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Technical Competency for Diploma in Mechatronic Engineering at Polytechnics Malaysia

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ABSTRACT

Mechatronics is the combination of mechanical engineering, electronic engineering, computer engineering, software engineering, control engineering, and systems design engineering in order to design, and manufacture useful products. Mechatronics is a multidisciplinary field of engineering. The paper discusses about the technical competency for diploma in mechatronic engineering at the polytechnic graduates. This competency is reference accreditation board for engineering and technology, American Society of Mechanical Engineers and Japan accreditation board for engineering education. Competency standards are statements of attainment in specific abilities in the workplace that graduates have to accomplish upon completing their studies in their respective programmes in polytechnics. Competency standards for the program, highlight the standards or statements of attainment to measure accomplishments in the programme of diploma in mechatronic engineering at the polytechnics. Curriculum development process started by getting feedback from the industry, information from government documents relating and interpreting the results of a needs analysis. In addition, this process also involves designing and providing a program structure, courses and syllabi for courses of study according to the criteria. Statement of the competency standards serve as a guide in preparing the course syllabus for the DEM. Accordingly, the standard of competence is a summary of learning outcomes as described by course learning outcomes in curriculum documents.

Keywords: Technical Competency, Mechatronic Engineering, Polytechnics
JEL Classifications: J10, M10

1. INTRODUCTION

The shift toward globalization and a knowledge-based economy as well as rapid changes in the labor market now mean that hard work can no longer guarantee employment for young people (Shyr, 2012). Industry has identified a need for engineers with knowledge of this integration (Allen, 2006).

In the world of globalization, employability skills are one of the most important skills required. Employability skills necessary for each individual will be able to effectively and efficiently. Employers will typically outline several criteria for staff, such as communication skills, technology skills, problem solving skills, confidence and responsibility skills. However, today's graduates lack the skills required by employers. This causes employers to be less interested in hiring them.

The mismatch between the skills required by employers and the skills possessed by the graduates is one of the causes of unemployment (Husain et al., 2013) (Shutt et al., 2010). A skill gap report in 2005 found that nearly half of the employers surveyed expressed that existing employees lacked work ethics and self-management skills, such as attendance and punctuality. In addition, 46% of employers reported that their employees lacked problem solving skills (Elsen et al., 2005).

Graduates that dominate technical skills are not the main driver of the unemployment problem. Employers evaluate prospective employees,

not only on technical skills, but also on their non-technical skills (Maniam and Liong, 2007). Graduates are not exposed to the concept of good theory at school or tertiary institutions.

As a result, graduates lack the skill to think, analyze, communicate in different languages, and to interact with society. Raybould and Sheedy (2005) state that an employer generally requires employees who are able to work under pressure, have the ability to make decisions, communicate, teamwork, are self-confident, and have self-management and learning skills.

Under the impact of globalization and the knowledge-based economy, as well as the influence of rapid change in the labour market, working hard is no longer a guarantee as a way for a youth to gain initial employment. The threshold required to be continually employed for a youth has increased annually and, starting from the 1990s, developed countries in Europe and America have considered the enhancement of the competencies of young people as an important policy in promoting their core skills so that they can adapt to a varied and flexible career development modes (Yeh et al., 2010).

2. RELATED WORK

The term "mechatronics" was first introduced in Japan in 1969 to describe the integration of mechanics and electronics accreditation board for engineering and technology and American Society of Mechanical Engineers (ABET and ASME). The term is widely used in Europe and is generally understood by engineers in the U.S., but is less recognized by the general public. As of 2006, the ABET recognizes 42 undergraduate Mechatronics Engineering programs around the world. However, there is only one undergraduate Mechatronics engineering degree program in the U.S. that is accredited by ABET. ABET has recognized the emerging importance of mechatronics engineering and has recently proposed specific evaluation criteria for "mechatronics engineering and similarly named programs" that are in the review process (Auyang, 2004).

Mechatronics integrate the fundamental elements of mechanical, electrical, engineering, and information systems, to form a powerful, adaptable, interdisciplinary approach to solving practical problems (Shyr, 2012). Other that, mechatronics is explained as an integrated multidisciplinary approach to product design and therefore differs fundamentally from classical single-discipline engineering programs (Acar, 1995) (Allen, 2006). Mechatronics is poised to become the key enabling technology for enhancing competitiveness in the modern era, making it indispensable to the continued competitiveness of national economies (Shyr, 2012).

The component of mechatronic based on IEEE/ASME in (Allen, 2006) involve of:

- The synergistic integration of mechanical engineering with electronics.
- Intelligent computer control in the design and manufacture of products and processes.
- The blending of mechanical, electronic, software, and control theory engineering topics into a unified framework that enhances the design process. The multiple disciplines involved with Mechatronics as shown in Figure 1.

The concept of competence is the key to vocational and education training (VET) (Mansfield, 1989). Definition of competent refers to products or educational training and experience, rather than a natural feature such as intelligence (Gipps and Stobart, 2003). Competency in VET refers to individuals who are able to consistently implement the knowledge and skills based on the required performance standards at work (NCVER, 2012) and have the ability to meet the performance standards in the workplace (Fletcher, 1994). Competence at work refers to (i) The performance of technical skills that can be accepted (ii) organizational tasks (iii) provide appropriate feedback and reaction when there is a problem or mistake (iv) fulfil a role in all of the work (v) the transfer of knowledge and skills to new situations (Gillis and Bateman, 1999).

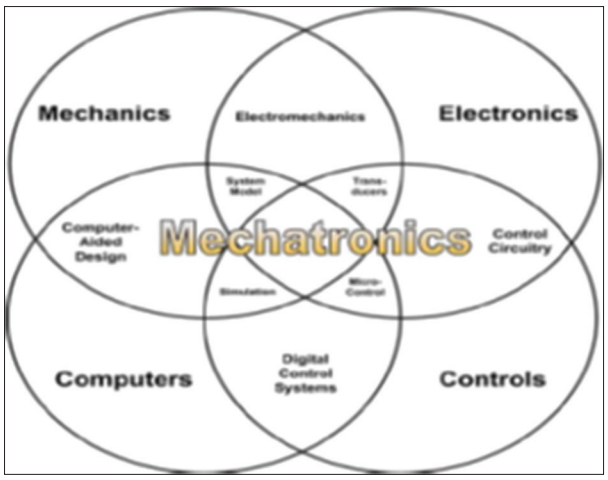
Thus the concept of competence is emphasized by several authors is the ability to perform tasks in the workplace (Rahman et al., 2014). The function of universities in providing curriculum and components of educational field are not in line with the required workplace skills. This leads to the difficulties among the graduates to obtain jobs, which match their skills and qualifications. This also leads to a problem, in which graduates are not able to implement what they have learned at the educational institutions in their working field (Hanapi and Nordin, 2014).

3. MATERIALS AND METHODS

The aim of this study is to determine the technical competency for diploma in mechatronic engineering at the polytechnic graduates. In order to achieve this aim, the study was conducted qualitatively in the form of a document review. Several previous study reports, conference proceedings, and journals have been referred to as a literature review, and analysed with the data collected using a matrix table (Strauss and Corbin, 1990). Based on Sallabas (2013) and Best and Kahn (1998), the document review method is the most appropriate tool to collect information in a qualitative study.

Moreover, Onwuegbuzie et al., (2012) believe that the variables relevant to the topic can be identified by conducting a quality

Figure 1: Disciplines of mechatronics (Allen, 2006)



review of the literature. This technique was used, because it is an organized method of reviewing and evaluating paper documents and electronic resources. Literature studies from journals, reports, and working papers were used as materials and resources for our document analysis.

4. RESULTS AND DISCUSSIONS

Based on previous research that has been discussed before, researcher concludes that student must be competent if knowledge, skill and attitude will be perform and expert while working in the industry. Some past research shows that efficiency is considered external behaviours, consists of knowledge, skills, and attitudes (Shyr, 2012). There are some research and surveys in the world that present competency from various perspectives such as in Taiwan, Asia dan Japan. The studies had been done from different view and different characteristics. For example, study on competency for knowledge in term of sensors, electrical machinery control, programmable logic control, pneumatic control, mechatronics, graphical monitoring and control, computer control, remote monitoring and control, and system integration (Shyr, 2012). Additionally, there was a study to explore the competency for mechatronic user in Japan accepted by Acar (1995) in Tan et al., (1998) assessing about mechanical, microprocessor hardware and software, electronics, actuators and control.

Moreover, most mechatronics education and research activities in Asia are related to process oriented CAD:CAM, intelligent mechatronics and intelligent controls (Tan et al., 1998). On the other hand, it is shown that there are different aspects, sight and factors related to competency in knowledge are reported in previous study. In literature, it is not patent which of these factors are significant in knowledge for views industry oriented competency for mechatronic technology in Malaysia.

Thus, to keep abreast with rapid technological advancements and evolving requirements in industries today, department of polytechnic education (DPE) constantly collaborates with major industry players in the country in developing the respective curriculum. One of the most important factors driving the growth of productivity is by having a qualified and talented manpower in order for the industry to develop and remain competitive in the world market. This is equally true in industries where there is a rapidly growing demand for highly competent and technically savvy workforce. The activities of many industries require increasingly competent technician in engineering field, particularly in mechanical engineering (DPE, 2010).

In response to these issues, curriculum development and evaluation division of the DPE has developed and introduced diploma in mechatronic engineering for polytechnics. This programme aims to prepare students with knowledge, skills and abilities necessary in the Mechatronic engineering industries. To meet the needs of the industry, which revised the curriculum content of several key players from the industry, which were involved in the process of curriculum development (DPE, 2010).

Diploma in mechatronic engineering for polytechnic is developed to give balanced emphasis on theoretical and practical aspects. Six semesters required to complete, in which five academic semesters at the polytechnics each and one semester of industrial training in the relevant industries in the fourth quarter.

The technical components of the body of knowledge for diploma in mechatronic engineering at the polytechnics comprise eleven knowledge areas namely, electronic system, mechanical system, computers and control systems. These knowledge areas are further divided into their respective sub-areas as shown in Table 1.

Diploma in mechatronic engineering program comprises 4 areas of study and in which each area is sub divided into different sub areas. The four areas comprise mechanical systems, electronic systems, computer systems and control systems. Each area of study is further subdivided into several knowledge sub-areas. Mechatronic Engineering area of study comprises 16, dynamic of mechanical system fundamental of mechanics, mechanical drawing and CAD, power electronics, industrial electronic, energy conversion (motors and actuators), Interfacing, computer programming, real time computer systems, software engineering, computer systems, interfacing, system modelling and simulation, control systems, digital control systems, robotic and automation.

5. CONCLUSIONS AND SUGGESTIONS

The results from this study are able to serve as a guide for researchers to identify the technical competency for diploma in mechatronic engineering at the polytechnic graduates. Competence is important in the working world, because workers cannot be considered complete or competent; if they only have good technical ability, without knowledge of employability skills. Competence (or competency), which is the ability of an individual to do a job properly, is a set of defined behaviors that provide a structured guide to enable the identification, evaluation, and development in individual employees. Development of standards of competence and implementation of integrated curriculum standards in polytechnic education system has improved market access, increasing the individual earnings and enhance mobility within the polytechnic graduates (Mohamood and Shariff, 2010). This study aims review about curriculum development process starts with getting feedbacks from industries, information from the relevant

Table 1: Body of knowledge

Knowledge area	Knowledge sub area
Technical	
Mechanical systems	Dynamic of mechanical system fundamental of mechanics mechanical drawing and CAD
Electronic systems	Power electronics industrial electronic energy conversion interfacing
Computer systems	Computer programming real time computer system software engineering computer systems interfacing
Control systems	System modelling and simulation control systems digital control systems robotic and automation

Source: Department of polytechnic education (DPE, 2010), Competency standards for polytechnic graduates: Diploma in mechatronic engineering

government documents and interpreting needs analysis results. Apart from that, the process also involves designing and preparing the programme structure, courses and syllabus for a programme of study according to specified criteria. Statement of competency standards serves as a guide in the preparation of the course syllabi for diploma in mechatronic program. Thus, the statement of competency standards is the summary of curriculum learning outcome statements as described by the course learning outcome in the curriculum document. Therefore, this study will be made to develop framework enhance student competency in mechatronic for industrial and DPE to explore their competency to improve knowledge, as this is important for the success of human capital.

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