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Learning Design Based on Industry 4.0 (Teaching Industry) to Improve Students' Practical Skills in Vocational High School

Purnamawati[1], Muhammad Yahya[2], Fitrah A. Darmawan[3], Muhammad Akil[3,*]

[1] *Electronics Engineering Education, Universitas Negeri Makassar*
[2] *Automotive Engineering Education, Universitas Negeri Makassar*
[3] *Mechatronics Engineering Education, Universitas Negeri Makassar*
[*] *Corresponding author. Email: muhammadakil@unm.ac.id*

ABSTRACT
This study aims to produce an industry-based learning design 4.0 (Teaching Industry) in improving students` practical skills in SMK. This type of research and development uses the Plomp approach. The research subjects were Vocational High Schools in Makassar City with expertise in Industrial Electronics and Programmable Logic Controllers competency achievement indicators. Based on the stages of needs analysis of learning design, the results that produce a learning design based on Industry-based Electronics Industry 4.0 (Teaching Industry) with preliminary investigations and theoretical analysis of learning needs analysis of Industry-based Electronics Industry 4.0 (Teaching Industry), namely: (1) the learning design fulfills the concept of work in the industrial electronics expertise industry at SMK, (2) learning design based on learning theories by applying the concept of learning by doing, (3) Identification of Industrial Electronics learning objectives, (3) Problem Analysis of Industry-based learning 4.0 (Teaching Industry), and (4) Industry-based learning design analysis 4.0 (Teaching Industry).

Keywords: *Learning Design, Teaching Industry, Practicum Skill.*

1. INTRODUCTION

Improving the quality of Human Resources (HR) needs to be directed to create higher-quality educational graduates, improve workforce skills, and encourage certification of workers' competence in order to be competitive in the ASEAN and international markets [1]. Next INPRES No. 6 (2014) [2] on the improvement of national competitiveness in order to face the economic society of the Association of Southeast Asian Nations explains that the development of the labour force, which focuses on: (1) Increasing the Competitive Power of Labor; and (2) Improving the competence and productivity of labour. Both of these things, provide an understanding of the importance of the development of quality SDM which is the main priority scale in producing a professional workforce facing MEA.

Vocational education or vocational education in Indonesia can not meet expectations, so it is necessary to make structural and systematic improvements to address the problem of unemployment of vocational or vocation education, challenges, hopes and solutions [3]. Combs & Davis (2010) argued that the alignment between both sides of professional or vocational education with the industrial world jointly builds cooperation between the two sides, so that the graduates of vocational or professional education can be accepted or absorbed into the world of industry. Students will learn according to the equipment or similar that exists in the industry so that the learning of professional education with vocational education can be realized.

INPRES Number 9 (2016) introduces six policies for the Ministry of Education and Culture, namely: (1) creating a roadmap for SMK, (2) perfecting and coordinating the SMK curriculum with competencies according to the needs of graduate users (link and match), (3) increasing the number and competence of SMK educators and educational personnel, (4) improving cooperation with ministries/agencies, local governments, and the enterprise/industrial world, (5) improving access to SMK graduate certification and SMK accreditation, and (6) forming SMK development working groups [4].

Furthermore, Sakarinto (2020) stated that vocational education and training at the level of secondary and higher education needs to equip graduates with a more general range of competences, namely life and career competence, competence in learning and innovating, as well as competence to use information, media, and technology . Life and career skills include: (1) flexibility and adaptability, (2) initiative and self-regulation, (3) social and intercultural interaction, (4) productivity and accountability in managing projects and producing products, and (5) leadership and responsibility. Learning and innovation skills include: (1) critical thinking and problem solving; (2) communication and collaboration; and (3) creativity and innovation. Meanwhile, information media and technology skills have components: (1) information literacy, (2) media literacy and (3) ICT literacy. This kind of provision of competence is packed with the term 21st Century Skills. (21st Century Skills).

In order to anticipate such statements, a learning model is needed that can improve thinking skills and working ability through vocational education, in particular SMK and DUDI cooperate to build the industry class so that the necessary 21st century capabilities can be met in synergy between SMK, DUDI, and government policy. Vocational education is basically "education to work". It is therefore crucial to develop the "teaching industry" as one of the learning models for developing the skills of graduates, including the ability to use critical thinking skills and working ability in the face of developments in the world of work globally.

2. RESEARCH METHODS

This research is research and development (R & D). The development model used was the development phase of Plomp's educational planning (1997:5) accompanied by several modifications taking into account the R&D research steps. There are four stages of Plomp: The MPBKEI-BMs development procedure consists of two (two) stages, namely: the pre-development stage (research stage) and the development stage. (tahap development). The pre-development phase includes: initial investigation, design, and realization/construction, the intermediate development stage includes: testing, evaluation, and revision. (test evaluation and revision phase). The problem studied in this article performs a need analysis (Plomp: Early Investigation) development model.

3. RESULT AND DISCUSSION

The initial phase of investigation by conducting discussions with a team of experts in the field of Engineering and Engineering Education, the results of theoretical studies and discussions through FGD found the following results:

3.1. Learning design meets working concepts in the Industry Electronics Industry expertise at SMK

The analysis of needs is necessary in the early study of the phenomena needed in providing an overview of the Teaching Industry-based Learning Model of Industrial Electronics (ELIND) as an alternative to the effective model in cultivating critical thinking skills and employability of SMK students.

Skills become the part produced in teaching industry learning. SMK and DUDI work together to build an industrial class with the teaching industry so that the 21st century skills needed can be met in synergy between SMK, DUDI, and government policy. Therefore, all learning devices are developed by looking at the most important components in 21st century skills and the components of learning models that involve and collaborate Project-Based Learning (PjBL) and Work Based Learning (WBL)

3.2. Learning design based on learning theories by applying the concept of learning by doing

Teaching Industry-based learning model has the basic concept of transferring part of the educational process and industrial processes into a learning design, so that the organizer of the competence-based education that gives birth to SDMs winning in global competition [5]. Teaching industry-based learning is an industrial learning activity aimed at conditioning students into the actual production process situation in the industry, by presenting materials combined between SMK curriculum materials with materials from the industry so that synchronization between the two materials occurs. Prastyawan et al., (2017) revealed that teaching industry or industrial learning is a form of undertaking to give real experience to students by involving students in this production/service in industry or in school by directly involving learners. Industrial learning is different from other learning, where industrial learning participants gain real experience that meets the needs of the industry [6].

Thus, to realize the teaching industry-based learning conditions required the skills of teachers who are professional in their fields, and competent industry instructors, innovative learners capable of creating new technological innovations. In addition, the government policy that includes the ongoing processes, so that the partnership is synergistic SMK, DUDI, and government to fulfill the ability of graduates can be achieved in accordance with the objectives of vocational education to be able to face various challenges in the 21st century through the learning model based on Teaching Industry [7]. Through this learning model, critical thinking skills and working skills can be enhanced.

3.3. Identify the purpose of learning Electronics Industry

Teaching industry can adopt the student-an Project-Based Learning (PjBL) and/or work-based learning model. (WBL). The description of the two models is as follows.

PjBL involves learners and teachers in finding solutions to questions about the environment around them. Investigating questions of real-world conditions in which students investigate consumption has long been referred to as a worthy learning method. Thus, project-based learning triggers curiosity and active involvement of learners to know what is happening in their surroundings [8]. This PjBL learning model has a syntax in the teaching industry model. PjBL syntax consists of 4 stages, namely: 1) Reading about Science, (2) Direct Instruction, (3) Process Science Teaching, and (4) Project-based learning.

Project-based learning, as project work, can be seen as an extensive, problem-based activity in which students need to find a way to verify a phenomenon or solve a problem. Thus, the defined skills aspects are relevant to the attitude and ability aspects required by the student, including skills such as critical thinking, creative thinking, time management skills and the ability to work cooperatively with others [9]. Netto-Shek et al. (2014) emphasized that PjBL focuses on generating questions or inquiries that direct learners to look at concepts and principles related to their learning. He explained that the work of this project takes a long period of time, involving learners to generate new knowledge to build on the premise of their research and understanding[10].

PjBL enables students to sharpen and develop skills through knowledge reconstruction as they work together to develop their projects and address the problems faced, thus forcing them to maximize their cognitive aspects and theoretical understanding thoroughly as well as identifying their theoretic knowledge gaps [11]. This is a more authentic approach to student learning experience compared to the traditional approach.

Work-based learning (WBL) is a term used to describe a university program class that brings together universities and work organizations to create learning opportunities in the workplace. (Boud & Solomon, 2001), Mahfud (2016) and Ambiyar et al., (2020) stated that WBL is a learning model approach that uses the workplace as a science transfer medium [12][13][14]. Thus, WBL as all forms of learning that exist in the workplace.

3.4. Analysis of Learning Problems based on Industry 4.0 (Teaching Industry)

Discrimination of the results of FGD against the design of the ELIND learning model based on the teaching industry in the revision / improvement is then summarized in the following description: (1) In the design of the teaching industry model gives the clarity of the use of PjBL syntax and work based learning (WBL) with the syntaxis of the Teaching industry model, (2) The initial phase/step of the syntax of the IT learning model should be added to one early phase, namely the analysis of market needs, (3) clarify the relationship of the Industrial Electronics expertise program with the IT model, (4) an overview of its production process in the industry/imaging the production machinery used with the application of PLC as its control, (5) Focus on the competence that students want to, rather than on the final product, (6) Adding production process control technology to the partner industry plan table, (7) Some sensors and other automation systems can be added to the miniature production machinery to be made, and consider its production process, and (8) The evaluation instrument must be specific and standard to measure student competence.

3.5. Analysis of Learning Design based on Industry 4.0 (Teaching Industry)

Here are the steps of the internship program as one of the parts of the implementation of the WBL, i.e. (a) Internship Planning, where the level of planning aspects that play a role in the management and successful learning of vocational/professional education and the couple industry. The aspects that play a role in determining the learning process of teaching in the school and the industry of the partner include: internship tutor teachers, industry instructors, students as internships participants, tools and materials in the industry, teaching materials, internshipping methods, schedule of internshows, (b) Supply is the activity of structuring the organization, the selection of personnel, the preparation of task descriptions, the elaboration of work mechanisms including the provision of guidance to students, as well as the formulation of the coordination system, (c) Implementation is the stage in which students implement learning in the industry, (d) Supervision and Evaluation are the activities of monitoring and evaluating the implementation of internships in industry.. The monitoring aims to know the success of the internship. To know the success of the internship is obtained by evaluating student learning in the industry. Student assessment carried out by the industry through competence tests by field instructors. Assessment at school is realized in the form of a written report containing activities during the internship. The form of responsibility of the report is with the oral exam by the teacher in the school. The oral examination performed

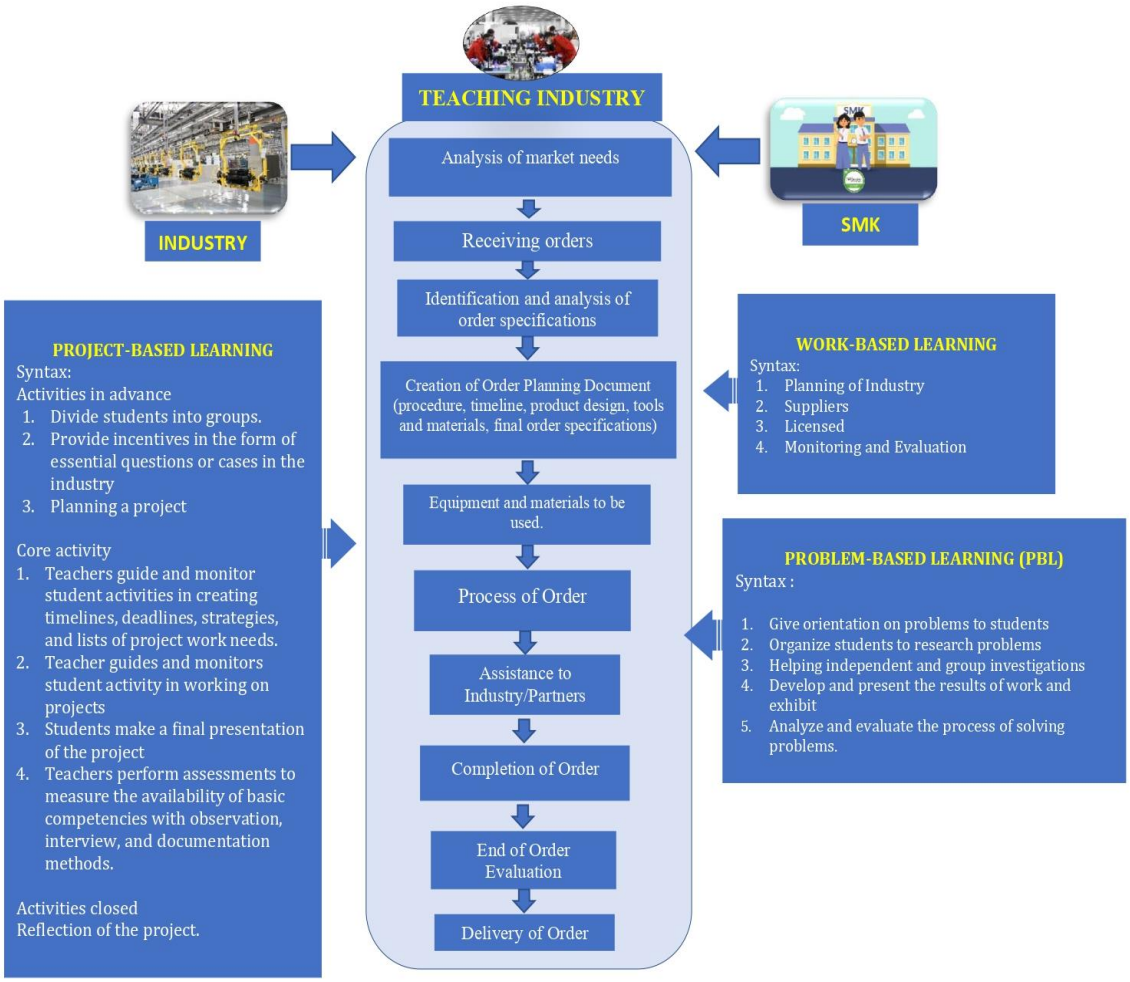

Figure 1 Industrial Electronics Based Teaching Industry.

can know and reveal the experience acquired by the students during the internship.

The learning model is based on the teaching industry to improve critical thinking skills and work ability that is developed consists of 5 (five) components, namely: (1) Syntax: syntax is the phase phase of activity in the learning model that is realized in the network of learning activities. Thus, the syntax of the learning model designed in this study is generally a compound between the design of the researcher with the ramble or the classification of learning that has been much proposed by the designers of learning models such as: [15][16][17] [18][19][20] and [21]. (2) Social system: The social system is a condition or situation or rule that applies in a learning model; (3) the principle of reaction is a pattern of activity that describes the response of the teacher to the student, both individually and in a group, or as a whole; (4) the support system: the system that supports a model of learning is things that can support the achievement of learning goals by applying the learning model [22]. Things referred to as support systems such as means, materials, devices, and auxiliary tools or media; (5) Instructional impact and followers/accompanying impact: The user principle of the model should endeavour to synergize all components in order to the learning objectives.

Productive teachers in the field of industrial electronics expertise have had sufficient experience in support with contract teachers who have the knowledge and skills of working several working equipment in the laboratory. Nurfuadi (2019) says that a teacher should have adequate skills and competence in the field he is examined in order to improve his performance along with performance or results and outcomes on a job [23]. Nurhadi & Lyau (2018) stated that the quality of teachers is very important in order to support the economic development of the country [24].

Competent teachers deliver students who are able to enhance critical thinking skills and employability. ELIND based teaching industry learning that has been designed with the development phases of learning model

problem analysis, Teaching Industry Model Analysis, and the description of the content of ELIND teaching industries based learning model, provides a framework of industry teaching model with the phase that systematically starts its analysis and development so that after being tested is expected to effectively boost critical thinking and working ability. Critical thinking skills are also related to students' ability to analyze arguments, make conclusions using reasoning, evaluate or evaluate, and make decisions or solve problems [25][26]. Critical thinking skills can be skilled through learning in school, especially on vocational education as a supply of competitiveness for graduates [27][28]. For this reason, optimizing the learning of critical thinking skills in the classroom is important because it can affect student learning outcomes [29][30]. Critical thinking skills are one of the forms of 21st century skills that are expected to equip students to have strong competitiveness in the face of the competition in the labour market [31][27]. Some key indicators in measuring critical thinking skills such as ability to interpret, analyze, draw conclusions, evaluate, give explanations, and self-regulation [28]. This explanation provides an understanding of the importance of integrating metacognitive strategies into learning devices. If learning devices are packed well in accordance with the learning objectives will grow HOTS capabilities and produce effective learning.

Based on the results of data analysis and discussion of the research results, it can be concluded that: (1) conducting a literature study, (2) Images of teachers in the SMK field of industrial electronics expertise in SMK have the ability to implement the IT model, (3) Identification of the Learning Goals of Electronics Industry is adapted to the TI model, (4) Analysis of Learning Problems of Industrial Electronics is developed with the approach of the IT Model, and (5) IT Model Analysis by approaching the concept of industrial processes in SMC, (6) Results of Focus Group Discussion (FGD), so that students can master ELIND learning with the production process in Industry and can grow critical thinking ability and working ability.

4. CONCLUSIONS

Based on the analysis phase of learning design needs to produce learning design of Industry Electronics based Industry 4.0 (Teaching Industry) with the initial investigation and theoretical analysis of learning needs Industry based Electronics 4.0 (teaching industry), namely: (1) learning design meets the concept of work in the industry of industrial electronics expertise in SMK, (2) learning design based on learning theories by applying learning by doing concepts, (3) Identification of learning objectives Industry electronics, (4) Analysis of learning problems based on industry 4.0 (Teaching industry) and (5) Industry-based learning design analysis 4.0. (Teaching Industry).

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