



## Higher Order Thinking Skills as Effect of Problem Based Learning in the 21st Century Learning

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### **Abstract**

This study aims to determine the responses of learners to learning using a scientific approach in Problem Based Learning integrated with the inculcation of critical thinking, communicative, collaboration; and creative (4C skills) in 21st century learning. The design of this study is true experiment by using posttest only control design. The sample of the research is vocational school students selected by using cluster random sampling technique in Surakarta, Indonesia. The techniques of collecting data are using tests whose validity, reliability, level of difficulty, and the discrimination index have been tested. The data obtained are then tested using t test. The result of the research shows that higher order thinking skills of experimental class students learning using scientific approach in Problem Based Learning which is integrated with the inculcation of 4C skills are higher than those of the control class that are learning using scientific approach in Think-Pair-Share which is integrated with the inculcation of 4C skills.

**Keywords:** Higher order thinking; Scientific approach; PBL; TPS; 4C skills

### **Introduction**

Thinking is a skill that must be possessed by learners. Through this thinking skills, they will be trained to solve the problems faced now or in the future. Thinking can be divided into 2 categories namely lower order thinking and higher order thinking; both are part of the cognitive domain. It is reinforced by Arends and Kilcher (2010: 231) that thinking consists of the use of skills and cognitive processes; and Soltis, Verlinden, Kruger, Carroll, and Trumbo (2015: 2) that Bloom's Taxonomy is divided into two categories: lower level and higher level. Higher levels of Bloom's Taxonomy consist of analyzing (C4), evaluating (C5), and creating (C6) used to measure high-order thinking since 2002 (Pecka, Kotcherlakota, and Berger., 2014: 216). Higher order thinking skills are the highest level in the cognitive processes/hierrarchi (Alias and Ibrahim., 2015: 20). Curriculum 2013 emphasizes that higher order thinking skills are an important skill that must be possessed by learners. This is supported by Wang and Wang (2014: 179) research results that higher order thinking skills are an important learning outcome in education.

The importance of higher order thinking skills are also expressed by Craig (2011: 70) that the core problem in the 21<sup>st</sup> century is higher order thinking skills. In this century individuals will be faced

with an unusual problem; uncertainty and dilemma; if they are successful to have this skill, they will be able to be critical, logical, reflective, metacognitive and creative; therefore, in order for the skill to be achieved, learners need to be involved in situations and tasks related to problem solving, not just remembering, memorizing, and repeating. In relation to that, Purnamawati and Saliruddin (2017: 141) also revealed that there are changes in the characteristics of the 21<sup>st</sup> century work that require problem-solving skills by using higher order thinking skills. Thus, higher order thinking skills become a necessary skill in the 21st century. Hong, Vadivelu, Daniel, and Sim (2015: 1) reveal that higher order thinking skills are also called metacognitive ability, that are, one will know when to take control of the chosen plan, be able to monitor and evaluate its progress, be adaptable, flexible, and able to overcome problems in various contexts. Therefore, a person who has higher order thinking skills are not only capable of analyzing, evaluating and creating but having control over the chosen plan, even this skill can make it adaptable in multiple contexts.

The data show that Indonesia is a country with low higher-order thinking. Based on the results of the Program for International Student Assessment (PISA) survey conducted by the Organization for Economic Co-operation and Development (OECD) shows that the average value of Indonesian students is still low by ranking 69 out of 76 countries, as expressed by Kemendikbud on the release of PISA value achievement, Tuesday 6 December 2016, in Jakarta (Kemendikbud., 2016, p. 1). Meanwhile, the results of observation indicate that learners have been accustomed to work in groups but not familiar with the activities of analyzing (C4), evaluating (C5), and creating (C6). The group simply summarizes the learning materials and presents them. Referring to the above, it is necessary to implement the action in the cognitive dimension to give a positive impact on higher order thinking skills to be owned by the individual considering the importance of the skill in the 21st century. Activities that fall within this capability and can be used to stimulate it are analyses consisting of analyzing, organizing, summarizing, selecting, comparing, and differentiating; evaluation can be applied by evaluating, estimating, assessing, defending, criticizing and justifying activities; creating or synthesizing can be formulated by designing, hypothesizing, supporting, schematizing, writing, reporting, discussing, planning, designing, constructing, constructing; as well as other capabilities used to synthesize information and solve problems (Tofade., Elsner., and Haines., 2013: 3; Davidson., 2009: 139; Billings and Kowalski., 2005: 244).

Saido, Siraj, Nordin, and Al-Amedy (2015: 17) suggest that educators can improve the ability by adopting learning activities that encourage higher order thinking skills; and curriculum designers will assess the extent to which the curriculum has achieved its objectives and designed solutions to improve higher order thinking skills. Thus, the learning chosen by the educator will affect how high and low higher order skills of the learners themselves are. This further clarifies that it takes learning that can give a positive effect on higher order thinking skills learners. Applying the right learning model is needed to overcome the problems that cause low order higher skills; that is learning model which involves the implementation of analyzing, evaluating, and creating. The selected learning model should also be integrated with the scientific approach and the inculcation of 4C skills. A scientific approach is a learning process designed to enable learners to build or find out concepts, laws, theories or principles by following steps such as observing, formulating problems, proposing hypotheses, collecting data with various techniques, analyzing and managing data, drawing conclusion, and communicating cautiously and neutrally (Hosnan., 2014: 33; Meyer., Capps., Crawford., and Ross., 2012: 217).

Gunawan (2017: 102) and Permendikbud (2013: 35) mention that the scientific learning process consists of several steps commonly known as 5M, i.e. observing, asking, gathering information, associating, and communicating. Based on this, the steps in the implementation of a scientific approach consist of observing, questioning, gathering information, associating, and communicating. Learning model that can be tested to give positive influence to higher order thinking skill is the model of Problem Based and Think-Pair-Share Learning. Both models will be implemented in conjunction with a scientific approach that also instills 4C skills. Problem Based Learning is a learning model based on Constructivism

theory, Vygotsky, Piaget, Bruner, and Dewey (Arend and Kilcher, 2010: 327-328; Sugiyanto, 2010: 130-132). Problem Based Learning is a learning model that involves learners to work in groups or small groups and stimulate them to analyze, integrate, and use problems. In this learning, the educator is a facilitator who guides learners to express opinions and find solutions. This model can encourage learners to actively participate in interactive discussions through groups, peers, and facilitators to solve problems (Asyari, Muhdhar, Susilo, Ibrahim, 2016: 37; Downing, Ning, and Shin, 2011: 57; Yeo, 2007: 876; Sofyan & Komariah, 2016: 263). Therefore, this learning model is the implementation of the student-centered learning because students become the main actors in learning activities while educators only facilitate the learning activities in order to run with the emphasis on the use of problems in everyday life.

Based on this, in solving problems in Problem Based Learning, students can apply the steps of a scientific approach that observes the problems provided by the educator by reading, listening, or viewing the source of the problem given; asking a group of friends or educators if they do not understand the observed problem; collecting information by reading relevant sources or conducting interviews and even experiments; processing the information that has been obtained to solve the problem so as to produce a final conclusion on each group and; presenting the results of his group discussion. The next learning model is Think-Pair-Share. This model was first introduced by Frank Lynam in 1987 which means that this model is a paired strategy that makes learners think about individual problems or questions and then in pairs will discuss it; after which each pair will distribute or present the results of their discussion to the whole group (Herrman, 2011: 455; Marota and Hargis, 2011: 384; Putpuek & Kiattikomol, 2013: 182; Akbar, 2013: 62). Thus, this learning model only divides the learners in small or paired groups consisting of 2 persons. Learners complete individual tasks before discussing with their partners and presenting their final conclusions. Arends and Kilcher (2010: 308) suggests that the roots of cooperative learning are based on Piaget and Vygotsky's theories, while Rusman (2014: 201) suggests that cooperative learning models are based on the theory of constructivism. Accordingly, since this model is a part of the cooperative learning models. The theory underlying Think-Pair-Share is Piaget, Vygotsky, and Constructivism.

A scientific approach must also exist in this model so that individual learners complete the task (think individually stage) by observing the problems provided by the educator by reading, listening, listening, or looking at the source of the problem; asking if not understand the problem observed; collecting information by reading relevant sources or conducting interviews and even experiments; processing the information that has been obtained to solve the problem; and drawing individual conclusions. The next stage is the pair. Each pair discusses their ideas and concludes them by making the more specific answers together by using 5M according to the needs of each pair. Next is the share stage. Learners share or present the results to the whole class and question each other. Learning incorporates not only a scientific approach in Problem Based Learning or Think-Pair-Share but also its implementation which is also equipped with 4C skills, namely Critical Thinking, Communicative, Collaboration; and Creative.

4C skills included in the guidebook of the School Literacy Movement in Vocational High School (2016: 13) explain that there are four skills needed in the 21st century, that is, learners are encouraged to think critically and be able to solve problems by learning problems, and seeking to solve problems by seeking information (critical thinking); learners are encouraged and trained to share ideas or ideas based on literacy activities they have done (communicative); learners are trained to cooperate with other parties through the exchange of information and experience in doing the work or completion (collaboration); and learners can be familiarized to create goods, services, creations, which are high-powered, practical, simple and easy to use (Creative). Critical thinking skill is an ability to reason effectively, make decisions, and solve problems (Trilling & Fadel, 2009: 53). Communicative skills are trained by formulating arguments and communicating them either orally or in writing so as to make others understand (Binkley et al., 2012: 45). Activities that support the growth of collaboration skills can be done by sharing activities,

information, skills, responsibilities, resources, risks, and making plans (Heloisa et al., 2009: 53). Creative skills can be nurtured by encouraging openness to new ideas, high levels of trust, and learning from mistakes and failures so that one of the most effective ways to develop creative skills is through challenging projects so that learners find solutions to real-world problems (Trilling & Fadel., 2009: 57-59). The 4C skills should be reflected in the lesson plans and implemented in conjunction with the scientific approach in Problem Based Learning or Think-Pair-Share together to provide a positive effect on higher order thinking skill.

### ***Methodology***

The design of this research is true experiment by using posttest only control design which classifies the class into 2; they are experimental class using scientific approach in Problem Based Learning which is integrated with the inculcation of 4C skills and control class using scientific approach in Think-Pair-Share integrated with the inculcation of 4C skills. The research was conducted in class XI at SMK in Surakarta, Indonesia, with Business and Management majors. The sample was selected by using cluster random sampling technique and obtained 3 schools namely SMK Batik 1 Surakarta as a test class, SMK Batik 2 Surakarta as experimental class, and SMK Negeri 1 Surakarta as control class in odd semester of academic year 2017/ 2018. The research instrument used is validated test by expert and then tested the validity using Product Moment correlation formula, reliability using Alpha formula, difficulty level, and discrimination index test. The next step is to test the normality using Lilliefors test and homogeneity test using F test. Data was obtained before data analysis using  $t_{\text{-test}}$  with SPSS 22 application.

### ***Discussion and Analysis***

The data of higher order thinking skills of learners is obtained from the test in the form of a description of 8 items, the total score is 100. Higher order thinking skills are measured on the subject of workshop and entrepreneurship by using 8 indicators of achievement of competencies developed by 8 indicators. Each indicator is represented by 1 problem created using the cognitive domain between C4, C5, or C6. The problems were consulted to experts first and then tested in a trial class of SMK Batik 2 Surakarta. The first test results obtained 6 valid problems with a level of reliability of 0.513. The next step was to test the level of difficulty of these 6 problems and obtained a moderate level for items number 3, 4, and 8 while item 1 and 7 fell into the easy category. Discrimination index test was the next test. From the 6 problems, there are only 4 problems of which are feasible to be used.

The second try out was conducted to complete the first phase of testing because there are still indicators of achievement of competencies that have not been represented. Validity test results yield 6 valid questions with a level of reliability of 0.495. The difficulty test resulted in that item 1, 2, 4, 5, and 8 are medium and item 3 is easy. The last step is to test the discrimination index, the result shows that item 2 and 4 have very good differentiation; item 5 and 8 are in good category. On the other hand, item 1 and 3 cannot be used because the problem has less difference. Finally, all indicators can be represented by 8 questions obtained from the first and the second tryout. The data obtained showed that the experimental class had an average higher order thinking skills of the students who were taught using a scientific approach in Problem Based Learning which was integrated with the inculcation of 4C skills at 84, 10. The highest score was 94 while the lowest score was 72 so the score ranges for 22. The median is 85 and so is the mode.

**Table 1** Frequency distribution of higher order thinking experiment class skills

Score Range	Absolute Frequency	Relative Frequency
72 – 75	5	11.9
76 – 79	7	16.67
80 – 83	4	9.52
84 – 87	12	28.58
88 – 91	8	19.05
92 – 95	6	14.28
Total	42	100

The control class is a class that uses a scientific approach in Think-Pair-Share that is integrated with the inculcation of 4C skills to produce different scores. The average score in the control class is 80.77; the median is 81, and the mode is 80. The value range is 19 obtained from the highest score of 90 and the lowest score is 71.

**Table 2** Frequency distribution higher order thinking skills control class

Score Range	Absolute Frequency	Relative Frequency
71 – 74	4	13.33
75 – 78	4	13.33
79 – 82	11	36.67
83 – 86	6	20
87 – 90	5	16.67
91 – 94	0	0
Total	42	100

Thus, the scientific approach in Problem Based Learning that is integrated with the inculcation of 4C skills has higher average order thinking compared to the scientific approach in Think-pair-Share which is integrated with the inculcation of 4C skills. Effectiveness analysis was conducted to find out which model was more effective by using t-test. Prior to the t-test, the data obtained should be tested for normality by using the Lilliefors test and homogeneity test using F test. The result of experimental class normality test obtained  $L < L_{table} = 0.113 < 0.136$ , with sig  $0.200 > 0.05$  means normal distribution data while control class obtained  $L < L_{table} = 0.108 < 0.162$ , with sig.  $0.200 > 0.05$  means that the data is normally distributed.

The results of Homogenistas test with F test have provisions that  $F \leq F_{table}$  then the data is homogeneous. The value obtained is  $F 1.506 < F 3.128$ . It can be concluded that higher order thinking skill data in both classes have the same or homogeneous variance. The t-test can be continued because the data is normally distributed and homogeneous. This  $t_{-test}$  tests 2 hypotheses  $H_0$  which shows that there is no difference of higher order thinking skills between learners who learn using scientific approach in Problem Based Learning model with the inculcation of 4C skills and those using scientific approach in Think-Pair-Share with the inculcation of 4C skills. While  $H_1$  shows that there is difference of higher order

thinking skills between learners who learn using scientific approach in Problem Based Learning model with the inculcation of 4C skills and those using scientific approach in Think-Pair-Share with the inculcation of 4C skills.

Based on the test obtained  $T > T_{table}$  or  $T = 2.359 > T_{table} = 1.994$ . Thus, there is a difference of higher order thinking skills between learners who learn using scientific approach in Problem Based Learning model with the inculcation of 4C skills and those using scientific approach in Think-Pair-Share with the inculcation of 4C skills. The difference of higher order thinking skills can be seen from the mean difference that is, 84.10 for the experimental class and 80,77 for the control class. The result of higher order thinking skills is a combination of the value obtained by learners during learning activities using a scientific approach in the learning model of Problem Based Learning and Think-Pair-Share. In each meeting, each learner does the task or worksheet provided and will be assessed by the educator. The value comes from meeting I, meeting II, meeting III, and post-test. The weight of each meeting is 20% and 40% post-test so that the final score of higher order thinking skills is obtained. The implementation of the scientific approach in Problem Based Learning began with the formation of small groups followed by solving problems related to daily life by using the steps of scientific approach that is observing, asking, gathering information, processing information, and presenting the results of group work. The problem used is a problem that comes from everyday life, it is in accordance with the opinion of Nurtanto and Sofyan (2015, p.356) that the problem in Problem Based Learning is a complex problem in the real world and unstructured.

The implementation of scientific approach in Think-Pair-Share was done by completing the task individually by using steps of scientific approach and by draw individual conclusion. Next, the couple discussed their ideas and concluded by making the more specific answers together by using 5M according to the needs of each pair and presenting the results. The task or problem was given by emphasizing the activity of analyzing (C4), evaluating (C5), and creating (C6). The students' higher order thinking differences who taught by using PBL with TPS which they are integrated by scientific approach and 4C skill building are caused by several reasons. First reason, there are differences among group quantity in its implementation between PBL and TPS. The member of group is bigger about 5-6 people in learning by using PBL model makes each group will discuss or solve the problem simultaneously and details, due to the ideas come from many people. It is differently compared with TPS learning model which consists of 2 people or pairing. The further reason relates into the different steps in each learning. In PBL learning, every given problem will be solved simultaneously from beginning to end of learning. Furthermore, it is also different with TPS model that guides students to think individually previous it, then continued by discussing in pair. The given assignment among those models is actually equal, it is focused on the elements which is able to stimulate students' higher order thinking skills.

Each member of groups finishes simultaneously the given duty by teacher through some stages, they are observing, questioning, collecting information, displaying information, and presenting the key result. Learning activity is started by observing the given duty of teacher. Furthermore, conducting the questioning activity if each group does not comprehend the given duty or to collect information for completing the given problem or duty. The collected information and data will be analyzed in order to draw a conclusion or final issue to answer the question or problem. Each group will communicate the key result in front of the class. Especially for TPS learning model, several final stages will be conducted individually previous it, then continued together in pair. When students have discussed with their partner, they tended to discuss the final result of the given duty or problem and do not re-implement 5M completely. That causes their higher order thinking skills are not high as a student whom taught by using PBL model.

The inculcation of 4C skills consisting of critical thinking, communicative, collaboration, and creative was done on every learning activity using either scientific approach in Problem Based Learning or Think-Pair-Share. The inculcation of critical thinking was done by encouraging learners to think critically through the search for problem solving by seeking various information. Learners were trained to understand and communicate ideas with the goal of preparing a workforce capable of becoming a communicator. This is a communicative skill inculcation that is implemented when learners present the results of discussions with their group or couple. The collaboration skills are required in performing or completing work with others. Therefore, learners were trained to work with their friends to complete the task or problem given. The last skill is creativity. SMK graduates are prepared to be able to become manpower and an entrepreneur. Therefore, learners can be familiarized to create goods, services, creations which are high-powered, practical, simple and easy to use. This was as implemented at the third meeting in the experimental and control classes. Learners were given the freedom to make handicrafts by taking into account the opportunities of the surrounding area.

The implementation of the scientific approach in Problem Based Learning and Think-Pair-Share ultimately gives impact to higher order thinking skills. Higher order thinking skills itself is part of the learning outcomes of the cognitive domain. If the school has a standard to be achieved 75 then by using both models the learners have been able to exceed those standards. Basically, both models can have a positive effect on higher order thinking skills if it refers to the standard, but the effect is higher when using scientific approach in Problem Based Learning rather than scientific approach in Think-Pair-Share. These results reinforce the previous research which states that PBLs report higher and more significant scores in the overall subjects as well as general skills development (Downing et al., 2011: 66) also strengthened by Craig (2012: 69- 71) that Problem Based Learning facilitates learning through content and provides an opportunity to use higher order thinking skills implicitly in academic tasks and solve real problems that learners do. Arends and Kilcher's statement (2010: 328) also reinforces the results of the study that this model can enhance liveliness, curiosity, imagination, interest and motivation, encourage achievement, and higher order thinking skills. On the other hand, Murthy et al (2015: 21) suggest that the pair stages in Think-Pair-Share can increase higher order thinking skills. Nevertheless, the implementation of both models shows that higher order thinking skills are higher using a scientific approach in Problem Based Learning than in the Think-Pair-Share scientific approach if they are compared.

### ***Conclusion***

Based on the result of data analysis, it can be concluded that learners who learn using scientific approach in Problem Based Learning model integrated with the inculcation of 4C skills have higher higher-order thinking skills than those learning using scientific approach in Think-Pair-Share learning model with the inculcation of 4C skills. Referring to the above, the learning model can be implemented in the learning activities by the educator as a facilitator in learning oriented to higher order thinking skills that is integrated with 4C skills considering both skills are needed skill in the 21<sup>st</sup> century. The other researchers may further do research about the development or the increase of 4C skills to prepare learners in the face of 21<sup>st</sup> century challenges.

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