

# TEACHING MATERIALS DEVELOPMENT OF STUDENT WORK SHEET (SWS) GUIDED INQUIRY BASED ON THE MATERIALS FOR LEARNING RATE OF CHEMICAL REACTION

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**Abstract**— Has conducted a study on the development of teaching materials in the form of student worksheet (SWS) on the base on guided inquiry learning materials for the chemical reaction rate class XI SMA (Senior High School). This study aims to produce a form of worksheets subjects were then tested for validity and its practicality so that it can be used as teaching materials. This type of research is the Research and Development (R & D), which produces a specific product and tests the effectiveness of the product. This study was designed to study the basic model of software development model 4-D, which is the stage of defining, designing, development, and deployment. Validity test is done on lecturers and some chemistry teacher in high school, while the practicalities of the test carried out in class XI Science and chemistry teacher who taught in high school Adabiah Padang. The instrument used was questionnaire validity and practicalities. Based on analysis techniques using kappa moment gained an average of 0.82 validity by validator, the practicalities of the questionnaire responses of teachers is 0.80, and the practicalities of students' questionnaire is 0.80. If the score is interpreted in very high category  $\geq 0.81$  then SWS-based guided inquiry on material reaction rate is valid and practical to use as teaching material and shows that students understand the subject matter well.

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**Keywords**— SWS based Guided Inquiry, Rate of Chemical Reaction, Validity test and Practicality.

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## I. INTRODUCTION

Education is one of the facilities which sought by the government to improve the nation's intelligence and human resources. Educational progress will be achieved when the quality of education is good. One of the government efforts to improve the quality of education is to conduct reforms in the curriculum. Government represented by the Ministry of Education and Culture has imposed a new education curriculum, called Curriculum 2013. Implementation of learning appropriate to the demands of the curriculum in 2013, namely learning-oriented students are active <sup>[11]</sup>. Chemistry is a part of natural science that studies the composition, properties and transformations of matter and how the composition of a material affects its properties <sup>[6]</sup>. In studying chemistry students are not only required to learn more about the concepts and principles of science in verbally, rote, the introduction of formulas and the introduction of terms through a series of exercises in verbal. One material that is in high school chemistry class XI is the rate of reaction. For the learning process in accordance with the demands of the curriculum in 2013, then needed a strategy that can make learning chemistry is profoundly understood the substance of the material. One of chemical learning strategies appropriate to the demands of the curriculum in 2013 was guided inquiry learning strategy. This strategy is a form of learning-oriented approach to their students (student centered approach), because in this strategy the student holds a very dominant role in the learning process.

Guided inquiry is a student-centered strategy, students work in small groups with individual roles to ensure that all students are fully engaged in the learning process <sup>[14]</sup>. Guided inquiry-based learning process focused on the main concepts. And it encourages a deep understanding of learning materials that develop thinking skills level. "A learning activity that applies the use of guided inquiry learning cycle consists of 5 stages: orientation, exploration, discovery concept or concept formation, application of concepts and cover" <sup>[10]</sup>.

In support the strategy of guided inquiry-based learning, teaching materials need to be designed to encourage active student in the learning process. Teaching materials meant that the teaching materials in the form of worksheets that the preparation of the material is based guided inquiry learning cycle namely orientation, exploration, formation of concepts, applications and cover.

Guided inquiry-based teaching materials in the form of SWS is equipped with teaching materials that contain orientation (connecting new knowledge to prior knowledge) and key questions (critical thinking questions) that leads students to discover concepts which is being studied. In a study using guided inquiry-based teaching materials, the activity of the student is directed by the teacher to seek and find their own answers (facts, concepts, principles) of something that is questionable so that teachers act as facilitators and motivators of student learning. The material reaction rate is one of the material taught in class XI SMA/MA in semester 1. This research aims to develop teaching materials in the form of student worksheet (SWS) is based on a guided inquiry

learning materials for the chemical reaction rate class XI SMA / MA.

## II. RESEARCH METHOD

This type of research is the development of research or Research and Development (R & D). Development research is research used to produce a specific product and test the effectiveness of these products<sup>[13]</sup>. The development model used in this study model 4-D (four D models) as developed by Thiagarajan, and SemmelSemmel in 1974. The 4-D model consists of four main stages, namely: (1) define (definition), (2) design (design), (3) develop (development) and (4) disseminate<sup>[15]</sup>.

Based on the research and development of the above research was conducted to develop teaching materials in the form of Student Worksheet (SWS) is based guided inquiry on the material reaction rate for chemistry learning class XI SMA/MA were tested by high school students Adabiah Padang in the second semester of academic year 2013/2014. The development phase is intended to produce a valid teaching materials and practical.

The type of data in this study is primary data. Primary data is data obtained directly from professors, teachers, and students are taken through a questionnaire testing the validity and practicalities. The data were analyzed with descriptive statistics to obtain average figures and percentages. Data analysis techniques for each of the research data can be described as follows:

### Techniques of validity analysis

Mechanical analysis of the validity of the content, design, and the practicalities based on the modified categorical judgments of Boslaugh<sup>[5]</sup>. In categorical judgments, validator given a statement to then provide an assessment of each of these statements. Sheets were given a questionnaire and at the end of the validator given the opportunity to decide the outcome of the judgment has been given.

Rate validator to each of these statements is analyzed using Cohen's Kappa formula, which at the end of the processing of obtained kappa moment.

This follow:

$$Kappa\ moment\ (k) = \frac{P_o - P_e}{1 - P_e}$$

$P_o$  is the proportion that is actually realized, is calculated by:

$$P_o = \frac{\text{Number of total value by validator}}{\text{Number of maximum value}}$$

$P_e$  is the proportion that is not realized, calculated as follows:

$$P_e = \frac{\text{Number of max value} - \text{Number of val. by validator}}{\text{Number of maximum value}}$$

Kappa moment ( $k$ ) ranges from 0 to 1 with the interpretation by Boslaugh & Watters<sup>[5]</sup> presented in Table 1.

Table 1. Category Decision According to Kappa Moment ( $k$ )

Interval	Category
0,81 – 1,00	Very High
0,61 – 0,81	High
0,41 – 0,60	Medium
0,21 – 0,40	Low
0,00 – 0,20	Very Low
< 0,00	Invalid

### Techniques of practicality analysis

Similarly, the analysis of the content and construct validation sheet, then the practicalities of assessment sheet obtained from the questionnaire responses of teachers and the provision of student questionnaire responses were also analyzed using Cohen's Kappa formula.

## III. RESULTS AND DISCUSSION

### 3.1 Results

Based on the objectives and procedures of the study, the teaching material is produced in the form of guided inquiry-based worksheets on the material reaction rate, and the validation of the results obtained by the lecturers teaching materials and teachers, as well as the practicalities of teaching materials by teachers and students.

This study was designed to study the basic model of software development model 4-D, are as follows:

### Stage Definition

In the define phase is done fixing and defining the terms of learning. In determining and setting out the terms of learning begins with the analysis of the purpose of the restriction of materials by analyzing the basic competencies (KD) and materials based on the subject matter of curriculum syllabus 2013. The steps in the define phase include:

#### a. Analysis of the open-ended

Curriculum 2013 is the development of competency-based curriculum that has been initiated in 2004. The foundation of curriculum development in 2013 to cover the conceptual aspects of the learning process (learning activities) is through understanding the strategy of increasing the effectiveness and the effectiveness of absorption. Effectiveness is achieved through an understanding of learning that emphasizes personal experience through observation (listening, seeing, reading, and hearing), asks, concluding, and communicates. While the effectiveness of absorption achieved through learning continuity horizontally and vertically

Among the important changes to the curriculum in 2013 developed by perfecting the mindset of one of them: 1) the pattern of teacher-centered learning becomes learner-centered learning; 2) learning patterns in one direction (teacher-learner interaction) into an interactive learning (interactive teacher-learners-community-natural environment, source / other media); 3) the pattern of passive learning into active learning-seeking; 4) patterns of learning itself becomes a learning group (team-based). It can be concluded based on the demands of the curriculum learning implementation in 2013 is the implementation of learning that is oriented to students active. Students are required to actively and independently in learning and teachers act as facilitators and motivators. Based on the analysis of the curriculum teaching material in the form of worksheets, so that the demands of the curriculum can be achieved.

#### b. analysis of students

Subjects in this study were high school students grade XI 3 aged between 15-17 years.

The results of the analysis of the characteristics of the students into the background the need for development of teaching materials in the form of guided inquiry-based worksheets on reaction rate material.

#### c. The task analysis

The task analysis aims to analyze the students' ability to master. The task analysis in the form of analysis of core competencies (KI), Basic Competency (KD), and the subject matter.

#### d. Analysis of the concept

Analysis of the concept is the identification of the main concepts in the material to be covered. The main concept that will be discussed is the reaction rate material. The main concepts were identified, among others solution, molar, a concentrated solution, aqueous solution, the reaction rate, factors that affect the rate of reaction (concentration, surface area, temperature, catalyst), the collision theory, reaction rate constants, reaction order.

#### e. Analysis of learning objectives

Analysis of learning objectives is the stage of conversion of the results of analysis tasks and analysis concepts into learning objectives.

#### Stage Design (Design)

After learning indicators formulated, as well as the concepts defined, the next step is to design a guided inquiry-based teaching material in the form of worksheets, as follows:

a. Designing instructional materials in the form of worksheets that done by selecting the appropriate format with guided inquiry learning cycle and writing format worksheets in the book Teaching

Materials Development Guide the Ministry of Education in 2008.

- To set the title to the subject matter will be developed guided inquiry-based teaching materials in the form of worksheets.
- Determine KI and KD will be developed guided inquiry-based teaching materials in the form of worksheets.
- Based on identification KD and subject matter, the next steps outlined learning indicators to be achieved.
- Designing a model that suits the learning indicators to be achieved.
- Based on the model presented in SWS, made key questions so that students can find the concept by observing and investigating the given model.

Furthermore, give exercise will be direct application of the concept, so as to assist students in establishing the concept.

#### Stage of Development

Develop phase aims to produce teaching materials in the form of guided inquiry-based worksheets that have been revised based on input from the validator, so we get a device that can be used in research.

#### a. Validation of teaching materials

Teaching materials in the form of guided inquiry-based worksheets that have been created will be validated by the validator. Validator provides an assessment of the teaching materials with attention to three aspects, namely the content components, presentation components (construction), parts and components graph. The result of linguistic expert validation (validator) was conducted to reveal the content validity of chemical in form of worksheets that are already designed to be performed in the process learning in the classroom.

##### 1) Component Content

The results of the validation of the contents of the component aspects of chemistry teaching materials in the form of worksheets on the material guided inquiry-based reaction rate of the validator I and II have a high validity and category III validator has a very high validity of the category.

Table 2. Data Rate Component Content Subjects by Validator I, II, and III

Validator	Total score given validator	Total score maximum	Kappa Moment (k)	Validity category
I	33	40	$k = \frac{\left(\frac{33}{40}\right) - \left(\frac{40-33}{40}\right)}{1 - \left(\frac{40-33}{40}\right)}$ $k = 0,79$	High
II	32	40	$k = \frac{\left(\frac{32}{40}\right) - \left(\frac{40-32}{40}\right)}{1 - \left(\frac{40-32}{40}\right)}$ $k = 0,75$	High
III	35	40	$k = \frac{\left(\frac{35}{40}\right) - \left(\frac{40-35}{40}\right)}{1 - \left(\frac{40-35}{40}\right)}$ $k = 0,86$	Very high
The result of content validity			0,80	High

Note: k = Kappa moment validator

## 2) Assessment Component Construction

The results of the validation of aspects of construction components (components presentation) chemistry teaching materials in the form of guided inquiry SWS based on the material of the reaction rate validator I, II and III have the validity of the very high category.

Table 3. Data Rate Component Construction Subjects by Validator I, II, and III

Validator	Total score given validator	Total score maximum	Kappa Moment (k)	Validity category
I	17	20	$k = \frac{\left(\frac{17}{20}\right) - \left(\frac{20-17}{20}\right)}{1 - \left(\frac{20-17}{20}\right)}$ $k = 0,82$	Very high
II	17	20	$k = \frac{\left(\frac{17}{20}\right) - \left(\frac{20-17}{20}\right)}{1 - \left(\frac{20-17}{20}\right)}$ $k = 0,82$	Very high
III	19	20	$k = \frac{\left(\frac{19}{20}\right) - \left(\frac{20-19}{20}\right)}{1 - \left(\frac{20-19}{20}\right)}$ $k = 0,92$	Very high
Result of construct validity			0,86	Very high

Note: k = Kappa moment validator

## 3) Components Linguistic and Graph

The results of the validation of the linguistic components and chemical graph of teaching materials in the form of guided inquiry SWS based on the material of the reaction rate validator class I and III have very high validity and validator II has a high validity category.

Table 4. Data Rate Components Linguistic and Graph of teaching materials by Validator I, II, and III

Validator	Total score given validator	Total score maximum	Kappa Moment (k)	Validity category
I	31	36	$k = \frac{\left(\frac{31}{36}\right) - \left(\frac{36-31}{36}\right)}{1 - \left(\frac{36-31}{36}\right)}$ $k = 0,84$	Very high
II	27	36	$k = \frac{\left(\frac{27}{36}\right) - \left(\frac{36-27}{36}\right)}{1 - \left(\frac{36-27}{36}\right)}$ $k = 0,67$	High
III	33	36	$k = \frac{\left(\frac{33}{36}\right) - \left(\frac{36-33}{36}\right)}{1 - \left(\frac{36-33}{36}\right)}$ $k = 0,91$	Very high
Conclusion Validity category Components Linguistic and Kefrafikan			0,80	High
The overall average			0,82	Very high

Of the three components of teaching materials chemistry votes obtained an overall average of 0.82 with the validity of the very high category. Although the validity of chemistry teaching materials in the form of SWS is very high, but still there are some components that must be repaired.

Based on the results of expert validation of the chemical teaching materials in the form of worksheets on the material guided inquiry-based reaction rates obtained validation analysis worksheets are valid with high validity category.

## b. Practicalities of teaching materials

In the next development stage, conducted trials are done. This trial aimed to determine the practicalities of guided inquiry-based teaching materials in the form of worksheets that developed. Practicalities data obtained from questionnaires to teachers giving chemical subjects and student questionnaire responses. Rate practicalities of questionnaire responses obtained with high teacher moment kappa value of 0.80. From the results of these practicalities, the teaching materials in the form of guided inquiry-based worksheets can be applied to the learning process in school. Practicalities assessment of student questionnaire responses obtained the practicalities of every aspect rated highly by the moment kappa value of 0.80 with the practicalities of high category.

Table 5. Data practicalities of Questionnaire Responses Teacher and Student

Questionnaire Response	Give total score	Maximum total score	Kappa moment (k)	Validity category
Teacher	40	48	$k = \frac{\left(\frac{40}{48}\right) - \left(\frac{48-40}{48}\right)}{1 - \left(\frac{48-40}{48}\right)}$ $k = 0,80$	High
Student	40	48	$k = \frac{\left(\frac{40}{48}\right) - \left(\frac{48-40}{48}\right)}{1 - \left(\frac{48-40}{48}\right)}$ $k = 0,80$	High
Practicality category result			0,80	High

Note : k = kappa moment

## Stage Deployment

In the context of the development of teaching materials, researchers at the stage of dissemination of this limit is only up to the stage of socialization of teaching materials in Annex 11-14 Pages 85-91. If the response of the target, the teaching material is good, then the newly performed printing in large quantities and marketing of teaching materials so that it can be used by a broader target. However, researchers did not do the printing in large quantities and marketing due to time and cost.

### 3.2 Discussion

Product assessment is done by using the assessment sheet that has been validated by three experts in chemistry. Data validation of teaching materials in the form of guided inquiry SWS based on material obtained from the reaction rates 1 votes professor of chemistry and 2 high school chemistry teacher Adabiah Padang. Election of three experts is based on the opinion of Sugiyono stating that to test the construct validity of instruments, can be used on expert opinion (judgment experts) that the amount of at least three people<sup>[13]</sup>.

Based on the validation of the third sheet validator provides an assessment of the teaching material in the form of guided inquiry-based LKS produced in terms of the content components, construction components (the presentation component), and a linguistic component. Data validation assessment sheets chemistry teaching materials in the form of guided inquiry SWSberbasis are then analyzed using Cohen's Kappa formula.

Based on the results of the validation provided by validator I then obtained an average using kappa moment as much as 0.82 with a very high validity category by using the category of decisions by Boslaugh with 9 aspect rated scoring strongly agree and 15 aspects assessed scoring agree. Validator I give criticism, feedback and suggestions. Advice given validator I was correct equation with HCl Mg and Fe with HCl, the add information about how to determine the reaction order, the work procedure no sentence questions and note the use of question marks in the sentence. Advice given validator I be useful to revise the teaching material in the form of Student Worksheet (SWS) based guided inquiry to make it better so we get a decision validator I found "valid with the repair contents".

Based on the results of the validation provided by validator III then obtained an average using kappa moment as much as 0.89 with the validity of the very high category using the category of decisions by Boslaugh with 15 aspects assessed scoring strongly agree and 9 the aspects that give scoring agree. Validator III gives criticism, feedback and suggestions. The advice given by the validator III is correct key questions on page 9 of molar; drawing on the factors that affect the rate of reaction (surface area) is clarified. Advice given validator III useful to revise the teaching material in the form of Student Worksheet (SWS) based guided inquiry to make it better so we get a decision validator III that "valid with the repair contents".

Acquisition moment kappa ( $k$ ) to express practicality guided inquiry-based teaching materials in the form of worksheets on the reaction rate material. From the results of the assessment indicate that the average score of the practicalities of teaching materials in the form of worksheets obtained was 0.80 with high practicality meaningful category of teaching materials in the form of guided inquiry SWS based on material

developed reaction rate can be applied in the learning process in schools".

Based on the practicalities of assessment instruments student questionnaire responses obtained an average value of 0.80 kappa moments. It is revealed that the chemical teaching materials in the form of worksheets produced has high practicalities category for use in the learning process. The use of color and design in the image greatly assist students interested in learning. Textbooks and worksheets were developed to make students interested for textbooks and worksheets to see its interest to students.

In the use of chemicals in the form of teaching materials Student Worksheet (LKS) based guided inquiry can lead students in finding the concept of the overarching questions by observing the model that is focused on student learning. In addition to the chemical teaching materials produced in the form of worksheets that can help students to understand in depth the substance of the material. Based on the practicalities of assessment instruments student questionnaire responses obtained an average value of 0.80 kappa moments. It is revealed that the chemical teaching materials in the form of worksheets produced has high practicalities category for use in the learning process. The use of color and design in the image greatly assist students interested in learning. Textbooks and worksheets were developed to make students interested for textbooks and worksheets to see its interest to students.

### CONCLUSION

Based on the research that has been done, it can be concluded that the teaching material has been produced in the form of guided inquiry-based worksheets on the material reaction rate for class XI SMA/MA by research development by using 4-D model of the development of the category of high validity and practicalities.

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