Improvement of a cashing trainer assembly methodology for FPGA development in vocational education students

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Abstract

Learning media is defined as a tool used in conveying learning messages to students. Teachers or lectures can use the media to stimulate thoughts, feelings, attention and abilities or skills, and one of them is the use of trainers. The development board FPGA of trainer tools for skill learning in digital technology-based vocational education today has been a problem that obstructs the growth of experts in high-tech-based vocational field. The Spartan development board and its software can be used to elaborate the improvement of skill learning. This research analyse how the development board can be used to enhance students' thinking skill. The trainer tools in the market lately are still in the form of a mother board that can be interfaced with various devices commonly used to perform various digital automation technology. This study elaborates the use of the cashing trainer assembly among electrical engineering students and mechanical engineering students in a joint project to assembly a development mother board.The learning media is also used in group training among the peers.Based on trials and observations made by researchers, the students as the object of research results, have not performed optimally to combine planning of cashing trainer assembly methodology and practice in the assembly.

Keywords: *FPGA, Trainer, cashing, vocational education*

Introduction

The problem of vocational education is always faced with how to improve the ability of its students (students/students) to have skill competencies. In the development of technology in the digital era, graduates' competencies required are not only hands-on laboratory work skills, but also must have skills that are often referred to as Software and Hardware skills. The demand for quality vocational education to be able to work in industry and develop engineering technology has started from the Vocational High School (SMK) level with the implementation of the 2013 curriculum with a teaching factory, and a central curriculum of excellence that is being piloted in selected Vocational Schools, then to Vocational Education (Vocational Education D1, D2, D3, D4) and academic higher education in the field of engineering S1 graduates must be able to adapt and innovate with digital system technology.

The application of industrial technology in education is not easy to do with only extensive laboratory facilities, workshops or workshops, complete tools when faced with the acceleration of digital technology innovation. Equipment and components to develop skills and innovations in the development of engineering technology are expensive if they are built in the form of a discrete trainer for educational purposes. Digital Technology FPGA which is an integration of Software technology and Hardware technology, then in learning media which is an important tool to be used in conveying learning messages to students. The development of increasingly complex electronic designs can be simplified through FPGA technology. FPGA technology plays a role in system development that requires a reliable team in the fields of hardware, firmware, software and system engineering and requires expensive costs to be cheaper and easier. So that in this research can be obtained and share information about the use of FPGA.

In the FPGA there are parts that can be assembled with automation prototype equipment for various equipment in the fields of technology, engineering, information and communication. FPGA emerged its role as part of being added to the Basic Computer Skills Module (BCSK) education program required in Integrated Circuit (IC) technology design (Wibowo, 2018). It can be believed that learning will be more efficient for students, the acquisition of lifelong learning will be possible and will be more in line with current conditions. Competencies that can be evaluated at the elementary and undergraduate students level through the skills to access the correct data, evaluate the data accessed and how to use the data for the expected results. In the research it is estimated that lecturers can play an important role in encouraging students to internet-based research and computer-aided guidance in accessing correct data. This study analyzes the differences in student thinking through an approach to students when conducting research on the Xilink Spartan FPGA board which is a new development board to be used as a training tool to produce competence in the field of digital system design to be able to determine the assembling components that will be used on the equipment used. will be developed. This study aims to elaborate so that the FPGA technology-based development board, known as the Xilink Spartan FPGA development board, can become a tool as a learning media for training tools to conduct experiments, design components and systems to develop and can be taught through Information and Communication Technology (ICT). So if ICT is a technology or system that is able to reduce various limitations of space and time in order to be able to move, retrieve, present, analyze, store, and convey data information into important information. So in current vocational education, training tools are needed that can be used so that students have the ability to master digital technology. Teachers or lecturers must have the ability to use and determine the appropriate training tools to master digital concepts in order to be able to use them as a medium to stimulate thoughts, feelings, attention and abilities or skills, and one of them is the use of trainers that can be used without the need for a laboratory room. or workshops. The development of skills learning trainer tools in digital technology-based vocational education is currently an obstacle that hinders the growth of experts in the high-tech-based vocational field. The Spartan FPGA development board and software can be used to describe skills learning enhancements. FPGA development board as a training tool which is a tool that has the ability to realize computer simulation results through the FPGA development board. Computer simulation is an effective method for predicting the complex real world using mathematical models (Wang & Kang, 2022).

Through the development board, the planned design can be realized and the system and components can be determined that will be used in ICT-based automation devices. This study analyzes how FPGA development can be used to improve students' thinking skills. Trainer tools that are circulating in the market lately are motherboards that can be connected to various devices commonly used to perform various digital automation technologies. This is part of the Fourth Industrial revolution, which is a socio-technical, ideological, and rhetorical construction rooted in neoliberal discourse that reflects the main tenets of global capitalism (Loumpourdi, 2021). With the development of an FPGA development that will be able to produce an ideological foundation that is designed and designed to be part of the digital technology developer needed for the benefit of the welfare of mankind and make faith in the existence of a Creator who allows humans to build their various needs in order to facilitate, alleviate, accelerate their activities. At this time digital technology can be said to have penetrated the boundaries of space and time. Converting energy from motion into light, light into data, sound into motion, sending, processing data and receiving data all devices can penetrate space and time. So what is needed in developing

vocational education at this time is how to elaborate the use of cashing trainer assembly which is assumed to be used to improve how students develop their skills through design combining cashing trainer assembly planning with assembly methodology in practical learning activities by doing assembly through development boards Xilink Spartan FPGA.

Literature Review

However, because the practice of education is complex and covers diverse domains of knowledge, an important topic for future research is how to integrate information from different knowledge sources (Prof & Willis, 2007).

A. Development Board FPGA Spartan

The main principles and the development of digital automation-based techniques developed on the FPGA development board is the ability to synthesize to model various digital components that can be designed to develop automation equipment for various aspects of sound, motion, image propagation that can be integrated through software and language simulations. hardware that can be integrated with hardware. This FPGA stands for Field programmable gate array which is a logic platform that can be reconfigured and can be executed parallel to its bit operations on hardware programming. Successful computational modeling is the basis for many applications in auralized/virtual acoustics, ranging from real-time simulations in multimedia and computer games, to non-real time situations that require high accuracy, such as prediction of room acoustic conditions in music performance halls. Acoustic spaces including single rooms or multi-room spaces, with simple or complex geometries and boundary conditions to manage outdoor spaces can range from urban environments to open landscapes which Svensson discusses about aspects of computational accuracy and efficiency and which acoustic phenomena can and cannot can be modeled using various techniques. With the FPGA platform, these computational models can be executed simultaneously through Xilink's FPGA development board with the SPARTAN Series, Intel with the Altera Series which are marketed at affordable prices and developed in vocational education (Svensson, Peter; Kristiansen, 2002). The uncertainty of the simulation results through the FPGA development board can be analyzed theoretically, synthesized, simulated and executed with a development board that can be assembled as shown in Figure 4 below.
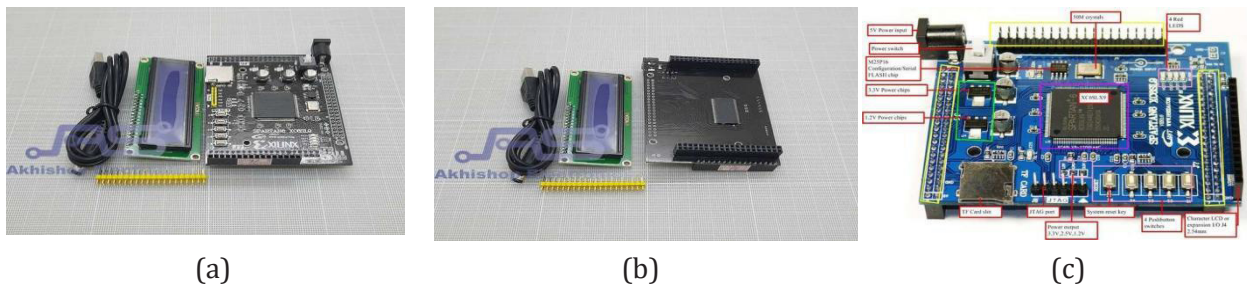

(a)   (b)   (c)

Figure 1. XILINX SPARTAN 6 XC6SLX9 Development Board: (a) Front view, (b) Back view, (c) Pinout

The development of an FPGA that can be assembled with other devices, with a small board size can be a medium used in the development of the Basic Computer Skills Module (BCSM) education program, it is believed that learning will be more efficient for students, the acquisition of lifelong learning is also possible would be more in line with current conditions. The strengthening of student-lecturer relationships can be evaluated at the elementary and undergraduate students in accessing the right data, evaluating the data accessed and how to use the data for the expected results (Mowla, 2013). From this point of view, it is estimated that lecturers can play an important role in encouraging students to use internet-based research and computer-assisted guidance in accessing correct data. students and their parents about computer literacy at elementary school age, the development of the FPGA development board in vocational education by students in the learning model is encouraged and even given projects or problems that can produce products. Because today's computer literacy

skills can hardly be doubted starting from the elementary school level. So at the level of vocational education both students and college students can be applied to produce a synthesis or product of digital technology (Dincer, 2012). This is in contrast to the results of research by Korkmaz and Mahiroḷlu which revealed the situation regarding the level of computer literacy in students who had just entered college in 2009 very few students could see themselves as computer literate and most of these students did not have computer literacy skills, or have low-level computer literacy skill (Korkmaz & Mahiroḷlu, 2009). Expressing this situation as Computer literacy skills are not only behaviors acquired in school but at the same time they are behaviors that can be acquired in present life in different environments. With the Spartan FPGA development board which is marketed as a practicum learning medium, it is hoped that it will contribute to education/teaching in personal and individual life in work life for individual success in achieving targets and thus that success can develop automation needs in various activities in the community.

B. Cashing Trainer Assembly Methodology

In developing digital technology, it is necessary to organize training and education as well as a means of delivering material to be practiced. Vocational education is engaged in the technical field whose success will be determined by the existence of practical activities in learning activities. With the rapid development of digital technology, vocational education at the University is faced with gaps and inability to produce graduate technology that can be directly used by industry in the field of engineering technology and information technology. Cashing training assembly is developing training in assembling components in digital technology into tools that can be cashed or in other words can be produced. So that the components are not only a trainer kit that only functions and benefits for teaching aids, but can be used as a testing tool, where the tool can be a learning tool for students. In the cashing training assembly function, the indicator of understanding the material they are studying is the success of making tools that can be assessed in the form of prices or cashing, so that they can improve the quality of human resources to support training activities, introduction of materials, and not just teaching aids. The method of applying material with only theory because the educational method of delivering material in theory is not optimal but must be a training that can produce chasing, so to improve the delivery of material optimally, namely by implementing an assembling trainer in every practical teaching and learning activity that is able to form a team between teachers and students in determining the results of a technology. Picture. 4 below is an example of an FPGA board from Figure 1 which was assembled between the Xilinx Spartan-6 FPGA Development Board XC6SLX9 ADC AD and DA DAC AB06 from the board in Figures 1, 2 and 3 which was then assembled into a cashing trainer assembly board.
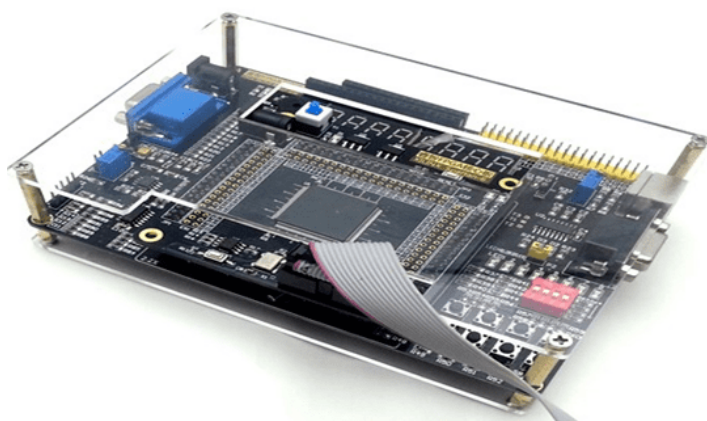

Figure 2. AD and DA Xilinx Spartan-6 FPGA Development Board XC6SLX9-TQG144 AB06 which is marketed has been assembled as a trainer

The form of application of the cashing trainer assembly learning activity method will be carried out using developed learning activities where students are trained to look for components that can be assembled on the FPGA motherboard. The learning model carried out can be done with a formal education system which in terms

of learning activities is still oriented to just a training tool. to be able to educate or make students skilled in using technology without knowing the value of cashing equipment. Information and communication technology and engineering today has produced various components that can be assembled for various needs of automation activities without having to assemble complex discrete components. Assembly is a modern alternative. This assembly method brings together data, talent and technology to deliver a global omnichannel media + business, technology and data consulting solution.

Assembling ability is an ability that shows mastery of competence in the field of technology that can immediately generate money. Assembling is a process of merging or unifying two or more components by mechanical means into a unit that can be traded. This ability is indispensable in the field of machinery, computers, mobile phones which are equipment produced from engineering, information and communication technology.

C. FPGA in Vocational Education Learning Model

Field programmable gate array (FPGA) which is integrated with very high speed integrated circuit hardware description language (VHDL) which can act as a tool in developing learning models. Complex theoretical and practical learning models become simple and inexpensive learning models In the Big Indonesian Dictionary it is explained that a model is a pattern, example, reference of something to be made or produced. Education experts in Indonesia say that the learning model is stated as a pattern for approaching, implementing plans, stages of arranging learning materials and instructions on how to organize classes to carry out learning activities in accordance with the curriculum objectives to be achieved. distinguish it from strategies or procedures, namely: logical theoretical rationale, rationale for what and how students learn (learning objectives to be achieved), teaching behavior needed so that the model can be implemented successfully. And the learning environment needed so that Broadly speaking,Joyce et al., (1992) make the classification of learning models into four categories as follows:

1. Group model of social interaction.

    This model focuses on the relationship between individuals with society or with other individuals. This model is oriented towards improving the individual's ability to relate to others, improving democratic processes and improving society.

2. Information processing model group.

    This model is based on cognitive theory and focuses on students' ability to process information and systems that can improve that ability. This model is concerned with the ability to solve problems and the ability to think productively as well as with regard to general intellectual abilities.

3. Personal model group.

    This model is based on the view in humanistic learning theory and is oriented to individuals and self-development. This group of models focuses on shaping the individual's personality and organizing his complex reality. The main goal of this model is personal development or personal ability.

4. Behavioral systems model group.

    This model is based on behavioral theory. One of the characteristics of this model group is the tendency to solve learning tasks into a number of small and sequential behaviors. In this group model, learning is not seen as a comprehensive one but is seen in real and observable steps. Teaching is nothing more than making observable changes in student behavior.

In fact, the most effective learning experience is when the student/person experiences/acts directly and actively in their learning environment. Providing broad opportunities for students to see, hold, feel and activate more of their senses and express themselves will build an understanding of their knowledge, behavior and skills. Therefore, the main task of educators/teachers is to condition a learning experience situation that can stimulate or stimulate the senses and curiosity of students. Another thing that needs to be considered is the teacher's knowledge of the psychological development of students and the curriculum in which the two must be interrelated. An FPGA platform that has features as a development board can of course be used and created as a

tool in implementing the learning models mentioned above or used in other learning models.

Methods

In increasing the use of FPGA development board teaching aids as a tool for designing automatic control devices, it is necessary to develop ways to develop these tools in order to obtain reliable and as expected tools. The method used in this research is the prototyping method. The prototyping method can be used to link the user's understanding of technical matters and requirements specifications to software developers. The prototyping model starts from collecting user requirements for the software to be made. Then a prototype program is made so that users can better imagine what is being developed so that they can make prototypes that have a price value. The research was conducted through group activities that combined two groups of students in electrical engineering and mechanical engineering education. The students were formed in project activities to be able to develop the FPGA prototype development into a trainer tool that has a selling value.

Results and Discussion

In the results of the study, observations were made on students consisting of different skill programs, namely students with expertise in the field of electrical engineering and in the field of mechanical engineering, observations made on students seeking information from the FPGA prototype and observing the transfer of information sharing to find out software and hardware on prototype with basic computer skills that students already have which are considered facts to allow the use of computers to master the FPGA information transfer software at the college level can not be doubted.

With the production of the FPGA development board which is a logic platform that can be reconfirmed and can be executed in parallel with bit operations with hardware programming that has the ability to synthesize various digital system designs. With young middle-level human resources in Indonesia having a very vital position, the equipment can be used to become the equipment used to develop cashing trainee Asembly. Based on the test results for 9 students to develop circuit systems using a logic platform and executed on the Xilink SPARTAN series FPGA development board, it can be seen in table 2 below.

Table 2. Process of Trainner Module Learning Activities Spartan 3 FPGA development board

Logical function platform		Learning process
Logic gates	Factual Knowledge	1st meeting
AND	A.B	
OR	A + B	
NOT		
NAND		
NOR		
Combinational Logic circuits	Conceptual Knowledge	2nd meeting
Sum of Product	$F = \overline{A}\,BC + AB\overline{C}$	
Product Of Sum	$F = \overline{(A + B + C)}.(A + B + \overline{C})$	
Half Adder		
Full Adder		
		3rd & 4th meeting
Multiplexer		
De Multiplexer		

Sequential Circuits	Procedural Knowledge	5th meeting
SR FLIP FLOP		
REGISTER		
COUNTER		
		6th meeting
T FLIP FLOP		
D FLIPFLOP		
JK FLIP FLOP		
Finite Machine	Metakognif knowledge	7th meeting
Moore Machine		
Maely Machine		

In table 2 above is a logic platform that is learned by students by way of a project learning model through a collaborative approach of electrical engineering students and mechanical engineering students. The description of the knowledge required from each of these logic platforms can describe the sequence of logical thinking capabilities on the FPGA platform. With vocational education that has the main demands on mastering the basic competencies or technology skills of the digital era. Based on Bloom's taxonomy, the ability to master knowledge that can develop a way of thinking is factual knowledge, conceptual knowledge, procedural knowledge, and metacognitive knowledge. (I.Anderson, Lorin W., Krathwohl, 2001). So that the required knowledge can be grouped as in table 2. The learning activities carried out are carried out in a learning model as shown below:

Figure 3. Project-Based Learning Model Collaborative Activities

The way students learn is as shown in Figure 3 above. Students from electrical engineering conducted a test of the device, the aim of which was to encourage them to be able to find digital technology innovations through the FPGA development board device. The results of trials and training using hardware and software that succeeded in producing a synthesis for a counter circuit with RTL (Register Transfer Logic) configuration that were successfully executed on the FPGA development board as shown in Figure 4 below:
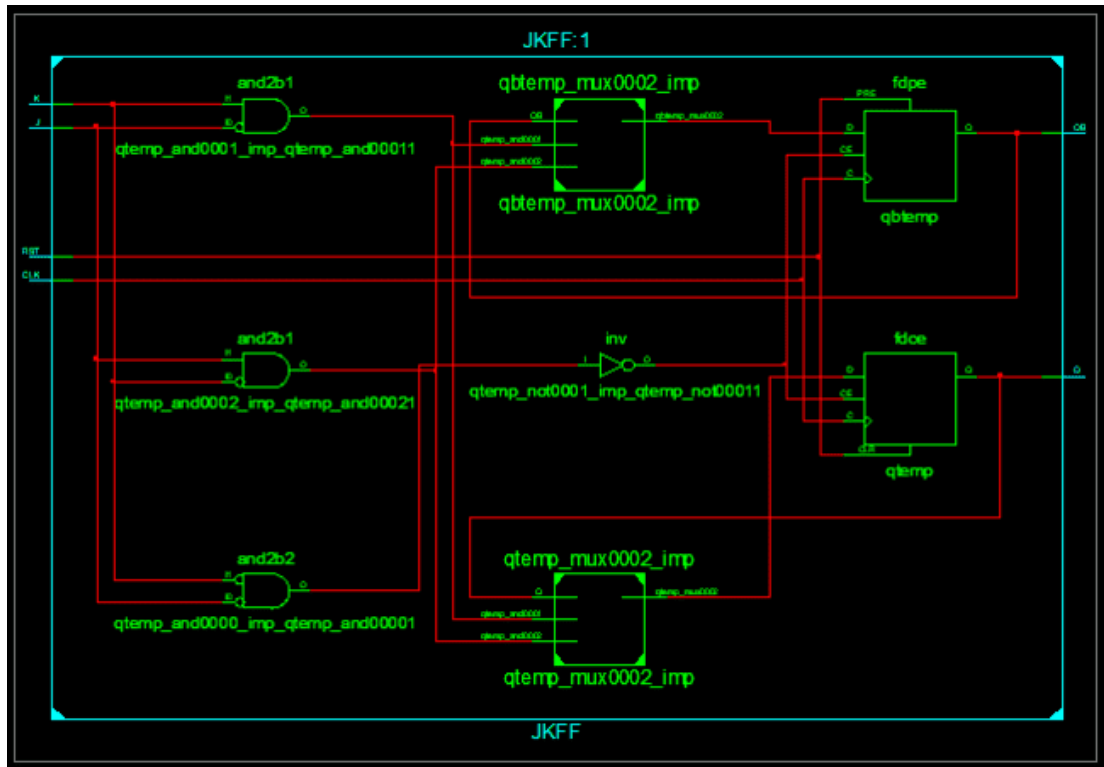
Figure 4. Test results and synthesis of the Xilink series FPGA development board platform Spartan 3

Table 3. Execution of the simulation synthesis on the FPGA development board

NO	J (3A=T9) (6=)	K (3A=U8) (6=)	Q (3A=W21) (6=)	QB (3A=Y22) (6=)	Execution result
					3A
	0	1	0	1	

With the ability of students to synthesize and execute Xilink ISE Design Suite 13.4 software which can be accessed for free by students and executed on spartan 6 as shown in Figure 4. This shows that this configuration can be realized on digital equipment. So that mastering the competence of FPGA technology, it is hoped that vocational education graduates can adapt to the world of work or the world of assembling industry in the era of digital technology. The existence of a curriculum for vocational vocational students is piloted to apply the central vocational high school curriculum and vocational education is oriented to holding independent learning that is allowed to take MKBN both in formal and non-formal education. This shows that a formal educational institution is increasingly required to better adapt to existing technological developments. Thus, to achieve the required competencies in the learning system, it is necessary to prepare seriously. Through the learning model of the Center for Excellence and the Merdeka Lecture, the requirement to pass the school exam can no longer be said to be a measure of the value of the learning process carried out by the educational institution. The responsibility of formal education institutions for vocational education must be able to strengthen how students have good personalities and noble character and participate in teaching and learning activities in accordance with the commitments proposed by these students as indicators of their level of success. Competence is the key word

to measure the resultant education at the vocational level. Along with the increasingly sharp competition between countries due to limited living resources in the environment and the rapid changes in technology in every aspect of human life, it has logical consequences, where every country needs competent human resources in order to provide satisfactory and oriented results. on the value for the country. This individual competence has been the subject of cultivation in the vocational education system. Given the importance of vocational competence as an indicator of the quality of young middle-level human resources for the country, various efforts must be made to encourage its success. One of them is synergizing the role of the business world and the industrial world with the competence itself. As a benchmark for the level of success of vocational education graduates, they play a role in the industrial world which are expected to contribute to meeting the needs of human resources who are ready to face the world of work in the digital era. Competence level of readiness to face every need in this industrial era, digital devices presence in the industrial world is in dire need of workers who have the competence of software and hardware expertise for the field of automation.

Therefore, in the process, it is hoped that internal parties or vocational education and external parties from the business and industrial world can play a proper role. To help develop component equipment, in order to match the curriculum with the needs of the industrial world, which has a big role, so that SMK graduates must be prepared to always follow the needs of the industry. Each supporting component starting from teachers/ lecturers, students/students, materials, facilities/infrastructure and the industrial world must create a good synergy so that in the process of fulfilling a competent workforce in the field of digital technology there must be harmony between the world of education and theindustrial world and must be awake. The world of education must be able to catch up with the dynamics that occur in the industrial world. For this reason, configurable simulations on FPGA development and computers are used in learning as a training assembly tool to innovate automation systems in the digital era.

In the results of the interpretation of mechanical engineering students on the Xilink SPARTAN FPGA development board, they succeeded in creating an FPGA board to be made into a training tool in trainer equipment that can be carried more effectively so that it becomes a portable tool. For more details can be seen in the designs as in Figure 5 below:

Figure 5 Student engineering results for the mobile case model for the FPGA   board

From the results of the case model design developed by students through the interpretation of what is on the FPGA board which is still in the form of a card. This activity can be developed for a Problem Based Learning (PBL) model or become a Problem Based Learning (SPBM) strategy as a tool for stimulus to develop an FPGA board from the assumption that learning is a process of changing behavior thanks to experience. In the Problem Based Learning Approach, The lack of discriminatory information about what teachers actually

do in PBL classes differentiates them from lecture-discussion classes and how these differences are associated with improved student learning. Although as a powerful and engaging learning strategy that leads to continuous and transferable learning (Mergendoller et al., 2006). Problem Based Learning approach that is faced with real problems that occur in life and which will produce more abilities for fields related to vocational education. Thus what is proposed by Problem-Based Learning (PBL) is an innovative educational approach that has become famous in higher education. A literature review of PBL outcomes summarizes, across studies, the positive effects of problem-based learning PBL is an educational approach in M'hich complex problems serve as the context (Claire H. Major & Betsy Palmer, 2001). In problem base learning, when the learning process takes place, a student is able to experience a balanced development between cognitive, affective and psychomotor aspects. Even Sanjaya explained that in base learning learning there is a series of learning activities, and there are a number of activities that must be carried out by students to be able to solve problems using a scientific thinking approach, namely deductive/inductive, systematic (gradual), and empirical (data/facts). (Sanjaya, 2016) and Savote and Hughes (1994) (in Wendy Flint. 2001) suggest that when solving problems, the process that will be experienced by Engagement students is encouraged to be able to find problems and solve them, Inquiry. To find and collect information through investigative activities. Solution Building. With a collaborative project learning model and a problem based learning model of electrical engineering and mechanical engineering students for 3 months by conducting discussions to find solutions to problems that were presented in 1 offline meeting and 1 online meeting for Debriefing and Reflection, sharing opinions and Inclaem with others through question and answer activities to evaluate the process and results of problem solving and presentation of student finding based on product results can be seen in Figures 4 and 5, and from the results of observations made by researchers on students as research objects, they have not been able to perform optimally in combining cashing trainer assembly planning with assembly methodology and assembly practice. In the ability to write plans, reports on activities or other products produced during learning and then presenting them in seminar publications can be successfully carried out. The description of the data shows that the object of research has not been able to perform optimally in integrating cashing trainer assembly planning with assembly methodology and assembly practice.

Conclusion

The conclusion of the research conducted by researchers on students as research objects, has not been able to perform optimally in combining cashing trainer assembly planning with assembly methodologies and assembly practices. learning Problem base learning, even learning models with steps and roles between students are carried out collaboratively with lecturers/teachers, namely:

1. Improve the ability to acquire and form knowledge in an efficient and integrated manner.
2. Develop the genetic skills and attitudes needed in the future.

However, this effort can be used as an alternative for the vocational education model which is expected to support the quality of human resources who are able to develop technology that can be achieved.

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