

Industry Internship In Local Industries to Improve Engineering Design Competence of Undergraduate Engineering Students

Author:
Dr. Sudiyatno, ME*)
sudiyatno@uny.ac.id

Abstract

The aim of this study is to design a model of industry internship program in local industries for undergraduate engineering students to improve their engineering design competence. The students take this industry internship model in two months. During this program, the students, working in groups, design a machine or device that is needed by the local industries at that time. Methods used to analyse the effectiveness of the internship program in improving student's engineering design competence were observation during the program and product performance test. There were three groups of students taking the internship program in two different local industries. The student's engineering design competence were assessed in four different attributes: knowledge of procedures, operational skills, social skills and cognitive skills. Then, the results of these assessment were compared with those of students taking conventional industry internship. The product performance test was done to assess the quality of the machine. Results of the test showed that in all attributes of the competence (knowledge of procedures, operational skills, social skills and cognitive skills of the students) were better than those of students taking conventional industry internship. Results from the product performance test showed that the machines produced by the students taking the program had worked well.

Key words: industry internship, engineering design, competence, undergraduate student

1. Introduction

Indonesia is a developing country with more than 250 millions people. Most of them live in rural areas and have low economic and academic background. To provide better labour forces and to decrease the number of unemployment, the Government increases the number of vocational schools. In addition, local industries with low technology are developed to employ low educated workforces.

One program called industry internship in vocational schools is held to give an opportunity for students having a real experience in industry. Nancy O'Neill (2010) stated that for those students who are clearer about their career interests and academic pursuits, an internship can help them apply what they are learning in "real world" settings, gain more substantial professional experience, and begin to develop a network of people in fields that interest them. From this statement, it is clear that internship program is a "bridge" connecting between academic world (classroom) and real world. For engineering students, mostly their real world is industries.

There are many models of internship. One of them is developed by Kiser (2000). Her model consists of four-stage: (a) pre-placement, (b) initiation, (c) working, and (d) termination. The pre-placement stage occurs before actually conducting the internship. It encompasses the process of identifying, investigating, interviewing and determining an internship placement site with

input from the potential internship supervisor and academic instructor. After a mutual decision is agreed upon, pre-placement activities include setting a work schedule, continuing contact with the future internship supervisor, rearranging personal schedules and activities to include the demanding responsibilities inherent with an internship placement.

The initiation stage occurs when the internship experience actually begins. Orientation, becoming familiar with co-workers and clients, and becoming acquainted with agency policies and procedures are routinely associated with this second stage. Students observe their new surroundings while supervisors assess students' strengths and weaknesses.

The working stage is the time for students to accomplish tasks and to reach the internship goals. During this stage, students and supervisors become more comfortable communicating and identifying personal strengths and admitting limitations. Students work as regular workers, get an increasing self-confidence and work more autonomously.

Termination, the last of the four stages, begins when plans for ending the internship are considered. At this stage, it is important for students to complete tasks or give incomplete tasks to others. The internship supervisor accomplish assessment and feedback. It is also a time for the student to reflect on his/her performance, as well as professional and personal lessons learned.

To further improve the effectiveness of the industry internship, this paper will present a model

of industry internship program in local industries for undergraduate engineering students to improve their engineering design competence.

2. Engineering Design Competencies

Engineering design is iterative, creative, at times both analytic and synthetic, incorporates elements of problem-solving, and incorporates intuitive as well as heuristic methodologies. Therefore, many engineering educators should teach and train students to understand how to generate design specifications and how to proceed from design specifications to a final product based on the specified objectives and criteria. The Canadian Engineering Board has proposed the definition of engineering design (CEAB 2002), engineering design integrates mathematics, basic sciences, engineering sciences and complementary studies in developing elements, systems and process to meet specific needs.

The perspective on design competency relates to the broad context of the practice of engineering. According to [3] th NSERC Design Chair Group, there are seven types of knowledge and skill competencies needed by engineers working on engineering design (Tabel 1). First, general knowledge, that is a knowledge needed to understand a phenomenon, a situation, a problem, a

process, etc. Second, specific knowledge in a professional environment, that is knowledge of the technologies, the rules, the standards, the culture, etc. needed in working on design process. Third, knowledge of procedures, methods and processes, such as product development process, engineering design process, engineering design tools (market research, functional analysis, QFD, design for cost and cost estimation, etc).

Fourth, operational skills, such as how to use the procedures, the methods, the technologies, etc. Fifth, experiential skills, that is to know how to use tacit knowledge, such as doing design by similarity, design by experience, etc. Sixth, social/personal skills, these are to know how to listen, to cooperate, to work in team, to manage life (personal and professional), to feel (intuition, perception, etc.). Seventh, cognitive skills, these are skills needed to solve problem, to design, to manage a project, to take decisions, etc.

Based on “Reference 3”, this study designed an assessment to measure internship student competency in engineering design in four categories to encompass the skills and knowledge essential for mechanical engineering design. Those were knowledge of procedures, operational skills, social skills and cognitive skills.

Tabel 1. Engineering Design Competencies

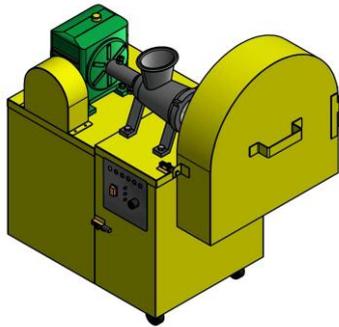
No.	Type	Description	Engineering – All disciplines	
1	General knowledge	To understand a phenomenon, a situation, a problem, a process, etc.	Mathematics	Linear algebra, calculus, differential equation, probabilities, statistics, etc
			Basic sciences	Chemistry, Physics, Biology, earth Science, etc
			Engineering sciences	Mechanics, Materialsl, Thermodynamics, Heat Transfer, Mass Transfer, etc.
2	Specific knowledge in a professional environment	To know the technologies, the rules, the standards, the culture, etc.	Technologies, standards, regulations, safety, liability, intellectual property, ethic, role in the society	
3	Knowledge of procedures	To know the procedures, the methods, the processes, etc.	Product development process, engineering design process, engineering design tools (market research, functional analysis, QFD, design for cost and cost estimation, etc)	
4	Operational skills	To know how to use the procedures, the methods, the technologies, etc.	To have executed and practiced the design process	
5	Experiential skills	To know how to use tacit knowledge	Design by similarity, design by experience, etc.	
6	Social/Personal skills	To know how to listen, to cooperate, to work in team, etc.	Teamwork, communications, leadership, negotiation, professionalism	
		Initiative, thorough, curious, etc.	Initiative, thorough, curious, practical, humble, responsible, adaptable, confident, awareness, respectable, entrepreneurialism	

		To manage life (personal and professional), to feel (intuition, perception, etc.)	Self-awareness, managing emotions, motivating oneself, empathy and handling relationships
7	Cognitive skills	To solve problem, to design, to manage a project, to take decisions, etc.	To know your limitations, to create, to look at the big picture, to manage project (including the system engineering perspective), to decide (decision-making), to learn how to learn, to manage information and knowledge, to define a problem, to define potential solutions, to learn from past experiences, to manage resources, to take and manage risk

3. Model of Internship in Local Industry

Model of industry internship in local industries was developed in two industries:

Position figures and tables at the top and bottom of the column. Avoid placing them in the middle column. Large images and tables may span both columns. Figure captions should be centered below the figure; table captions should be located at the top left of the tables. Avoid placing figures and tables before their first mention in the text. Use the abbreviation "Fig. 1," even at the beginning of the sentence.



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