



# Adaptive Test Design Competency Test

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**Abstract.** It is important to carry out a competency test for students who will pass to find out the extent of the student's competency abilities when they enter society or industry. The aim of preparing competency tests is to obtain assessments that can determine students' true competency abilities. It takes five subjects to become an expert in electric power systems: electrical circuits, basic electronics and digital, microprocessors, lighting and electric power installations, electric power network systems, and electrical machines. The questions on the competency test are based on basic knowledge from these subjects. The passing category in the competency test consists of not passing, passing in the good category, and passing in the very good category. Flexibility in selecting item difficulty levels is based on pre-test results. The pre-test results will determine the choice of questions to pass in the good or very good category.

**Keywords:** Competency test, Electric power systems, Passing category

## 1 Introduction

The competency test is a prerequisite for students aiming to complete their undergraduate studies at Universitas Negeri Medan (Unimed). The test outcomes act as a supplementary document accompanying the diploma for Unimed graduates. Within the Department of Electrical Engineering Education, there are three study programs offered: Electrical Engineering Education, Electrical Engineering, and Informatics and Computer Engineering Education. The Electrical Engineering Education and Electrical Engineering programs share a similar focus within the electrical field but differ in their graduate profiles. The Electrical Engineering Education Program is tailored to produce educators specializing in electrical engineering, while the Electrical Engineering Program equips graduates to work as professionals in advancing or applying electrical engineering knowledge within industrial settings.

Graduates of a bachelor's program in electrical engineering education or electrical engineering are required to pass a competency test in the electrical field. This test, specifically aimed at students in the Electrical Engineering and Electrical Engineering Education programs, evaluates their proficiency in areas such as basic electrical circuits, electrical machines, and power system networks. We design the assessment to measure both cognitive understanding and psychomotor skills. Conducted four times a year to align with Unimed's graduation schedule, the test requires a well- developed

question bank to ensure it effectively reflects students' capabilities. As a result, the Department of Electrical Engineering Education must prioritize the preparation of standardized testing tools to support this process.

Typically, exam-takers are required to complete all assigned questions. Students are compelled to complete all the assigned questions, regardless of their ability level. This results in some students feeling hopeless, especially if they often fail in tests.

Based on this, it is crucial to design a test that aligns with the student's chosen ability level while adhering to the graduation standards of the current study program. The selection of question items from the competency test has three categories: passing (not passing), passing with a good category, and passing with a very good category. For students who do not graduate, it is necessary to relearn the basic concepts of the electric power system.

We use adaptive tests to evaluate an individual's skills against established standards. The grouping of competency levels is typically defined by the institution, which sets thresholds that participants must achieve. In many cases, industries or educational institutions mandate that candidates pass these tests to qualify. Those who successfully pass are considered capable of performing their tasks efficiently and adapting to their roles in the workplace. The purpose of a standardized test is to measure either academic performance or potential abilities in a fair and objective manner [1].

Both manual and computerized methods are available for the use of adaptive tests. The form of adaptive testing is to adjust the ability of the participant; if in the initial test they are not able to complete the questions according to the set standards, the participant will continue the test on questions with an easier level of difficulty, but the success criteria will be included in the good category [2] [3]. Meanwhile, the category of excellent ability will include participants who achieve excellent ability standard scores.

We use the results of adaptive tests to evaluate the strengths and weaknesses of students' learning achievements. Furthermore, these tests play a significant role in curriculum development to enhance the level of students' performance. Test results serve as benchmarks to determine eligibility for special education and pinpoint areas of strength and weakness in school learning, as stated in [2]. They also assist professionals in designing instructional plans by pinpointing curriculum areas where students underperform compared to their peers.

The adaptive test assumes that all test participants have average ability, so at the beginning of the test, all will get questions in the medium category. For participants who cannot meet the score limit, the next question will be easier. On the other hand, if participants can reach the specified score limit, they will get more difficult questions. Differences in the difficulty level of this question item provide a grouping of competency standards for test takers, namely very good, good, and incompetent.

## **2 Research Methodology**

The Department of Electrical Engineering Education conducts the research, which focuses on development studies using the Borg and Gall model [5].

### 3 Results and Discussion

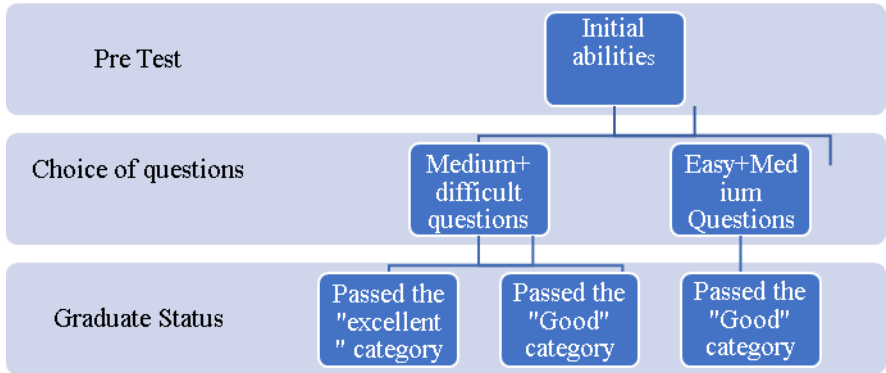
Based on an analysis of the needs for creating adaptive tests [6], which are meant to measure the level of skill of electrical engineering graduates, the final design of the adaptive tests can be summed up as follows:

- a. The question preparation assumes that students in the Electrical Engineering Study Program possess the necessary competence to understand the core concepts of the electrical power system.
- b. It is assumed that Electrical Engineering Study Program students' ability to understand the basic ideas of the electrical power system follows a normal pattern based on how they got into the program.
- c. Assumption of normality refers to the ability of students divided into three categories, namely underprivileged, good and very good
- d. Three categories are the basis for selecting the main questions of the competency exam
- e. For students in the underprivileged category, it means that they have to learn to better understand the main material of the electric power system. For students who are in the good category, they will choose easy and medium questions. For students with a very good category, the choice of questions is medium and difficult
- f. Selection of question types for competency tests based on the results of the Pretest conducted at the beginning of the test.

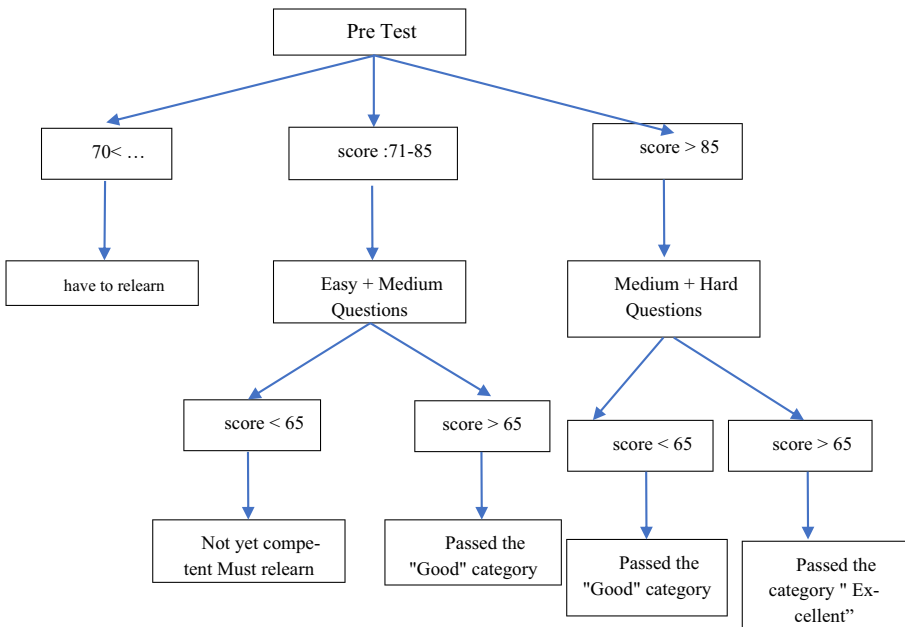
Design of adaptive test models as shown in fig. 1 and 2. Limited adaptive test in the development of competency tests aims to find out the extent of students' competency abilities towards the electric power system. The adaptation of question choice is limited to 3 categories of ability, not in its entirety to assess students' abilities to the point where students answer the test items correctly [7].

For students who are unable to achieve the minimum standard score in the pre-test, they must study again before taking the competency exam. This is because the pre-test includes question items with an easy and medium level of ability, using the same indicators as those in the main test.

The determination of the level of student competence is based on the standard score that has been determined, namely the graduation limit at the State University of Medan. This applies to the graduation limit in the pretest and in the selection of the main test question category [8]. The main test questions are divided into two categories, namely the category for passing well and the category of questions for passing with the category of very good. The minimum graduation limit is 65, pass with a good category of 75-84.9 and pass with a very good category of 85 and above.



**Fig. 1.** Adaptive Test Planning Design



**Fig. 2.** Logical Output Competency Test.

## 4 Conclusion

The adaptive competency test provides an alternative for students to choose question categories according to their maximum abilities.

Different types of test questions for electrical power systems are based on five main topics: electrical machines, lighting and power installations, basic electronics and digital microprocessors, and electrical circuits. The results of the adaptive test of the electric power system are divided into three levels: not passed or repeated, good category, and very good category.

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**Disclosure of Interests.** The authors have no competing interests to declare that are relevant to the content of this article.

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