

**DEVELOPMENT OF STUDENT WORKSHEET USING SCIENTIFIC APPROACH
TO TRAIN STUDENT CREATIVE THINKING SKILL ON ACID AND BASE
MATTER FOR SENIOR HIGH SCHOOL GRADE XI**

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Abstrak

Penelitian ini bertujuan mengembangkan LKS yang layak ditinjau dari kriteria isi, penyajian, kebahasaan dan kegrafikan, melatih keterampilan berpikir kreatif, serta respon siswa. Jenis penelitian adalah penelitian dan pengembangan (R&D). Sasarannya adalah LKS yang dikembangkan. Instrumen yang digunakan terdiri dari lembar telaah, validasi, soal pemahaman konsep dan keterampilan berpikir kreatif, dan angket respon siswa. Sumber data berasal dari dosen kimia, guru kimia, serta 12 siswa kelas XI SMA dan data dianalisis secara deskriptif. Hasil penelitian berupa LKS untuk melatih keterampilan berpikir kreatif dengan persentase kelayakan antara 75% - 93,75%. Keterampilan berpikir kreatif dengan *originality*, *elaboration*, *fluency*, dan *flexibility* dikategorikan berturut-turut sangat baik (3,12 – 3,73), sangat baik (3,02 – 3,91), sangat baik (3,6 - 4), dan sangat baik (3,64 - 4). Respon siswa memperoleh persentase antara 75% - 100%. Dengan demikian, LKS yang dikembangkan dikategorikan layak.

Kata kunci: LKS, *scientific approach*, keterampilan berpikir kreatif

Abstract

The aim of this research was to develop the feasibility of student worksheet on some criteria: content, presentation, language, and graphical, to train student creative thinking skill, and student's response. The type of research was a research and development (R&D). The target was the student worksheet that developed. The instrument that used consists of analysis sheet, validation, question of comprehension concept, student creative thinking skill, and student response questionnaire. Source of data were obtained by chemistry lecturer, chemistry teacher, and 12 students grade XI Senior High School and data was analyzed descriptively. The result was student worksheet to train creative thinking skill with percentage of feasibility between 75% - 93.75%. Creative thinking skill on aspect *originality*, *elaboration*, *fluency*, dan *flexibility* respectively (3.12 – 3.73), (3.02 – 3.91), (3.6 – 4, and (3.64 - 4) on very good categorize. The response of students got percentage between 75% - 100%. Therefore, the student worksheet that developed categorized as feasible.

Keywords: student worksheet, scientific approach, creative thinking skill

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PRELIMINARY

Education is a conscious effort and planned to create an environment of learning and learning process so that learners are actively developing the potential for him to have the power of religion spiritual, self-control, personality, intelligence, character, and skills needed him, society, nation, and state [1]. Education to build the life of the present and the future better than the past with different intellectual abilities, communication skills, social attitudes, awareness, and participate to build a social life life and a better nation (experimentalism and social reconstructivism) [2].

Learning process on Curriculum 2013 emphasized that learning should be student-centered. One of the learning resources that can be used is student worksheet [3]. Student worksheet is sheets contain tasks that must be done by the students [4]. Student worksheet usually in instructions form, the steps to complete a task. A task that was ordered in activities sheet should be clearly related to the competencies to be achieved. The results of interviews with teachers, that the student worksheet that used is not made of teachers and school concerned but from publishers so student worksheet that used is generally not adapted with the curriculum at the school. Along with the importance of the role of student worksheet as one of learning resource, hence needed of student worksheet in teaching chemistry at schools.

Based on the result of interviews with the chemistry teacher, methods or strategies that used in teaching chemistry is a lecture and discussion, while the method using a scientific approach has not been practiced in learning because it takes a longer time than the lecture method, as

well as the teachers had never used the methods of scientific approach in teaching materials based chemistry experiments and non-experiment.

Learning with scientific approach is a learning process that is designed so that learners are actively constructing concepts, laws or principles through the stages observing, problem formulating, hypothesis formulating, collecting data with a variety of techniques, data analyzing, concluding and communicating [5]. Accordance with the objectives of the development of curriculum 2013, the study by using scientific approach method can be practiced to students gradually.

Optimal education of creative thinking ability is closely related with how to teach. The most important element in teaching is to stimulate and direct students to study [6]. According Plucker "creativity is the interaction between talent, processes, and the environment in which an individual or group to produce real products that are new and useful" [7]. It can explain the relationship between scientific approach learning strategies and creative thinking skills that using a scientific approach strategies teachers can practice creative thinking abilities of students.

Students with good academic performance have also high levels of creativity in learning chemistry [8]. The existence of a positive relationship between students academic achievement in chemistry and level of scientific creativity in chemistry. The results of field studies showed that creative thinking skills of students were still low. Students incorrect answer of the indicators of creative thinking skills originality, elaboration, fluency and flexibility respectively 62.07%, 84.38%, 96.55% and 51.72%.

The matter that used in this research was acid and base, the matter was widely applied in daily life, so that the matter was appropriate to be taught by using student activity sheet of scientific approach to train creative thinking skills of students.

Overcome the problems above, it is necessary to research, entitled "Development of Student Worksheet using Scientific Approach to Train Creative Thinking Skills Students on Acid and Base Matter for Senior High School Grade XI".

METHOD

This type of research was a research & development (R&D), which consists of three stages, namely the preliminary field testing, development and evaluation stage. The target of research was the student worksheet that developed. Source of data were obtained from chemistry lecturer, chemistry teacher, and 12 of student grade XI SMAN 1 Gedangan. The research only carried out at the stages of preliminary field testing and development, while the evaluation stage was not done.

The instrument of research were consists of analysis sheet, validation, question of comprehension concept, student creative thinking skill, and student response questionnaire. The techniques of collecting data are used questionnaires and tests. The questionnaire was used to obtain analysis data, validation, test and student response. The data were analyzed descriptively.

The score percentage of validation result data was obtained by Likert scale with a value scale of 0 (very less) to 4 (very good) [9]. After that the value of the validation results included into the formula to obtain the percentage of feasibility:

$$K = \frac{F}{N \times I \times R} \times 100\%$$

Then interpreted into criteria accordance with of Table 1 below:

Table 1. Score Interpretation Criteria

Percentage (%)	Criteria
0 – 20	Very Less
21 - 40	Less
41 - 60	Enough
61 - 80	Good
81 – 100	Very Good

[9]

Based on the score interpretation criteria, student worksheet that developed was feasible if comply the criteria of content, presentation, language and graphical with gained percentage $\geq 61\%$ with good criteria, so it could caterorized as feasible [9].

Percentage of data from student questionnaires was obtained by calculation Guttman scale score [9]. Students will answer "yes" when the aspect of the questionnaire accordance with the criteria, and answer "no" when the aspect of the questionnaire did not accordance with the criteria.

After that, the score was entered into the formula for obtain the percentage of feasibility.

$$P(\%) = \frac{\sum \text{data collection score}}{\text{criterion score}} \times 100\%$$

The calculation result of the percentage from student response questionnaire interpreted into criteria as in Table 1.

Based on the criteria was obtained, student worksheet categorized as feasible if gained the percentage $\geq 61\%$ [9].

Final test was used to determine and assess understanding of comprehension concept and creative thinking skill of student. Students did 12 question of description. The final test was assessed using a scale of 1-4 (multiplier of 0.33) were subsequently converted into the

predicate A to D. Technique to obtain the predicate of A-D, hence the value of students necessary to be converted into a form of value using the formula:

$$\text{Student scores} = \frac{\text{student scores}}{25}$$

Furthermore, the value is converted into an A-D in accordance with Table 2

Table 2 Conversion Value into Predicate

No.	Range of Values	Predicate
1.	3,85 – 4,00	A
2.	3,51 – 3,84	A-
3.	3,18 – 3,50	B+
4.	2,85 – 3,17	B
5.	2,51 – 2,84	B-
6.	2,18 – 2,50	C+
7.	1,85 – 2,17	C
8.	1,51 – 1,84	C-
9.	1,18 – 1,50	D+
10	1,00 – 1,17	D

[10]

Students are said to understand the concept when obtaining the value of final test ≥ 2.67 with predicate (B) [10].

The analysis data creative thinking skill of student with given 12 question of creative thinking skill which included four indicator of creative thinking skill that are: originality, elaboration, fluency and flexibility.

Each question will be calculated the averages for each indicator creative thinking skills. Through the average will get a value according to Table 2.

If the value obtained for each indicator reached ≥ 2.67 , the creative thinking skills of students in the indicator is categorized as good. Student worksheet can be said can practice creative thinking skills when the four indicators of creative thinking skills considered good.

RESULTS AND DISCUSSION

Validity of Student Worksheet

Validation of student worksheet that developed based on criteria of content shown criteria feasible and very feasible in various aspects. Compliance with the criteria of creative thinking skills, embrace: originality, elaboration, fluency and flexibility, which categorized as feasible in all student worksheet that developed. It is caused the overall student worksheet contains question that can practice four creative thinking skill sequentially and gradually.

Aspect of presentation contents that were classified criteria very feasible with a percentage of 87.5% which aspects cover presented of the content student worksheet. It is caused the cover image on student worksheet had been interpreted the contents of each student worksheet that developed. Cover of student worksheet 1 contains images chemists formulate a theory of acids and bases namely Arrhenius, Bronsted-Lowry and Lewis. Student worksheet 2 contains images of natural indicators that can be used to determine the nature of the acidity of the solution. Student activity sheet 3 contains images a color solution at a particular pH scale. It was done in order that the student interested using student worksheet that developed.

The language criteria, entire student worksheet that developed were categorized as very feasible in all aspects. It is caused all of the components in the student worksheet using Indonesian writing correct, clear, concise and easily understood by students.

The graphical criteria on student worksheet that developed were categorized as very feasible in all aspects. Like aspects of quality of paper used, and aspects of

good print quality and color were produced in accordance with the designs get a high enough value, so make the student interested using student worksheet that developed. As perfect as any material that we prepared, but if learners are not able to read clearly, then student worksheet would give maximum results [11].

Student Creative Thinking Skill

Problem of creative thinking skills used in the research consisted of 12 questions describing which represents the four indicator creative thinking skills that originality, elaboration, fluency and flexibility.

Indicators originality creative thinking skills in pretest obtain the lowest value is 0.67, whereas the overall post-test increases with the range of values obtained (3.12 - 3.73). It was caused to the first question pretest indicators of originality that is "Served table the results of experiments testing solution W, X, Y and Z using litmus paper indicator. It is seen that the first question that students can solve problems well enough, because the student had learned the material that had been taught in schools through textbooks and books remarks before the exercise of the pretest. The second question pretest, the results obtained were as much as three students got scored 3.2, because the students were easier to solve problems calculation compared with analyzing.

Indicators elaboration creative thinking skills in pretest obtained the lowest score is 0.89, while the overall posttest increases with the range of values obtained (3.02 - 3.91). One example about elaboration of explain how the acid-base reaction according to the Arrhenius theory of reaction between HCl and NaOH. Students were asked to describe each ion

reactions before and after the reaction. Overall the results obtained when the posttest increased in the indicator creative thinking skills. In accordance with the theory of information processing, from the initial processing will go on a short-term memory and the memory of their repetition, the students will arrive at the long-term memory [12].

Indicators fluency creative thinking skills in pretest obtained the lowest score at 1.2, but there is one student obtained 2.76, while the overall post-test increases with the range of values obtained (3.6 - 4). The first question as much as 2 students got percentage high enough, that is 3.2 contained in question of conjugate acid-base pairs reaction. It was seen that both the students can complete the pretest questions correctly. There was represented by previous research in improving the ability of creative thinking, teachers should be able to design learning that could enable the students [13]. Besides the assignment had given to be able to develop thinking skills that were not only focused on the answers so that they could construct the concepts, idea of his own thoughts became more widespread.

Indicators flexibility creative thinking skills in pretest obtained value with the range (0.71 - 1.87), whereas the overall posttest increases with the range of values obtained (3.64 - 4). The second question pretest results of the color changes in acid and base solution using natural indicators. Students were required to made conclusions based on the results that had been presented. Student worksheet effective as a instructional media to assist students in learning, increase knowledge and improve creative thinking skills [14].

It is proved that the thinking skills of students can be practiced in a way students

gather information not only through the experiment, but with observation and search literature students were also able to find a concept. Seen that creative thinking skills of students in the beginning was quite low, but can be practiced use student worksheet that developed to obtain the results of creative thinking skills that students could increase the skills of each indicator.

Response of Student

Criteria of contents, all aspects got very feasible criteria. One of them on the aspects of material in the student activity sheet is easy to understand and compliance activities with the experiments with the material obtained percentage of 100%. It was accordance with the function of student worksheet as teaching materials that facilitate students to understand the material given [11].

Criteria of presentation, the fourth aspects obtained very feasible criteria and one aspect obtained feasible criteria with the percentage were 75%, namely presentation aspects of student worksheet arouse curiosity so that students were motivated to ask. Students who were still difficult to made inquiries may be assisted by teachers to create questions after the activity observed phenomena. Students were given the opportunity as possible to ask questions after the activity observed, the teacher can provide questions to motivate students so that they could ask questions [13].

Criteria of language, student response questionnaire showed very feasible criteria in all aspects. Aspects of writing of student worksheet using easily understood terms and aspects of the language used clear and concise obtained very feasible results. This was supported by the results of the

validation aspects of the use on some criteria in the student worksheet and easy to understand, as well as aspects of the use of appropriate language also got a very feasible rating.

The last criteria is graphical, results of student responses questionnaire on aspects of the text color in the student worksheet support and in accordance with the illustrations or pictures get a percentage of 91.7%. This is supported by the results of validation on aspects of the background with the text color gained feasibility the percentage of 81.25%. Indicate that the student worksheet included in the criteria was very feasible. According to the information processing theory that the features in the student worksheet greatly assist students in understanding the material being studied, so that it can enter into long-term memory [12].

Based on the results of student responses questionnaire, the student worksheet that developed categorized as feasible, since all aspects contained in each of the criteria to got the percentage of > 61%.

CONCLUSION

Based on the result of research and analysis, can be concluded as follows.

1. The feasibility of student worksheet that developed on some criteria: content, presentation, language, and graphical categorized as feasible use as a learning resource with the percentage of each criterion between (75% - 93.75%).
2. Creative thinking skill on indicator: originality, elaboration, fluency and flexibility are respectively (3.12 - 3.73), (3.02 - 3.91), (3.6 - 4), and (3.64 - 4) on very good categorize.

3. The response of students for the student worksheet which developed shown a positive response with the percentage obtained for each criterion between 75% - 100%, thus categorized as feasible as a learning resource.

SUGGESTION

Suggestion can be given for further research and teachers who use student activity sheet that were developed in the learning process is as follows.

1. Implement of student activity sheet that have been developed for learning students of class XI senior high school with a longer time and regularly.
2. Practice creative thinking skills of student one using student activity sheet that were developed.

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