Design of Electrical Engineer Profession Certification Model Based on Recognition of Prior Learning

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M Ali[1], D Laras[2], Zamtinah[3], Djemari[4] and Soenarto[5]

[1] Engineer Profession Program, Faculty of Engineering, Yogyakarta State University, Indonesia.
[2,3] Electrical Engineering Education Department, Yogyakarta State University, Indonesia.
[4,5] Graduate School, Yogyakarta State University, Indonesia.

E-mail: muhal@uny.ac.id

Abstract. The ultimate goal of this paper is to discuss and develop the conceptual model of an Electrical Engineering Profession Certification based on Recognition of Prior Learning (EEPC-RPL) integrated with learning outcomes, assessment system and learning process for Engineer Profession Program in Yogyakarta State University (YSU), Indonesia. In Engineer Profession Program, Yogyakarta State University, the paper based Recognition of Prior Learning (RPL) was used as a tools to evaluate competence of students' knowledge, skills and achievement. The method of this research used the research and development approach consisted of five steps, they are: 1) need analysis, 2) design the EEPC-RPL model, 3) development the EEPC-RPL system, 4) implementation of the system and 5) evaluation. There are fours concepts to be discussed: (a) aspects of EEPC based on RPL, (b) model of EEPC-RPL, (c) assessment system, and (d) learning outcomes of electrical engineer profession certification program.

1. Introduction

As a developing country, Indonesia needs physical and non-physical development that takes into account the safety assurance, security, comfort and environmental sustainability (Ali, 2018). The government of President Jokowi's era plans and implements large infrastructure development including the construction of 3,733 km of toll roads, 65 dams over a period of time, bridges, and the construction of power plants with a total capacity of 35,000 MW (Intan, S, 2017). To realize and succeed in infrastructure development, a competent engineer is needed in their field. The assessment of professional qualification of electrical engineer as a candidate in industry of engineering area is very important (W. E. Kelly 2007). Professional engineer (PE) have many specific fields that have different characteristics must be considered for effectiveness and efficiency in certification process.

Engineer is one of profession refers to a person who is licensed in at least one state or who has completed an engineering degree program. Accreditation Board for Engineering and Technology (ABET) have stated the criteria that must be fulfilled by graduate of engineering to get engineer qualification (Atsushi and Erin, 2015). Based on these definitions, licensing and registration may be seen as governmental functions that seek to control the practice of an occupation or profession.

License laws are often referred to as "practice acts" and usually outline boundaries of practice. Certification can be seen as control the process by which governmental or non-governmental agencies or associations grant authority to use a specific title to an individual who has met predetermined qualifications (G. Wilbanks, 2011).

The National Society of Professional Engineers (NSPE) had compiled 30 capabilities that categorized in three areas for Professional Engineer (NSPE, 2017): They are: 1) Basic Knowledge consisted of basic sciences, mathematics and engineering, 2) Technical Skills consisted of design, installation, engineering economic, device and tools, engineering experiments, problem identification and solving, quality and risk management, electrical safety, societal impact, model and system, operation and maintenance, sustainability. And 3) Professional Practice consisted of business aspect of ethical responsibility, management and leadership, communication skills, lifelong learning, project management, professionalism, and teamwork.

Professional Engineer in Indonesia was regulated in Engineer Law (UU/11) in 2014 article 50 paragraph 1 states that all engineering work must be handled by a Professional Engineer, and whoever is not an engineer carrying out engineering work can be subject to criminal. Engineering work includes 1) Earth and Energy, 2) Civil and Environmental Engineering, 3) Industrial Engineering, 4) Conservation and Management of Natural Resources, 5) Marine and Shipping Technology and 6) Aeronautics and Astronautics (Handojo, 2016). The term professional engineer in another country was called Professional Engineer (PE). To accommodate the profession, the engineers formed an organization called the Indonesian Engineers Association (PII) as an official appointed by the government. To get the recognition of Professional Engineers from the Indonesian Engineers Association (PII), engineering graduates, engineering education graduates and science scholars who work in engineering must first obtain an Engineer Degree (Ir.) In Higher Education through the Engineer profession program. The procedure of electrical engineer profession certification can be seen at fig. 1.

Engineer profession education program in Indonesia uses recognition prior learning (RPL) based on paper portfolio that consisted of prior experience after finished from university. The lecturers will assess and evaluate the level of knowledge and performance of students uses RPL form. There are several terms used in relation to RPL. RPL was called Accreditation of Prior Experiential Learning in Malaysia (Kaprawi, 2011), The Prior Learning Assessment in USA, Accreditation of Prior Learning in UK, Scotland and Ireland, the Prior Learning Assessment and Recognition in Canada (Zamtinah, 2016).

To anticipate the industrial revolution 4.0 and the development of information and communication technology, it is necessary to make improvements to the engineer profession certification program with ICT-based systems. These improvements are in accordance with the Ministry of Research and Higher Education’s policies to improve delivery of existing engineer profession education by online implementation. It aims to improve the quality and innovation in engineer profession education system through the use of ICT to create an interactive education system. In facing the challenges of globalization, the electrical engineer profession education system must develop flexible and integrated in teaching and learning process uses information and communication technology (Neal, 2011).

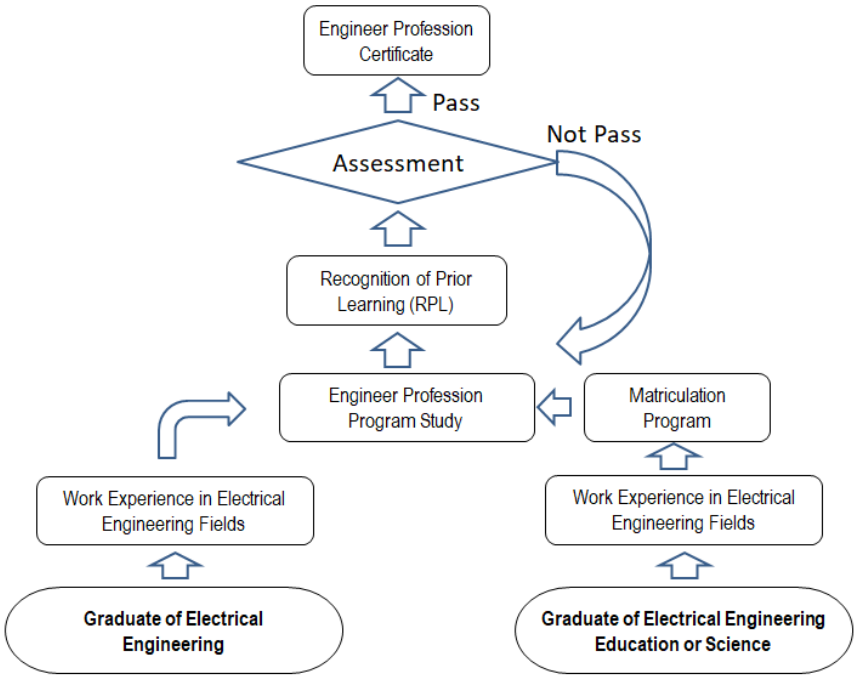

Figure 1. Flowchart of EEPC-RPL

2. Method

The EEPC-RPL is designed by research and development (R&D) methods based on ADDIE model that consisted of 5 stages are: 1) Analysis of the EEPC-RPL, 2) Design of the system, 3) Development and building EEPC-RPL system, 4) implementing EEPC-RPL, and 5). Evaluating and improvement.

2.1 Process 1: Analyze

The first phase is analysis of the EEPC-RPL system that done by Delphi method to find validation among electrical engineer experts using focus group discussion. The process begins with identification and analyse learning outcomes of electrical engineer profession program. The advance analyse were done by measurement of the data gathered by instrument that was used and distributed to electrical engineer experts.

2.2 Process 2: Design

The second phase is design of the EEPC-RPL system that derived from need analysis. EEPC-RPL system was designed based on engineer profession program curriculum and the result of expert's suggestions in previous stage. EEPC-RPL was designed in order to meet the competencies of electrical engineer based on curriculum and NSPE body of knowledge recommendations.

2.3 Process 3: Development

EEPC-RPL system consists of the application form for electrical engineer that must be filled by students. To ensure the assessment the student's application form, assessment rubric is developed to guide the lecturers to evaluate and assess the application. This process involves the production of EEPC-RPL in a real system.

2.4 Process 4: Implementation

The next phase is implementation of the EEPC-RPL system to evaluate and assess the students. Implementation will be done at Electrical Engineer Profession Program Faculty of Engineering, Yogyakarta State University. The implementation stage must be considered a lot of aspects to ensure that the developed system is suited with the needs.

2.5 Process 5: Evaluation

The EEPC-RPL system evaluation is done to test the feasibility of the content and technical aspects of the system. The evaluation means to collects data to improve the system so that it meets the requirements of electrical engineer profession certification program. The data from the evaluation is analyzed to identify the problems in the developing EEPC-RPL system and will be used to improve the system.

3. Conceptual Framework

The conceptual framework set out in Figure 1. shows the process of the electrical engineer profession certification.

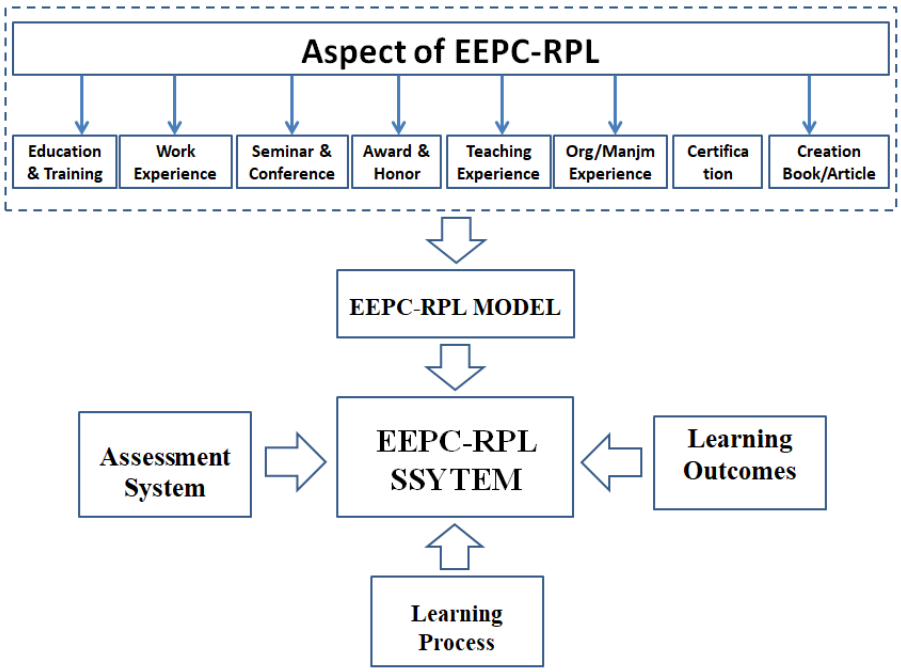

Figure 2. Conceptual Framework of EEPC-RPL

3.1 Aspect of EEPC-RPL

The principle of RPL had been present in education, both in academic, vocational and profession must be strongly suited with the practices of outcomes and competency-based learning. The assessment of students in Electrical Engineer Profession Program based on Recognition of Prior Learning consist of several aspects are: 1) education after finished S1 degree, 2) training experience, 3) work experience in electrical fields and others, 4) seminar and workshop experience both as participant, committee and speaker, 5) awarded and honor, 6) teaching experience, 7) organization and management experience,

8) certification both in electrical engineering and others, 8) publication, 9) creation, writing book and others.

3.2 Learning Outcomes and Curriculum

The learning outcomes of the Electrical Engineer Profession Program are 1) Mastering in basic science, mathematics and engineering, 2) Able to do electrical engineering work in accordance with professional ethics and engineering standards in a strategic and accountable manner, 3) Able to do electrical engineering planning and design by utilizing resources and conducting comprehensive evaluations by utilizing science and technology and 4) Able to solve engineering problems through a multidisciplinary approach with work management and professional communication in teamwork. The curriculum of Electrical Engineer Profession Program include of six (6) subject course are: 1) Engineer Ethics, 2) professionalism, 2) occupational Health and Safety, 4) engineering practice, 5) case study and 6) seminar.

3.3 Learning Process

Learning process in Electrical Engineer Profession Program focuses on achieving student learning outcomes. Learning process was done with blended learning model that combine classroom learning, workshops, field practice, case studies and seminars.

3.4 Assessment System

The assessment of electrical engineer profession certification based on recognition of prior learning. All of students must be arrange the prior experience and compiled it in RPL document based on their experience in electrical engineering work (electric generation system, transmission, distribution and installation, protection system, grounding and lightning protection, operating and maintenance, etc.). Assessment board will assess it based on rubric as a guide and give scoring to the students.

4. Conclusion

The use of RPL in Electrical Engineer Profession Certification Program at this time seems to work only as a repository of documents without connecting to the actual learning process. This system still cannot achieve the actual goal for assess and evaluate the students effectively. The development of EEPC-RPL system integrated with learning process, assessment system and learning outcomes, will give a comprehensive certification process in EEPC program.

Acknowledgments

Authors wishing to acknowledge assistance or encouragement from colleagues, special work by technical staff or financial support from organizations should do so in an unnumbered Acknowledgments section immediately following the last numbered section of the paper.

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