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DEVELOPMENT OF CHEMISTRY WORKSHEET WITH PROBLEM SOLVING ORIENTATION IN STOICHIOMETRY MATTER OF X GRADE SEMESTER 1

Noor Fathi Maratusholihah and Dian Novita
Chemistry Department, Faculty of Mathematic and Natural Science, State University of Surabaya
HP : 085649050828, email: fatqee@yahoo.com, diannovita@gmail.com

Abstrak

Tujuan penelitian ini adalah untuk mengetahui kelayakan Chemistry Worksheet berorientasi Problem Solving pada materi stoikiometri kelas X semester 1. Kelayakan Chemistry Worksheet dianalisis oleh guru kimia dan dosen kimia pada kriteria konstruksi, isi, dan kebahasaan. Desain penelitian yang digunakan adalah model 4-D (define, design, develop, dan disseminate) menurut Thiagarajan, namun tahap disseminate tidak dilakukan. Telaah Chemistry Worksheet dilakukan oleh dosen kimia dan guru kimia SMA, untuk menelaah konstruksi, isi, dan kebahasaan Chemistry Worksheet yang dikembangkan. Uji coba terbatas dilakukan oleh 15 siswa di SMA Negeri 1 Magetan. Metode pengumpulan data yang digunakan adalah metode angket dan tes. Teknik analisis data dilakukan secara analisis deskriptif kuantitatif dan kualitatif. Data hasil analisis penelitian ini menunjukkan bahwa Chemistry Worksheet berorientasi Problem Solving telah memenuhi kriteria kelayakan konstruksi,isi, dan kebahasaan dengan persentase berturut-turut 82,17%, 85,88%, dan 75%, sehingga Chemistry Worksheet ini layak untuk digunakan sebagai media pembelajaran.

Kata Kunci: Problem Solving, stoikiometri, Chemistry Worksheet

Abstract

The aim of this research was known the feasibility of Chemistry Worksheet with Problem Solving orientation on stoichiometry matter in X grade semester I. Feasibility of Chemistry Worksheet was analyzed by Chemistry teacher and Chemistry lecturer on construction, content, and language criteria.. Research design used 4-D model (define, design, develop, and disseminate) but disseminate phase was not done. Chemistry Worksheet review was conducted by chemistry lecturer and chemistry high school teacher, to review construction, content, and language of Chemistry Worksheet developed. Limited trial was done by 15 students in SMA Negeri 1 Magetan Collecting data method used were questionnaire and test method. Data analysis technique were done by quantitative and qualitative descriptive analysis. The data analysis result of this research showed that Chemistry Worksheet with Problem Solving orientation had filled feasibility criteria on construction, contents, and language with percentage respectively 82,17%, 85,88%, and 75%, so this Chemistry Worksheet is feasible to be used as learning media.

Keywords : Problem Solving, stoichiometry, Chemistry Worksheet

INTRODUCTION

Based on Standar Isi Kurikulum Tingkat Satuan Pendidikan (KTSP) / Contents Standard of Educational Unit Level Curriculum for high school in BSNP(2006), scope of chemistry are stressed on natural phenomena and its measurement on abstract concepts such as atomic structure, periodical system, chemical bonding, stoichiometry, etc [1]. Those concept need to be taught well in order to the student does not get difficulties in understanding.

Method that will be used in learning must appropriate with the characteristic of the matter that will be taught. There are some matters that teach about mathematical operation and problem solving that need step-by-step exercises, such as stoichiometry, reaction rate, etc.

This characteristic are very suitable with Problem Solving method.

Polya(1973) stated that Problem Solving steps consist of understanding the problem, devising plan, carrying out the plan, and looking back [2].

This *Problem Solving* method will be applied on stoichiometry matter, appropriate with questionnaire on pre research show that 100% students get difficulties in stoichiometry matter. It's supported with the result of interview to one of chemistry teacher which states that stoichiometry matter is difficult to be understood by students. Stoichiometry is one of important matter, because many chapters in chemistry using it as basic to solve the calculation.

One of learning media that can be used to apply this method is worksheet. Worksheet is packaged in such way in order to students can learn the matter independently with exercises completed with structured exercise to do. Problem Solving steps will be applied on example and exercise. SMA Negeri 1 Magetan already used worksheet in chemistry learning, but there is no component in worksheet used in SMA Negeri 1 Magetan that can help student to analyze problem and help their thinking process in solving chemistry problem. Therefore, students need another worksheet to support their study. It is supported by questionnaire result which have been distributed that 73,3% students need another worksheet as study supporter.

To know the early skill of student about Problem Solving, the researcher conducts tracking test. Based on tracking test result, 26,7% students are able to understand the problem, 44,3% students are able to devise a plan, 20% students are able to carry out the plan, and 6,7% students are able to look back problem solving that they have been done.

Problem that will be answered in this research is "How is the feasibility of Chemistry Worksheet with Problem Solving orientation on stoichiometry matter in X grade based on construction, contents, and language criteria?". The aim of this research is known the feasibility of Chemistry Worksheet with Problem Solving orientation on stoichiometry matter in X grade based on construction, contents, and language feasibility criteria.

This research is expected can be useful for students and teacher. For student, worksheet with Problem Solving orientation can train student's skill to solve problem. While for teacher, worksheet with Problem Solving orientation as an alternative solution to solve the difficulty on student in understanding stoichiometry matter.

The second and third pillars of KTSP application in BSNP(2006) are learn to understand and comprehend, also learn to be able to do and act effectively [3]. Based on that two pillars, it needs step-by-step training so student can understand, comprehend, do, and act effectively to the problem faced by student. Those steps are appropriate with steps in Problem Solving method.

Polya(2003) dalam Hudojo explains that problem solving is an effort to look for solution from a difficulty to reach goal that can't be reach quickly [4]. In this case, student is strived for finding precise strategy in solving problem. This problem solving process will train student to construct knowledge which they get independently and meaningful. Beside that, appropriate challenge and help from teacher or friend that has more ability, student go forward to their zone of proximal development that is place where new learning happen [5]. This case is appropriate with constructivism theory appointed by European psychologist Jean Piaget and Lev Vygotsky.

METHOD

Research design in this studeyused 4-D model (*define, design, develop,* and *disseminate*) based on Thiagarajan, but it is limited on develop step. Respondents are

15 students in XI.IA.4 class of SMA Negeri 1 Magetan taken heterogeneously.

Data collection method used are questionnaire and test methods. Research instruments used are review sheet, feasibility sheet, Problem Solving tracking test sheet and Problem Solving test sheet.

Review of media is done by two chemistry lecturers and one chemistry teacher of SMA Negeri 1 Magetan, while analysis of feasibility is done by two teachers of SMA Negeri 1 Magetan and one chemistry lecturer. Data obtained from review process is in form of suggestions that next is analyzed by qualitative descriptive analysis, while result of feasibility analysis is in form of percentage based on Likert scale that have been modified. Formula which is used to obtain the percentage is as follows

$$\text{Persentage (\%)} = \frac{\text{Total score of obtained data}}{\text{criteria score}} \times 100\%$$

Criteria score = highest score x total aspect x total respondent

Percentage obtained is interpreted into following criteria :

Table 1 Percentage criteria (Likert scale modification)

Percentage (%)	Kriteria
25 – 43,75	Very weak
43,76 – 62,50	Weak
62,51 – 81,25	Strong
81, 26 – 100	Very strong

Worksheet media can be stated as feasible if obtain percentage ≥ 62,51%.

Limited test of worksheet in this research is done twice with each duration is two hours lesson. This research is conducted by giving worksheet with Problem Solving orientation to students to be learnt. Then, students are asked to do available exercise by using Problem Solving steps. Second days, students are given Problem Solving test that one essay question with stoichiometry matter that they must do. The aim of giving this test is known how far Problem Solving skill of students in solving question after being given exercise by using worksheet with Problem Solving orientation.

Assessment of Problem Solving skill on stoichiometry matter is based on scoring orientation of Problem Solving skill as result of modification from Szetela, Walter, Nicol(2010) dalam Itan Yustiani Sya'ban [6].

Table 2 Scoring Orientation of Problem Solving Skill

Score	Problem Solving Steps				
	Understanding Problem	**Devising Plan**	**Carrying Out the Plan**	**Looking Back**	
0	No effort	No effort	No answer, wrong answer due to wrong plan	No effort	
1	There are more mistakes in understanding problem	There are more mistakes in planning	There are more mistakes in calculating	There are more mistakes in procedure	
2	There are less mistakes in understanding problem	There are less mistakes in planning	There are less mistakes in calculating	There are less mistakes in procedure	
3	Good problem understanding	There are plans that lead to right solution without mistakes	Solusi benar	Prosedur benar	
	Maximum score 3	Maximum score 3	Maximum score 3	Maximum score 3	Total = 12

Assessment of Problem Solving comprehending for each aspect use following formula :

$$Percentage(\%) = \frac{Total\ score\ obtained}{Criteria\ score}\ x\ 100\%$$

Criteria score = highest score x total aspect x total respondent

Data obtained then analyzed using percentage criteria of Likert scale [7] which have been modified as in table 1.

RESULT AND DISCUSSION

Review is done by two lecturers and one high school chemistry teacher. Result of this review are suggestions that next is used to revise worksheet draft that will be developed. The result of review such as writing correction, sentence correction, preface addition, etc

Analysis of feasibility is done by one chemistry lecturer and two chemistry teachers. It is done to know the construction, contents, and language feasibility of Chemistry Worksheet with Problem Solving orientation. Construction feasibility criteria consists of: appropriateness of Chemistry Worksheet with KTSP by adopting with foreign curriculum, appropriateness with Problem Solving method, and physical of Chemistry Worksheet. Contents feasibility criteria consists of appropriateness in matter, presentation, and illustration. Language feasibility criteria consists of well using of language, language used is appropriate with age of students and terms used is easy to be understood. Result of feasibility analysis of those three criteria are presented on table 3.

Table 3 Result of Three Criteria of Feasibility Analysis

No	Assessed criteria	Percentage (%)	Category
1	Construction	82,17%	Very Strong
2	Contents	85,88%	Very Strong
3	Language	75%	Strong

Based on analysis of feasibility result above, can be known that Chemistry Worksheet with Problem Solving orientation which is developed have been filled each feasibility criteria with percentage above 62,5%. The explanation of each criteria are as follows:

1. Construction feasibility criteria

   This criteria get percentage 82,17% with very strong category based on Likert scale that have been modified in table 1. It shows that Chemistry Worksheet has been filled aspects as follows:

   a. Appropriateness of Chemistry Worksheet with KTSP by adopting with foreign curriculum

      Acquirement of this aspect shows that basic competency and learning outcomes used in Chemistry Worksheet is written operationally and appropriate with curriculum that have been used by SMA Negeri 1 Magetan, so student get description about process and learning outcome expected after using this Chemistry Worksheet [9]. Beside that the allocation time in this Chemistry Worksheet is appropriate with curriculum that have been used, summary in Chemistry Worksheet contains fact, law, concept, and important principle that can help student in learning this matter. Also, questions in Chemistry Worksheet are easy to be understood by student and appropriate with learning outcome that want to be reached [9].

   b. Appropriateness with Problem Solving method

      Acquirement of this aspect shows that Chemistry Worksheet with Problem Solving orientation which is developed have been filled steps on Problem Solving method, such as understanding the

problem, devising plan, carrying out the plan, and looking back.

c. Physical of Chemistry Worksheet.

Acquirement of this aspect shows that font size are easy to be read, picture help understanding concept, writing arrangement is correct, writing of reference is appropriate with the rule, cover represent the content of worksheet, and sentences used is clear.

2. Contents feasibility criteria

This criteria get percentage 85,88% with very strong category based on Likert scale that have been modified in table 1. It shows that Chemistry Worksheet has filled aspects as follows:

a. Matter

Acquirement of this aspect shows that matter are appropriate with KTSP and Australian curriculum, relevant with learning outcome, containing fact, law, concept, principle and appropriate with knowledge structure

b. Presentation

Acquirement of this aspect shows that representation of this worksheet are logic and systematic, awaken motivation, interest, or curiosity, appropriate with thinking level and reading ability of student, interesting or gratify

c. Illustration

Acquirement of this aspect shows that this Chemistry Worksheet have appropriate with illustration criteria of BSNP(2006), that are illustration relevant with matter, must be good and clear, so it can make concept clearer

3. Language feasibility criteria

This criteria get percentage 75% with strong category based on Likert scale that have been modified in table 1. It shows that language used is well, language used is appropriate with age of students and terms used is easy to be understood.

In limited trial step, Problem Solving test is done. Aspects assessed in Problem Solving is student's skill in understanding problem, devising plan, carrying out the plan, and looking back [8]. Result of Problem Solving test of students is better than result of tracking test that have been done before. Each aspect get increase on percentage. Increasing percentage can be seen on Table 4.

Table 4 Comparation of Tracking Test and Problem Solving Test Result

No.	Criteria	Tracking Test (%)	Problem Solving Test (%)
1	Understanding problem	26,7	100
2	Devising Plan	44,3	93,3
3	Carrying Out The Plan	20	100
4	Looking Back	6,7	95,5

Based on Table 4, aspect of understanding problem, devising plan, carrying out the plan, and looking back get increase respectively that are 73,3%, 49%, 80%, and 88,8%. So, Problem Solving method can help students in understanding stoichiometry matter and doing given questions.

CLOSURE

Based on the data analysis result in this research, thus can be concluded that Chemistry Worksheet with Problem Solving orientation is feasible to be used as instructional media because it has filled construction, contents, and language feasible criteria with percentage respectively 82,17%, 85,88%, and 75%. It is supported by student's Problem Solving skill on aspects of understanding problem, devising plan, carrying out the plan, and

looking back are increase respectively 73,3%, 49%, 80%, and 88,8%.

For improvement of this research, further research need to be done for disseminate step and development in another matter.

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