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# Mapping the Spectrum of Expertise of Graduates from the Electrical Engineering Education Study Programme at Universitas Negeri Padang

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**Abstract**

Upon graduation, the aim of education graduates is to become qualified educators capable of meeting the needs of education, society, and industry. Graduates of the Electrical Engineering Education Study Programme are expected to possess superior competence and provide solutions to societal problems. The research conducted is descriptive in nature, utilising a qualitative approach. The study was carried out at the Faculty of Engineering, State University of Padang. The research instrument comprised documents such as course outlines, course synopses, and syllabi in Electrical Engineering Education at Padang State University. Data was collected through interviews and documentation. The study aimed to create a mapping of Electrical Engineering Education courses at Padang State University. The UNP Electrical Engineering Education program requires students to complete a set number of courses each semester. In semester 1, students must complete 22 semester credit system; in semester 2, 22 semester credit system; in semester 3, 22 semester credit system; in semester 4, 19 semester credit system; in semester 5, 22semester credit system; in semester 6, 20 semester credit system; in semester 7, 8 semester credit system; and in semester 8, 10 semester credit system of final courses. The requirement for Semester Credit Units for Electrical Engineering Education students at Padang State University is 145 credits.

## A. Introduction

A Bachelor of Education is a degree obtained by students after completing their studies in education. The goal of this degree is to prepare students to become qualified educators. Graduates are deployed directly to teach wherever they are placed, making good preparation essential for success in this field. Good preparation is necessary to become a Bachelor of Education. UNP, a higher education institution in Indonesia, is responding to this discourse by making efforts to establish a high-quality assurance system and implementing quality programmes. This will be achieved through continuous quality improvements, including the implementation of an external quality assurance system (SPME) through accreditation conducted by the National Accreditation Board for Higher Education (BAN PT) and international accreditation such as Asean University Network-Quality Assurance (AUN-QA).

AUN is a network organization of universities in ASEAN with the main purpose of strengthening and expanding cooperation in higher education between ASEAN countries. The ASEAN accreditation includes seven study programs: Electrical Engineering (FT), Physics (FMIPA), Management (FE), PE (FIK), Chemistry (FMIPA), and English (FBS)(Ganefri).

The Faculty of Engineering at Padang State University (FT UNP) is a higher education institution responsible for fulfilling the tri darma of higher education, which includes education, research, and service. FT UNP offers two educational pathways: a bachelor's degree (S1) in education and diploma programs (D3 and D4) in non-education fields. Consequently, FT UNP has the dual task of preparing both educational and non-educational personnel in engineering and vocational fields. This must be done in an integrated and synergistic manner.

Educational institutions must anticipate the rapid development of science and technology to prepare students and graduates for the workforce. According to Government Regulation No.17 of 2010, article 97, college curricula must be developed and implemented based on competence (KBK). According to Minister of Education and Culture Regulation No.049 of 2014 on National Higher Education Standards (SNPT), educational institutions are required to review and develop their curriculum by mapping and adjusting courses in accordance with the Spectrum of Expertise of Electrical Engineering Education Study Program Graduates, Expected Learning Outcomes (ELO), and Course Learning Outcomes (CLO).

The Electrical Engineering Department reviews the curriculum to ensure it aligns with technological developments and stakeholder needs, based on the aforementioned legal basis. It is necessary to study the implementation of the current curriculum and reconstruct it for the Department of Electrical Engineering at FT UNP.

Graduates are expected to meet the qualifications set by the world of work, enabling them to work both nationally and internationally. This is achieved through the development of the existing curriculum and reference to the AUN-QA qualification framework. The Department of Electrical Engineering Education at FT UNP aims to produce highly skilled professional educators in the field of electrical engineering in Indonesia by 2015, while remaining devoted to God Almighty.

Graduates of the Electrical Engineering Department possess both educational and non-educational skills. The aim is to compete in technology and vocational education in the field of electrical engineering with a focus on devotion to God Almighty. The objective is to apply innovative electrical engineering education at national and international levels, solve various problems independently and in groups, manage work groups, compile comprehensive written reports, make informed decisions based on analysis of information and data, take responsibility for work and achieve results, and carry out electrical engineering educational activities with self-confidence and strong character. To achieve these goals, relevant courses are necessary to support the formation of Faculty of Engineering UNP Electrical Engineering graduates in accordance with the desired profile.

## B. Research Method

The research conducted was descriptive and qualitative in nature. Descriptive research aims to provide a description of a phenomenon or event (9). The qualitative approach, (6), involves collecting data in the form of words and not using analytical procedures. It produces descriptive data in the form of written or spoken words from people or observed behavior.

Keirl and Miller (7) define qualitative research as a social science tradition that relies on observations, people, their own region, and relating to these people in their language and terminology. The qualitative method is a research approach used to investigate the state of natural objects. The researcher is the primary instrument, and data collection techniques are combined. Data analysis is inductive, and the results of qualitative research focus on meaning rather than generalization.

### 2.1 Research Instrument

Instruments are tools used to approach research targets. A research instrument is a tool used to measure observed natural and social phenomena (9). The main instrument in qualitative research is the instrument itself or members of the research team (8). In this research, the researcher acts as a data collector and an active instrument in collecting data in the field.

In addition to human data collection, various tools and documents can be used to support the validity of research results. However, these should only function as supporting instruments. The researcher's direct presence in the field is crucial for understanding the case being studied. This involves direct and active involvement with informants or other data sources.

### 2.2 Data collection technique

1. Interview, i.e. a series of written questions sent to respondents (by post, e-mail or other means of communication) and in person.
2. Documentation, i.e. collecting data by referring to various relevant documents.

### 2.3 Data Analysis Techniques

Data analysis is the process of systematically searching and compiling data obtained from interviews, field notes, and documentation by organising data into categories, describing them into units, synthesising them, arranging them into patterns, selecting names that are important and what will be studied, and drawing conclusions so that they can be easily understood by oneself and others (8).

Efforts to examine and compile the collected data, and then to process it and draw conclusions, are concrete efforts to make the data speak, because no matter how large the quantity and high the value of the collected data, if it is not arranged in an organisation and is not well systematic, then the data obtained from observations, field notes, or documentation will remain meaningless data and not easily understood by oneself or others. According to Miles and Huberman, qualitative data analysis is carried out interactively through data reduction, data display and verification processes. The steps for data analysis techniques in this research are as follows 1) Reduction. Data reduction is a process of coaching, focusing, paying attention, abstracting and transforming raw data from the field. This process takes place from the beginning to the end of the research as long as the research is being carried out; 2) Data presentation, Data presentation is a collection of structured information that provides the possibility of drawing conclusions and taking action, which is presented in the form of narrative text, networks and charts, among others. The aim is to make it easier to read and draw conclusions; 3) Verification and Conclusions, Verification is an integral part of activities and configuration. The meanings that emerge from the data are tested for truth and appropriateness to ensure their validity.

In the final part, the data are analysed qualitatively, in dialogue with the theories and concepts that have been presented and interpreted on a theoretical basis, while still referring to the primary data obtained in the field. The data obtained from the field is analysed interpretatively, which is an attempt to explain and compare the theories selected with the data processed. As explained by Sutrisno Hadi: "Inductive thinking is a process of analysis that starts with specific things and then draws general conclusions" (5). This means that through various processes of processing the data obtained, the author draws conclusions from the results of the research carried out by entering into a dialogue with existing theories.

**2.4 Data Validity Testing Plan**

In order to obtain the validity of the data, the researchers used several techniques to check the validity of the data, namely:

1) Technique to check the degree of trustworthiness.

This technique can be done by: a. The participation of the researcher as an instrument (tool) is not only carried out in a short period of time, but requires an extension of the researcher's participation, thereby allowing an increase in the degree of confidence in the data collected; b. Observation provisions, which aim to find characteristics and elements and situations that are very relevant to the problem being sought, and then focus on these things in detail. Thus, extended participation provides breadth, while persistence of observation provides depth; c. Triangulation is a technique for checking the validity of data that uses something other than the data for checking or comparison. The most commonly used technique is the examination of other sources; d. Adequacy of reference, i.e. recorded and recorded materials, can be used at any time as a benchmark for testing or evaluating data analysis and interpretation.

2) Transferability checking technique using detailed description.

This technique ensures that reports of the results of the research focus are as thorough and accurate as possible, describing the context in which the research

was conducted. The description must include everything that readers need to understand the findings.

3) Dependency checking technique through dependency auditing.

Techniques cannot be used unless they are accompanied by records of the conduct of the entire research process and the results. The recording is classified from the raw data, so that the formation of the instrument development is carried out before the auditing, in order to obtain the approval between the auditor and the auditee first.

In addition, in order for the data obtained to be truly objective, this research used the triangulation method to examine the data. The triangulation technique is a data verification technique that uses something other than the data itself to verify or compare the data. The triangulation technique used in this research is the source triangulation technique. This is in line with Moleong who stated that the triangulation technique used was checking through other sources.

Source triangulation can be achieved in the following ways: a. Comparing observation data with interview data; b. Comparing what people say in public with what they say in private; c. Comparing what was said during the research with all the times; d. Comparing one person's situation and perspective with different people's opinions and views; e. Comparing the results of the interview with the contents of a related document.

### 2.5 Research Results Description

#### 2.5.1 Research Overview

The Electrical Engineering Education Study Programme at Padang State University is one of the study programmes that has the opportunity to obtain an AUN QA Certificate by reconstructing its curriculum. In this research, the author mapped the existing courses, whether they were in accordance with the graduate profile or spectrum of graduate skills, Expected Learning Outcomes (ELO) and Course Learning Outcomes (CLO) in the Electrical Engineering Education Study Program.

The graduate profile is the most basic part of a programme plan, any graduate profile will be based on the needs of the graduate. Expected Learning Outcomes (ELO) are the structural outcomes or competencies that are expected from the content of the Objective Programme (PO) and the items that explain the content that must be present in a course. Course Learning Outcomes (CLO) include several professional output focuses which include teaching, engineering and vocational trainers. Course Learning Outcomes (CLO) are directional points that contain the existing focuses on Expected Learning Outcomes (ELO). After grouping the Expected Learning Outcomes (ELO) and Course Learning Outcomes (CLO) based on graduate profiles, a new course map will be formed according to the skill needs of graduates of the Electrical Engineering Education Study Programme, Padang State University.

#### 2.5.2 Research Focus

a. Graduate profile

The Graduate Profile will be prepared based on the stakeholders' wishes regarding PSPTE graduates. This graduate profile will be interpreted by researchers by combining the analysis of researchers and stakeholders.

b. Expected Learning Outcomes (ELO)

Expected Learning Outcomes (ELO) are structured outcomes or competencies expected from the content of the Programme Objective (PO). Expected Learning Outcomes (ELOs) are developed on several bases, including: expected learning outcome strategies can be calculated in accordance with the vision and mission of the institution, which are transparently known to faculty and students; expected learning outcomes (ELOs) are the results of graduate output; expected learning outcomes (ELOs) are designed to achieve specific capabilities, which include aspects of knowledge and skills as well as character at work; expected learning outcomes (ELOs) reflect the relevant needs of stakeholders. Expected Learning Outcomes (ELO) are grouped by researchers based on course categories, which include: 1) vocational courses, 2) technical courses, and 3) general courses (moral and environmental).

c. Course Learning Outcomes (CLO)

Course Learning Outcomes (CLO) are directional points that contain the existing focuses on Expected Learning Outcomes (ELO) and contain several professional output focuses that include teaching, engineering and vocational education instructors. A general overview of the research is given in Figure 1.

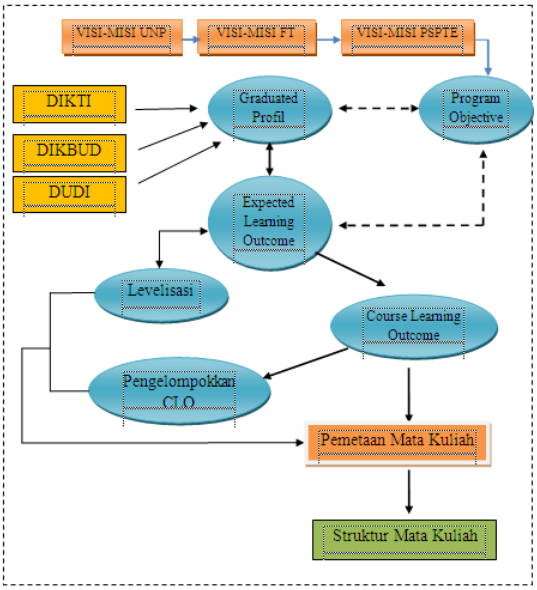


**Figure 1**. Research flow overview

The flowchart above is the process of organising the structure of the PSPTE course. Each flow component is prepared with reference to the standards set by AUN-QA. What the researchers will do is to map the UNP electrical engineering education courses from course leveling so that the courses are grouped into three, namely: vocational, technical, general (moral and environmental) education. The grouping of courses will be based on CLO as shown in Appendix 5. After grouping, you will get a mapping of the UNP electrical engineering education courses as shown in Appendix 7. Thus, from the mapping you can get the structure of UNP electrical engineering education courses.

### 2.5.3 Research findings

a. Profile of Graduates of Electrical Engineering Education Undergraduate

Study Programme prepared based on analysis of market needs based on tracer studies, analysis of developments in science and technology in the field of electrical

engineering, analysis of national and international qualification needs, vision and mission of Padang State University and owned resource capabilities. The electrical engineering graduate profile has 7 important points, which can be seen in Appendix 1.

b. Expected Learning Outcomes (ELO)

Expected Learning Outcomes (ELO) are structured outcomes or competencies that are expected from the content of the Programme Objective (PO). Expected Learning Outcomes (ELOs) are developed on several bases, including: expected learning outcome strategies can be calculated in accordance with the vision and mission of the institution, which are transparent to faculty and students; expected learning outcomes (ELOs) are the results of graduate output; ELOs are designed to achieve specific capabilities that include aspects of knowledge and skills as well as character in work; expected learning outcomes (ELOs) reflect the relevant needs of stakeholders. The Expected Learning Outcome (ELO) contains 17 items, which are arranged according to the needs of graduates in Appendix 2.

c. Course Learning Outcomes (CLO)

Course Learning Outcomes (CLO) are directional points that contain the existing focuses of the Expected Learning Outcomes (ELO) and contain several professional output focuses that include teaching, engineering and vocational training instructors. Course Learning Outcomes (CLO) is a small section that describes or supports the Expected Learning Outcome (ELO) contained in Appendix 3.

## C. Result and Discussion

In the current era of free markets, Indonesia must ensure that its citizens are prepared for the future. Universities must equip their graduates with the necessary skills to compete. UNP, an institution providing higher education in Indonesia, responds to this discourse by developing a curriculum and implementing a quality assurance system. The institution carries out continuous quality improvements by implementing an external quality assurance system (SPME) through accreditation by the National Accreditation Board for Higher Education (BAN PT) and international accreditation such as the Asean University Network-Quality Assurance (AUN-QA).

Padang State University, specifically the Department of Electrical Engineering Education, has developed an educational curriculum based on the requirements of DIKTI (Higher Education), DIKBUD (Education and Culture), and DUDI (Business and Industry). The course structure has been designed to meet the needs of these three institutions.

The Spectrum of Skills for Graduates of the Electrical Engineering Education Study Program at Padang State University is a field of expertise that aims to meet the educational, community, and industry needs. Graduates of the Electrical Engineering Education Study Program are expected to possess superior competence and provide solutions to problems that arise in society. Graduates are expected to participate in the nation's social, cultural, and economic progress and be ready to work anywhere. The researchers will map out the required courses or those suitable for graduates of Padang State University's electrical engineering education program.

This research aims to map the skills spectrum of PSPTE graduates. The objective program (PO) and graduated profile (GP) will be derived from stakeholder needs, which are aligned with the UNP Vision-Mission, FT Vision-Mission, and PSPTE Vision-Mission. The language used is clear, concise, and objective, adhering to formal register and conventional structure. Technical terms are explained when first used, and the text is free from grammatical errors, spelling mistakes, and punctuation errors. The expected learning outcomes (ELO) will be identified based on the graduated profile (GP) or existing graduate profile (7 points), consisting of 17 important points. These 17 points will lead to the Course Learning Outcome (CLO) supporting points, which describe the Expected Learning Outcomes (ELO). Based on this description, UNP electrical engineering education courses will be levelled using AUN-QA assessment standards. Levelisation involves assessing all courses based on ELO using the AUN-QA assessment standards, which consist of specific criteria. (1) The text is inadequate and requires immediate improvement. (2) The text is inadequate and needs improvement. (3) The text is inadequate, but minor improvements will make it adequate. (4) The text is adequate as expected. (5) The text is better than adequate. (6) These are examples of good practices. (7) The text is of a high standard.

In Appendix 4, the UNP electrical engineering education courses that have met the assessment standards are listed separately from those that have not. Following the levelization process, the courses will be grouped into three categories: vocational education, engineering, and general (moral and environmental), based on their corresponding CLOs. These categories can be found in Attachment 5. The CLO grouping indicates the appropriate CLOs for each course. The courses were then grouped based on the number of semester credit units and arranged according to the grouping in Appendix 6. The UNP electrical engineering education courses were mapped based on the CLO grouping and course groupings. This mapping resulted in a division of courses, such as: 1. The engineering courses are divided into control engineering, electrical energy utilization engineering, electrical power installation, and basic science. The moral and environmental subjects are divided into personality and social. The vocational education subjects are divided into curriculum, pedagogy, and research.

The researcher will create a course structure based on the mapping provided in attachment 7. The course structure for UNP electrical engineering education students in semester 1 includes 22 semester credit system (SKS) courses in engineering, morals, and the environment. This course is a fundamental course that introduces students to the basics of electrical engineering. Semester 2 comprises 22 semester credit system (SKS) courses in engineering, ethics, and environmental studies, as well as advanced courses in electrical engineering and personality. Semester 3 includes 22 semester credit system (SKS) engineering courses, while Semester 4 has 19 semester credit system (SKS) engineering courses. Semester 5 comprises 22 semester credit system (SKS) engineering courses, including practical and vocational courses. In semester 6, there are 20 semester credit system (SKS) courses covering vocational, moral, and environmental topics. Semester 7 includes 8 semester credit system (SKS) vocational courses, and semester 8 includes 10 semester credit system (SKS) final

courses that must be completed from the three groups of Electrical Engineering Education Courses. Industrial practice courses are available during semesters 5 and 6, while educational field practices are available during semesters 7 and 8. Therefore, students of Electrical Engineering Education at Padang State University must complete 145 credits in order to obtain the required number of Semester Credit Units (SKS).

## D. Conclusion

Universitas Negeri Padang (UNP), through its Electrical Engineering Education Study Program (PSPTE), has taken proactive steps to prepare its graduates for the challenges of the current free market era. UNP has developed a curriculum that is tailored to the needs of DIKTI (Higher Education), DIKBUD (Education and Culture), and DUDI (Business and Industry), ensuring that its graduates possess relevant competencies and can compete in the global job market. UNP has successfully formulated clear program objectives and expected graduate profiles through mapping the spectrum of graduate skills. This process leads to the determination of expected learning outcomes, which are then translated into learning objectives for each course. Additionally, the UNP electrical engineering education program assesses courses using the AUN-QA assessment standard to determine the level of achieved learning quality.

This assessment allows for differentiation between courses that meet the standards and those that do not, enabling grouping of courses by relevant areas of expertise. The categorisation of courses into three main groups - technical, vocational, and moral/environmental - facilitates the development of a well-organised curriculum structure. This results in a curriculum structure that encompasses basic to advanced courses, as well as the placement of practical industrial and educational courses in the appropriate semester. The determined number of Semester Credit Units (SKS) is in accordance with program requirements and practical aspects in the world of work.

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