Assimilate of work competencies standard into learning outcomes standard to face the G-4.0 era

P Handayani* and T Y Putro
Study Program of Electronic Engineering, Politeknik Negeri Bandung, Bandung, Indonesia

*penihandayani@ymail.com

Abstract. Competences of students which collected in the last three years from industries during they conducted internship showed that they have good basic technical knowledge and skills, but work ethic should be improved. This research aims to develop learning process and assessment model to assimilate the work competences standard into learning outcomes. It has taken case study in the Electronic Study Program in Politeknik Negeri Bandung (Polban). Data collected by qualitative approach to find the appropriate learning condition in the workplace that can adopted into learning process and assessment in the campus. This research reveal that work competences cannot be built only by introducing work knowledge at the laboratory, but the students must be directly involved in work situation included assessment of work product and their performed in the end of the work even though it is done in the laboratory. This model could shift “way of thinking and learning of students” so that they more ready to face the world of work than before. Works assignment plays the main role in this case.

1. Introduction

The rapid changing of work field as an impact of technology have been responded by education institutions frequently by adjusting the content or materials of learning and teaching without change the process of learning, teaching and assessment although the base of its curriculum design has been changed. It made the education world difficult to define the direction of education, especially vocational institution as an institution that should supply skilled workers [1]. Many factors were influence this condition: for examples many lecturers were unaware that curriculum revision is not just changes of learning materials, but also should change the process and assessment method. They may don’t know that the students in the RI4.0 era have difference “lifestyle” or they don’t know how start the changing [2,3].

Many new jobs and works opportunity that we cannot imagine before have emerged in the last decade years. All countries revised their policies and priority programs to face this era. Vocational education and training institutions should change their learning targets and strategic to implement their new curriculum. The needs of work competencies should be redefined in order to be compatible with this situation. Many competencies have short lifetime, especially in the electronics field. Technical skills that needs to be built through a long learning process will expire when student graduate. The students have learning style which is difference from previous generations. They learn from many resources. They prefer learned from media such as YouTube and then engage activities learning in the classroom with their lecturer [4]. The lecturer now has the role as a facilitator.
In the other side, the implementation of ICT in all work sectors influenced pattern of work and triggers many opportunities to emerge new jobs that unimaginable before. The work characteristic in the era industry 4.0 is customize, personal, networking, fast transaction, need higher knowledge and technology. Vocational educations must be flexible in the design of their curriculum [1,4-6]. UNESCO World Bank for Africa Region Reported that it need higher skills and knowledge human resources to compete successfully in the new globalized era [7]. Meanwhile, the designing vocational curriculum, people frequently were focused on adjusting content of learning related to new technology. It was not followed by developing of learning process, designing of assessment method and tools, up grading laboratory equipment and tools for work, etc. [8]. The assessment has been more focused on cognitive aspect than performance of other aspect. It impacted the performance of vocational competencies cannot be measured. The assessment must include three dimensions, namely cognitive, affective, and psychomotor dimensions. Assessment tools must be developed in all dimensions comprehensively by breaking down it into learning targets and thinking skills. It can be organized by using taxonomies of learning targets. For example: Bloom-Anderson’s Taxonomy can be used to develop learning targets in the cognitive dimension; the Krathwohl taxonomy can be used to develop learning targets in the affective dimension; and the Harrow taxonomy can be used to develop learning targets in the psychomotor dimension [7].

Learning targets sometimes referred to as learning outcomes (LO) or graduate competencies must be converted into capability to enable graduates can work well in the latest work patterns [6]. The definition of competences and the levels for assessing the competences can be developed based on the context in which competences should be developed [9].

Learning outcomes which are established by every higher education especially by polytechnic as a higher vocational education must be matched with the qualification in the workplace. AEC give many opportunities to everybody to work in any country of AEC member. Graduates of higher vocational education will face into work situation which is connected to other work organization in the world. So that they are demanded to be able to communicate effectively using foreign language, work in a discipline manner, honest and responsible, use knowledge to do jobs [5,7]. Human resource plays the main role in the global competitiveness. People must have an ability to innovate. Innovation is an ability to generate and apply knowledge and idea in the workplace and in society in large [10]. The question is how to prepare the students, so they have qualification which are needed in the world of work in their era.

This research aims to develop learning process and assessment model to assimilate the work competence standards into learning outcomes for maintenance and repair of electronics work. Even though the work competency changes rapidly, but the standard of work competencies is still needed for reference of quality performance.

2. Method
This research used qualitative method to collect main data such as: The Indonesian National of Work Competencies Standard (SKKNI) in the Maintenance and Repair sector, the Learning Outcomes (LOs) of Electronics Maintenance and Repair (MR) Subject and other subject related to the work of MR include its performance indicators. This data has been explored from curriculum document, teaching planning for this subject, the internal regulations, and information related to the models of competencies assessment which has been explored through literature tracing, and interviewed apprentice students. The standard of work competencies needed in the workplace has been explored by observation and interviewing the students who have been apprenticed.

3. Results and discussion
Preliminary study of this research revealed that in the last three years, the graduates have good knowledge and basic skills to do job at the operator level (Level-3 KKNI) during internship, but the work ethic such as creativity, independence in learning, struggling of self-development, discipline must be improved. They should be able to do work that qualifies at least as level-4 KKNI. This fact which
was collected by interviewing apprentice students and industrial experts is rather surprising because they have learned by practice more than in the theory (60% practice and 40% theory). They should have higher knowledge and skills than high vocational school leaver (level-3 KKNI), but why is it happened? It has inspired to start this research form this point to find out the answer.

Data from curriculum showed that curriculum has been designed by collected the information from industries about competencies and qualification needed in the workplace, and by taking account the regulations and curriculum development guidelines of the ministry of higher education. Based on this information, the standard of learning outcomes and teaching materials have been updated to face the new technology which is used in industries.

Now let see the learning process. In the basic level (first year), the learning activities in the laboratory so far have only been to provide opportunities for students to strengthen their perception of the theories they are learning and built the basic skills such as using electronics measuring instrument, and assembling electronic devices and an instrument set in the assembled circuit. They did their task according to the works step guide in the job sheets which has been focused on electric variables measurement. Then they determined conclusion based-on the measured data. Students and lecturers were almost complete lack of awareness of the issue that these activities are part of work training. Moreover, the most of lecturers don’t have industrial work experience. The style of this laboratories activities still be used until the last year of the education programme. At the end of 4\textsuperscript{th} semester (for 3 years programme) or the end of 6\textsuperscript{th} semester (for 4 years programme), the students must take an internship program in industry for 3 months. During this programme, they have been introduced about company profile, work process orientation, and conducted technical activities such as electronic equipment testing as part of maintenance activities. They didn’t know well about work standard and procedure such as technical standard, procedure, and product in the workplace. Three months or less is a short time for students to build a new habit such as a work ethic or work culture in industry. Therefore, work ethic must be introduced as early as possible in the learning process in polytechnic. This problem is not about technology as learning materials, but the learning process and assessment.

Competencies as LOs must be monitored periodically. The progress of LOs achievement need to be planned and classified into various levels of complexity. The LOs can be assessed in three domains namely: cognitive, affective, and psychomotor domains. In the cognitive domain, LOs are focused on knowledge and abilities requiring memory, thinking and reasoning process. LOs in the affective domain are focused on feelings, interests, attitudes, dispositions, and emotional states. In the psychomotor domain, LOs are focused on motor skills and perceptual progress [7]. Collected data from observation and documents tracer related to LOs achievement at 3\textsuperscript{rd} and 4\textsuperscript{th} semester showed that LOs mostly were focused on cognitive domain, and most students have difficulties to express their mind. They stuck in detail and didn’t understand about the basic concept of theory, so that they couldn’t apply the knowledge or theory to discuss or give reasoning to explain data or phenomena which they have measured. They also lack information about the opportunity and challenges in the workplaces. This condition decreased the spirit of struggle to self-developments.

These facts showed that in the education, the curriculum review which is interpreted just change the subject and/or materials of subject is not enough to build competencies. The learning process and assessment also be concerned and planned seriously. Collaboration between education and enterprises must be improved by sharing knowledge and resources. These problem and expectations may be solved by assimilate the work competencies standard include work ethic into work assignments in the laboratories and workshop during they learn in Polytechnic.

This paper proposes a model of assimilation that carried out through the stages as describe in Figure 1. Firstly, determine the work sector or sub-sector as a model of work. This research has taken case study for Maintenance and Repair (MR) work in industrial automation sector, sub-sector Maintenance and Repair Electronics equipment. Second step, identify the work competencies needed, include work process standard or procedures. In the other side, identify academic competencies that expressed by Learning Outcomes (LOs) of subjects related to Electronics MR. Third step, LOs must be broken down
into performance criteria standard. These criteria should be benchmarked and aligned it with work criteria standard at the 3rd step. In this step assessment tool should be developed as well.

Fourth step develop work assignment in the laboratory activities to enrich knowledge and work experiences. The achievement of vocational competencies which is blended competencies of works and academic, can be monitored or assessed periodically.

Figure 1. The model of assimilation process.

The benchmarking of LOs to work competencies and its performance criteria revealed that work competency units have performance criteria which describe types and level of work assignment, responsibility of its work result, management ability of work, discipline in procedure and standard process, and the quality of work result, while LOs have performance criteria that are focused on cognitive achievement. The biggest form of responsibility in academic domain is plagiarism-free. Now the academic performance is more dominant than work performance. It is not vocational education characteristic. While it’s mastery of work abilities or work skills during internship are equivalent to the operator level (level 2-3 KKNI). The achievement work ability should be equivalent to the level 4 KKNI.

Figure 2. Starting work culture through vocational character building.

The gap between work competencies and LOs can be used to enrich the work assignment, or to improve learning and teaching method in the laboratory. This gap could be solved by introducing more work competencies than before through laboratory activities. The vision of laboratory activities is no longer to strengthen of the theory perception, but to strengthen of the perception that laboratory activities are part of learning and work. The function and capacity of laboratory must be upgraded to support the
higher achievement of LOs and work experiences. Laboratory activities must help students to develop their learning ability and create ideas to solve problems in the workplace or in new situations they face. Related to the application of internet, students must have the ability to select the information source that is suitable for use as a reference to solve problems. The learning targets must be directed to the habit of work standards or work ethics and culture in industries, besides enriching academic competencies as well. Learning targets in the laboratory should be able to raise student awareness that these activities are part of their work. In other words, the vocational character must be enriched through the laboratory activities as shown in Figure 2. Work assignment-based learning can be used to build vocational character and to grow the ethics, culture of work, and to foster students to use their knowledge to do jobs. It needs an environment to maintain and strengthen this character. Performance criteria and work standards should be socialized to them so that “a new habit” can be built from their own sense. The goals written on each job sheet must contain academic ability and the work targets that must be achieved. The students also need support from lecturers to appreciate their “new style of learning”. They preferred firstly to learn from digital media and then engage in class discussions about concept theories with their lecturer and other students. The limited implementation of this model shows that this learning strategy can change the student performance toward a good work ethic with better ability in applying their knowledge even under supervision. The progress of performance achievement of students has been monitored periodically according to the stage of learning targets. The students now have more opportunities than before to get certification of competence which is conducted by the National Board of Professional Certification (BNSP).

4. Conclusion
The assimilation of work competencies into learning outcomes can be used to cope with the disparity between the outcomes of polytechnic education and the needs of the workforce that is rapidly changing. This learning strategy can change the mindset and performance of students toward a good work attitude with better ability in applying their knowledge even under supervision.

The laboratory activities are the best opportunity to train and assimilate work skills and attitudes while applying knowledge to work. This process requires adequate laboratory capacity and environmental support, such as learning and assessment methods, students who have learning difficulties, and professional lecturers.

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