Innovation assessment with employability skills for vocational students in the electrical field

E Sulistiyo1,* and S C Wibawa2

1 Electrical Department, Universitas Negeri Surabaya, Surabaya, Indonesia 60231
2 Informatics Engineering Department, Universitas Negeri Surabaya, Surabaya, Indonesia 60231

*edysulistiyo@unesa.ac.id

Abstract. The mobility of students and the workforce between countries provides a challenge for universities to gain recognition from the global community on the results of their vocational education. This study aims to determine the outputs of the aspects of the quality of Project Base Learning (PjBL) learning outcomes which include: basic electronics and electrical knowledge, products, innovative, and creativity from the employability skills assessment model through PjBL to be better. The results refer to the assessment of employability skills through the PjBL showing that out of 100 students as respondents had a sensitivity of 85%; think newest and think adaptively 79%; 77% social intelligence; transdisciplinarity-literacy 85%; literacy ability 81%; design mindset 78%; cognitive management load 82%; virtual collaboration 84%; computational thinking, 88%. The implication that the implementation of Project Base Learning on students can be applied and validated properly.

1. Introduction

The report mentioned the skills and capabilities needed by workers at this time, sorted from the highest level of importance include: team working (67%), followed by sector-specific skills, communication skills, computer literacy, being able to adapt to new situations, first-class abilities in reading/writing, analytical and problem-solving skills, and planning and organizational skills (53% -62%) [1].

The application of project-based learning contributes to understanding why and how to drive an educational shift in electrical engineering that can educate students and improve 21st-century engineering skills [2].

PjBL is a student-centered learning strategy that can foster student initiative and focus students on the real world, projects that can increase motivation and encourage various abilities including practical knowledge and skills. The results showed that students match the ability to overcome high-level cognitive problems in a microcontroller (MCU) [3].

Research shows that students' cognitive abilities are positively influenced by the teaching and social presence, which is supported by the theoretical framework of CoI (Community of Inquiry) [4]. Learning using tools such as DSLR animation includes 21st-century learning because it can improve students' critical thinking and technology as supporting learning [5].

Challenges and strategies of 23 universities in Japan aimed at increasing employability skills (work skills). The university selected in the national project to "Improve Higher Education in Accordance with Industry Needs" funded by Japan's Ministry of Education, Culture, Sports, Science, and Technology
aims to improve the higher education system that can help develop the employability skills required by industry with various challenges and strategies who works with companies [6].

Early research shows that more than 90.9% want to use the PjBL learning model that is equipped with tasks in the PjBL project (90.9%) and must use the PjBL learning syntax according to the instructions that should be used. The average lecturer who uses the PjBL model considers the assessment of employability skills as very important to use, especially those related to; task design skills, technical planning, creativity and innovation, problem-solving skills, communication skills, oral presentation skills, information seeking skills, collaborative work skills, and class mastery skills.

The following points are about the employability skills needed in the future [1]:

- Having sensitivity, the ability to know more deeply the meaning or meaning of what is expressed;
- Think newest and think adaptively;
- Social intelligence has the ability to interrelate directly with others;
- Transdisciplinarity-literacy and the ability to understand concepts across disciplines;
- The ability of literacy to assess and develop content that uses new media, and to use media to make persuasive communication;
- Design mindset and ability to represent and develop work tasks and processes for desired results;
- The cognitive burden of management, the ability to sort and filter important information, and understand how to maximize cognitive function by using various tools and techniques;
- Virtual collaboration, the ability to work productively, encourage involvement, and show virtual team members’ presence;
- Computational thinking, the ability to translate large amounts of data into abstract concepts and understand data-based reasoning.

From preliminary research conducted on 36 students who take Audio Video courses using PjBL, it can be seen that the employability of student skills is still low, especially in technical planning, creativity, innovation, problem-solving skills, and information-seeking skills.

Based on the background of the problems outlined, it is necessary to conduct research on the development of an employability skills assessment model through project-based learning to increase the innovation and creativity of Unesa Electrical Engineering students. Considering the complexity of the problems, this research is limited to the electrical engineering department, because: (1) the background of researchers who have interests and empirical experience as managers of electrical engineering education; (2) the field of electrical engineering education has an advantage because the number of institutions and students (middle and high) is very large and has specific characteristics; (3) the field of electrical engineering is a developed industry; (4) the concern of the industrial world / electrical engineering business towards educational programs and high field experience; (5) the innovation of project-based learning programs in the field of electrical engineering is still open.

![Figure 1. PjBL learning in the electrical field [7].](image-url)
2. Method

2.1. Research model
The development method in this study refers to the R&D stage model recommended by Plomp [8]. Development according to Plomp includes: (1) the preliminary investigation phase (preliminary investigation), (2) the design phase, (3) the realization/construction phase, (4) the test, evaluation, and revision phase (test, evaluation and revision), and (5) implementation phase [8].

2.2. Assessment model
The employability skills assessment model developed through project-based learning consists of three elements: (1) students, (2) lecturers/mentors, and (3) program managers. Activities undertaken by students are: (a) obtaining lecture information with PjBL both general and specific, (b) carrying out assignments from mentors/instructors, (c) obtaining mentoring / mentorship programs from mentors/instructors.

The lecturer/mentor's activities are: (a) giving lectures, (b) providing debriefing and selection, (c) preparing RPS (Semester Learning Design), (d) coordinating implementation with study programs, (e) conducting lectures to students, (f) carry out student guidance and mentoring, (g) carry out study evaluations and product presentations.

Figure 2. Procedure for developing employability skills assessment through project-based learning [8].

2.3. Research component
A model has several components and each component has contents in it. The components and contents of each component are explained in Figure 3. In Figure 3 the components of the model consist of communication and information, facilitation, mentoring, monitoring, process evaluation, and results in the evaluation. The stages of development can be mapped into three, namely: (1) the pre-development stage, (2) the development stage, and (3) the stage of applying the model.
3. Results and discussion

After validation and revision are made and the product/model is fit and good, the model is tested. The trial was conducted with the aim to obtain information on whether the model is more effective than the old model or other models / conventional. Therefore, testing is done by experiment, which compares the effectiveness of old/conventional models with the developed model (strategy/assessment model of employability skills through project-based learning). Indicators of the effectiveness of the employability skills assessment model through project-based learning are (1) the mastery of electrical knowledge is higher, (2) the product is better, (3) creativity is higher, (4) student innovation is improved, (5) academic atmosphere is more good, (6) perception of management performance of managers is better.

3.1. Research instruments

In research, research instruments are used by researchers to collect data for later processing using statistical analysis, therefore it is very obligatory for researchers to compile and construct research instruments. The research instruments used include:

- The validation sheet of the employability skills assessment model through effective project-based learning can improve the innovation and creativity of Electrical Engineering Unesa students,
- Output sheet assessment of the quality aspects of PjBL learning outcomes which includes: basic electronics and electrical knowledge, products, innovative, and creativity from the employability skills assessment model through project-based learning (PjBL),
- the employability skill assessment sheet for the developed model has a very significant effect on the innovation and creativity of Electrical Engineering Unesa students,
- Evaluation sheet of management's response as a user of the model The employability skill assessment model through PjBL will significantly influence the innovation and creativity of Unesa electrical engineering students.
- Employability skills assessment sheet directly influences significantly the quality of learning outcomes with PjBL, and
- The assessment sheet about the academic atmosphere has a significant direct effect on the quality of PjBL. Repeated depictions of activities, goals, methods/techniques, social dynamics, and psychological achievements see Table 1.
- Respondents had a sensitivity of 85%; think newest and think adaptively 79%; 77% social intelligence; transdisciplinarity-literacy 85%; literacy ability 81%; design mindset 78%; cognitive management load 82%; virtual collaboration 84%; computational thinking, 88%.
Table 1. indicators an employability skill assessment through PjBL Interaction of thinking about PjBL learning.

| Activity                  | Goals                        | Method                      | Social Dynamics                          | Psychological achievements                      |
|---------------------------|------------------------------|-----------------------------|------------------------------------------|------------------------------------------------|
| **Fundamental problem**   | Adaptation and introduction  | Individual approach and     | Interaction of thinking about PjBL learning | Interaction of thinking about PjBL learning    |
|                           |                              | group approach              |                                          |                                                |
| **Understanding of the problem** | Problems and ideas about the subject | Discussion and sharing of experiences | Interaction of thoughts about PjBL | Build motivation |
| **Targeted question**     | Questions about challenging and workable tasks | Discussion and consultation | Individuals and groups | Critical analytical thinking, |
| **Learning environment**  | Obtain learning resources print, digital, hypertext, web | Participatory | Individuals and groups | Satisfaction and creativity |
| **Learning process**      | Steps to solve problems with higher-level thinking, critical thinking, | Individual and group direct practice | Individuals and groups | Study and work |
| **Coaching**              | Student interaction with lecturers, peer counselling, guiding | Individual and group direct practice | Student interactions with lecturers | Build a sense of responsibility |
| **Collaboration**         | Collaboration between students working in groups of three is important to clarify difficulties | Individual and group direct practice | Individuals and groups | Creativity and innovation |
| **Assessment**            | Assessment of students’ knowledge and competencies as a result of the project work being evaluated | Presentation and demonstration | Individuals and groups | Independent and group |

4. Conclusion
Overall, this study aims to find common ground on computer system materials that are generally students who have learning difficulties, so there are no reason students who have difficulty learning computer systems because the material can be used by students learning at any time. Based on the results of the analysis and discussion, it can be concluded that the implication that the implementation of Project Base Learning on students can be applied and validated properly.

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