

**CHEMISTRY STUDENT WORKSHEET WITH
PROBLEM ORIENTED POSING TO PRACTICE STUDENT'S CREATIVE
THINKING IN SOLUTIONS STOICHIOMETRY
TOPIC FOR GRADE XI**

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Abstrak. Penelitian ini bertujuan untuk mengetahui kelayakan *chemistry Student Worksheet* berorientasi *problem posing* untuk melatih berpikir kreatif pada materi stoikiometri larutan kelas XI RSBI berdasarkan penilaian dari dosen kimia, guru kimia, dan ahli bahasa terhadap kriteria kelayakan isi, penyajian, kegrafikaan, dan kebahasaan. Penelitian ini menggunakan model pengembangan 4-D oleh Thiagarajan, tetapi hanya terbatas pada tahap *develop*. Instrumen yang digunakan pada penelitian ini adalah lembar telaah dan lembar validasi. Hasil penelitian menunjukkan bahwa *chemistry Student Worksheet* berorientasi *problem posing* yang dikembangkan telah layak digunakan dalam proses pembelajaran kimia pada kelas RSBI karena telah memenuhi kriteria isi, penyajian, kegrafikaan, dan kebahasaan dengan persentase berurut-turut sebesar 91,05%, 96,94%, 92,36%, dan 75,00%.

Kata Kunci: *chemistry Student Worksheet*, *problem posing*, kelayakan, stoikiometri larutan

Abstract. The aim of this research is determine the eligibility of chemistry Student Worksheet with problem posing oriented to practice creative thinking in solution stoichiometry topic for Grade XI RSBI based on the assessment by chemistry lecturer, chemistry teacher, and linguist in eligibility criteria for contents, presentation, graphs, and linguistics. This research uses a 4-D of development model by Thiagarajan, but it is limited in develop step. The instruments that used are review sheet and validity sheet. The result show that of chemistry Student Worksheet with problem posing oriented has been developed in learning process of RSBI class has met eligibility criteria for contents, presentation, graph, and linguistics with a sequential-share percentage 91.05%, 96.94%, 92.36%, and 75.00%.

Key words: *chemistry Student Worksheet*, *problem posing*, *eligibility*, *solution stoichiometry*

INTRODUCTION

KTSP curriculum changes cupled with efforts to improve the learning quality through school internationally known pioneering international school (RSBI). RSBI holding is an implementation of Law No. 20 of 2003 on National Education System (UUSPN 20/2003) of Article 50 paragraph (3) [1].

Pioneering international school is a curriculum that is adaptive and adoptive using KTSP as a national curriculum, combined with

the Cambridge International Examination (CIE) as a reference for international curriculum. Through the application of KTSP started the academic year 2006/2007, the school has broad authority in setting up its own curriculum, including adopting and adapting the curriculum of Cambridge who is believed to have had a reputation of quality that is recognized internationally, but still refers to the National Education Standards Agency (BSNP) according to

standard of content and standards of competency.

One school which is pioneering international school is the SMA Negeri 1 Grati, Pasuruan. The chemistry learning process use English and Indonesian languages (bilingual), but more dominant Indonesian. Based on the pre-study questionnaire that was distributed to 36 respondents, 78% of students stated that chemistry is a difficult subject because of the many formulas that are applied in the matter, analyzing and resolving problems.

According to 50% of students, one of chemistry topic that requires more understanding, especially in understanding and solving of problem is the solution stoichiometry topic. This is because the topic contains a lot of calculations which also includes the concept of acid-base reaction. This topic is also one of the materials related to students' understanding of the stoichiometric topic in grade X. Standards of competence of this topic is to understand the properties of acid-base solution, the method of measurement, and applied. Basic competence is calculated the number of reactants and reaction products in an electrolyte solution of the acid-base titration.

Delivery of this topic in chemistry student worksheet that is expected in bilingual. This is supported by a statement of subjects teacher that the chemistry student worksheet should be used is given bilingual because the students' understanding of terms and concepts of chemistry in the English language less than the maximum. Teachers and students want the subjects chemistry student worksheet that uses clear language and easy to understand, many exercises, and colors that appeal to motivate students. In addition, the chemistry student worksheet should be able to train high-level thinking to the students such as the level of critical thinking and creative thinking.

To achieve a solution of KD in stoichiometry topic, delivery of content can be done with the learning strategies that can train student ability to think creatively in accordance with the characteristics of the topic that is mathematically. This topic contains the calculation of chemical reaction which involves a mathematical process. Mathematical operations in the chemistry learning process can also develop critical, systematic, logical, and creative thinking. Chemistry learning in which there are structures and processes of mathematics have a strong link between the concepts is to allow students to think rationally. Student's Output who have such ways of thinking and a willingness to have effective cooperation has been the demands of today's global world.

One method that is appropriate for the ability to think creatively is the method of problem posing [2]. Problem posing is a method of learning that gives assignment to students to make matter of the information provided, and solved it. This giving task is the task of working towards an attitude of creative thinking in solving problems. It is adapted to the difficulties experienced by students in problem solving solution stoichiometry. When students are required to create questions, students are also required to understand the problem well. This stage is an early stage of the answer to problems created due to be completed. If you understand the matter has been passed, then to the stage of completion about the next stage will be open.

Problem posing method is used for mathematical material can be applied in three different forms of cognitive activity, ie. pre-solution posing, with in solution, and post solution posing [3]. This method can be included in a chemistry student worksheet containing material, examples of problems that accompanied the settlement, the titration lab instructions and tasks that require students to create

questions covering all three components of cognitive activity by incorporating creative thinking. Creative thinkings of student who trained are fluency, flexibility and novelty in posing and resolving problems. Fluency in the posing a problem refers to the number or diversity of the student posed a problem. Flexibility refers to the ability of students pose a problem that has different way of settlement, while novelty refers to the ability of students apply different problem than the problem presented previously [4].

METHOD

This development study using 4-D model of development (four D) suggested by Thiagarajan [5]. Model development consists of four stages, namely define, design, develop, and Disseminate [5]. In this research only restricted to the develop stage because this study only to determine the eligibility of the worksheet. Design of this research can be presented through the following flow chart:

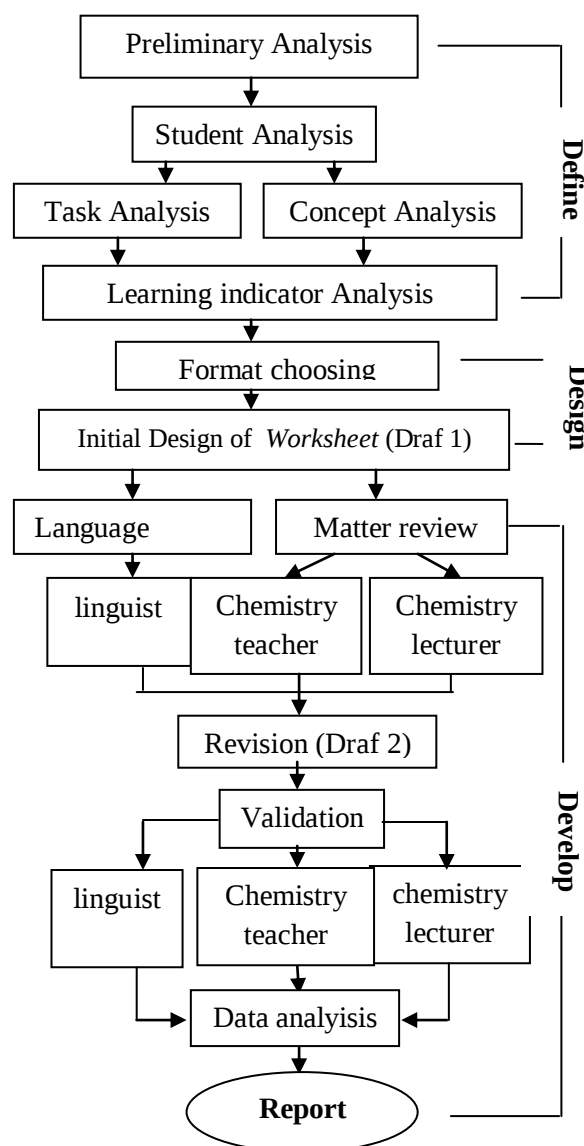


Figure 1 Research design of chemistry student worksheet with problem oriented posing to practice student's creative thinking in solutions stoichiometry topic

Source of research data consists of a chemistry lecturer, two teachers of chemistry, and an English lecturer. The method used in the assessment of the feasibility of the chemistry student worksheet is questionnaire method. Questionnaire administered in the form of review sheets and sheet validation. Analyses were performed on each of the eligibility criteria with the content, presentation, graphs, and linguistics. The percentage of the data

obtained by questionnaire Likert scale calculations are described in table 1:

Table 1 Likert Scale [6]

Penilaian	Nilai skala
Is less	0
Less	1
Enough	2
Good	3
Very good	4

To calculate the percentage of use formula:

$$\text{Percentage (\%)} = \frac{\text{total score of data collection result}}{\text{score of criteria}} \times 100\%$$

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

The percentages obtained are interpreted in the following criteria:

Table 2 Criteria for interpretation score [6]

Percentage (%)	category
0 – 20	Is less
21 – 40	Less
41 – 60	Enough
61 – 80	Good
81 – 100	Very good

RESULT AND DISCUSSION

Review the results of the analysis worksheet chemistry student problem posing oriented

Review of student worksheet chemistry was performed by 3 expert material (2 SMAN 1 Grati chemistry Teachers and a Unesa chemistry lecturer) and linguists (1 Unesa English lecturers). From the review obtained advice and input such as some pictures in the worksheet that needs improvement is in every picture in the worksheet that has not been accompanied by a description and name of the source image. The pictures must be accompanied by the name of the image and its source, so that students more easily understand the purpose of the displayed image. Some of the writing in Indonesian and English

writing needs to be improved include the decimal point should be consistent. Decimal point in accordance with the rules of Indonesian is a comma (,) and the decimal point in accordance with the rules of English language is a dot (.). Repair is performed on each worksheet. Based on some of these inputs to the revision of draft 1 and produce draft 2.

Data analysis results of the validation worksheet chemistry student problem posing oriented

Analysis validation data results be descriptive quantitative. Validation of the worksheet (draft 2) performed using the validation sheet content, presentation, graphs and linguistics. Validation is performed by three expert material (1 Unesa chemistry lecturer and 2 chemistry teachers Grati SMAN 1) and linguists (1 Unesa lecturer in English).

If these criteria had assessments with percentages $\geq 61\%$ according to the interpretation of Likert scale scores in Table 2, the chemistry student that was developesaid to be worthy [6]. A the validation results of Chemistry Student Worksheet Problem Posing oriented as follows:

Table 3 The results of the validation Chemistry Student Worksheet Problem Posin Oriented

No	Criteria aspects	Percentage (%)	Criteria
1.	Content	91,05	Very good
2.	Presentation	96,94	Very good
3.	Graph	92,36	Very good
4.	Language	75,00	good

Based on table 3 the assessment of Chemistry Posing the Problem-Oriented Student Worksheet can be described as follows:

Criteria of contents

One of the important eligibility criteria chemistry student worksheet is criteria for content of chemistry student worksheet [7]. Based on table 3 chemistry student worksheet problem posing oriented has been developed to meet the eligibility criteria by the percentage content of 91.05%. Based on the interpretation of Likert scale scores in Table 2 can be said that the criteria of content worksheet chemistry student posing problems oriented is very good because it is on a percentage interval 81% -100% .

Chemistry student problem posing oriented worksheet is said to be very well developed in the criteria of the contents can be viewed from several things, namely, the material presented in accordance with the indicators of learning outcomes listed in the worksheet on page 4, 26, and 50. Training activities about which there has also been corresponding with the three cognitive activities in problem posing. The third event is the pre-solution posing (manufacturing problem based on the situation), With-in solution posing (making about the problem), and post-solution posing (manufacturing problem by modifying the problem) [3]. These three cognitive activities can provide opportunities for students to be busy in creative activities that involve creative thinking component that is mathematical fluency, flexibility, and novelty [4].

Criteria of presentation

Based on table 3 chemistry student worksheet problem posing oriented has been developed to meet the eligibility criteria by presenting the percentage of 96.94%. based on the interpretation of Likert scale in Table 2 it can be said that the results of the validation of criteria presentation of the chemistry student worksheet developed by posing problems oriented said to be very good because it is on a percentage interval 81% -100

Validation results can be achieved due to the percentage of the worksheet presented coherently ranging from easy to difficult concepts, from concrete to abstract, from the known to the unknown. It is expected that the material presented in the previous worksheet can help the understanding of matter at the next worksheet. In addition, the presentation of the worksheet can motivate students to the features presented. As the pre-concept that tries to give a preliminary description of material to be covered with a dish picture. Chem part in our environment that provides information about the chemistry associated with everyday life. This section is intended to increase students' motivation to learn chemistry that is not only related to the concept or the material in the book, but also studied the chemical environment of everyday life.

Criteria of graph

Based on table 3 chemistry student worksheet problem posing oriented has been developed to meet the eligibility criteria of graphs with percentage 92.36%. Based on the interpretation of the Likert scale in Table 2 can be said that the criteria of graph of chemistry student problem posing oriented worksheet is very good because it is on a percentage interval 81% -100%.

Criteria of graph can be said to be very good for several things including the use of fonts that are easily read by students. Form of the selected font is *Agent Orange*, *Times New Roman*, *Viner Hand ITC*, and *Lucida Caligraphy*. These forms of this paper were chosen because when it is used not to confuse students when reading a *worksheet*. In addition, the selections of different fonts are intended to emphasize the point- different points on each section of the *worksheet*. In addition to the use of font, illustrations or images that are presented are also considered, as illustrated on

the *worksheet* that describes the process of making a solution intended to increase motivation and understanding of the concept of molarity. Students not only learn the process of making a solution in theory, but students can also imagine how the process of solution in the laboratory

Criteria of language

Based on the validation results in Table 3 *chemistry student worksheet problem posing* oriented has been developed to meet the eligibility criteria of language with the percentage of 75.00%. Based on the interpretation of the Likert scale in Table 2 can be said that linguistic criteria *chemistry student worksheet problem posing* was good because it is at the interval the percentage of 61% -80%.

Linguistic criteria said to be good have been due to using language effectively and efficiently. Sentences used in the delivery of content language should be simple, straightforward, and can represent the contents of the message [7]. In addition, the use of symbols or icons on the *worksheet* has been consistent each represented by the images that allows students to know what will be discussed in these parts.

CONCLUSION

Based on the analysis of research data can be concluded that the *Chemistry Student Worksheet Problem Posing* Oriented to practice Students Creative Thinking stoichiometry solution topic has been developed to use as a device worth learning because it has reached a percentage of $\geq 61\%$ on a Likert scale score interpretation. Percentage of the eligibility criteria of content, presentation, and graphs of 91.05%, 96.94% and 92.36% in the category very

good, and linguistic criteria with a percentage of 75.00% in good category.

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