Enhancing Personal Knowledge and Metacognitive Competence Through Work Based Learning Model: A Case Study on Electrical Measurement Skills

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Abstract. This study aims to determine: 1) the need for developing the Work Based Learning model and 2) the effectiveness of the Work Based Learning model in improving electricity measurement skills—data collection techniques through interviews and questionnaires. The research approach is development research (R&D) with Thiagarajan 4D (Define, Design, Develop, and Disseminate). Data were analyzed with descriptive, qualitative, and inferential statistics. This research is a qualitative descriptive study that analyses the material requirements for developing learning models. The results of the research are in the form of Work Based Learning model products for the practice of electricity measurement for Taruna TBU, which are feasible and effective: 1) the need for professional identity aspects of personal knowledge and metacognitive competence contributed most to the achievement of electrical measurement skills, 2) the test results in the experimental class group TBU IX with WBL model learning were adequate compared to the results of the control class group TBU X through traditional learning. It was concluded that learning the WBL model could effectively improve the electrical measurement skills of Cadets TBU IX.

Keywords: Needs Analysis · Work-Based Learning · Electrical Measurement

1 Introduction

Makassar Aviation Polytechnic is an official vocational education with the vision of becoming a superior Polytechnic, characterized and accountable for producing competent, professional and globally competitive aviation Human Resources (HR). Through its curriculum and education system, it aspires to create graduates capable of sustainable aviation transportation. School innovation and training institutions need to respond to shifting competency requirements by adjusting pedagogical practices, assessments, curricula, and learning environments that contribute to creating creative workers [1, 2]. Makassar Aviation Polytechnic with a learning curriculum of 30% theory and 70% practice, emphasizing that exercise is more dominant than theory which is the hallmark of vocational education. Practical learning can shape the psychomotor aspects of

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students/cadets focused on mastering practical skills in the workplace through On Job Training (OJT) practices or apprenticeships. According to Wijaya, apprenticeship is a mandatory program for outstanding students that effectively supports practical work courses to improve abilities, skills, and attitudes [3].

The phenomenon of apprenticeship, it is known, is that TBU Cadets are still experiencing obstacles at work at the airport. Electricity measurements constrain more than 60% of OJT practice cadets with an analog multimeter to measure SQFL voltage, CT CCR current and UPS battery voltage measurements. Student's difficulties in analyzing electrical circuits impact work results that are not optimally caused by a mismatch of learning materials and methods [4]. Raelin emphasizes applying Work Based Learning (WBL) learning in schools by involving school partnerships and organizations that provide work opportunities as experiential education [5]. Lafton & Furu argued that WBL is adequate for the complexity of schooling by outlining learning concepts applied in practice [6]. This is due to a weakness in students' cognitive understanding, so they find it difficult to know their development and have limited reflection on their learning experience [7]. These problems are traditional learning, an obstacle to connectivity between professional competencies and competencies in the workplace. This requires mandatory placement, school-to-work alignment, job-based supervisors, access to resources, and task complexity are significant moderators between competencies learned in schools and competencies used in the workplace [8].

1.1 Professional Competence

Rauner and colleagues describe how Technical, and Vocational Education Training (TVET) school teachers develop and evaluate student competency [9]. They use theoretical and empirical models to test and better understand the strengths and weaknesses of their teaching and training methods. This includes using competency assessments to measure cognitive performance and focus on professional action competence as a critical factor in measuring professional competency.

Peterson et al. suggest that the traditional view of professional competence involves the application of scientific knowledge developed through laboratory experiments or field research to solve human problems [10]. In contrast, professional competence is generally regarded as a trait or quality of existence characterized by having adequate resources, readiness, and knowledge [11]. Thus, professional competence is the individual competence of learners in each lecture, including developing learning materials that are mastered creatively and professional development on an ongoing basis by taking reflective actions.

1.2 Work-Based Learning (WBL)

WBL complied Helyer et al. described that students in the WBL program could positively contribute to the organization. For this, it is necessary to engage effectively with work stakeholders and keep their interests in mind significantly through work-based projects [12]. Raelin states that WBL's relation of theory to practice, knowledge to experience, and the workplace offers many classroom learning opportunities [5]. WBL complied

with Gibbs [13], explaining that epistemologically and ontologically is potentially critical because a closed course cannot total the logical practice; it is challenging to see WBL as fully part of a field dominated by theorizing discourse. Ian Cunningham assumes that the transfer of learning is a learning process that approaches job requirements: The organizational context for transfer and Transfer of education and the individual [14]. Connectivity and transformation of knowledge embedded in social practices, environments, tools, and notions have important implications for training [15]. More broadly, vocational school learning transfers are divided into organizational transfers, individual transfers, and placing professional identity on professional knowledge and personal knowledge.

2 Method

This research method with a qualitative and quantitative descriptive approach. Data collection techniques with observation, interviews and questionnaires. The research approach is development research (R&D) with Thiagarajan 4D (Define, Design, Develop, and Disseminate). The research subjects were four lecturers in electrical measurement and 24 cadets of the TBU Study Program at the Makassar Aviation Polytechnic for the 2021/2022 academic year. The object of research includes aspects, namely: professional identity, including parts of professional knowledge, aspects of personal expertise and aspects of self-evaluation. Data analysis techniques were carried out through qualitative, descriptive and inferential analysis.

Research framework with the R&D model Borg and Gall (2014) [16] stages 4D Thiagarajan (1974) [17]. The defined stage research conducted observations, direct observations and interviews with Cadets of TBU IX and lecturers. At this stage, the researcher will identify and analyze the needs of professional knowledge, personal knowledge and self-evaluation related to learning the practice of electrical measurements. The design stage is to design instruments and learning tools for work-based electricity measurement practices adapted to the needs of the three aspects mentioned above. Develop step, validating learning instruments and tools through FGD by the validator team, improving validation results and continuing trials in a class by dividing the experimental class with the WBL Cadets TBU IX model and the control class using the traditional Cadets TBU X method to find out the effectiveness of the WBL model learning. In addition, to find out the response of TBU Cadets in using the practice module was carried out through a questionnaire, while observers assessed the response to the WBL-based electricity measurement practice activity. The dissemination stage is carried out through seminars to get answers and publication of articles as wide dissemination of information on the final product of the WBL model.

Table 1. Summary of Interview Results

Subject	Description
Lecturer interview	The performance of the lecturers guiding the cadets in measuring electricity is quite good, but the lecturers still need efforts to improve the skills of the cadets regarding the development of measurement practices focused on measuring electrical equipment, such as those at the airport.
Lecturer questionnaire	Overall, the lecturer has fulfilled the requirements as a teacher of electricity measurement practice in professional identity, professional knowledge, and self-evaluation in guiding the Cadet's training.
Cadets Interview	Professional identity aspects of cadets' professional knowledge, personal knowledge, and self-evaluation aspects are not a good or low category.
Cadets Questionnaire	In general, the results of observations on the three aspects are categorized as less optimistic and not positive. This explains that cadets' professional knowledge, personal knowledge, and self-evaluation are classified as low.

3 Results and Discussion

3.1 Interview Results and Questionnaire Aspects of Professional Knowledge, Personal Knowledge, and Aspects of Self-evaluation

3.1.1 Define Stage

The information pertains to evaluating the lecturers and cadets involved in measuring electricity. The performance of the lecturers in guiding the cadets in this practice is good, but there is still room for improvement in developing the cadets' skills in measuring electrical equipment, especially those used at airports. According to the lecturer questionnaire, the lecturer has fulfilled the requirements as a teacher of electricity measurement practice regarding professional identity, professional knowledge, and self-evaluation in guiding the cadets' training. However, based on the cadets' interviews and questionnaires, the cadets' professional knowledge, personal knowledge, and self-evaluation are not good or low. The results of observations on these three aspects are categorized as less cheerful and not optimistic, indicating that the cadets need to improve in these areas (Table 1).

3.1.2 Design Stage

See Table 2.

3.1.3 Development Stage

The results of the questionnaire on the close relationship between aspects of professional knowledge, personal knowledge, and self-evaluation of TBU Cadets on electricity measurement skills simultaneously are as follows:

Table 2. WBL Model Prototype

WBL Model Prototype	Description
Model goal	To assess measurement practice and improve electricity measurement skills by learning the WBL Taruna TBU model
Model characteristics	1. Integration of electrical measurement practice learning with aspects of professional knowledge, personal knowledge, and work-based self-evaluation 2. The practice of measuring electricity made in the workflow according to the achievement targets for the skills needed in the workplace
Model components	RPS learning tools, teaching modules, and WBL-based practice modules Assessment instruments in the form of test and non-test questions (questionnaire) Instrument assessment result data
Model syntax	1. Initiation; 2. Selection; 3. Exploration; 4. Formulation; 5. Collection; 6. Presentation; 7. Assessment
Modeling instrument	1. Observation of the lecturer's ability to manage WBL learning 2. Observation of educational design and work environment 3. Observation of cadet activity response to WBL learning 4. Questionnaire on the aspect of professional identity, the element of personal knowledge, and the part of self-evaluation 5. Response questionnaire to learning the WBL model
Model usage guide	Contains guidelines: implementing the WBL model learning, how to collect information, how to use the information, and how to make a report on the results

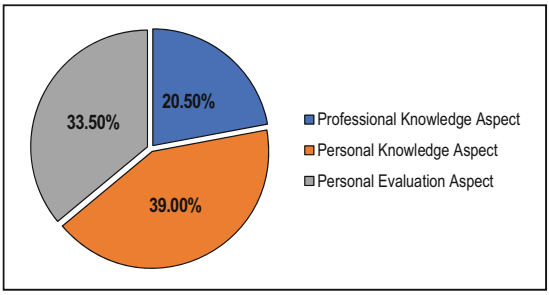

Fig. 1. Results of the Cadets Questionnaire

Figure 1, personal knowledge gains 39%, or it can be said that this aspect contributes more to improving electricity measurement skills.

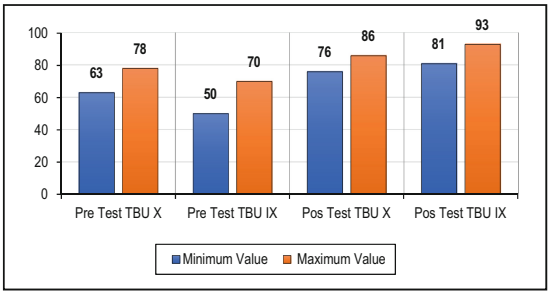

Fig. 2. Pre-Test Result and Post-Test Result Data of Cadets TBU

Figure 2 shows that the learning outcomes of electrical measurement practices with the WBL model have a positive effect compared to conventional methods in improving the learning outcomes of Cadets TBU IX.

3.1.4 Results of the WBL Model Effectiveness Test

The results of the calculation of the N-gain score test are used to determine the effectiveness of the WBL model, as shown below:

Figure 3 shows that the average value of the experimental class was obtained at 73.50% or that the WBL model is more effective in improving the skills of measuring electricity for Cadets TBU IX.

Based on the results of interviews with four lecturers on professional identity, aspects of professional knowledge and aspects of self-evaluation in practical guidance, it is carried out professionally in guiding Cadets TBU IX. Meanwhile, the results of interviews with Taruna TBU IX on these three aspects showed that there was an aspect of personal knowledge in their low metacognitive competence. In this regard, it seems essential that lecturers must be able to increase metacognitive activities so that TBU cadets can develop personal knowledge. Lecturers must provide practical electrical measurement jobs that begin with basic electrical measurement practical activities, such as measuring current and voltage on components similar to CCR, SQFL and UPS equipment objects. Cadets are encouraged to reflect on the material in the primary electrical measurement

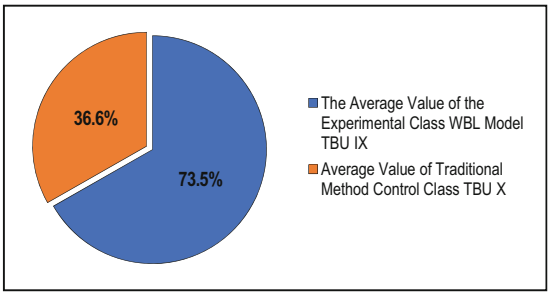

Fig. 3. N-Gain Value of Experiment Class and Control Class

practice job that they have learned through independent presentations and discussions and conducting self-evaluations so that they can find out their strengths and weaknesses. Therefore, lecturers need to build practical learning by training the thinking level of TBU cadets through suitable jobs designed with the right learning strategy.

4 Conclusion

Referring to the stated research objectives, it can be concluded that professional identity factors, aspects of personal knowledge, and metacognitive competence contribute the most to the achievement of electrical measurement skills. This aspect is the material requirements used to develop the WBL model. The learning results of practical electricity measurements through tests in the experimental class group TBU IX in WBL mode were more effective than the empirical learning results of electricity measurements in the TBU X control group using traditional methods. This WBL learning model can solve problems in electricity measurement practices discovered by themselves so that TBU Cadets can be motivated to work collaboratively in teams and add confidence to their future careers.

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