

## DEVELOPMENT STUDENT WORKSHEET ORIENTED PROBLEM BASED LEARNING TO TRAIN CREATIVE THINKING SKILLS IN CHEMICAL EQUILIBRIUM MATTER

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### Abstract

The purpose of this research is to know the feasibility of student worksheet with Problem Based Learning oriented to train creative thinking skills, determine student responses and the worksheet role in training student creative thinking skills such as Fluency, Flexibility, Originality in the chemical equilibrium matter. The object of this research is student worksheet oriented Problem Based Learning to train creative thinking skills in chemical equilibrium matter. Collecting data method used questionnaires and tests. The questionnaire method consists review sheets, feasibility sheet, and the student questionnaire responses sheet and the test method used to determine the ability of creative thinking of students through worksheets developed. This researches conducted according to the 4D development procedure. Feasibility validation results were analyzed by quantitative descriptive method, based on a Likert scale. Analysis of student responses using a Gutman Scale and creative thinking skill analyzed by descriptive method. The experiment result shown that the Chemistry worksheet oriented Problem Based Learning in the chemical equilibrium materials are feasible with the 1<sup>st</sup> and 2<sup>nd</sup> worksheet validation result of content, presentation, graphics and linguistic criteria are 91,7%; 88,3%; 91,7% and 79,2%. The students responses to the 1<sup>st</sup> and 2<sup>nd</sup> worksheet based on content, presentation, graphics and linguistic criteria are 95,5%; 93,3%; 96,6%; 100% and at 2<sup>nd</sup> worksheet are 95,5%; 93,3%; 100%; 100%. Developed student worksheet can train students creative thinking skills, it shown by student answer which already reflected the creative thinking activity such as fluency (creative thinking level 1), originality or flexibility (creative thinking level 2), originality or fluency (creative thinking level 3) and, originality and flexibility (creative thinking level 4) in the 1<sup>st</sup> and 2<sup>nd</sup> worksheet.

**Keywords:** Student Worksheet, Problem Based Learning, Creative Thinking Skill, Chemical Equilibrium.

### INTRUDUCTION

Chemistry learn knowledge of facts, theories, principles and laws as the product as stated in the chemistry essence. In addition there are attitudes and processes as scientific work, focused on the direct observation by learners to be able to see and observe the state of natural surroundings. Chemical concepts that are owned by students besides a factual or

concrete theres also abstract as claimed by Kean and Middlecamp [1].

Giving abstract chemistry question and not associated with the presence in daily life raises the reluctance of students to study chemistry, whereas everything that happens in life is closely related to the chemistry. According to Arrends [2] students will better understand the lesson if it is was associated with the real problems

that occur in daily life because the students will be more conscious that the chemistry lesson that learned is really happening and experienced by the students. So the curiosity of students will appear, making it a necessity to understand the environment and motivate students to investigate and construct the students concept thinking in chemistry.

Thinking is a mental ability that exist in every people. According to Yuli [3] thinking is a mental activity that a students experiences when faced with a problem or situation to be solved. Johnson [4], Krulik and Rudnick [5] suggest that higher-level thinking can be divided into critical thinking and creative thinking. According to McGregor [6], creative thinking is one type of thinking that directs gained new insight, new approaches, new perspectives, or new ways of understanding things. Creative thinking occurs when triggered by tasks or challenging problems. While Grieshaber [7] defines creative thinking as the process of obtaining an idea that emphasizes the aspects of fluency, flexibility, originality, and elaboration in thinking.

This is in line with Rule of Educational and Cultural Ministry No. 69 of 2013 [8] which aims to prepare Indonesia people in order to have an ability to live as individuals and citizens who believe, productive, creative, innovative, and affective and able to contribute to the society, nation, state, and world civilization. One way that can be used to realize the goal of education is to change the mindset of the individual.

Since the beginning John Dewey [9] hoped that students are taught thinking skills. However, until today, this thinking skills have not been adequately dealt with

seriously by the teacher. It is supported by the discovery of Rofi'udin [10] claimed that there was a complaint about lack of creative thinking abilities possessed by basic education graduates to college because of thinking skills is not handled properly. Therefore, the handling of creative thinking skills is very important to integrated in every subject.

This is consistent with the results of the pre-study XI MIA SMA Manyar-Gresik, on 28 March 2015 with 30 students, showed that 50% of students can build the thinking concept in chemical equilibrium matter if learning given phenomenon that related with daily life. The results of pre-study showed 83% of students stated that chemicals worksheet that act as supporting chemistry learning, not shown the phenomenon, real problem, or images that can train students to find ideas, as well as to find solutions for their problems involving the thinking process to solve the learning concept. So that students are not trained thinking. While 50% of students said that was not able to build the concept by the real problem because students are more often get a directly concept provided by the teacher. It is tragic, students are expected to be active learners in the learning process begins to turn into a personal passive and spoiled, students are always waiting for the teacher to give notes and explain matter in detail so that students are not trained to solve a concept independently through the mindset development of the students.

This also resulted in low creative thinking skills possessed by the students. Another reality results of the data pre-study shown that 76% of students stated that the use of various way are required in solving problem of chemistry but 73% of students never solve chemical problems

using their own way because the students are afraid of. 96% of students stated that no student worksheets provide facilities such as the appropriate answer column to solve chemical problems. As many as 60% of students of class XI MIA SMAN 1 Manyar Gresik also stated that the chemical equilibrium is a material that is difficult while according to the chemistry teacher of SMAN 1 Manyar-Gresik, Siti Aminatus stated chemical equilibria material including the subject matter with middle percentage of learning outcomes that are due to the students always confuse between early moles, react, decompose, balance, and remaining.

Ruseffendi [11] explains to disclose or solicit creative people it suppose to be use an open-ended questions (divergent), the question whose answer can be more than a and unpredictable than ever before. In addition, divergent questions demands suspect to make hypotheses, to check whether or not the hypothesis, thoroughly evaluate the problem solving and draw conclusions.

To create an interactive learning process, inspiring, fun, challenging, and motivating students to actively participate can be done using methods that adopts konstruktivisme. One method of applying the principles of constructivism is the method of Problem Based Learning (PBL) for this method helps students to conduct research, acquire knowledge and skills to develop and solve problems, and to build a concept invented by the students themselves [12].

Arrends [13] states that there is a relationship between the Problem Based Learning (PBL) with creative thinking because Problem Based Learning (PBL) is a learning approach where students are faced with the authentic problem (real

problem) so that students are expected to draw up his own knowledge, develop high thinking skills level, student's independence and improve their confidence. It is also stated by Ibrahim and Muhammad Nur [14] which states that PBL can develop students' thinking skills, practice the skills to solve problems and improve the mastery the subject matter because PBL applied to stimulate higher-level thinking in a situation-oriented issues, including learning how to learn

One effort that can be done to train the students creative thinking through problem-based learning approach is using Student worksheet. The aim of making student worksheet is to guide the students in various activities that need to be given as well to consider the thought process that will be grown on students. Teaching and learning activities supported by students workheet can support the learning process becomes more focused and facilitate an understanding of the subject matter obtained [15].

Students worksheet can be developed through the Problem Based Learning (PBL) strategy. Problem Based Learning (PBL) strategy requires teachers to help students find their own data, information and facts from various sources in order to, that activities become experiences for students to solve another problem [16]. So that students truly understand and can apply the knowledge, students should work to solve problems, find everything themselves, and trying desperately with his own ideas [17]. So that students' ability to think creatively can be honed through the problem solving analysis of phenomena or facts.

According to Amir [18] Problem Based Learning (PBL) model support materials in chemical equilibrium because

it has the characteristics begins with a problem, the matter having context with the real world, students in groups actively formulate the problem and identify the students gaps knowledge, studying and find their own material related to the issue, and report the solution of the problem.

Similar studies with PBL method also conducted by Novianti [19] which states that Problem Based Learning worksheet based on digestive system material that developed can be expressed very decent with percentage of feasibility results 97%. Purnamaningrum [20] states that Problem Based Learning improve creative thinking abilities of students in the subjects of biology in grade X-10 SMA Negeri 3 Surakarta 2011/2012, Wasonowati [21] states that the student learning outcomes in the realm of knowledge, attitudes, and skills with PBL models equipped with worksheet has good categorized by percentages 78%, 81.24% and 78.13%, and Sumaryani [22] indicates that there is a positive effect of the application of PBL learning model towards understanding concept student of SMAN 1 Paraung on material Chemical Equilibrium

Based on background above, developed worksheet oriented Problem Based Learning (PBL) to train students in creative thinking on the chemical equilibrium material. The objectives to be achieved in these researches are: (1) Determine the feasibility of worksheet oriented n Problem Based Learning to train creative thinking of students. (2) determine students' response to LKS developed and (3) determine the role of LKS oriented melatihkan Problem Based Learning in the creative thinking of students.

## METOD

This is developed reasearch which purpose developing student worksheet of chemical subjects for high school students based on the Curriculum 2013. This study used 4-D model of development which is limited at develop stage. The test of developed worksheet conducted on 15 students of XI MIA 9 SMA Negeri 1 Manyar-Gresik, on 18 February, 2016. The goal of this research is developing student worksheet oriented Problem Based Learning (PBL) to train creative thinking skill on material chemical equilibrium. The instruments used in this reaseach are review sheets, validation sheets, student questionnaire response sheets and creative thinking of students sheets. Collecting data method of this study using questionnaires and tests. The questionnaire method consists of study sheets, feasibility sheet, and the student questionnaire responses sheet and the test method used to determine the ability of creative thinking of students through worksheets developed.

Data analysis Methods used in this research is the analysis method of validation results, response analysis and the analysis of students' creative thinking skill. Data validation results to Student Worksheet developed was analyzed by calculating the Likert scale ranging from 0 (very poor); 1 (less); 2 (sufficient); 3 (good); 4 (excellent). Calculation of percentage of eligibility criteria is interpreted by 0-20% (very poor); 21-40% (Less); 41-60% (Enough); 61-80% (Good); 81-100% (Very Good). The worksheet is feasible if the percentage of data validation and response results students achieve  $\geq$  61%. While the results data based on the student questionnaire responses calculated with Guttman scale with a choice of "yes" with a 1 score and "no" with a 0 score.

creative thinking abilities of students were assessed using four levels of creative thinking there are 0 (no component of creative thinking); 1 (Fluency); 2 (Originality or flexibility); 3 (Fluency and originality or fluency and flexibility.); 4 (Fluency, flexibility and originality or originality and flexibility). Then the data obtained from the creative thinking of the student analyzed by descriptive method.

## RESULT AND DISCUSSION

The validity of student worksheet oriented Problem Based Learning to train creative thinking skills of the student at chemical equilibrium matter shown at Table 1:

Tabel 1. Hasil Validasi Lembar Kerja Siswa

Aspect	1 <sup>st</sup> worksheet		2 <sup>nd</sup> worksheet	
Criteria	(%)	Criteria (%)	Criteria (%)	Criteria (%)
Content	91.7	Very good	91.7	Very good
Presentation	88.3	Very good	88.3	Very good
Graphic	91.7	Very good	91.7	Very good
Linguistic	79.2	Good	79.2	Good

Content criteria of worksheet oriented Problem Based Learning (PBL) is very good developed with a percentage of 91.7%. This is because the material, KD presented in accordance with the syllabus of 2013 Curriculum, which applies the shift towards equilibrium and the equilibrium constant  $K_c$  and  $K_p$ . Description or explanation in the worksheet oriented PBL students easily understood. The material presented can broaden the students with the present of concept maps so can provide a preliminary description of the material that can be discuss, the short material according to the indicators as well as any phenomenon the LKS can provide students insight about the application of chemical equilibrium that occur in daily life accordance with the characteristics of the Problem Based learning model. Question which training

also accordance with the activities of Problem Based Learning (PBL), which leads to creative thinking component. According Arrends [13] activities of Problem Based Learning is student orientation to the problem (to understand the problem), guiding the individuals investigation (designing problem solving), develops and presents the results of work (to solve the problem with the steps that have been determined), to analyze and evaluate the problem solving process (formulate conclusions and evaluate the answers by matching various sources of literature). These activities can provide opportunities for students to be implicated themselves in creative activities that involve creative thinking component, namely fluency, flexibility and originality [3].

Presentation criteria adapted from Department of National Education [15] where the assesment aspect of worksheet oriented Problem Based Learning (PBL) consist of a cover that represents the contents of LKS, clarity of indicators to be achieved, the coherent of provided content, can provide motivation and appeal as well as worksheet presentation can give a full information. Based on the validation results in Table 1. Worksheet oriented Problem Based Learning (PBL), which developed in compliance with the eligibility criteria on the aspects of the presentation by the percentage of Worksheet 1 and 2 amounted to 88.3%. Based on the interpretation of Table 1 Likert scale can be said that the validation results of the worksheet oriented Problem Based Learning (PBL) developed is very good because in the interval percentage 81% -100%.

Graphic criteria at worksheet adapted from Department of National Education [15] where the assessment aspects in the worksheet oriented Problem Based Learning (PBL) consists of the use of appropriate fonts and easier reading, conformity layout or layout of the component, illustrations or drawings that

can increase motivation and understanding of the concept and writing a bibliography in accordance with the applicable rules. Based on the validation results in Table 1 LKS-oriented Problem Based Learning (PBL) developed has met the eligibility criteria on graphic aspects with the percentage of 91.7%. Graphic criteria in this worksheet is very well because several things including the use of fonts that are easily read by students. Selected font is Century Gothic (for every word and sentence orders), Calibri (for questions in LKS), and Times New Roman (used for short material inside LKS). Forms of writing have been due not to confuse students when reading worksheets. In addition, the selection of different font in the LKS oriented Problem Based Learning (PBL) is intended to emphasize different points on each part of the worksheet. The layout also prepared in accordance and arranged sequentially. The proportion of image and text also get a very good score in validation because it has been prepared with balanced. In addition to the use of fonts and layouts, illustrations or images that are presented are also considered in order to increase students' motivation and reflect the intent of the phenomenon sentence that given.

Linguistic criteria can be quite good with a percentage of 79.2%. This is because the worksheet used effective and efficient language. According to the Department of National Education [15] phrases used in the delivery of the material should be a language that is simple, straightforward and can represent the contents of the message that need to be delivered. It is supported by a 100% response of students who answered "yes" that the worksheet language oriented Problem Based Learning (PBL) to train creative thinking skill is easily understood. In addition, the use of the symbol or icon on each worksheet oriented Problem Based Learning (PBL) is consistent, the representation of pictures allows students to know what is discussed in each question.

The language between chapters, sub-chapters, paragraphs and sentences have been good. These criteria are intended that the messages between sub-chapters, alienation of sub-chapters and the linkage content delivered [15]. The language used in accordance with the level of students' progress according to Piaget's theory of development is at the stage of formal operation. At this stage, students can think logically, systematically, and abstract. It can be seen from the language used in the question LKS oriented Problem Based Learning (PBL) that provoke students to think creatively trying to find solutions to problems as independently.

Validation result straighted by student response. Student response is a student opinion that gave to the developed worksheet using student response sheets. The data of student response to the worksheet 1 and 2 oriented *Problem Based Learning* shown at table 2.

Tabel 2. Data of Students Response

Criteria	1 <sup>st</sup>	2 <sup>nd</sup>
	worksheet	worksheet
	Persentase	Persentase
Content	95.5%	95.5%
Presentation	93.3%	93.3%
Graphic	96.6%	100%
Linguistic	100%	100%

Content, presentation, graphics and linguistics criteria for LKS 1 acquire a percentage respectively for 95.5%, 93.3%, 96.6% and 100%, and Content, presentation, graphics and linguistics criteria on Worksheet 2 are 95.5%, 93.3% 100 % and 100%. Based on these data, it can be said that the students response of developed worksheet was excellent, with the average percentage of both worksheets that achieved  $\geq 61\%$ . This shows that the worksheet oriented Problem Based Learning (PBL) to train students to think creatively developed got a positive response from students

From validation data and positive students response, the worksheet that developed can train the Creative thinking skills in the Chemical Equilibrium materials. In this research post-test isn't conducted because it refers to the previous researches conducted by Rachmawati [23] that researches still focused on the training student creative thinking process. Developed worksheet can train student creative thinking skills it shown by student answer which already reflected the creative thinking activity such as fluency (creative thinking level 1), originality or flexibility (creative thinking level 2), originality or fluency (creative thinking level 3) and, originality and flexibility (creative thinking level 4) in the 1st and 2nd worksheet. Increasing creative thinking score that got by the student from 1<sup>st</sup> and 2<sup>nd</sup> worksheet in answer A question and B question can be seen from the student number 1-5 with a creative category, 6-10 is quite creative category, and 11-15 are students with less creative category. The success of creative thinking training with worksheets developed significant visible on the quite and less creative student it can be seen from the creative thinking scores of quite and less creative student in answer question A have a range of score answer 0-2 and in question A in 2<sup>nd</sup> worksheet have a range answer 3-4 it is also accompanied with the students commented that the students become more understand about the equilibrium shifts because when learning chemical equilibrium matter teacher less emphasis on material shifts, teacher more likely to give calculations question, the comments also approved by some students who adds that they finally understand that reaction of equilibrium shifts that studied closely related to the events that occur in daily life because the

students are not only given a reaction question, but also the authentic phenomenon.

The successful of training student creative thinking skills also shown in the question B in the 1<sup>st</sup> and 2<sup>nd</sup> worksheet it significant visible on the quite and less creative student it can be seen from the creative thinking scores of the quite and less creative student when study with 1st worksheet have a range of score answer 0-2 and successfully increase at the B question in 2nd worksheet becoming 3-4 it indicate that chemistry worksheet oriented problem based learning can train the creative thinking skills of the student because the definition of study it self is student from don't know phase becoming know and undergoes significant increasing knowledge through that experience that through it. It proven by better average of student creative thinking skill in the 2<sup>nd</sup> worksheet. it is also supported by the response of students say that although it initially looked confused because of the diversity of questions and should make 3 design in detail and different also with problem solving, finally students said that students are not confused in distinguishing between early moles, decompose, react, equilibrium and rest like said by Mrs. Siti Aminatus when pre-study conducted. So it can be said that the learning process of chemical equilibrium matter in class XI MIA 9 was handled well.

## **COVER**

### **Conclusion**

Based on the results of analysis data can be concluded that the worksheet Oriented Problem Based Learning (PBL) to train Creative Thinking Skill in Chemical Equilibrium matter that developed already feasible to use as a learning tool with the

percentage of 1st and 2nd Worksheet on the contents, presentation, graphic and linguistic criterion amounted to 91,7%, 88,3%, 91,7% and 79,2%. Students' response to LKS developed very well. With the percentage of student responses on the 1st in the contents, presentation, graphic and linguistic criterion amounted to 95,5%, 93,3%, 96,6%, 100%, and the contents, presentation, graphic and linguistic criterion amounted to 95,5%, 93,3%, 100%, 100%. Developed student worksheet can train students creative thinking skills, it shown by student answer which already reflected the creative thinking activity such as fluency (creative thinking level 1), originality or flexibility (creative thinking level 2), originality or fluency (creative thinking level 3) and, originality and flexibility (creative thinking level 4) in the 1<sup>st</sup> and 2<sup>nd</sup> worksheet.

#### Suggestion

Researchers only training creative thinking abilities by developed worksheet. Therefore, it is necessary to know the progress by final test of creative thinking skills of students on the chemical equilibrium matter. For improvement, it is suggested to conduct further research on the disseminate phase.

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