Theoretical And Empirical Studies Of The Use Of Problem Base Learning In The Technical And Vocational Education And Training (TVET) In The Context Of The XXI Century

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Artikel info	
	***Abstract:** The research aims to find out: (1) how far PBL has been used as a learning model in the vocational environment; and (2) how far is the influence of PBL on learning outcomes? The study was conducted with literature studies through theoretical and empirical studies of references and relevant research results, and continued with focus group discussions (FGD). The relevant references include learning theories, and theories about problem base learning (PBL). While the study of the results of relevant research, is a study of studies on the influence of PBL on "learning out comes" in vocational high school students as an integral part of technical, vocational, education and training (TVET). The study concluded that: (1) PBL has been widely used in learning in the vocational environment; (2) PBL is able to improve student learning achievement both process and results; and (3) the number of students who actively study, the number of students who ask questions, and student learning outcomes increase significantly on the application of PBL.*
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INTRODUCTION

Problem-based learning (PBL), is one of the innovative learning models that can provide active learning situations and conditions to students. PBL is a learning model that is oriented to the framework of constructivism learning theory, Piaget,

Ausubel, Vigotsky, Jerome S. Bruner, and Albert Bandura. PBL is a learning model that involves students to solve a problem through the stages of the scientific method so students can learn knowledge related to these problems and at the same time have skills to solve problems.

Through PBL, students will get "learning out comes" which includes: (1) inquiry and skill in problem solving, (2) learning adult behavior models (adult role behaviors), and (3) independent learning skills (skills for independent learning) "Learning out comes" as it is in line with the needs of life in the XXI century, which requires the schooling world to print graduates with "4C" competencies, namely critical thinking, creative & innovation, collaborative, and communicative-based fields of study concerned. Based on these thoughts, the following questions arise: (1) how far has the PBL approach been understood by teachers, especially productive teachers in the vocational environment ?; (2) how far do vocational high school (VHS) facilities have in order to implement PBL ?; (3) as an integral part of technical, vocational, education and training (TVET), how far vocational schools have been able to print graduates who have life skills that are faithful, productive, creative, innovative, and affective and able to contribute to community life, nationhood, statehood and world civilization? To answer a portion of these questions, a research should be conducted with the title "Theoretical Study and Empiric on the Use of Problem Base Learning in Technical Vocational Education and Training (TVET).

As explained above, education aims to prepare Indonesian people to have the ability to live as individuals and citizens who are faithful, productive, creative, innovative, and affective and able to contribute to the life of the world, nation, state and world civilization. While the objectives of vocational education are: (1) preparing students to enter employment and develop professional attitudes; (2) increasing the ability of students to be able to develop themselves along with the development of science, technology and art; (3) improve the ability of students as members of the community who are able to establish reciprocal relations with the surrounding social and natural environment;

and (4) preparing students to continue to higher education.

Thus, Vocational High School (VHS) as part of vocational education is aimed at preparing students to have knowledge, skills and work attitudes in accordance with the needs of employment, both in the industrial environment, as well as the business world. According to Sudira (2018: 65), as candidates for the XXI century workforce, they must be able to: (1) improve the competitiveness of human resources (HR) as human capital: (2) increase the readiness of citizens to work: (3) improve community creativity and competitiveness in building prosperity, justice and prosperity; (4) improving the quality of production and services in the world of work; and (5) increasing the capability of the community as an entrepreneur.

Problem-based learning (PBL), is one of the innovative learning models that can provide active learning conditions to students. PBL is a learning model oriented to the framework of constructivism learning theory, Piaget, Ausubel, Vigotsky, Jerome S. Bruner, and Albert Bandura PBL is a learning model that involves students to solve a problem through the stages of the scientific method so that students can learn knowledge related to the problem and at the same time have skills to solve problems. PBL has the following characteristics: (1) learning begins with a problem, (2) the problem given relates to the real world of students, (3) the teacher organizes learning around the problem, not around scientific disciplines, (4) gives a large responsibility to students to directly on their own learning process, (5) learning using small groups, and (6) demanding students to me Demonstrate what they have learned in the form of products or performance. It should be noted that one of the characteristics of PBL is learning using small groups (cooperative), where research in cooperative schools provides important findings, including that cooperative learning can be used effectively over a long period of time, and equally effective for students who smart or not smart (Sharan, 2012: 49). Another important characteristic is that problems in PBL relate to the real world, where the real world will provide very valuable lessons for the brains of students. Research on the brain tells us that environmental influences are greater than we imagine. The brain of a child who spends time

watching television is very different in structure to the brain of children who often talk to adults (Johnson, 2014: 55). In line with the opinion of Schunk (2012: 70), that the factors that influence brain development are: (1) genetic factors; (2) environmental stimulation; (3) nutrition; (4) steroids; and (5) tetarogen.

Furthermore, based on the explanation above, PBL starts with: (1) the existence of a problem (can be raised by students or teachers); (2) students deepen what they need to know to solve the problem; (3) students can choose problems that are considered interesting to solve so that they are encouraged to play an active role in learning; (4) problems as the focus of learning can be solved by students through group work; (5) PBL can provide diverse learning experiences to students (collaboration and interaction in groups, learning experiences related to problem solving such as making hypotheses, designing experiments, conducting investigations, collecting data, interpreting data, making conclusions, presenting, discussing, and make a report); (6) PBL provides a lot of experience to students; (7) PBL can improve students' understanding of what they are learning so that they are expected to be able to apply it to real conditions in daily life; (8) with PBL, students not only have to understand concepts that are relevant to the problem at the center of attention, but also gain learning experiences related to the skills of applying scientific methods in problem solving and fostering critical thinking patterns.

From the explanation above, it can be acknowledged that the application of PBL in learning can encourage students to have initiatives to learn independently. According to Johnson (2014: 179) that independent learning: (1) provides an extraordinary opportunity to sharpen awareness of their environment; (2) enable students to make positive choices about how they will overcome anxiety and chaos in daily life; and (3) allow students to act on their own initiative to shape the environment. These three experiences are very necessary in everyday life, where the development of one's mindset and pattern of work depends on how he teaches himself. If children are given the opportunity to use higher levels of thought at each level, they will eventually accustomed to

distinguishing between truth and lies, appearance and reality, facts and opinions, knowledge and beliefs (Johnson, 2014: 184). Therefore, Arends (2007) states that there are three important learning outcomes that must be obtained by students who study with PBL, namely: (1) inquiry and skills in problem solving, (2) learning adult behavior models, and (3) independent learning skills (skills for independent learning). As generally in scientific steps, there are eight steps to solving problems in PBL learning: (1) identifying problems; (2) collect data; (3) analyze data; (4) solving problems based on data; (5) choose ways to solve problems; (6) planning the implementation of problem solving; (7) conduct a trial of the plan set; and (8) take action to solve problems.

Furthermore, in order to properly implement PBL, the role of teachers and students in PBL is as follows: (1) the teacher as a trainer; (2) students as problem solvers; (3) problems as initial challenges and motivations; (4) asking about thinking (asking about thinking); (5) monitor learning; (6) probbing (challenging students to think); (7) keeping students involved; (8) regulate group dynamics; (9) maintain the ongoing process; (10) participants who are directly involved in learning; (11) building learning; (12) interesting to solve; and (13) provide needs that have to do with the lessons learned.

Based on the study as described above, it can be noted that a number of advantages of PBL are: (1) can develop critical thinking and creative skills of students; (2) improve problem solving skills; (3) increasing student motivation in learning; (4) help students learn to transfer knowledge to new situations; (5) can encourage students to have initiatives to learn independently; (6) encouraging students' creativity in disclosing investigations of problems that have been carried out; (7) with PBL there will be meaningful learning; (8) in PBL situations, students integrate knowledge and skills simultaneously and apply them in relevant contexts; (9) PBL can improve critical thinking skills, foster student initiative to work, internal motivation to learn, and can develop interpersonal relationships in group work. Furthermore, if further criticized, that PBL deficiencies include: (1) teachers and students are less familiar with the PBL method; (2) teachers and students are still

carried away by the habits of conventional methods (giving teaching material occurs in one direction); (3) lack of learning time; (4) PBL processes sometimes require more time; (5) students sometimes need time to deal with problems given; (6) the timing of PBL implementation must be adjusted to the curriculum load; (7) PBL is not a new curriculum, but rather in the same curriculum but through different learning models; (8) students cannot really know what might be important for them to learn, especially in areas where they have no prior experience; (9) a teacher adopting the PBL approach may not be able to provide teaching material as much as conventional based lecture courses; (10) PBL is very challenging to implement, but requires a lot of planning and hard work for the teacher; and (11) this can be difficult at first for the teacher to "let go of control" and become a facilitator, encouraging students to ask the right questions, rather than submitting solutions to them.

Based on the advantages of PBL as described above, that with PBL, students are trained to be able to think critically, be able to integrate knowledge and skills simultaneously and apply them in relevant contexts. By being trained to be able to think critically, allow students to find truth in the middle of a flood of events and information surround them every day (Johnson, 2014: 185). The ultimate goal of critical thinking skills needed for students is to achieve a deeper understanding of something, which allows them to understand behind the ideas that direct their lives, which in turn they will be able to express the meaning behind an event or event.

METHOD

This research was conducted through theoretical and empirical studies of references and relevant research results, and continued through focus group discussions (FGD). The relevant references include learning theories, and theories about problem base learning (PBL). While the study of the results of relevant research, is a study of studies on the influence of PBL on "learning out comes "In vocational high school students as an integral part of technical, vocational, education and training (TVET).

RESULTS AND DISCUSSION

As explained above, that problem-based learning (PBL) is an innovative learning model that can provide active learning situations and conditions to students. PBL is a learning model that is oriented to the framework of constructivism learning theory, Piaget, Ausubel, Vigotsky, Jerome S. Bruner, and Albert Bandura. PBL is a learning model that involves students to solve a problem through the stages of the scientific method so students can learn knowledge related to these problems and at the same time have skills to solve problems.

In connection with the use of PBL, there are a number of studies that describe the influence of PBL on student learning outcomes. There, Mohd, Adnan, Audu (2015) conducted research with the title "Effects of problem-based learning in teaching and learning of technical and vocational education and training" , concluded that: (1) PBL has been accepted as a learning model in many fields of study since it was first introduced in the medical field around the 1960s; (2) but PBL as innovative learning has not been recognized as the learning of technical vocational education (TVET) in several countries; (3) this article briefly discusses the concept, and the effectiveness of the PBL approach in learning in TVET which concludes that PBL is an important tool / media for student learning in the fields of technical and vocational commerce. The results of this study indicate that PBL is a learning model that is still it is necessary to continue to be tested in teaching various subjects on TVET as an important tool / media, so that students are accustomed to solving problems in daily life. The advantages of PBL include being a medium for developing critical thinking and creative skills for vocational students.

Related to PBL, Savery (2006) conducted a study entitled "Overview of problem-based learning: definitions and distinctions", concluding that: (1) PBL is an instructional approach that has been used successfully for more than 30 years and continues to gain acceptance in various disciplines; (2) PBL is an instructional approach that empowers students to conduct research, integrate theory and practice; (3) PBL applies knowledge and skills to develop

viable solutions to defined problems; and (4) this picture presents a brief history, followed by a discussion of the similarities and differences between PBL and other experiential approaches to teaching, and identifies some of the challenges that lie ahead for PBL. In line with Savery (2006), Gorghiua, Drăghicescub, Cristeac, Petrescub, & Gorghiud (2015) report the results of the study entitled "Problem-based learning: efficient learning strategy in science lessons", which concluded that: (1) PBL is often known as inquiry-based learning; (2) PBL is an effective way for students to actively learn; (3) PBL can build students' basic skills in various curricular fields; (4) in PBL, the problem is generally proposed and explained by the teacher; (5) students work cooperatively and choose the right strategy to solve the problem. Furthermore, how does the PBL procedure have to be done, so that learning gets optimal results? Related to these questions, there is a preliminary study conducted by Hamidah & Palupi (2015) with the title "Integrated problem based learning for improvement of soft skills and high order thinking of vocational students "Which concluded that: (1) initial information was needed about patisserie learning; (2) the need for soft skills in various industries in patisserie; (3) both information are important for developing the initial design that illustrates PBL integration with high-level soft skills in patisserie learning; (4) the role of teachers and students during the learning process can be examined; and (5) this model will contribute to the growth of high-level thinking soft skills for vocational students to succeed. The results of this study indicate that to implement PBL well, initial information is needed about learning "a particular subject" and "what soft skills" that need to be developed in these subjects, so PBL can be designed, which can then be implemented properly.

Complementing the results of the preliminary research Hamidah & Palupi (2015) above, Silver & Barrows (2006) conducted a study entitled "goals and strategies of a problem-based learning facilitator", reporting that: (1) analysis of PBL group facilities needed to students; (2) the focus of analysis is to understand the goals and strategies of an expert facilitator in supporting collaborative learning in PBL; (3) interaction analysis was carried out using video data that encouraged memory to examine two PBL group meetings; (4) need to analyze how specific strategies are used to support PBL goals in order to help students build causal explanations, reason effectively, and become independent learners, but still maintain a student-centered learning process; and (5) able to articulate that this strategy is an important step in helping others learn the art of PBL facilitation. The results of this study indicate that in addition to "preliminary information" as stated by Hamidah & Palupi (2015), it turns out that "analysis of facilities" needed for PBL as a student-centered learning model can be implemented well, is an important initial activity before PBL is implemented.

Still related to the PBL procedure, Basri, Zain, Jaafar, Basri, Suja (2011) report research with the title "Introduction to environmental engineering: a problem-based learning approach to enhance environmental awareness among civil engineering students", which provides information about PBL procedures are as follows: (1) the assessment of PBL components around 30% of the total assessment of the overall course; (2) team work is applied in the PBL approach with 3 to 5 students in one group; and (3) various PBL topics on environmental issues are proposed by students. The results of this study indicate that issues related to subjects, are proposed by students in the study group consisting of 3 to 5 students. Issues originating from these students are important as implementation that PBL is a learning model that can encourage students to have initiatives to learn independently. This experience is very necessary in everyday life, where the development of one's mindset and work patterns depends on how he teaches himself .

The research report above is in line with the findings of Kirkman (2016) who conducted a study entitled "Problem-based learning in engineering ethics courses" which concluded that in PBL: (1) groups of students develop problems based on their own experience and expertise in practice; (2) the process of searching and problem solving is guided by the teacher to focus their attention on basic ethical values; (3) PBL is closed by observing the process of designing the course, and laying the groundwork for the next formal assessment. The important thing to note for the results of this study is that the

development of problems in PBL is based on the experience and expertise of students, where the problem solving process is guided by the teacher. Thus it is logical that there is a demand that a teacher as an implementer of PBL must be truly competent in the field of study being taught. These demands are very reasonable and logical, because of the four competencies of a teacher, one of them is "professional competence" where a teacher must master the field of study that is well taught.

Furthermore, how the application of PBL empirically influences critical thinking skills for students, Masek (2011) reports the results of a study entitled "The effect of problem based learning on critical thinking abilities: a theoretical and empirical review", finding that: (1) process specific in PBL theoretically supports the development of students' critical thinking in accordance with the design applied; (2) empirical evidence in general cannot be convincing in explaining the effects of PBL on students' critical thinking abilities, especially outside the medical field; (3) some evidence shows that PBL requires long-term exposure to foster critical thinking skills for students; and (4) some predictors might also influence the relationship of PBL and critical thinking such as age, gender, academic achievement, and educational background. The results of this study as empirical evidence, are slightly different from the PBL theory which states that: (1) PBL can improve critical thinking skills for students; (2) PBL can foster student initiative to work, and motivate internally to learn; (3) PBL can develop interpersonal relationships in group work; and (4) in PBL situations, students have the opportunity to integrate knowledge and skills simultaneously and apply them to relevant contexts in everyday life. Nevertheless, the results of Masek's (2015) study still provide clues, and are well aware by the education community that to foster critical thinking skills for students it takes a long time, especially if the initial information is needed in designing PBL as stated by Hamidah & Palupi (2015), was not carefully analyzed, so PBL could not be implemented properly, as the principles and rules of PBL should be. In the case that some predictors might also influence the relationship between PBL and critical thinking, such as age, gender, academic

achievement, and educational background, as expected from Masek (2011) as described above, it is alleged that there is some truth, and because it is a challenge for researchers in the field of technology and vocational education in particular.

How far can PBL affect "student learning outcomes", Raharjo, Khairudin, & Baser (2018) report the results of research through a journal entitled "The influence of problem-based learning (PBL) and direct teaching (DT) on students' learning outcomes" concluded that: (1) learning outcomes did not differ significantly between students who used PBL and DT; (2) learning outcomes are not significantly different (0.652) between high and low motivation students; (3) learning outcomes differ significantly (0.039) between students with high and low creativity; (4) there is an interaction between learning methods and learning motivation towards learning outcomes; (5) there is an influence of interaction between learning methods and creativity on learning outcomes; (6) learning outcomes did not differ significantly between students who used PBL and DT in terms of learning motivation; and (7) learning outcomes do not differ significantly between students who use PBL and DT in terms of creativity. The results of this study indicate that the effect of PBL on "student learning outcomes" is influenced by several moderator variables such as motivation to learn, creativity, or maybe even gender, academic achievement, and educational background, theoretically justifiable. How far the moderator variables influence the relationship between PBL and "student learning outcomes" is an interesting and challenging research field for researchers and observers in the technological and vocational education environment.

Empirical evidence about the relationship between PBL and "student learning outcomes" was reported by Ismana (2016) through a journal entitled "Increasing learning achievement of XIA class students through problem based learning models in" doing basic mechanical work "subjects in the installation engineering program electric power at VHS Negeri 5 Surakarta "concluded that if compared to the average learning outcomes in the initial conditions with the average test results in the final condition in

cycle 2 (class action research), there was a fairly high increase of 1.04 (7.60 - 6.5), and if the percentage there is an increase in the average value of 15.85%. Improvements in terms of the learning process when compared to the initial conditions are as follows: (1) the number of students who ask in the initial conditions there is as much as 6.06%, increasing to 15.15%; (2) the number of active students from 12.12% to 63.63%, and (3) the number of students who use other learning resources from 0% to 24.24%. Thus it can be concluded that PBL is able to improve student learning achievement in subjects "doing basic mechanical work", both in process and in results. Empirical evidence from the results of this study shows that the number of students who are actively learning, the number of students asking questions, and student learning outcomes significantly increases the application of PBL in "doing basic mechanical work" subjects through classroom action research in cycle 2. The results of this study can be different, if done on another subject, by another teacher, moreover PBL participant students are also different, even though PBL is done through more or less the same procedure. This will greatly depend on PBL facilities in the subjects concerned, the background of PBL implementing teachers, the background of PBL participants, and many other moderator variables that influence the relationship between PBL and "student learning outcomes".

Some of the results of the following research are other evidences about the effect of PBL implementation on "student learning outcomes", such as the results of the research described above. These additional empirical evidences include those reported by Nurtanto & Sofyan (2015), Luthvitasari, Made, Linuwih (2012), Sagocak, Yilmaz, & Karahan (2013), Karo-Karo, Restuati, and Silaban, (2017), Diansari , Suratman, & Soejoto (2017), and others.

The findings of Nurtanto & Sofyan (2015), as described above, were supported by the findings of Ismana (2016) who reported the results of the study entitled "The implementation of problem-based learning to improve learning of cognitive, psychomotor, and affective of students in vocational school "Which concluded that: (1) student activity increased by 11.20%; (2) activeness of very high category students as many as 36 students

and high categories as many as 3 students; (3) student learning outcomes in the cognitive, psychomotor, and affective domains increased by 5.32%, 5.03%, and 2.05% respectively; and (4) student learning outcomes (cognitive, psychomotor and affective domains) that achieve minimum competencies of 36 students (92.31%), 36 students (92.31%), and 38 students (97.40%) respectively. from as many as 39 students through the application of problem-based learning (PBL).

The results of research by Nurtanto & Sofyan (2015) and Ismana (2016) as described above, are supported by the findings of Karo-Karo, Restuati, and Silaban (2017) through their research entitled "The effects of problem-based learning with mind mapping to enhance students 'creative thinking skills and learning outcomes' who found that: (1) there is a PBL effect with mind mapping on student learning outcomes (p = 0,000 <0,05); (2) there is the influence of PBL with mind mapping on students' creative thinking skills (p = 0,000 <0,05); (3) there is a relationship between students' creative thinking skills and learning outcomes taught with PBL (p = 0,000 <0,05). Based on the results of this study, it is recommended that teachers be able to design and plan learning instruments or strategies, learning models, methods or media that can involve students more actively in the learning process. In addition to these suggestions, it should be noted that in implementing PBL, it is important a learning media in order to encourage PBL learning is more meaningful. Muslim, Gitama, Suprianto, Rahmadyanti, Kusumawati (2018) suggest the use of adobe flash based media because it turns out to have a significant effect on psychomotor domain learning outcomes. Also consider the use of "e-learning" Suparno & Muslim (2018) conducted a study entitled "Effectiveness of e-Learning for vocational high school building engineering program students", found that the advantages of e-learning include: (1) a learning media that can be utilized when and anywhere; (2) tasks and materials that are easily accessible; and (3) communication can run smoothly. The advantages of e-learning will facilitate vocational students in learning, which in turn will improve the learning outcomes of vocational students.

Another study, conducted by Luthvitasari, Made, Linuwih (2012), with the title "Implementation of project-based physics

learning on critical thinking skills, creative thinking and generic science skills", found that: (1) project-based learning can improve aspects of thinking skills critical, creative thinking and generic skills of vocational students; (2) every aspect of critical thinking skills has a relationship with aspects of creative thinking skills; (3) most students respond well and are happy with project-based physics learning. While research on the comparison between PBL and direct learning (DL), conducted by Wynn & Larsen (2014), through research entitled "Measuring the Effects of Problem-Based Learning on the Development of Postformal Thinking Skills and Engagement of First-Year Learning Community Students ", concluded that: (1) students who were taught with PBL had the highest level of change in postformal thinking thinking skills, involvement, and perceived relevance of content; and (2) PBL produces a higher level in "postformal thinking skills" than direct learning (DL). In line with that, and how far the influence of PBL on soft skills, Diansari, Suratman, & Soejoto (2017), reports the results of the study entitled "The effect of problem-based learning model, audio visual media learning and internship on student's soft skills" concluded that soft skills are influenced by problem-based learning, instructional audio-visual media, and internships in the industrial world. Thus for teachers who want their students to have high qualifications including soft skills, the application of PBL to learning is mainly in subject areas, very important to consider.

In connection with the results of the above research, Sagocak, Yilmaz, & Karahan (2013) reported a journal study entitled "Knowledge, skills and creativity in vocational and technical education", suggesting that: (1) the fundamental emphasis is on the importance of the role vocational education and technical institutions; (2) improve quality and transparency; (3) achieving international competency levels in schools, both theoretical knowledge and practical applications for work skills and experience; (4) hardware facilities, spatial and academic structures must be improved; (5) relations and cooperation with industry must be strengthened; (6) in addition to vocational knowledge and skills, interest in arts and culture is also needed. The results of this study remind the stakholders that the achievement of competency levels (academic,

and practical applications) of TVET graduates can only be achieved with a genuine and committed role from vocational and technical education institutions, through collaboration with industry / business parties.

Therefore, along with the demand for graduate competency in the vocational education environment including in polytechnics, which has implications for learning that focuses on "student centered", Yusofa, Roddin, & Awang (2015) through research entitled "What students need, and what concluded that: (1) the pattern of teaching and learning processes in most polytechnics is traditionally more focused where the teacher functions as a storehouse of knowledge; (2) on the other hand, students want to be more active in learning; (3) this approach is not sufficient to develop generic competencies; (4) several factors have influenced the teacher in choosing the learning approach they like; (5) this research is very important because it provides the basis for a more effective and systematic structure in the learning process in the polytechnic along with the needs of the workforce with new competencies. The results of this study call for the need for a learning approach in the field of vocational education (TVET) including in the polytechnic, more directed towards learning with the approach of "focusing on students" and reducing learning that is "teacher centered". Moreover, the XXI century requires the schooling world to print graduates with "4C" competencies, namely critical thinking, creative & innovation, collaborative, and communicative-based fields of study. Even according to Chinien & Sigh, and Wagner (Sudira, 2018: 99) that in order to face life in the XXI century "5C" skills are needed, namely: (1) critical thinking; (2) creative; (3) collaboration; (4) communicative; and (5) cellebration. The profile of graduates with such qualifications cannot be printed through "teacher centered" patterned learning but must be printed through learning with a "student centered" approach, one of which is PBL.

CONCLUSION AND SUGGESTION

Based on the results of the research and discussion as described above, this study found: (1) PBL is an instructional approach that has been successfully used for more than

30 years; (2) PBL is an instructional approach that empowers participants; (3) preliminary information is needed about learning the field of study; (4) what soft skills information is needed by the industry; (5) both information are important for developing initial designs that illustrate PBL integration with high-level soft skills in learning subject areas; (6) need to analyze student-centered PBL group facilities; (7) the focus of analysis is to understand goals and strategies in order to support collaborative learning in PBL; (8) PBL approach is conducted by group learning between 3 to 5 students per group; (9) various PBL topics proposed by students; (10) empirical evidence shows that with PBL, the number of students who actively study, the number of students asking questions, and student learning outcomes increases significantly in cycle 2 (in class action research); (11) students who are taught with PBL have the highest level of change in postformal thinking thinking skills, involvement, and perceptions of content relevance; (12) PBL produces a higher level in "postformal thinking skills" than direct learning (DL); (13) the XXI century requires the schooling world to print graduates with "4C" competencies, namely critical thinking, creative & innovation, collaborative, and communicative-based fields of study; (14) the profile of graduates in the XXI century must be printed through learning patterned in "student centered" one of which is PBL; (15) PBL is an effective way for students to learn actively in order to build basic skills in various curricular fields.

Based on some of the findings above, the study concluded that: (1) PBL has been widely used in learning in the vocational environment; (2)) with PBL, the number of students who actively study, and the number of students asking questions increases significantly; and (3) PBL is able to improve student learning achievement both process and outcome. Furthermore, the research suggests the need to use PBL in learning at Vocational high School (VHS) because PBL turns out: (1) learning activities and the number of students asking questions increases; and (2) student learning outcomes increase significantly.

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