

**PROJECT WORK USED IN A COMPREHENSIVE ASSESSMENT
TO MEASURE COMPETENCES OF UNDERGRADUATE
ENGINEERING STUDENTS**

*Sudiyatno, Engineering Faculty YSU
sudiyatno@uny.ac.id*

Abstract

Assessment of student learning outcomes is not only based institutional criteria, but also based on professional criteria. Several general criteria of learning outcomes have been in Indonesian Qualification Framework (KKNI) and National Educational Standard of Higher Education (Permendikbud 49/2014). This paper shows an authentic assessment model to measure comprehensively competences of undergraduate engineering students based on the two criteria. The method used to develop the assessment model is mainly based on papers produced by researches in applying various assessment models in engineering education, one of them was Kano's Model of Customer Needs. The comprehensive assessment model developed has two main parts. One part contains what and how students should work and produce a product. Another part is about what and how lectures should prepare, organize and deliver the instrument during assessment process in classrooms/workplaces. The object used in this assessment model is the final project work which demonstrates the student achievement in mastering the learning objectives (an ability to identify, formulate and solve engineering problems). The final marking of learning outcomes are separated in four categories: exceeds expectations, meets expectations, need improvements and unacceptable. These four categories are then converted into four grades, as stated in the Standard, : A, B,C, and D.

Keywords: qualification framework, undergraduate student, final project, comprehensive assessment

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*Sudiyatno, Engineering Faculty YSU
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A. Introduction

The question of how to improve our higher education quality is a hot issue especially after Indonesian Government spent a huge of money to pay incentives for professional teachers and lecturers. The Government has launched national standar of higher education (Permendikbud No. 49/2014). In this Standard, it is stated clearly that learning outcomes of any educational institutions should meet the Indonesian Qualification Framework (IQF) consisting nine levels of qualification as shown in Figure 1. All the levels have four components: 1). moral and ethics; 2) work competences; 3) knowledge comprehensions; and 4) autonomy and responsibility. Therefore higher education institutions should reset their educational goals which are met the National Standard and IQF.

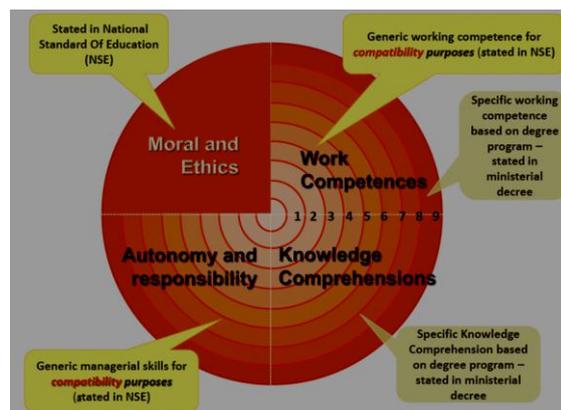


Figure 1. Indonesian Qualification Framework

Improving the higher education quality, for example in engineering, it means increasing the graduate (engineer) competences. According to [1] in preparing engineering students for the 21st century, they must be equipped to be

global engineers who are technically versatile (multi-disciplinary), able to solve problems from a systems-level perspective, effective communicators, function in diverse ethnic teams and demonstrate social responsibility. The quality of graduate competences can be improved by redesigning curricula to provide a proper learning environment for students to develop their competences. In addition, improving student's competences can be obtained by developing an effective assessment plan but with the flexibility to adapted for a variety of settings and purposes [2].

Most undergraduate engineering programs uses project works as the final examination. It is because educational programs for undergraduate engineering students are put more emphasis on practical abilities. This project-oriented approach is designed to improve the practical ability of students; to give the opportunity to explore and solve problems with a real application; to deepen their understanding of the course; and promote multidisciplinary work [3]. In addition cooperation with industries is established to get real world applications in technology.

This paper shows an authentic assessment model to measure comprehensively competences of undergraduate engineering students based on Indonesian Qualification Framework (KKNI) and National Standard of Higher Education. A case study is also presented to illustrate how to use the project-oriented approach to measure undergraduate engineering student competences. At the end of this paper, it will be a discussion of the importance of establishing collaborations among universities, educational researchers and industries.

B. Learning Outcomes and Assessment of Final Project Work

It has been clearly requires in the National Standard that graduates of undergraduate program demonstrate four components of learning outcomes: 1) moral and ethics, stated in the National Standard; 2) work competences (generic working competences for compatibility purposes, stated in the National Standard and specific working competence based on degree program, stated in ministerial decree); 3) knowledge competences (specific knowledge comprehension based on

degree program, stated in ministerial decree); and 4) autonomy and responsibility (generic managerial skills for compatibility purposes, stated in the National Standard). There are ten criteria in moral and ethics: devoted to God and shows religious attitude; uphold the human values; contribute to improve quality of societal-life; nationalist; appreciate to diversity; tolerance; having social empathy; and having responsibility and entrepreneurship.

The generic working competences for compatibility purposes, stated in the National Standard, consists of nine criteria: 1) an ability of apply logical, critical, systematic thinking; 2) an ability to show performance independently, qualified and measurable; 3) an ability to review application of science and technology; 4) an ability to construct scientific description as final project; 5) an ability to make accurate decisions based valid data and information; 6) an ability to develop and maintain networking; 7) an ability to be responsible for his/her jobs; 8) an ability to do self evaluation; 9) an ability to compile, store, secure and discover data.

General criteria of student outcomes for baccalaureate level program, stated in Accreditation Board for Engineering and Technology (ABET) criterion 3, engineering programs must demonstrate that their graduates have an ability: 1) to apply knowledge of mathematics, science, and engineering; 2) to design and conduct experiments, as well as to analyze and interpret data; 3) to design a system, component, or process to meet desired needs; 4) to function on multidisciplinary teams; 5) to identify, formulate, and solve engineering problems; 6) an understanding of professional and ethical responsibility; 7) to communicate effectively; 8) the broad education necessary to understand the impact of engineering solution in global and societal context; a recognition of the need for, and ability to engage in, life-long learning; 9) a knowledge of contemporary issues; and 10) to use the technique, skills, and modern engineering tools necessary for engineering practice.

Both above criteria are similar where student performances are not judged in term of classes passed, but based on outcomes-based assessment. To shift the focus of evaluation to ‘student outcomes assessment’, institution must take the following four steps: 1) define their distinctive mission; 2) design a curriculum to

help students achieve these goals; 3) assess student learning outcomes according to both institutional and professional criteria, and 4) create a culture of continuous improvement to better align steps (1) and (2) [4].

To do a such ‘student outcomes assessment’, lecturers in engineering study program are then develop specific measurements to assess how well students succeeded in demonstrating through their various projects that they meet the criteria. One step of evaluation at the end of study which represents the culmination of the student learning process is the final year project work. The project work is a complex event, where students have to use their previously knowledge and personal skills, and its assessment has a major influence on decisions regarding the student’s readiness to graduate. An overview of how the final year project is assessed form various sources and how the final mark is obtained is shown in Figure 2 [5].

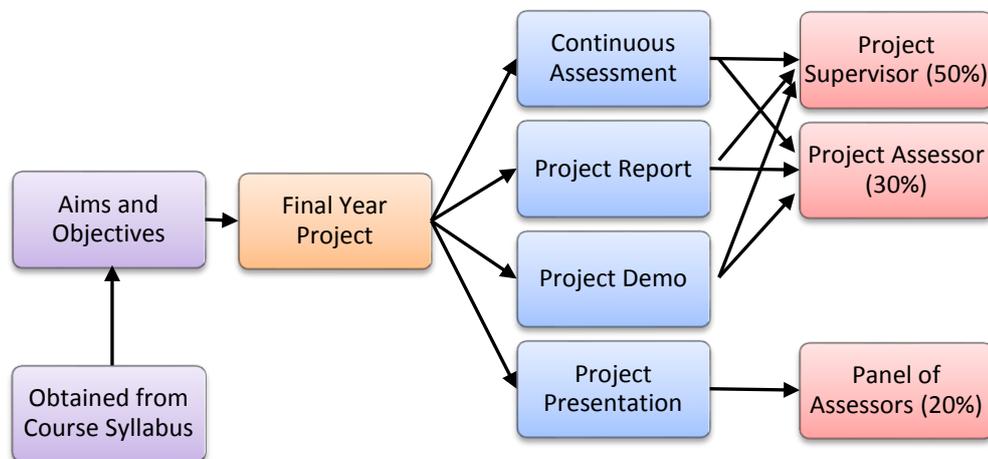


Figure 2. Assessment of Final Year Project

It is seen that in Fig. 2, assessment of the final project consists of four sources of document: 1) continuous assessment; 2) project report; 3) project demonstration; and 4) project presentation. The continuous assessment is project implementation assessment of four general outcomes: 1) formulation of design problem; 2) utilization of problem solving skills; 3) extension of knowledge; and

4) project management. Whereas, the project report is graded according to five general outcomes: 1) organization; 2) content; 3) relevance; 4) writing style and grammar; and 5) presentation of material.

The project demonstration is a live demonstration of the project to both the supervisor and the assessor. Students prepare supporting materials, such as diagrams and manual, to assist with any explanation in answering any questions that may be asked. The assessment during the project implementation, of the project report and of the project demonstration are carried out by the project supervisor and assessor. The amount contributed by the supervisor to the final mark of the project is 50%, and by the assessor is 30%, respectively.

Students give oral presentations to the panel of assessor. These oral presentations are a very important part assessment of students competences in communication skills. In this stage, students demonstrate their ability to transfer information in a manner that is interesting, informative, accurate and concise. Five specific learning outcomes are used to grade the presentation: 1) relevance; 2) accuracy; 3) organization, preparation, and effectiveness delivery; 4) style, pacing and body language; 5) time management. The amount contributed by the panel of assessors to the final mark of the project is 20%.

To get better quality of outcomes learning assessment in the final project course, it needs specific descriptions of what students should do and lecturers should do. Figure 3 shows deployment flow chart of quality assessment process [7]. It is seen that prior to the project work, lecturers prepare assignment and define expectations. Based on these assignment and expectations, students, then, prepare the project and go through this process, finally ends with assessment.

There are six stages that lecturers must follow to implement assessment procedure of the final project work [6].

1. Definition of (i) the learning outcomes associated with the final project work (ii) a set of objective descriptors for each of them;
2. Definition of (i) the moment (milestone) of assessment, (ii) the specific assessment action that must be performed at each milestone and (iii) the agents that will carry out the assessment;

3. Assignment of descriptors to each assessment action;
4. Definition of the levels of compliance with each descriptor, clearly and objectively establishing the level of competence that student must demonstrate that he/she possesses;
5. Drafting of assessment reports that the assessment agents must complete; and
6. Definition of the marking criteria to be used to assign the final mark for the final project on the basis of the results reflected in the assessment report.

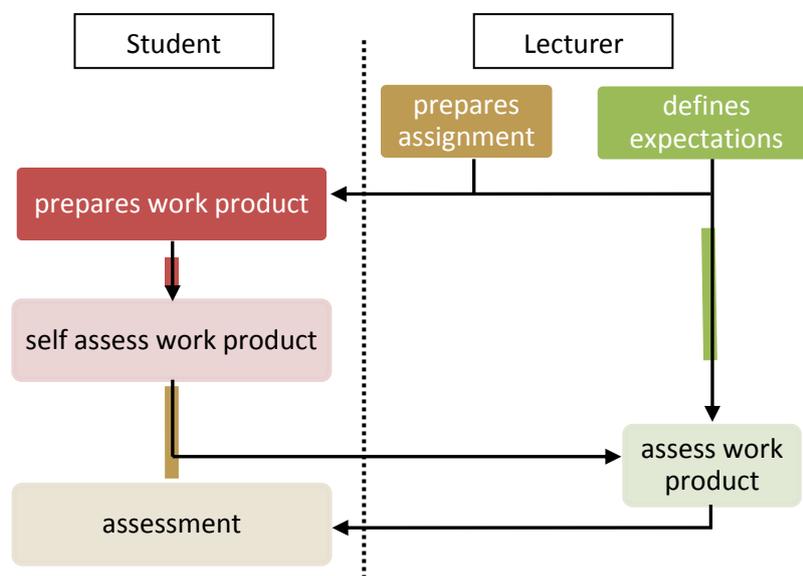


Figure 3. Flow Chart of Quality Assessment Process

There are several different grading methods used to assess students' learning outcomes in the final project course in engineering. Based on the way of any customer reacts to a product, i.e. they are either excited, satisfied, or disappointed. Then, these three categories are expressed into exceeds expectation (exciting), meets expectations (sufficing), and needs improvement (disappointing). Converting these three grades of customer reactions into four: 1) a course grade of A is assigned to students who demonstrate that they consistently exceed/above expectations; 2) a course grade of B is assigned to students who demonstrate that they consistently meet expectations; 3) a course grade of C is assigned to students who fail improve some of work that need improvement; 4) a

course grade of D is assigned to students who have a substantial work that was not complete [7].

C. Conclusion and Recommendation

The final project works are widely used by engineering education programs to assess student learning outcomes. This project involves students and lecturers/supervisor to actively work together start from the beginning. First, lecturers set up assignment and expectations that will be used by students to prepare and make planning chart for the project implementation. Along with the student works on the project, supervisor monitor regularly the progress made by the student in achieving the project objectives. The student submits progress report to both the supervisor and assessor.

At the end of the work, the student demonstrates the project to the supervisor and assessor. This live presentation gives opportunity to student to show his/her knowledge and skills and what have been reached. In case of the project does not work properly or not reach the original objectives, it is essential that student provides a good explanation of problems he/she encountered.

Assessment of the final project will reach peak stage at the oral presentation to panel assessors. This stage is very important part for student achievement, because at the same time all abilities in personality, knowledge and skills areas will be assessed. So, assessment of the final project work is a comprehensive assessment. Contribution of each agent in grading the final project course could be arrange as follows: 50% comes form the supervisor, 30% comes from the assessor and 20% comes from the panel of assessors.

There are four grades of the final project course: 1) a course grade of A is assigned to students who demonstrate that they consistently exceed/above expectations; 2) a course grade of B is assigned to students who demonstrate that they consistently meet expectations; 3) a course grade of C is assigned to students who fail improve some of work that need improvement; 4) a course grade of D is assigned to students who have a substantial work that was not complete.

Learning outcomes assessment requires a clear outcome criteria in every stages. Students, supervisors and assessors should have the same perceptions on to what extent minimum objectives must reached for each grades of course.

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