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THE DEVELOPMENT OF CHEMISTRY WORKSHEET ORIENTED BY PROBLEM SOLVING IN THE REACTION RATE TOPIC FOR XI GRADE OF PIONEERING INTERNATIONAL SENIOR HIGH SCHOOL

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ABSTRACT

This research was conducted to know the feasibility of Chemistry Worksheet, Oriented by Problem Solving in the Reaction Rate Topic for Pioneering International Senior High School. This research is development research which the target is Chemistry Worksheet which developed. The source data resulted by lecture and teacher of chemistry as reviewer and validator. Research design use Research and Development (R&D) method and instructional design ue 4-D (Four-D models) but limited to 3-D (Define, Design, dan Development). Research instrument are review sheet and validation sheet. A method of data analysis was done by descriptively qualitative for analysis the result of Chemistry Worksheet review and descriptive quantitative of percentages of assessment result from validator. The results showed that Chemistry Worksheet have been developed competent used in the learning process for the Pioneering International Senior High School since has met feasibility criteria for suitability with component of Problem Solving, Criteria of Content, Presentation, Language, and Graph, and presentation of Chemistry Worksheet, with a series percentage of 90%; 92,78%; 90,33; 86,87%; and 90%.
Keywords: *Feasibility, Problem Solving Components, Reaction Rate*

ABSTRAK

Penelitian ini bertujuan untuk mengetahui kelayakan *Chemistry Worksheet*, berorientasi *Problem Solving* pada Materi Pokok Laju Reaksi di kelas XI SMA RSBI. Penelitian ini merupakan penelitian pengembangan dengan sasaran penelitian adalah *Chemistry Worksheet* yang dikembangkan. Sumber data diperoleh dari tim ahli meliputi dosen dan guru kimia sebagai penelaah dan validator. Rancangan penelitian ini adalah *Research and Development* (*R&D*) dan pengembangannya mengacu pada 4-D (*four D models*) yang dibatasi sampai tahap 3-D (Define, Design, dan Development). Instrumen penelitian yang digunakan berupa lembar telaah dan lembar validasi. Analisis data dilakukan secara deskriptif kualitatif untuk hasil telaah dan deskriptif kuantiatif untuk hasil validasi terhadap kelayakan *Chemistry Worksheet*, serta aktivitas dan respon siswa. Hasil penelitian menunjukkan bahwa *Chemistry Worksheet* berorientasi *Problem Solving* yang dikembangkan telah layak digunakan dalam proses pembelajaran untuk SMA RSBI karena telah memenuhi kelayakan berdasarkan hasi validasi terhadap kriteria kesesuaian terhadap komponen *Problem Solving*, kelayakan isi, penyajian, kebahasaan, dan kegrafisan dengan persentase sebesar 90%; 92,78%; 90,33; 86,87%; dan 90%.

Kata Kunci : *Kelayakan, Komponen Problem Solving, Laju Reaksi*

INTRODUCTION

Education is an important aspect in life because education can create quality human resources. To improve the quality of national education, the government made various improvements in education. Undang-Undang Nomor 20 Tahun 2003 pasal 50 ayat 3, states that "the Government or local governments hold at least one unit of education at all levels of education to be developed into an international educational unit" Implementation of the law is begin the Pioneering International

Senior High School Education which implements Kurikulum Tingkat Satuan Pendidikan (KTSP) which combined with curriculum of Cambridge International Examination (CIE) [1].

According to KTSP, learning objectives of chemistry in high school is in addition to understanding the concepts of chemistry students are also required to be able to use the scientific method is based on a scientific attitude to solve problems in everyday life [2]. Implementation of these objectives that in addition to developing the facts, concepts, and principles, teachers also need to develop skills of scientific process skills and attitudes of the students.

One school in surabaya which build as Pioneering International Senior High School program is SMA Muhammadiyah 2 that stood since 2006. Curriculum implemented curriculum is the curriculum KTSP that combined with the CIE. Based on interviews with one of the chemistry teacher in SMA Muhammadiyah 2, the implementation of the learning objectives of chemistry at the SMA Muhammadiyah 2 Surabaya is still not optimal. This resulted in the chemical into one of the lessons that are considered difficult by students.

Based on the pre-study questionnaire that was distributed in grade XI of SMA Muhammadiyah 2 Surabaya, with 30 respondents, known as much as 80% of students stated that the chemistry quite a difficult subject and 73% of students stated that the teaching of chemistry has been done remains a theoretical which is emphasized in the lecture method. As many as 53% of students stated that teachers' teaching methods are still not make the students interested, challenged, and is active in studying chemistry. If this were to continue, it will affect the poor learning outcomes achieved by students.

The low student learning outcomes can be seen in the topic of reaction rate. As many as 49% of students expressed difficulty learning the material. From the three classes, with a total of 71 students, only 11 students who achieve exhaustiveness in the material completeness limit of the reaction rate with a minimum of 75. There are some reasons, the first is a lack of concept understanding of students in the reaction rate topic because student are rarely train to thinking skills. Second, given lack of direct experience through the experiment. Whereas in the study, the laboratory is a media liaison between the abstract knowledge with the knowledge that is real or apparent [3]. The third is lack of availability or Chemistry Worksheet as one of the supporting tools of learning. Some of Chemistry Worksheet is created only on a particular matter and only focused on products in the form of skills training of the National Exam Questions. As for the skills of the process is still not available. As a result, Chemistry Worksheet that is used is still not able to practice the skills in the students' thought processes.

One way to overcome these problems is to train thinking processes skills to the students so that student become more easily understand the concept of the lesson. One of way to help students understanding of the concepts is through solve the problem.

One means to assist teachers in these activities is to use Chemistry Worksheet with oriented by Problem Solving to support learning. Use of Chemistry Worksheet with oriented by Problem Solving in addition to assisting teachers in train the thinking skills in students, it will also be able to lead students to improve their observation skills, which in turn will train students to develop thinking skills in solving problems based on existing problems. So it can help students to improve understanding of the concept.

Based on the above, conducted a study to determine the feasibility of Chemistry Worksheet has been developed in terms of compatibility with the components of Problem Solving, appropriateness of content, presentation,

language, and graph. The benefits of research-oriented development Chemistry Worksheet with oriented by Problem Solving is for teachers are (1) As an alternative to increasing professionalism in developing learning tools that can be used as a tool used to train the students' thinking skills in teaching and learning at the rate of reaction material. (2) Realization of Chemistry Worksheet with oriented by Problem Solving that can be used to train the students' problem-solving skills on the reaction rate of the material. As for the students as one means to help students to better understand the concepts through problem solving.

METHODS

This type of study is a research development with the purpose of research is the learning that was developed is Chemistry Worksheet oriented by Problem Solving in Reaction Rate topic for Beginner International Senior High School. Sources of data in this study is the expert team includes chemistry lecturer and chemistry teacher as expert of content, linguists, and media as reviewers and validators, as well as 15 students class grade XI in Beginner International Senior High School.

The design of the development-oriented Chemistry Problem Solving Worksheet refers to the model of research Research and Development (R & D) with the development model used is a model of development of 4-D (four-D model) [4]. The study design is described as in **Figure 1** [5].

Instruments used in this study include study sheets and sheets of validation. Data collection techniques in research and development uses a questionnaire that aims to determine the respondents' assessment of the feasibility of Chemistry Worksheet with oriented by Problem Solving that will be developed. Chemistry Worksheet with oriented by Problem Solving material principal reaction rate in this study is said to be feasible if the percentage of each of the eligibility criteria achieved ≥ 61% [6]. Data of review sheets of the Chemistry Worksheet and then analyzed to provide a qualitative descriptive overview of the advice has been given a team of experts, so that the known deficiencies Chemistry Worksheet developed. While the results of data-oriented validation of the Chemistry Worksheet analyzed using quantitative descriptive.

The analysis was performed on each criterion on the validation sheet. The percentage of the data obtained by the calculation of this questionnaire Likert scale as in Table 1 as follows:

Table 1 Score of Likert Scale

Assessment	Scale Value
Less so	0
Less	1
Enough	2
Good	3
Excellent	4

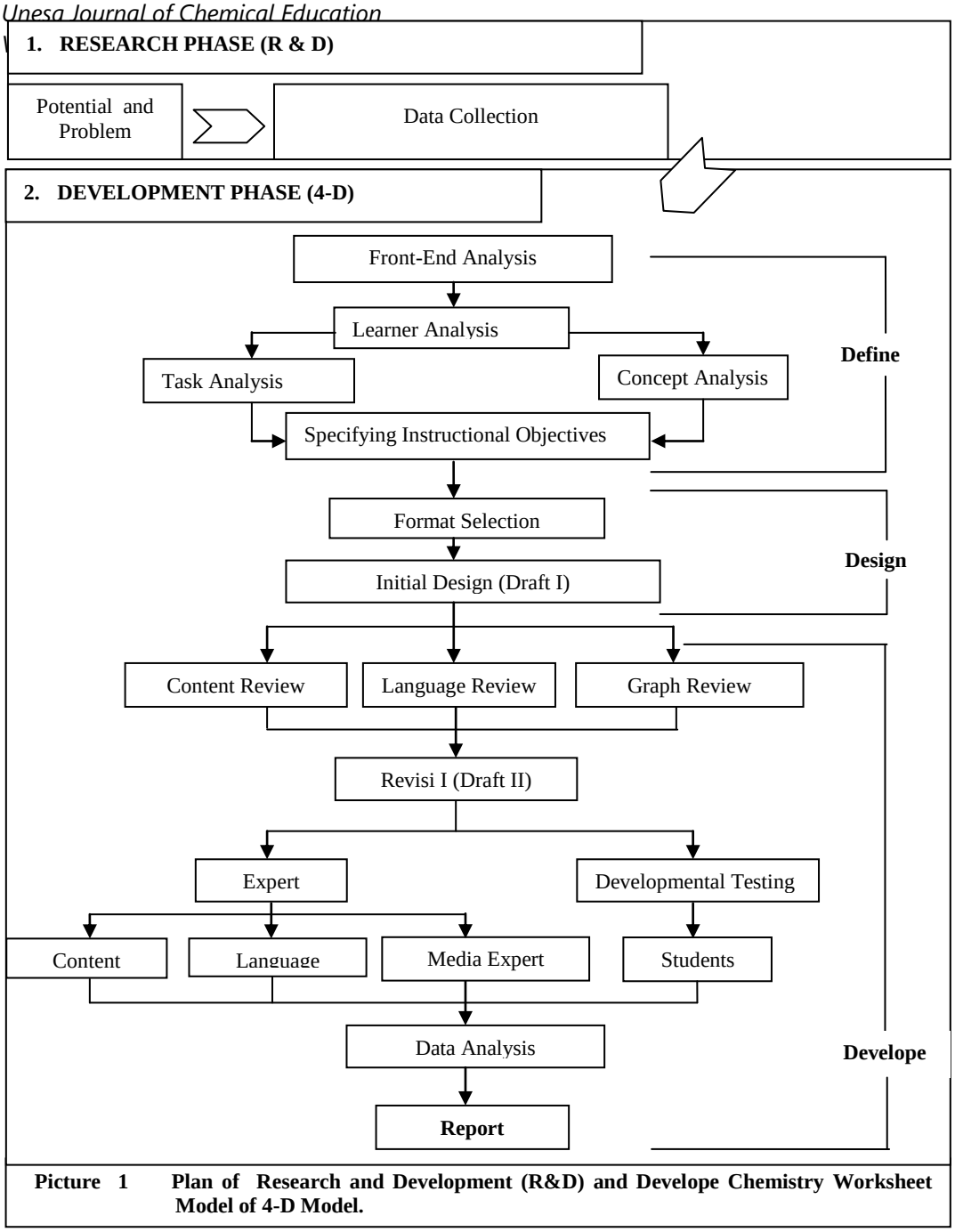
Riduwan [6]

The results of the validation sheet analysis is used to determine the feasibility of Chemistry Worksheet developed by using the interpretation of scores. Interpretation of the score table which shows a large percentage of the Chemistry Worksheet validation assessment by the validator is presented in Table 2 as follows:

Table 2 Interpretation Score Criteria

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

Riduwan [6]



Picture 1 Plan of Research and Development (R&D) and Develope Chemistry Worksheet Model of 4-D Model.

RESULTS AND DISCUSSION

Validation is performed respectively by 5 experts of content, anguage, and media consisting of four chemistry lecturer and chemistry teacher to use the validation sheet. Validation sheet used to collect data based on an assessment of the feasibility of suitability with the Problem Solving component, the feasibility of the content, presentation, language, and graph of Chemistry Worksheet developed. Result data validation Chemistry Worksheet with Chemistry Worksheet with oriented by Problem Solving can be seen from the following data: .

Table 3 Validation Results of Content Expert based on Suitability with Problem Solving Components

No.	Aspects of the Graded	Percentage of Each *Chemistry Worksheet* (%)			
		1	*2*	*3*	*4*
1	There are problems to be solved which looks at the features of ***phenomenon.***	85 %	85 %	90 %	85 %
2	There are features to assist students in establishing provisional estimates of existing problems, which looks at the features of ***hypothesis.***	90 %	90 %	90 %	90 %
3	There is feature for assist students in searching data / information that can be used to solve the problem, which looks at the features of ***the Experiment Data Collect***	85 %	90 %	85 %	90 %
4	There are features to assist students in examining the truth that has been put forward as an answer, which looks at ***Examine the Hypothesis***	95 %	95 %	90 %	90 %
5	There are features to assist students in drawing conclusions, students must arrive at the final conclusion that can solve the problem, which looks at the features ***Conclusion***	95 %	95 %	95 %	90 %
Aspect Percentages		90 %	91 %	90 %	89 %
Average		90 %			
Category		**Very Good**			

According to the Riduwan [6], Chemistry Worksheet which developed is feasible based on the criteria of suitability with Problem Solving component if these aspects of getting an appraisal with the percentage of ≥ 61% according to the Likert scale. Based on the validation of content experts in Table 3 is obtained that Chemistry Worksheet developed that meets the eligibility of criteria of suitability with Problem Solving component with the percentage of **90%** and in the category of **very good** because it is in the interval 81% -100%. Percentage suitability with Problem Solving component in a row for each Chemistry Worksheet by 90%, 91%, 90% and 89%.

In addition based on the assessment of the validator, the feasibility of Chemistry Worksheet can also be observed from the conformity with the theory that underlies learning in the learning step Problem Solving. Based on Kurt Lewin in the Sanjaya [8], learning is a process of problem solving. Students can learn about something when students can change the cognitive structure of one of them is to solve a problem. Based on this theory, Chemistry Worksheet developed can be said to be feasible if the Chemistry Worksheet developed to train students learn by solving a problem by using a step Problem Solving.

Through measures that were developed in Problem Solving in Chemistry Worksheet, students can be trained to be able to solve a problem in stages, to train students to construct knowledge, and make students interact openly with each other so as to make learning more meaningful. With the features of the phenomenon, students are trained to be able to understand an event or phenomenon is critical to conduct an analysis of a given phenomenon, thus indirectly the students are given the opportunity to uncover a problem in the formulation of the problem of a phenomenon. Based on the formulation of the problem, Chemistry Worksheet can train students to think more with the learning activities focusing on problem solving. Problem-solving activities performed by students in a joint study

group to find out the solution of the problem. The learning process is focused on the activities of investigation, discussion and social interaction.

Through inquiry activities, students are trained to think openly and to think more deeply to menyelesaiakan problems, and students are also trained to develop its knowledge possessed by constructing knowledge and relate it to concepts that have received so that learning becomes a challenge for students. Such a learning process in accordance with constructivist learning theory by Piaget in Sanjaya [8], which essentially states that every individual as a child already has the talent to construct his own knowledge. Knowledge is constructed by a child, it will be meaningful knowledge. While the knowledge gained through the notification process would not be meaningful knowledge.

Meanwhile, in a discussion of activities and social interaction, the student should be able to resolve the problems properly. The learning process by discussing how to make students receive more knowledge so as to make alternative problem-solving by students to be more. This is consistent with the constructivist theory of learning according to Vygotsky in Sanjaya [8], which states that social interaction, cultural elements, and its activity is to establish individual development and learning. Or in other words, knowledge is based on social interaction in social and cultural context. Thus the constructivist approach to learning can improve students' knowledge expansion, in addition to providing more opportunities for students to think through problem solving.

Table 4 Validation Results of Content Expert based on Content Criteria of Chemistry Worksheet with oriented Problem Solving Components

No.	Aspects of the Graded	Percentage (%)
1	***Coverage Matter***	
	a. Conformity with the curriculum *worksheets* curriculum materials and *cambridge.*	95 %
	b. Suitability of materials worksheet with Competency Standards (SK) and the Basic Competence (KD), and the purpose of learning outcomes in curriculum RSBI.	90 %
	c. Worksheet material relevant to the indicators of learning.	90 %
2	***Accuracy (truth and accuracy) of material***	
	a. Facts, concepts, principles, procedures, and theories are presented accurately and in accordance with policies in the field of chemistry.	90 %
	b. Accuracy of writing the symbol of atoms, molecules, molecular structure and the accuracy of the nomenclature of elements and chemical compounds.	95 %
	c. The linkage between the concepts and principles of chemistry with the observed properties of the material.	95 %
3	***Curiosity***	
	a. Description of the description and examples (questions, cases, or phenomena) to stimulate curiosity and to make students think more deeply.	90 %
	b. Worksheet is presented to give a challenge to learn to motivate further investigation and more information on the material presented.	90 %
	c. Presents concrete examples with the environment.	100 %
Aspect Percentages		92,78 %
Category		**Very Good**

According to the Riduwan [6], Chemistry Worksheet which developed is feasible based on content criteria if these aspects of getting an appraisal with the percentage of ≥ 61% according to the Likert scale. Based on the validation of content experts in **Table 4** is obtained that Chemistry Worksheet developed that meets the eligibility of content criteria with the percentage of **92.78%** and in the category of **very good** because is in the interval 81% - 100%.

Table 5 Validation Results of Content Expert based on Presentation Criteria of Chemistry Worksheet with oriented Problem Solving Components

No.	Aspects of the Graded	Percentage (%)
1	***Presentation Techniques***	
	a. Antarfakta logical relationship exists, between concepts, antarprinsip, and antarteori.	95 %
	b. Description of the substance between the worksheet is proportional to the mempertibangkan SK and KD.	95 %
	c. Appropriateness / accuracy of the illustration to the material in the worksheet, and can help the understanding of the concept.	95 %
	d. The layout of text, images, presented by the matching.	95 %
	e. Presentation of tables, images, and attachments in accordance with the subject matter and accompanied by a reference termasa listed in the bibliography.	90 %
2	**Supporting Presentation Worksheet**	
	a. Cover the contents of the manuscript presented the worksheet.	85 %
	b. Completeness of the presentation such as: Introduction, Table of Contents, and Bibliography.	95 %
	c. Introduction at the beginning of the worksheet contains the destination worksheet development, systematics worksheet, how to use the worksheet, as well as things that are considered important.	90 %
	d. List of books and other sources acual used as reference material written in alphabetical writing worksheet, and follow the convention of writing the usual references.	85 %
3	***Presentation of Learning***	
	a. The presentation of the material centered on the learner *worksheet* that motivate students to learn independently.	95 %
	b. Presentation materials are interactive worksheet and a motivating learners partispasif mentally and emotionally involved in the achievement of SK and KD.	85 %
	c. The method presented in accordance with the characteristics of the subjects.	90 %
	d. Presentation materials can stimulate deep thinking worksheet learners.	90 %
	e. Presentation and discussion keterampian more emphasis on the process.	90 %
	f. Worksheet presenting interesting, fun, and not boring.	80 %
Aspect Percentages		90,33 %
Category		**Very Good**

According to the Riduwan [6], Chemistry Worksheet which developed is feasible based on presentation criteria if these aspects of getting an appraisal with the percentage of ≥ 61% according to the Likert scale. Based on the validation of content experts in Table 5 is obtained that Chemistry Worksheet

developed that meets the eligibility of presentation criteria with the percentage of **90.33%** and in the category of **very good** because it is in the interval 81% - 100%.

Table 6 Validation Results of Content Expert based on Language Criteria of Chemistry Worksheet with oriented Problem Solving Components

No.	Aspects of the Graded	Percentage of Each *Chemistry Worksheet* (%)			
		1	2	3	4
1	Writing worksheet using the appropriate language to the level of development of the thinking of students.	90 %	90 %	90 %	85 %
2	The material is presented using a communicative language.	90 %	85 %	90 %	90 %
3	The illustrations used to explain the material in the *worksheet* relevant to the message.	90 %	85 %	85 %	85 %
4	Writing *worksheet* using the appropriate term in accordance with Indonesian and English and is easy to understand	80 %	80 %	85 %	80 %
5	Writing *worksheet* using the appropriate term in accordance with Indonesian and English and is easy to understand	80 %	80 %	90 %	85 %
6	Writing *worksheet* uses the term or symbol or emblem steadily	90 %	85 %	85 %	80 %
7	Keruntutan ketertautan language or inter-chapters, sub-chapters, paragraphs, and sentences in the worksheet.	90 %	90 %	90 %	90 %
Aspect Percentages		87,14 %	85,00 %	87,86 %	85,86 %
Average		86,47 %			
Category		**Very Good**			

According to the Riduwan [7], Chemistry Worksheet which developed is feasible based on language criteria if these aspects of getting an appraisal with the percentage of ≥ 61% according to the Likert scale. Based on the validation of language experts in Table 6 is obtained that Chemistry Worksheet developed that meets the eligibility of languange criteria with the percentage of **86.87%** and in the category of **very good** because it is in the interval 81% - 100%. Percentage viability of language in a row for each Chemistry Worksheet for 87.14%, 85.00%, 87.86% and 85.86%.

Table 7 Validation Results of Content Expert based on Graph Criteria of Chemistry Worksheet with oriented Problem Solving Components

No.	Aspects of the Graded	Percentage (%)
1	***Worksheet size***	
	a. Conformance with ISO standard sizes, ie for A4 size (210 x 297 mm)	95 %
2	***Cover part Worksheet***	
	a. Suitability of the front *cover*, back, and displayed as well as shown by contrast, is clear, interesting. Elements of color, illustration, and typography is displayed in a harmonious and interrelated with each other.	90 %
	b. Have a good view of the center of which is determined by the accuracy of the selection of typography, illustration, and color.	95 %

	c. Balance between the elements of the layout (titles of authors, illustrations, logos, etc.) with the size of the worksheet and have keseiramaan with content layout.	95 %
	d. Using and placing elements in a consistent layout of the series.	85 %
	e. The size of the worksheet title is more dominant than the author's name etc..	90 %
	f. Color contrast of the worksheet title background color.	90 %
	g. Shape, size, proportion and illustrations of objects in accordance with reality.	85 %
3	***Part Content Worksheet***	
	a. The layout of the contents of *the worksheet* presented consistently.	85 %
	b. Text and illustrations on the content of the worksheet together. Text and illustrations on the content of the worksheet together.	90 %
	c. Margin for pages that are presented side by side in proportion to and adheres to the two open pages (center spread).	95 %
	d. Suitability of the form, color, size, layout elements on the contents of the worksheet.	85 %
	e. Iustrasi contents reveal the meaning / significance of the object, and presented in a harmonious and proportional.	85 %
	f. Placement of page numbers adjusted to the pattern layout.	90 %
	g. Clarity of printed content is helping students in studying, understanding, and absorb the information conveyed.	90 %
4	***Typography***	
	a. Proportional font size than the size of the *worksheet.*	90 %
	b. Writing worksheet does not use too many font combinations.	90 %
	c. Typeface in accordance with the content material.	90 %
	d. Ornamental or decorative letters are not excessive	95 %
	e. The use of variations of the letters (Bold, Italic, All capital, small capita l) is not excessive.	90 %
	f. Normal text line spacing arrangement.	95 %
5	***Binding System***	
	a. Selected paper A4 100 grams with function as a medium to deliver information to survive for at least 5 years.	85 %
Aspect Percentages		90 %
Category		**Very Good**

According to the Riduwan [6], Chemistry Worksheet which developed is feasible based on graph criteria if these aspects of getting an appraisal with the percentage of ≥ 61% according to the Likert scale. Based on the validation of media experts in Table 7 is obtained that Chemistry Worksheet developed that meets the eligibility of graph criteria with the percentage of **90%** and in the category of **very good** because it is in the interval 81% -100%.

CONCLUSION

Based on the research analysis, it can be concluded that the Chemistry Worksheet with oriented by Problem Solving in the Reaction Rate Topic for Beginner International Senior High School has been used as a device worth in the learning process because it has reached a percentage of ≥ 61%, with the percentage of each aspect are: (1) The assesment result of Eligibility criteria

Chemistry Worksheet conformity with the Problem Solving component was 90%, the resut of eligibility criteria Chemistry Worksheet based on the content was 92.78%, the resut of eligibility criteria Chemistry Worksheet based on the presentation was 90.33%, and in the category of very good because the resut of eligibility criteria Chemistry Worksheet based on the language was 86.87%, the resut of eligibility criteria was 90% and all criteria in the category of very good because it is in the interval 81% -100%.

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