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DEVELOPMENT OF CHEMISTRY EXPERIMENT WORKSHEET WITH PROCESS SKILLS ORIENTATION IN CHEMICAL EQUILIBRIUM TOPIC FOR SENIOR HIGH SCHOOL GRADE XI

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Abstrak. Penelitian ini bertujuan untuk mengetahui kelayakan *Chemistry Experiment Worksheet* berorientasi keterampilan proses pada materi pokok kesetimbangan kimia pada kelas XI yang dinilai berdasarkan pada kriteria isi, kesesuaian dengan keterampilan proses, penyajian, kegrafikaan dan kebahasaan. Penelitian ini menggunakan desain *Research and Developmet* (R&D) , tetapi penelitian ini dibatasi sampai tahap uji coba produk secara terbatas. Sasaran penelitian ini adalah *Chemistry Experiment Worksheet* berorientasi keterampilan proses pada materi pokok kesetimbangan kimia dengan sumber data penelitian ini yaitu 1 dosen kimia, 2 guru kimia dan 1 ahli bahasa. Instrumen yang digunakan adalah lembar telaah dan lembar validasi. Pengumpulan data menggunakan metode angket yang dianalisis secara deskriptif kuantitatif. Hasil penelitian menunjukkan bahwa *Chemistry Experiment Worksheet* yang dikembangkan telah layak digunakan sebagai penunjang praktikum kimia karena telah memenuhi kriteria kelayakan isi, kesesuaian dengan keterampilan proses, penyajian, kegrafikaan dan kebahasaan, masing-masing dengan persentase berturut-turut sebesar 90,28%; 89,96%; 82,54; 80,05% dan 85%.
Kata Kunci: *Chemistry Experiment Worksheet*, keterampilan proses, kelayakan

Abstract. The aims of this research was determined the feasibility of Chemistry Experiment Worksheet with process skills orientation in chemical equilibrium topic for grade XI based on content criteria, suitability with process skills content, presentation, graph and languange. This research using design Research and Developmet (R&D), but this research was limited to a limited product trial. Research objectives is Chemistry Experiment Worksheet with process skills orientation in chemical equilibrium topic for grade XI and data sources of this research are 1 chemistry lecturer, 2 chemistry teacher and 1 linguist. Instrument of this research are review sheet and validation sheet. Methods of data collection sheet is questionnaire that analyze with quantitative descriptive. The results showed that Chemistry Experiment Worksheet have been developed competent used as advance for chemistry practical since has met feasibility criteria of content, suitability with process skills, presentation, graph and language, each with row percentage 90,28%; 89,96%; 82,54; 80,05% dan 85%.

Key Word: Chemistry Experiment Worksheet, process skills, feasibility

INTRODUCTION

Chemistry is a branch of Natural Sciences. Learning science means learning everything related to the objects of the universe, living thing and non-living thing, also matters and their change. Chemistry is a science based on experimentation and the development of applications demanding high standards in the experimental work [1]. Implementation of the chemical experiment help students understand the scientific method and arouse the curiosity of students to chemistry.

Chemistry experiment helps students acquire the skills, such as the manipulation of tools and materials,

observation, data collection, data analysis, interpretation of data, problem solving, teamwork, design experiments, and communication skills. Process skills that can be developed and acquired through practical activities is very important to be learned and mastered by every student [2].

When someone has mastered the process skill, it means they have mastered the necessary skills in high-level learning, such as conducts research and solve problems. Problem solving skills and research skill belong to life skill. Both of them are the highest learning outcomes that students need to learn [3]. Experiment worksheet can be used as a learning medium in a chemistry experiment. Experiment worksheet contains practical guide, list of materials and equipment that needed [4].

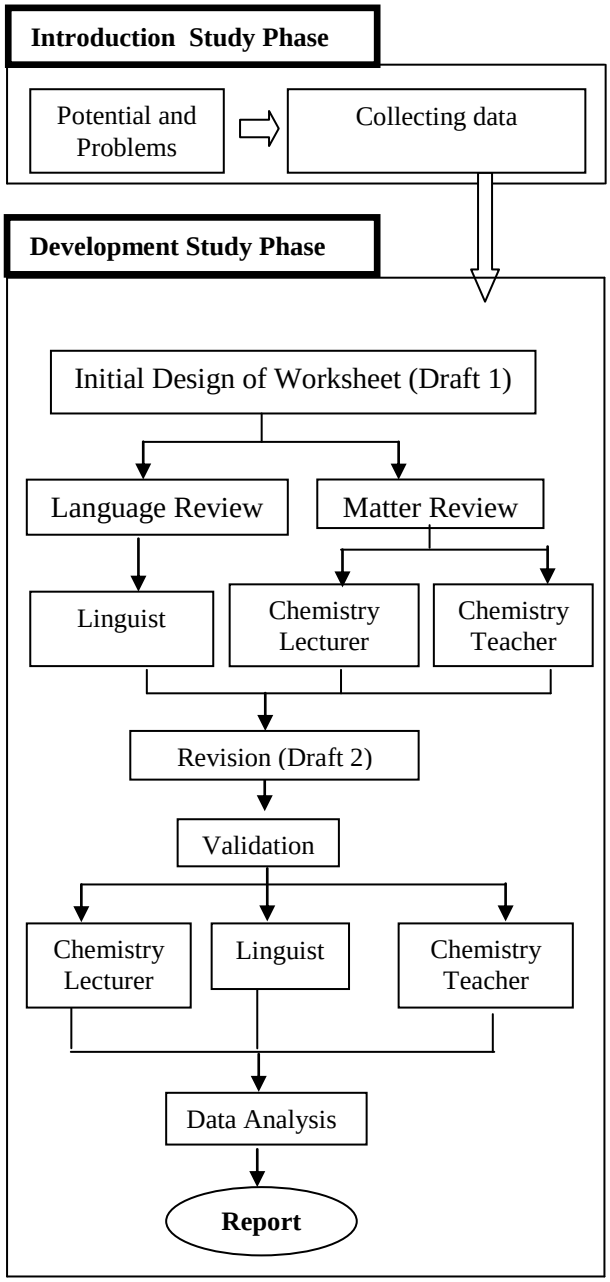
SMA Negeri 1 Cerme is one of the pioneering International School since 2009, and the learning process using a bilingual (English - Indonesia). Based on the pre-study questionnaire to the 30 respondent, the results obtained 23.33% of the students stated that the chemistry experiment are interesting and make students learn certain skills that are not derived from the learning activities in the classroom, such as observation skills, analyze data and communication skills. The total of 76.67% of students expressed difficulty in conducting chemistry experiment. It occurs because to do experiment they need understanding the theory related to the experiment but do not understand what should be done when they conducting experiment.

The students have never used the media to support practical learning in the laboratory, for example using *Experiment Worksheeet,* so students only use practical guide sheet provided by the chemistry teacher before experiment activities started. Sometime also use common worksheets with Indonesian language. There are many ways to minimize these difficulties, one of them is to optimize the use of learning tools, such as *Experiment Worksheet.* This is supported by the results of the questionnaire stated that to facilitate the experiment students want a guidebook or experiment worksheets for learning activities in the laboratory.

An approach is needed to practice process skills that gained from practical activities, one suitable approach is process skills approach. Process skill approach is a process of learning skills that are designed so that students can find the facts, build concepts and theories with scientific intellectual skills and scientific attitudes. Students are given the opportunity to be directly involved in scientific activities. Learning in the laboratory with process skills approach is expected to help develop the personality and scientific attitude of students [4]. Based on the reason , the researchers wanted to develop Experiment Worksheet presented a bilingual (English - Indonesia) with respect to eligibility criteria which includes the criteria of content, presentation criteria, linguistic criteria and graph criteria.

METHOD

This study using design *Research and Development* or *R & D* which consists of three stages, namely preliminary study phase, development study and the evaluation phase [5]. This study is limited to the development study phase, which is on the limited product trials.



Sources of review data in this research are 2 chemistry lecturer, 1 chemistry teacher and 1 linguist. Data validation is obtained from 1 chemistry lecturer, 2 chemistry teacher and 1 linguist. Feasibility assesment of Experiment Worksheet will be done through questionnaire method. The purpose of this questionnaire sheet was to determine the assesment and opinions of the chemistry lecturer, linguist and chemistry teacher (in the review sheets and validation sheet). Data analysis use descriptive quantitative method for every criteria contained in the validation sheet. The percentage of the data obtained by this questionnaire Likert scale calculations in Table 1.

Table 1. Likert Scale [6]

Category	Scale scores
Very Less	0
Less	1
Enough	2
Good	3
Very Good	4

The formula used in the calculation to obtain the percentages are:

$$P(\%) = \frac{total\ score\ of\ data\ collection\ result}{score of\ criteria} x100\%$$

score of criteria = highest score x number of aspects of x number of respondents.

The results of validation sheet was analyzed to determine the feasibility of *Chemistry Experiment Worksheet* have been developed by using the interpretation of scores in Table 2 as follows:

Tabel 2. Score Interpretation [6]

Percentage (%)	Category
0-20	Much less
21-40	Less
41-60	Enough
61-80	Good
81-100	Very good

RESULT AND DISCUSSION

Data of validation results obtained from the validator's assessment analyse descriptive quantitatively. Validation results of the *Chemistry Experiment Worksheet* presented in Table 3.

Table 3. Validation Results of *Chemistry Experiment Worksheet*

No	Criteria	Percentage (%)	Category
1.	contents	90.28	Very good
2.	compliance with process skills	89.96	Very good
3.	presentation	82.54	Very good
4.	graph	80.05	Good
5.	Languistic	85.00	Very good

Worksheet is feasible if it satisfies the percentage of ≥ 61% based on the interpretation of Likert scale scores [6]. According to Table 3 it can be seen that the feasibility assessment worksheet is as follows:

Contents Criteria

Based on the validation result of the chemistry lecturer and chemistry teacher in Table 3 show that the contents of Chemistry Experiment Worksheet have been developed reach the eligibility criteria with a percentage of 90.28%, and in the category of very good because it is in the interval 81% -100%. These results indicate that the contents of Chemistry Experiment Worksheet with process skills orientation that has been developed reach the eligibility criteria as in BSNP (2006). It means Chemistry Experiment Worksheet contains material with the accuracy of the concept, the accuracy of the procedure, and the suitability of experimental activities and curriculum materials in the KTSP, Competency Standards (SK) and the Basic Competency (KD) to be achieved.

Materials of chemical equilibrium topic in the Chemistry Experiment Worksheet relevant to the learning indicators and it can support laboratory activities, Chemistry Experiment Worksheet easy to understand and in accordance with the indicators of learning outcomes. In addition, laboratory activities are also prepared in accordance with the Basic Competency (KD) to be achieved.

Compliance with Process Skills Criteria

Chemistry Experiment Worksheet is said to have met the criteria for compliance with process skills obtain an average percentage of 89.96%, which is at 81% -100% interval. So the criteria for compliance with the skills to obtain very good category. Validator's assessment for each component of compliance with process skills criteria are as follows:

1) Observing

This component obtained very good category with 94.45% percentage assessment. These results indicate that the presented experimental activity gives students the opportunity to conduct observations. Observation is the use of one or more of the senses to gather information about the world [7]. It is expected that with the observation component in Chemistry Experiment Worksheet, students can learn to gather information way by identifying common characteristics with the right concept and determine the changes that occur in the experiment.

2) Predicting

This component obtained very good category with 86.11% percentage assessment. These results indicate that the experimental activity presented in Chemistry Experiment Worksheet provides an opportunity for students to make predictions. With the prediction skills students are expected to determine the chances of that happening and determine the probability of multiple events by using previous experimental data.

3) Interpreting Data

This component obtained very good category with 88.89% percentage assessment. These results

indicate that the experimental activity presented in Chemistry Experiment Worksheet provides an opportunity for students to perform data interpretation. Data interpretation activities encourage students to be able to detect patterns from the information gathered through observation, measuring and using numbers to make rational explanation [8]. Data interpretation skills also make students to think critically in order to make a rational explanation of a phenomenon.

4) Controlling Variables

This component obtained very good category with 91.67% percentage assessment. These results indicate that the presented experimental activity gives students the opportunity to control the experimental variables. Under this component is expected to train students to determine the relevant variables in the experiment (the control variable, the response variable and variable manipulation). Controlling variables will be one of the basic skills that must be mastered before students learn the skills of manipulation and experimentation.

5) Making hypothesis

This component obtained very good category with 86.11% percentage assessment. This result suggests that the experimental activities in Chemistry Experiment Worksheet presented provides an opportunity for students to make a hypothesis. Making hypothesis skills train students to make a possible explanation of a scientific question. It is expected that the presence of this component students can practice making initial presumption by determining the relationship between the variables and the response variable manipulation based on inferences made [7]. A student can make a hypothesis if the student was able to determine the relevant variables in the experiment, then these skills will also be the basic of the skills of manipulation and experimentation.

6) Planning a Scientific Investigation

This component obtained very good category with 95.83% percentage assessment. These results indicate that the experimental activity presented in Chemistry Experiment Worksheet provides an opportunity for students to plan a scientific investigation. Planning skills of scientific inquiry, including the experimental manipulation skills and advanced skills as a basic process [8]. Under this component is expected that students are able to practice planning to make a set of experiments ranging from determining the formulation of the problem, hypothesis, variables and design working procedure.

7) Conducting scientific investigations

This component obtained very good categories with percentages rating 100%. This process skills encourages students to be able to design experiments that have been made using the correct tools and materials. With the components of a scientific investigation, is expected to inculcate future scientific attitude in students.

8) Collecting and Recording Data

This component obtained very good categories with percentages rating 100%. Under this component, is expected to train students to be able to record the results of measurements and observations. These skills act as a continuation of the skills of observation and measuring and using numbers that have been previously trained students in basic process skills. This skill requires foresight and the high accuracy of the students in collecting data, so no events are missed and not recorded.

9) Analyzing and Interpreting Data

This component obtained very good categories with percentages of

87.5% assessment. These results indicate that the experimental activity presented in Chemistry Experiment Worksheet give students the opportunity to practice analyzing and interpreting. Skills to analyze and interpret data including experimental manipulation skills and encourages students to use an inexact science in explaining and interpreting the observations [8]. So with this component is expected to train students to analyze the data in detail using multidisplin relevant science. This skill also trains students to think critically and use their reasoning power in processing existing information to produce rational explanations for a phenomenon that is also relevant to science.

10) Making Conclusion

This component obtained very good categories with percentages rating 100%. These results indicate that the experimental activity presented in Chemistry Experiment Worksheet provides an opportunity for students to practice making inferences. Under this component is expected that students are able to determine whether the hypothesis is accepted or rejected in accordance with good reason to consider whether the evidence collected supports the conclusion.

Presentation Criteria

Based on the validation results in Table 3 show that the Chemistry Experiment Worksheet have been developed reach the eligibility of presentation criteria with a percentage of 82.54%, and in the category of very good because it is in the interval 81% - 100%. These results indicate that the Chemistry Experiment Worksheet with process skill orientation reach the eligibility criteria as in the presentation of BSNP (2006). Chemistry Experiment Worksheet contains cover, who presented the content, clarity of indicators to be achieved, a good indicator of product, process and affective all in accordance with the Competency Standards and the Basic Competence. Illustration according to subject matter, images that can help the understanding of the concept, the pictures on the Chemistry Experiment Worksheet to help illustrate abstract concepts so easy to understand the students.

The next presentation of the criteria component is the presentation fun and intriguing students. Fun presentation can be seen in the layout and design of Chemistry Experiment Worksheet that is not boring, and there are features that can arouse the curiosity of the student instance with the features Chemist Zone, features Chems Wall. Both of these features contain knowledge that can arouse the curiosity of students about chemical phenomena in daily life, as well as chemical scientists. The last component in the presentation of the criteria is writing a bibliography according to a regulatory filing. Bibliography can be seen on each end of the Chemistry Experiment Worksheet.

Graphic Criteria

Based on the validation of the chemistry lecturer and chemistry teacher in table 3 show that the Chemistry Experiment Worksheet have been developed to meet the eligibility criteria of graph with a percentage of 80.05% and belong to good category because it is in the interval 61% -80%. These results indicate that the Chemistry Experiment Worksheet with process skill orientation that have been developed to meet the eligibility criteria of graph as in BSNP (2006) because of the appearance of the layout elements on the skin of the face and the back of the Chemistry Experiment Worksheet has the unity, the element size proportional layout, color elements harmonious layout, has good contrast, placement of elements and layout consistent, clear spacing between paragraphs, text and

illustrations together, not too much use of ornamental or decorative letters, the use of variations of the letter was not excessive and consistent hierarchy of headings.

Languistic Criteria

Based on the validation of language criteria in Table 3 show that the Chemistry Experiment Worksheet that have been developed reach the eligibility criteria of language with a percentage of 85% and in the category of very good because it is in the interval 81% - 100%. These results indicate that the Chemistry Experiment Worksheet with process skill orientation have been developed reach the eligibility criteria of language as in BSNP (2006). Chemistry Experiment Worksheet using appropriate language to the level of development of high school students, using good and true English language, have effective language or suitability between paragraphs, and sentences, drafting Chemistry Experiment Worksheet using terms that are easily understood and used a steady symbol or emblem.

CONCLUSION AND RECOMMENDATIONS

Based on the validation result from chemistry lecturer and chemistry teacher, Chemistry Experiment Worksheet with process skills orientation in chemical equilibrium topic have been developed reach the criteria of eligibility content criteria of 90.28% (very good), compliance with process skills 89.96% (very good), presentation criteria 82.54% (very good) and graph ic criteria 80.05% (very good) and the eligibility of languistic criteria 85% (very good).

Based on the results of data analysis and the conclusion, some suggestions can be put forward as follows (1) The research was only done through the development stage. Therefore, further research needs to be done at this stage of the spread (disseminate).

(2) The use of materials and color layout worksheet should be made more simple, so the printing costs can be cheaper and in accordance with the conditions of middle school.

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