Equality of Competencies for Diploma 3 Mechanical Engineering

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Equality of Competencies for Diploma 3 Mechanical Engineering Study Program Graduates of Bali State Polytechnic (BSP) with the Competencies Needed by the World of Work in Bali

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Abstract

This study aims to: 1) determine the level of competency equality in the curriculum of the Diploma 3 Mechanical Engineering Study Program at the State Polytechnic with the competencies needed by the world of work. 2) find out the level of competency gap in the D3 Mechanical Engineering BSP study program curriculum with the competencies needed by the world of work in Bali. The research was conducted at the Bali State Polytechnic, using a mixed quantitative and qualitative descriptive method. The subjects are alumni who have worked, industry leaders where alumni work, and teaching lecturers in the Mechanical Engineering department. Samples were taken using Snowball Sampling. Data were collected through a survey using a questionnaire and analyzed descriptively. The results of the analysis show that the level of equality of the D3 Mechanical Engineering study program curriculum in PNB with the competencies required by the world of work in Bali reaches 78.24% in the high category, and 2) the competency gap level in the D3 Mechanical Engineering BSP study program curriculum with the competencies required by the working world in Bali ranges from 8.94%.

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1 Introduction

The curriculum is a written document used to plan and organize the experiences of learners in an organized manner for their learning (Billett, 2011; Junaidi, 2020). The curriculum is the lifeblood of a learning program so its existence requires dynamic planning, implementation, and evaluation in accordance with the times, the needs of Science, Technology, and Arts as well as competencies needed by the community, as well as the world of work. The curriculum is designed in synergy between government, industry, and education. The material is always updated according to industry needs and contains competencies needed by the world of work, the business world, and the industrial world. The curriculum must have: 1) conformity to the demands, needs, conditions, and development of the community. 2) conformity between curriculum components such as content in accordance with the objectives, the process in accordance with the content and objectives, and evaluation in accordance with the process, content, and objectives of the curriculum (Sukmadinata, 2020). The curriculum must be flexible and always perfected to achieve an increase in the quality of education both locally and nationally (Hamalik, 2013).

The curriculum is expected to provide a basis, and content and become a guideline for the optimal development of students' abilities in accordance with the demands and challenges of community development (KepresRI, 2003). Curriculum development is carried out by referring to national education standards to achieve national education goals. Each development, apart from having to be based on a number of foundations, must also apply certain principles. One of them is the general principles, namely: equality, flexibility, continuity, practicality, and effectiveness. These principles form a strong landscape for realizing a curriculum that fits the needs of students, lecturers, and the world of work (Sukmadinata, 2020). The principle of equality implies that a curriculum must be in accordance with the development of science and technology so that students learn the latest science and technology, thus enabling them to have insights and thoughts that are in line with the times. The principle of curriculum equality is its relevance to the world of work. The curriculum must have compatibility between what is taught on campus and what is desired by the world of work. Curriculum equality with the world of work is one of the principles of curriculum development that is carried out so that the curriculum implemented on campus becomes meaningful. The existence of this principle will make graduates have appropriate knowledge and be in harmony with the competency needs in the world of work (Rizany et al., 2018; Klein & Fowles, 2009).

The BSP Mechanical Engineering D3 Study Program implements the revised 2017 Higher Education Curriculum based on the National Higher Education Standards which have generally been constructed through a long and evolving process. However, until now it has not been known the level of equality with the competencies needed by industry, business and the world of work. On the other hand, the world of work as a market for curriculum products for the D3 Mechanical Engineering study program continues to experience changes as a result of increasing people's living standards, technological advances, infrastructure, openness, and changes in the demographic landscape. The equivalence of the D3 Mechanical Engineering study program curriculum with the world of work is important to do to find out how far the gap is between the target curriculum competencies and the competencies needed by the world of work. The research aims to determine: 1) the level of equality of the D3 Mechanical Engineering study program curriculum in BSP with the competencies required by the world of work in Bali, and 2) determine the competency gap level in the BSP Mechanical Engineering D3 study program curriculum with the competencies required by the working world in Bali (Deveugele et al., 2005; Müller-Christ et al., 2014).

2 Materials and Methods

This research is quantitative descriptive research with a survey method. The subjects are lecturers, alumni and the world of work where alumni work. Samples were taken using snowball sampling. Lecturer subjects from the teaching staff in the Mechanical Engineering department were 28 people, 75 alumni, and the world of work were 21 business fields in tourism, transportation, contractors, education, state-owned enterprises, entrepreneurship, and other fields. The data is sourced from alumni who have worked, leaders of the world of work where alumni work, and faculty staff majoring in Mechanical Engineering. Data is collected using methods: online or offline surveys. The instruments were compiled by the researchers themselves based on competency formulation in the curriculum, and were tested using the Aiken Validity theory approach (Aiken's V) (Aiken, 1985). The validity level of the questionnaire for the World of Work V = 0.88, Lecturer V = 0.87 and the questionnaire for alumni V = 0.88, all three of which are categorized as very feasible (Hahn et al., 2015; Bound & Turner, 2011).

Data were analyzed using descriptive statistics. Data from each competency is classified by its tendency into five categories with an ideal normal curve (Mardapi, 2012). Meanwhile, the level of competency equality in the curriculum with the competencies needed by the world of work is determined using the criteria developed by Akbar as shown in Table 1.1 below (Akbar, 2013).

Table 1
Equality Criteria

No	Interval	Equivalence category
1	85.01 % – 100 %	Very high
2	70.01 % – 85.00 %	High
3	50.01 % – 70.00 %	Low
4	05.01 % – 50.00 %	Very low

3 Results and Discussions

The curriculum is a series of learning experiences and activities that are planned to be carried out by students in order to achieve learning outcomes (Permendikbud, 2020). The curriculum is a reference in producing graduates using human resources, infrastructure, facilities and infrastructure owned by education providers. The preparation of the curriculum is not only related to the results of the competency achievements of graduates, it is also related to the resulting learning outcomes. The preparation of the current vocational education curriculum has referred to the Indonesian Qualification Framework (IQF) or international standards. The D3 Mechanical Engineering study program curriculum stipulates 46 competencies that must be possessed by graduates. The mastery of competence in students when they pass the D3 mechanical engineering program, on average, reaches 80.7%, which is categorized as high. The response of the world of work to the soft skills of graduates is an average of 72.4% in the high category, but there are 4 Soft skills, namely: Critical thinking and problem solving skills, Initiative and entrepreneurial spirit, oral and written communication, and curiosity and imagination are categorized less or weak (Sapuan, 2001; Björkdahl, 2009).

Soft skills are abilities that an individual has naturally related to intelligence, both emotional and social, communication or other individual interactions (Robles, 2012). Soft skills are the innate characteristics of each individual in the form of non-technical skills, and a series of other non-technical skills. The various soft skills of graduates of the BSP Mechanical Engineering study program observed in this assessment, namely: 1) Critical thinking and problem solving skills, 2) collaboration and leadership, 3) Agility and adaptability, 4) Initiative and entrepreneurial spirit, 5) oral communication or in writing, 6) access and analyze information, 7) curiosity and imagination, 8) mathematical thinking skills, 9) work ethics and etiquette, 10) decision-making abilities, and 11) data and fact identification skills. The alumni response to the eleven soft skills averaged 88.89%, categorized as very supportive of carrying out work in the world of work. Curriculum support for the development of the eleven soft skills is an average of 80.8%, categorized as supportive.

Equality is the connectivity between one element and another or the relationship between one institution and another. Equality in vocational education is related to the suitability of the competencies or skills learned with the competencies required by the world of work. The closer the equality, the easier it will be for graduates to get a job after graduation. Equality is directed at increasing collaboration with industry, affirmation programs, and job matching for graduates. The equivalence of the BSP Mechanical Engineering D3 study program curriculum with the competencies needed by the world of work in this study includes the breadth and depth of the competencies taught by PNB compared to the competencies required by the workforce based on the level 5 IQF certification scheme that has been set by BNSP. The breadth includes differences in the types of competencies required by the world of work and the types of competencies that have been taught by PNB. The depth of competence includes the level of competence required by the world of work and the level of depth of competence that has been developed at BSP (Suleiman, 2017; Burke & Ng, 2006).

Based on observations, the BSP Mechanical Engineering D3 Study Program implements the 2016 revised 2017 Higher Education Curriculum (HEC) based on the National Higher Education Standards (NHES). The resulting competencies are called learning outcomes (LO). The learning achievement at the D3 level (Level 5 - IQF) is based on the IQF-based learning achievement. The curriculum structure of the Mechanical Engineering D3 Study Program

is divided into 6 semesters. Subjects are grouped based on scientific fields which refer to the Director's assistant letter No: 08.8804/PL8.I/TU/2016, at point 7. There are 46 competency items grouped into elements of attitude and value competence, general skills, mastery of knowledge, and general skills. The responses from the lecturers, the world of work, and alumni to the subject of competence from each element of learning achievement with the competencies needed in the world of work are presented in Table 2.

Table 2
Equality of Competence in the Curriculum of the D3 Mechanical Engineering Study Program, Bali State Polytechnic with the Competences Needed by the World of Work in Bali

Competency	Lecturer (%)	Category	World of Work (%)	Category	Alumni (%)	Category	Gap (%)
Attitudes and Values	85.43	Very High	84.90	High	81.27	High	-0.53
General skills	90.03	Very High	84.17	High	81.11	High	5.85
Mastery of knowledge	85.66	Very High	64.44	Low	0.00	High	21.21
Special skills	88.46	Very High	79.43	High	82.07	High	9.03
Average	87.43	Very High	78.24	High	81.47	High	9.16
							8.94

Based on Table 2, the average percentage score of the lecturer's response to competence in the D3 Mechanical Engineering BSP study program curriculum is 87.43%, which is in the very high category. Regarding the elements: attitude competence and values of 85.43% which are in the very high category, general skills are 90.03% which are in the very high category, mastery of knowledge is 85.66% which is in the very high category, and special skill elements are 88.46% which are in the very high category. The average response percentage score from the world of work is 78.24% which is in the high category. Regarding the elements: attitude competence and values 84.90% in the high category, general skills 84.17% in the high category, knowledge mastery 64.44% in the low category, and special skills 79.43% in the high category. While the average percentage score of alumni responses was 81.47% which was in the high category. Regarding the elements: attitude competence and values 81.27% in the high category, general skills 81.11% in the high category, knowledge mastery is not measured, and special skills 82.07% is in the high category. The average gap between the competencies in the D3 mechanical engineering study program curriculum and the competencies needed by the world of work is 8.94%, which is in the low category. The biggest gap percentage is 21.21% for knowledge mastery competency. Competency subjects from the elements of knowledge acquisition competence, namely: Applied Chemistry, Applied Physics, and Applied Mathematica are considered less needed by the world of work, but the lecturer's response as a competency product for these three subjects is very much needed (Raziq & Maulabakhsh, 2015; Suleiman, 2017).

Mastery of knowledge is the systematic mastery of concepts, theories, methods, and philosophies of certain fields of science obtained through reasoning in the learning process, student work experience, research and community service related to learning (Permendikbud, 2020). Mastery of knowledge is mastery of concepts, theories, methods, and philosophies in the field of engineering systematically obtained through reasoning in the learning process, student work experience, research or community service related to learning in the Mechanical Engineering D3 study program. Mastery of knowledge is mastering the theoretical concepts of certain fields of knowledge in general and specific theoretical concepts in these fields of knowledge in depth, and being able to formulate procedural problem solving in the learning process. In the curriculum structure of the D3 mechanical engineering study program, the study of mastery of knowledge including applied physics, applied mathematics, and applied chemistry, is a mandatory competency (Permendikbud, 2020). These three elements, including basic knowledge, have an indirect impact on the competencies required by work. Essentially, basic knowledge is the fundamental basis for developing general and specific competencies in students. So that the level of need for basic knowledge in learning engineering is categorized as high. Basic science encourages the development of logical thinking, critical thinking and problem solving.

The level of equality of the D3 mechanical engineering study program curriculum at BSP with the competencies needed by the world of work. reached 78.24% categorized as high. The BSP Mechanical Engineering D3 Study Program implements the 2016 revised 2017 HEC based on the NHES. Evaluation and adjustment are carried out

through several stages of a long process of activity. Starting with conducting a SWOT analysis and tracer study by considering the vision and mission of the study program and the flagship umbrella of the BSP, namely tourism. From the results of the analysis, it is found that the curriculum of all study programs under the Department of Mechanical Engineering needs to contain courses that characterize the department. It was agreed by the curriculum development team, for the D3 semesters I, II, and III programs to contain and develop the same learning outcomes for all study programs which are referred to as mandatory programs of the Mechanical Engineering Department of the BSP.

Based on the results of the analysis, a graduate profile is determined which includes the job or profession objectives of the graduate. The graduate profile takes into account the work competencies required by the local, national and regional job market. Referring to the graduate profiles and the IQF, then the Study Program learning outcomes (SPLO) are formulated, translated into curriculum learning outcomes (CLO) and then into course learning achievements (CLA). Based on the learning achievements of the curriculum, the fields of study that must be given are selected and from the learning achievements of the courses, study materials can be prepared which are then used to determine the courses presented in the matrix of study materials and learning achievements. The D3 mechanical engineering study program curriculum has high compatibility with the competencies needed by the world of work. The D3 study program curriculum is dynamic and adaptive to the needs of the world of work. A dynamic and up to date curriculum is a curriculum that always keeps up with the times, namely the development of science and technology (Hamalik, 2013). The expectations of the world of work for the development of the D3 Mechanical Engineering BSP study program curriculum, that all competency subjects in the competency elements of attitudes and values, general skills, mastery of knowledge, and specific skills are said to be on par with requirements, but students' soft skill abilities need to be developed. priority soft skills that need to be developed in order of percentage as shown in Table 3.

Table 3
Order of Soft Skills that Need to be Developed in the Curriculum of the D3 Mechanical Engineering Study Program of PNB

No	Variety Soft Skill	Percentage (%)
1	Critical thinking and problem solving skills	81.0
2	Communicating orally and in writing	66.7
3	Decision-making ability	66.7
4	Agility and adaptability	61.9
5	Collaboration and leadership	57.1
6	Ability to identify data and facts	57.1
7	Mathematical thinking ability	47.6
8	Initiative and entrepreneurial spirit	23.8
9	Curiosity and imagination	19.0
10	Accessing and analyzing information	14.3
11	Ethics and work etiquette	9.5

Based on Table 3, the ability to think critically and solve problems is a top priority that really needs to be developed. Besides that the critical thinking and problem solving abilities of graduates are in the weak category, this ability is one of the skills demanded in the 21st century. Essentially critical thinking is an active process in which individuals think about various things in depth, ask questions for themselves, obtain relevant information. according to himself rather than accepting things from outside himself (Johnson, 2007). These skills are fundamental skills in the 21st century, including the ability to access, analyze, synthesize information, be trained and mastered. Critical thinking skills describe other skills such as communication and information skills, as well as the ability to examine, analyze, interpret, and evaluate facts. In the 21st century era where the flow of information is very abundant, students need to have the ability to choose the right and correct sources and information, find quality sources and evaluate sources from the aspects of objectivity, reliability and sophistication.

Problem solving skills include identification skills and the ability to search, select, evaluate, organize and consider various alternative solutions and interpret information. Problem solving really requires teamwork, communication, effective and creative collaboration of one person and another. Problem solving really requires critical thinking skills, critical thinking is a fundamental skill in solving problems. An individual must be able to

effectively and efficiently apply the right tools and techniques to solve a problem. Soft skills, the ability to think critically and solve problems, are essential to be developed through the integration of elements of the D3 Mechanical Engineering curriculum competency elements into each subject.

4 Conclusion

The equivalence level of the D3 Mechanical Engineering BSP study program curriculum with the competencies needed by the world of work in Bali reaches 78.24% which is in the high category, and 2) the competency gap level in the D3 Mechanical Engineering BSP study program curriculum with the competencies needed by the world of work in Bali is around 8.94% . Recommendation: competency equality in the curriculum needs to be optimized, needs to be harmonized through synchronization involving world of work partners, Chair of the Association of Chief Engineers (ACE), and Alumni Association. The curriculum needs to be aligned every 2 years with a model of synchronization of competency needs in the world of work with competency construction in the curriculum of the D3 Mechanical Engineering study program.

Conflict of interest statement

The authors declared that they have no competing interests

Statement of authorship

The author have a responsibility for the conception and design of the study. The author(s) have approved the final article.

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