

DEVELOPMENT OF STUDENT WORKSHEET WITH PROBLEM BASED LEARNING ORIENTED TO TRAIN STUDENT CREATIVE THINKING SKILL IN ACID BASE MATTER BY USING NATURAL PRODUCTS

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Abstract

A research had been conducted on developing Student Worksheet with Problem Based Learning (PBL) oriented to train student creative thinking skill in acid-base matter. This study aims to determine the validity, practicality, and effectiveness of the developed Student Worksheet. The method of development research used the steps of product development by Thiagarajan, it is the 4-D (four-D) model which is limited at the development stage only. The feasibility of Student Worksheet in validity aspect is obtained from the results of the validation assessment by three validators are two chemistry lecturers and one chemistry teacher. The results of the validity are 88.33% on the content validity and 82.81% on the construct validity with a very valid category. The feasibility of effectiveness is reviewed from the post test results of students creative thinking skills and it is obtained that the Class Achievement Index is 94,12% with a very high category, also for each component as fluency got 100%, flexibility got 100%, elaboration got 91,50%, and originality got 100% with very high category for all. The feasibility of practicality is based on the responses from students which had received much positive responses as 91.31% with very high categories, also the result of students activities observation during learning using Student Worksheet got 98,89% in the first day and 97,78% in the second day with both in very high interpretation.

Keywords: Student Worksheet, Problem Based Learning (PBL), Creative Thinking Skill, Acid Base

INTRODUCTION

Learning is one of the most important aspects in the world of education. National Education System Regulation Number 20 of 2003 states that education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious spiritual strength, self-control, personality, intelligence, noble character and the necessary skills themselves, society, nation and country [1]. There have been many government efforts to improve the quality of education so that it continues to grow and can compete in the global era to produce productive students, this is in line with the objectives of the 2013 National Education Curriculum.

The objectives of the 2013 National Education Curriculum are explained in the appendix of Permendikbud Number 69 in 2013, which is preparing Indonesian people to have life skills as individuals and citizens who are faithful, productive, creative, innovative, and affective and able to contribute to the life of society, nation, state, and civilization world [2]. With this, it is expected that education in Indonesia can

develop far better than before, especially in the field of natural science.

Process of natural science learning emphasizes the provision of direct experience that aims to develop competencies in order to explore and understand the natural environment naturally [3]. Chemistry is one of the sciences included in the natural science, therefore chemistry has the same characteristics as natural science. Chemistry as part of natural science is obtained and developed based on experiments to find answers to the questions of what, why, and how about natural phenomena especially those related to the composition, structure, properties, transformation, dynamics and energetics of substances [4]. How to get answers to natural phenomena and their usefulness is expected to be a motivation for students to learn the knowledge that has been obtained so that it can be applied in daily life.

Students need a creative thinking skill to be able to associate natural phenomena with facts, concepts, principles, theories, and laws in chemistry subjects. Creative thinking is the general ability to create something new, as the ability to provide new ideas that can be applied in

problem solving, or as the ability to see new relationships between pre-existing elements [5]. Students creative thinking will improve more if they work in peer to solve a problem or express their opinions from the discussion on a certain topic [6]. There are four characteristics of creative thinking expressed by Gilford and Torrance [7], those are: (1) originality, (2) elaboration, (3) fluency, and (4) flexibility.

Based on the results of the pre-research questionnaire, as many as 94.87% of students felt chemistry subjects were interesting to learn and 64.10% felt chemistry subjects were easy to understand. As many as 66.67% of students stated that the learning method that had been used by teachers was still in the form of lectures or direct learning in the classroom. As many as 89.47% of students are interested if the chemical learning process is accompanied by practicum activities in the laboratory because 100% of students have never done acid-base practicum in the laboratory. As many as 76.92% of students stated that their teacher had taught creative thinking skills to solve problems in daily life by linking them to chemical concepts, but 54.05% of students felt they had never applied the acid-base concept in solving problems in their daily lives.

Based on the description above, one of the efforts to maximize student interest is very high, through the use of the acid-base matter that has been learned in life. Actually chemistry is very close to the daily lives of students. Therefore chemical learning is designed by utilizing natural products around us. One of them is by utilizing several types of colored plants or flowers around the student's life as an indicator of natural acid and base [8]. Activities that can support these uses can be done through solving the problems in everyday life that support the presence of creative thinking skills.

The learning model that can be used to train students creative thinking skill is a learning model that is in accordance with chemical characteristics especially in acid-base matter. Implementations of acid base matter are easy to be found in daily life, so the right learning model to teach this matter is Problem Based Learning (PBL). PBL is a learning model that exposes students to real world problems to start learning and is one of the innovative learning models that can provide active learning conditions to students [9]. Arends suggests five learning stages in PBL, those are: (1) Orientation of students in the situation, (2) Organizing students to learn, (3) Guiding individual and group investigations, (4)

Developing and presenting work, (5) Analyzing and evaluating problem solving processes [10].

For the sake of fulfilling learning devices and learning models that are also able to train students' creative thinking skill, a student worksheet can be developed. Student worksheet is a guide for students who are used to carry out investigation and problem solving activities [11]. The student worksheet that will be developed in this study adopts the PBL learning model. Student worksheet oriented to problem-based learning puts forward problems as a driver of learners to learn, because the problems which are used are problems in everyday life which certainly attract students' interest to investigate how to solve them [12]. In addition, the student worksheet can improve the skills of students in the cognitive domain, problem solving, and creative thinking.

Based on several relevant studies, learning is the first step to know the concepts before being implemented in a real life to solve a problem, while they needs to be open minded and creative to find the solutions [13]. It is supported by the results of research conducted by Strobel and Barneveld (2009) show that PBL is superior for long-term memory, while traditional approaches are more effective for short-term memory as measured by the final examination of the matter that has been studied [14].

Based on this background, it is necessary to develop student worksheet with a problem-based learning model that is suitable for acid-base matter and also able to train creative thinking skill. The title of the research that will be conducted is "Development of Student Worksheet with Problem Based Learning Oriented to Train Student Creative Thinking Skill in Acid Base Matter by Using Natural Products".

METHOD

The research design used in this student worksheet development uses a device development model according to Thiagarajan, that is 4-D models. This model has 4 main stages, those are Define, Design, Develop, and Disseminate. But in this study only limited to the development stage.

The instruments used in this study include: review, validation, response of students, and tests of creative thinking skills. Review is done to get an expert advice. The study was carried out by one expert, a chemistry lecturer. The aim is to get advices and input to obtain a truly appropriate student worksheet design.

Subsequently, revisions were made according to inputs and suggestions from expert which then produced draft II. These results were then validated by three experts consisting of two chemistry lecturers from State University of Surabaya and chemistry teacher at Surabaya 1 Senior High School. The results of the validation data were then analyzed using quantitative descriptive methods using a Likert scale and obtained the percentage of feasibility reviewed based on content validity and constructs. The developed student worksheet is said to be valid if it meets the percentage results of $\geq 61\%$ with a valid category. The Likert scale shown in Table 1 and the interpretations of the validation score are shown in Table 2.

Table 1. Likert scale

Scale Value	Valuation
1	Very Bad
2	Bad
3	Normal
4	Good
5	Very Good

[15]

Table 2. Interpretations of Validation Score

Percentage (%)	Categories
0-20	Not Valid
21-40	Less Valid
41-60	Enough Valid
61-80	Valid
81-100	Very Valid

[15]

The validated student worksheet then tested to 33 students of class XI in Surabaya 1 Senior High School. Data obtained from limited trials in the form of questionnaire responses of students were used to determine the practicality of the developed student worksheet. The student worksheet is said to be practical if it meets the percentage results of $\geq 61\%$ with the responding category. Calculations for this data use the Guttman scale which is presented in Table 3 which is then interpreted in Table 4.

Table 3. Guttman Scale

Statement	Value of Positive Statement	Value of Negative Statement
Yes	1	0
No	0	1

[15]

Table 4. Interpretations of Students Response

Percentage (%)	Categories
0-20	Very Low
21-40	Low
41-60	Normal
61-80	High
81-100	Very High

[15]

In addition, observation of the students activities is also carried out to support students' responses. The calculation of the percentage of activity is as follows:

$$\% \text{ students activities} = \frac{\sum \text{frequency of appearing activities}}{\sum \text{total frequency}} \times 100\%$$

The percentage of the result then can be interpreted as in the Table 5 below:

Table 5. Interpretations of Students Response

Percentage (%)	Categories
0-20	Very Low
21-40	Low
41-60	Normal
61-80	High
81-100	Very High

[15]

While the results of the test of creative thinking skills are used to determine the effectiveness of the developed student worksheet. The student worksheet is said to be effective if the percentage of the Class Achievement Index is $\geq 75\%$ with a high category. The following formula calculates the Class Achievement Index:

$$\text{Class Achievement Index} = \frac{\text{Average Score}}{\text{Maximum Score}} \times 100\%$$

Then the percentage of Class Achievement Index is interpreted in the following Table 6:

Table 6. Interpretations of Class Achievement Index

Percentage (%)	Categories
0-30	Very Low
31-54	Low
55-74	Normal
75-89	High
90-100	Very High

[16]

RESULT OF THE RESEARCH AND EXPLANATION

This study describes the feasibility of student worksheet to train creative thinking skill in acid-base matter which is reviewed based on validity, effectiveness, and practicality.

The Validity of Student Worksheet

Validity of student worksheet which was developed are reviewed based on its content and construct. Component of validity includes completeness; accuracy; and the suitability of the student worksheet with learning matters, curriculum, and indicators; and the suitability of the student worksheet with the components of creative thinking skill. While construct validity includes language, presentation, and graphics [17]. The developed student worksheet is said to be valid if it meets the percentage results of $\geq 61\%$ [18].

Before being validated, the student worksheet was reviewed to find out the weaknesses of the student worksheet. Then the results of the review in the form of comments and suggestions were used to perfect the developed student worksheet. Based on the results of the study obtained some comments and suggestions from the reviewers, such as: relating to the cover of the student worksheet to be more representative so as to attract students' interest in knowing the contents of the student worksheet, the use of colors in the appropriate image illustrations, language clarity, content components, and the addition of related information with the matter given in the student worksheet. These suggestions and inputs are then used to improve the student worksheet before being validated.

Then the revised student worksheets as draft II will be validated. The results of the validation of the devices developed consisted of content validity and construct validity which was assessed by three validators using validation instruments. Data from the validators on the validation instrument are presented in Figure 1 as follows:

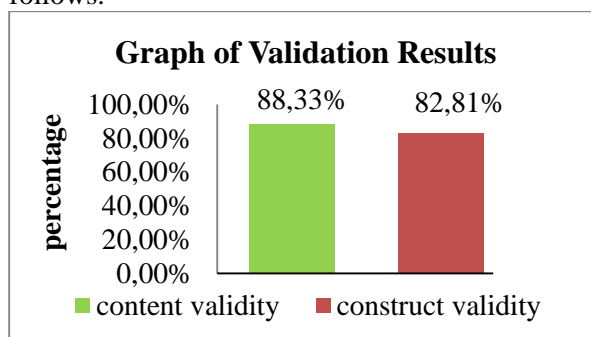


Figure 1. Graph of Validation Results

Content validity showed the suitability of the student worksheet with criteria related to the component of content validity which includes completeness; accuracy; and the suitability of the

student worksheet with learning matters, curriculum, and indicators; and the suitability of the student worksheet with the components of creative thinking skill. Validation results based on content validity obtain an average percentage of 88.33%, which got a criteria as very valid.

Construct validity showed the suitability of the student worksheet with criteria related to the components of construct validity that include language, presentation, and graphics [17]. Validation results based on construct validity obtained an average percentage of 82.81%, which got the criteria as very valid.

The Practicality of Student Worksheet

The practicality of the developed student worksheet is reviewed based on the responses of students and supported by observing the students activities during learning by using the student worksheet. The response of the students was obtained through questionnaires that were distributed after learning process. This response questionnaire was in the form of a questionnaire containing 15 positive and negative statements with a choice of "Yes" and "No" answers which was distributed to 33 students. The student worksheet developed was considered practical if the results of the analysis of student response data showed $\geq 61\%$ positive responses with very high category [18]. Based on the results of the questionnaire responses of students to the learning of the developed student worksheet, it was shown that the average response rate included was very responsive category. The results of student response analysis data, the average practicality percentage was 91.31%. This shows that the developed student worksheet is very practice. Student response data is shown in Figure 2 below:

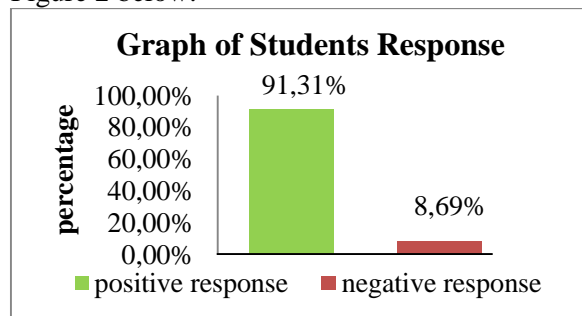


Figure 2. Graph of students response

The response data is supported by students activities. The students activities were observed for two meetings and the percentage of relevant activities in the first meeting is 98.89% and the percentage of relevant activities at the second

meeting is 97.78%. Graphs of student activities is presented in Figure 3 below:

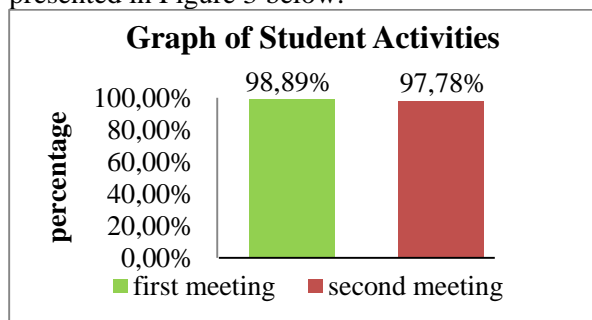


Figure 3. Graph of Student Activities

The percentage of students relevant activities is very high. This is able to support the response data because it can show the sincerity of students in working and providing feedback on the developed student worksheet.

The Effectiveness of Student Worksheet

Effectiveness of student worksheet to train creative thinking skill in acid-base matter in terms of the results of tests of creative thinking skill. This creative thinking skill test consists of 2 stages, those are the pre test given to students before using student worksheet and post test given to students after learning using the developed student worksheet. The score of the pre test results is used to determine the students' initial creative thinking skill while the post test results are used to measure the effectiveness of the student worksheet after being tested to students. Data on the assessment results of students creative thinking tests are presented in Figure 4 below:

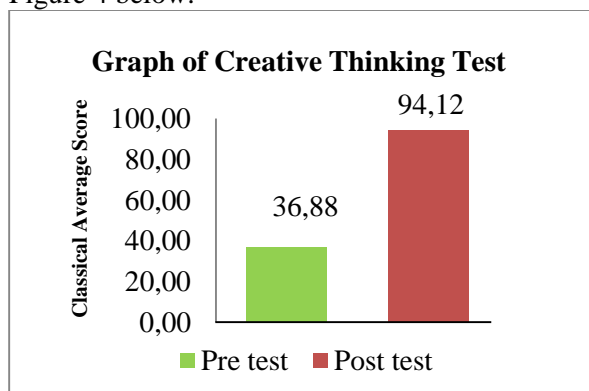


Figure 4. Graph of Creative Thinking Test

Based on the results of the pre test scores that had been obtained, all students still could not reach the minimum score that has been set, that is 75. The percentage of the Class Achievement Index obtained is 36.88% with a low category. The percentage of each component of creative thinking from the pre test are fluency at 44.95%, flexibility at 50%, elaboration at 31.28%, and

originality at 50% with a low category for all. After a limited trial, a post test was conducted and all students had reached the minimum score and obtained a percentage of Class Achievement Index as 94.12% with a very high category.

Based on the results of the test of creative thinking skill above, it can be seen that all students have increased their score. This shows that the developed student worksheet is declared effective with a percentage of Class Achievement Index as 94.12%, which means it is in the very high category. The percentage of each component of creative thinking from the post test are fluency at 100%, flexibility at 100%, elaboration at 91.50%, and originality at 100% with a very high category for all. The percentage of each component of creative thinking from pre test and post test are shown in Figure 5 as follows:

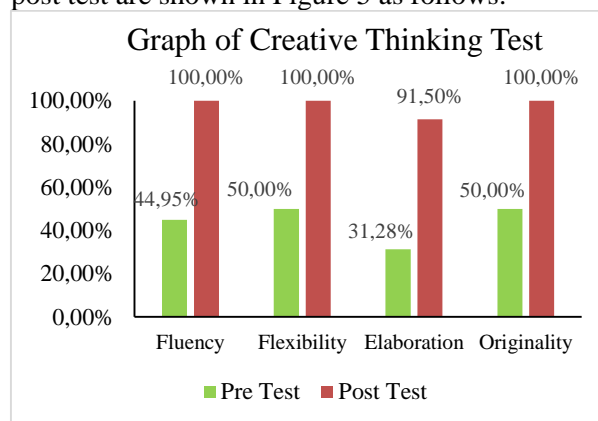


Figure 5. Each Component of Creative Thinking

CLOSURE Conclusion

Based on the results of data analysis and discussion of research on the development of student worksheet to train creative thinking skill in acid base matter by using natural product, it can be concluded that student worksheet is feasible to be used as a learning media because it has met the feasibility requirements, those are:

1. Based on the validity aspects stated as very valid based on the results of the validator's assessment. Validity values in each aspect were reviewed from the content validity and construct validity with each percentage is 88.33% and 82.81%. The average validity is 85.57% with very valid category interpretation.
2. Based on practicality aspects, it is stated to be very practical based on students' responses with the percentage of average response is 91.31% in the interpretation of

very high categories also with the students relevant activities percentage of first day got 98,89% and second day got 97,78% with both in very high interpretation.

3. Based on the effectiveness aspects stated very effective based on the results of the test of creative thinking. Based on the results of these tests, it is known that 100% of students have achieved the minimum score and the percentage of Class Achievement Index is 94.12% with very high category. In addition, the percentage of creative thinking skills in each component, such as fluency of 100%, flexible thinking of 100%, elaboration thinking of 91.50%, and originality thinking of 100% with overall categories are very high.

Suggestions

Based on the results obtained from this development research, some suggestions can be given as follows:

1. The development of student worksheet to train creative thinking skill in other matter, so that students' creative thinking skill can be better.
2. Development of student worksheet on acid-base matter is more expanded so that the range of matter presented is not only on acid-base indicators.
3. All of the developed student worksheets to train creative thinking skill on acid base matter can be a learning media, but the creative thinking skill must be introduced first before the training.
4. This student worksheet can be developed again in the future by adding 5th phase of PBL learning model that is analyzing and evaluating problem solving process.

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