literature review above and also the results of the analysis of the needs of learning media in the department of physics education and physical majors, this article will explain theoretically related to the development of diagnostic tests in learning modern physics in higher education. The e-learning diagnostic test development method proposed in this article uses the ADDIE [20] model. The contents of this article are expected to provide useful information for researchers, PT staff, and Middle School teachers who want to develop E-Learning based learning.

2. Result and Discussion
The ADDIE model [20] has five phases, namely Analysis, Design, Development, Implementation, and Evaluation, the five phases are shown in Figure 1. In the context of E-learning diagnostic test development the stages of applying the ADDIE model include [20] as follows:

The Analysis Stage is the activity of obtaining information from the field (feedback) related to the needs of the e-learning diagnostic test to be developed. Information obtained through this analysis phase (in the context of e-learning diagnostic test development in physics learning) includes:

- Information about the achievements of physics learning outcomes so far, in the department that the diagnostic test wants to apply for Higher Education.
- Any physics concept that is difficult for students to understand.
- What is the motivation and interest of students in learning physics during this time.
- What is the readiness of ICT facilities from lecturers and students so far.
- A How far is the knowledge of lecturers and students about the use of web learning, in this case e-learning, so far.
- How to access the internet in the learning environment so far, especially in the campus environment.
- What is the experience of lecturers and students in using internet or web-based teaching material resources so far.
The Design Stage is to plan e-learning diagnostik test development activities on one of the subject topics or evaluations courses. The diagnostik test design offered in this article refers to the syllabus and lecture contracts that have been developed in each institution. Design stages include:

- The course phase of the course: In this phase the subjects are selected and the SKS is determined as a face-to-face and SKS practical course.
- Determine the material for 16 meetings, including the Middle Semester Examination (MSE) and Final Semester Examination (FSE) activities. Lecture sequence format as in table 1.

| Lecture to | Topic | Activities |
|------------|-------|------------|
| 1<sup>st</sup> | Introduction to test and non-test instrument | note and discussion |
| 2<sup>nd</sup> | Introduction to diagnostic test | note and discussion |
| . . . | . . . | . . . |
| . . . | . . . | . . . |
| 16<sup>th</sup> | implementation of Diagnostic test | carry out the test (FSE) |

- Based on the order of time each meeting in the above discussion can be described in detail at each meeting. The format of the details of the activities of each meeting is filled out in the Web Based Form as shown in the following table 2 (as an example for the first lecture)

| Topic 1 | Introduction to test dan non-test instrument |
|---------|---------------------------------------------|
| Name of Module | Concept of test and non-test instrument |
| Lecturer | Dr A Halim, M Si |
| Standard of Competencies | Students are able to understand the basic concepts of instruments in the form of tests and non-tests. |
| Competencies of Basic | 1. Students are able to describe the meaning of tests and non-tests. 2. Students understand thoroughly the basic concepts of instruments |
| Indicators | Students understand and are able to describe what basic concepts exist in developing the test. |
|------------|---------------------------------------------------------------------------------------------|
|            |                                                                                             |

- Scheduling Courses: Describe in detail the days and dates of lectures and the form of meetings at each activity. The implementation of lectures uses two approaches, namely face-to-face and Web-based lectures in the form of e-learning. In this section also explained percentage of each activity, for example 20% Practicum, 15% Assignment, 10% online quiz, etc. The detailed activity table for 16 meetings is shown in the following table 3 (as an example for the first meeting).

### Table 3. Scheduling Courses

| Topic of Courses | Development of Diagnostic Test |
|------------------|--------------------------------|
| Description      | The course discusses ways to develop diagnostic tests using the web or e-learning. |
| Course objectives| The aim of this course is for course participants to understand how to develop diagnostic tests using e-learning or the web. |
| Form of course activity | Lecture, web (e-learning), evaluation, and assignment |
| General Form     | Students are able to describe the meaning of tests and non-tests development |
| Dates            | Basic competencies the subject |
| Week 1           | Students are able to describe the meaning of tests and non-tests development |
| Week 2           | . |
| Week 16          | Able to complete tests related to the basic concepts of test development |

The **Develop Stage** is the activity of developing e-learning diagnostic tests in one subject (eg Modern Physics). The stages of development include:

- Preparing of test development material in the form of lecture notes (eg dictates, books, manual diagnostik tests, etc.).
- Preparing softcopy-based learning support media (in the form of ppt, pdf, excel, etc.).
- Setting up online or online interactive animation and simulation media (eg PhET simulations, etc.)
- Prepare learning videos that are related to lecture material (eg lecture videos from youtube, etc.).
- Enter the e-learning or learning web (eg [www.elearning.unsyiah.ac.id](http://www.elearning.unsyiah.ac.id), etc.). One example of the front page of e-learning is shown in Figure 2.
If you are a lecturer at the relevant university, you can immediately develop the subject you are teaching in the current semester. For example after you enter e-learning, it will appear as shown in Figure 6 below.

- All courses in the current semester will appear and teaching staff can develop content or material for each meeting.

- If we choose one subject, a meeting will appear from topic 1 to topic 16, as shown in Figure 4.
At each meeting the teaching staff can develop or type the contents of the syllabus that has been prepared in the previous stage (i.e., the design stage).

The results of the addition of the description in accordance with the lecture contract are shown in Figure 8 below (an example for modern physics courses), as shown in Figure 5.

To change (edit) what has been typed or added, activate the green icon as the top right. If you press the green button, an icon will appear for editing, as shown in Figure 6.
Now the teaching staff can add other course materials in the form of PPT, excel, word, PDF, etc. or can also add media from other sources such as videos, animations, simulations, etc. As shown in figure 7.

If the addition of material or source from online and offline is complete, press the save and display command.

At this stage of development, e-learning diagnostik tests that have been developed need expert validity, including content validity, appearance, ease of access, etc.

The Implementation Stage is the stage of using the e-learning diagnostik test instrument for students who take part in the course, because their names have appeared in the course. To see the effectiveness of the diagnostik tests that have been developed can be carried out trials on students of the course as well. Data from limited trials and trials are expanded to become guidelines for the revision of the e-learning diagnostik test, so that e-learning diagnostik tests can be produced that are easily
accessible and love to be used by students. The design of the implementation method as indicated in table 4.

Table 4. Design of Diagnostic Test Instrument Implementation

| Groups  | Pre-test | Treatment      | Pos-test |
|---------|----------|----------------|----------|
| Experiment | O1       | E-Learning      | O2       |
| Control  | O1       | Conventional    | O2       |

The Evaluation Stage is the evaluation phase of the effectiveness or function level of the e-learning diagnostik test in Modern Physics courses. A comprehensive assessment is carried out after the limited trial phase and expanded trials. Evaluation is not only carried out in the final stage (implementation phase) but evaluation is carried out at each stage, starting from the analysis stage to the implementation stage. Assessment techniques like this are adopted from the results of previous studies [21, 22, 23]. The complete evaluation process is shown in figure 8. Besides developing the contents of the learning diagnostik test with e-learning, through e-learning learning can also be developed tests, both formative and summative tests or diagnostic tests as manual diagnostic tests have been developed [24, 25, 26, 27, 28]

Figure 8. ADDIE Model Operations (source: Dick and Carey, 2014)

3. Conclusion
The development of e-learning diagnostik tests in Modern Physics courses (eg) using the ADDIE model has been discussed in depth and in detail. The stages of diagnostik test development include; analysis phase, design phase, development stage, implementation and evaluation stage. Although the evaluation phase is at the last stage, in the implementation the evaluation phase applies at all stages. The implementation was carried out in two sessions, namely limited trials and expanded trials. Data from the trial results provide an overview of the effectiveness and ease of access of e-learning diagnostik tests.

4. Acknowledgment
Our gratitude goes to Ministry of Research and Higher Education for financing the implementation of research through the Postgraduate Team Grants, with the research contract number: 110/UN11.2/PP/SP3/2018. In addition, we also express our gratitude to the LP2M Syiah Kuala University for facilitating the implementation of this research.
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