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THE DEVELOPMENT OF STUDENT ACTIVITY SHEET ORIENTED GUIDED DISCOVERY LEARNING MODEL TO PRACTICE SCIENCE PROCESS SKILLS ON REDOX REACTION SUBJECT FOR TENTH-GRADE SENIOR HIGH SCHOOL STUDENT

Mamik Damayanti and Dian Novita
Chemisty Department FMIPA Universitas Negeri Surabaya
email: mamikdamayanti5@gmail.com. Mobile phone: 085746359494

Abstract

This study is aimed to 1) Determine the internal validity of students' activity sheet developed regarding to the criteria in terms of content, presentation, linguistic and graph 2) Determine the external validity of students' activity sheet developed in terms of student responses supported by the observation data. The research object is the learning material that developed in the form of students' activity sheet that will be used as a learning tool in *X* grade of *SMA/MA*. The design of students' activity sheet development refers to the method of development of the four-D method proposed by Thiagarajan, Semmel, and Semmel. Science process skill drilled in this research is to design a scientific research, conduct scientific research, collect the data, analyze the data, and draw a conclusion. Sources of the data in this study were obtained from the data review and validation of chemistry lecturer and high school chemistry teacher. The limited trial was conducted on 30 students of XI grade of Senior High School that got the redox material included in the evaluation field. The data were analyzed descriptively. The results of the study based on the validation data from each of the criteria get a percentage between 90.35% to 93.33%, students' activity sheet developed is categorized as valid. Based on the data from student questionnaire students responses for each criterion get a percentage around 88.24% to 97.00%. Therefore, the students' activity sheet developed is categorized as valid.

Keywords: students' activity sheet, guided discovery, science process skill, redox.

INTRODUCTION

Education is the important aspect with a systematic process to improve the human dignity. One of the issue that influence education process is the curriculum in Indonesia. The curriculum is a set of plans and arrangements regarding to the objectives, content and learning materials used to guide the implementation of learning activities to achieve specific educational objectives [1]. The curriculum that is used in Indonesia at this time is 2013 curriculum. The curriculum of 2013 is developed to improve the mindset of the students [2].

Balancing the mindset in the 2013 curriculum is also developing a balance between the spiritual and the social attitude, knowledge and skills and apply it in a variety of situations in the schools and critical community [3]. In fact, in the learning process, the teacher tend to motivate the students to memorize and amass a number of learning materials. This is also proved with the results of the questionnaire in SMA N 1 Manyar that 69% of teachers are teaching chemistry from the beginning until the end and then give the questions and only 6% of the teachers that lead students to have a discussion.

From those fact, the students are expected to be able to apply those through practical activities that have been carried out. It is because that experience involves all five senses so that the students will be able to interact with the environment

directly. This is related with the theory from Bruner states that a person is considered as learn if she or he is having the interaction actively with their environment [4].

Along with the development of student learning, it is needed to make the innovation. One attempt to do to improve student learning outcomes, especially in chemistry subject is by applying the model of guided discovery learning.

Guided Discovery learning is the combination of two ways of teaching that is teacher-centered and student centered. In guided discovery learning, the teacher's role is as the facilitator that guides the students to acquire knowledge and enable them to be active. The teacher also be an instructor who gives a case or problem then guide the students to think step by step so they can solve the problems [5].

The model of learning that is often used in the learning process is cooperative learning model. In addition, teacher also uses discovery learning in teaching but only once in two semesters and the results are not maximum because it is cannot be implemented yet for the students and they still tend to use teacher-centered learning. Based on the result of the interview, it can be concluded that the teacher rarely uses guided discovery method of teaching chemistry material of experimental and non-experimental based. Discovery learning is a method. Guided Discovery Learning is a method that combines two ways of teaching that is teacher-centered and student-centered [6].

Based on the fact above, it shows that the practicum can provide real learning experience and train the science process skills of the students in the learning process [4]. Guided discovery learning requires students to investigate the Science Process Skills (SPS) both primary and integrated.

Science process skills includes observing, inferring, predicting, classifying, modeling, communicating, measuring, calculating, designing the experiments, asking questions, developing hypotheses, controlling variables, making an operational definition, interpreting the data, drawing conclusions, making of table of the data and making graphs [7].

Based on the results of questionnaire in pre-study at SMA Negeri 1 Manyar some students said that the most difficult material of chemistry is about redox. This is consistent with the results of the questionnaire in pre-study they answered that on the material role of chemistry in life (9%), atomic structure (44%), a solution of electrolytes and nonelectrolytes (9%), oxidation-reduction reactions (47%), and other materials (28%). It also has not been carried out the experiments on redox material in SMA Negeri 1 Manyar since the X class materials, the experiment ever undertaken is only identify the electrolyte and non-electrolyte. It is also consistent with the result of a questionnaire which is only 6% who said that if the experiment of redox has been conducted. That is why the students still require more understanding in order to understand the redox material.

Based on the result of the questionnaires in pre-study conducted in SMA Negeri 1 Manyar that in the learning process still use worksheets that contained formulas of chemistry learning and then immediately given to the student, then provided examples of questions and the students were asked to answer those questions. It makes the students uninterested in studying chemistry for Students' activity sheet only in the form of questions and formula. In addition, science process skills of the students is very low. The use of Students' activity sheet in the learning process cannot be able yet to exercise the students in finding the concepts through their own discoveries. Some students say that they need a learning sheet that include implementation

in everyday life in order to more easily understand the material because most of them not understand how apply the chemistry materials in their life. They only understand the chemistry material, but do not understand its application in their life. This is consistent with the results of pre-study questionnaire. Based on the data, 79% of SMA Negeri 1 Manyar cannot formulate a hypothesis from the problem, there is only 19% of students who can formulate variable correctly, 77% of students are able to design experiments of the existing problems, 44% of students are able to create a table with observations but only 19% of students who can analyze observations properly and 41% of students can formulate a conclusion. Therefore, one of the skills that can exercise students' understanding of the material application in everyday life is the science process skills.

Another alternative for exercising in the science process skills, students need their media other than books that can be used in teaching and learning. The most common media that recently used is power point and rarely use other media such as virtual video. This is consistent with the results of pre-study in SMA Negeri 1 Manyar Gresik that the media used by the teacher in learning process is power point 69% and virtual video is only 16%. It is needed to develop the Students' activity sheet modified with a video for supporting material in learning.

The purpose of this study was to determine the internal based on content criteria, presentation, linguistic and a graph and external validity based on students response supported by observation data of the Students' activity sheet developed. The benefits expected through this research are the Students' activity sheet produced is valid and be able to exercise the students' science process skills and also can motivate the students in solving chemistry problems that occur in everyday life. In addition, this study is expected to help the teacher in providing alternative teaching materials to train students' science process skills.

METHOD

The research of students' activity sheet development refers to the method of development of the four-D method proposed by Thiagarajan, Semmel, and Semmel [8]. The implementation of development in this study is only at the development stage.

Sources of data in this study were obtained from the data review and validation of chemistry lecturer and high school chemistry teacher. The limited trial conducted in 30 high school students.

The students' activity sheet developed is examined first. The Students' activity sheet have been reviewed by 2 chemistry professor from state university of Surabaya and the chemistry teacher to examine and advise toward students' activity sheet developed, subsequently the students' activity sheet is revised, then it is validated by a chemistry lecturers of UNESA and two chemistry teachers.

The data obtained from the results of the validation of the validator is analyzed descriptive quantitatively of each criterion. The validators provide an assessment based on the Likert scale in Table 1.

Table 1 Likert Scale

Category	Value Scale
Very appropriate	5
appropriate	4
Enough appropriate	3
Less appropriate	2
Not appropriate	1

The data obtained then calculated by using the formula:

$$\% = \frac{total\ score\ of\ collecting\ data}{scoring\ criteria}\ x\ 100$$

The scores were then interpreted in Table 2.

Tabel 2 Interpreting score

Value Scale	Category
0%-2%	Not appropriate
25%-40%	Less appropriate
41%-60%	Enough appropriate
61%-80%	Appropriate
81%-100%	Very appropriate

Adaptation [9]

Based on table 2, the students' activity sheet is categorized as feasible if the percentage gained is 61%.

After that the students' activity sheet is examined. The data obtained from the result of student questionnaire responses and observations.

Student questionnaire responses assessed on a scale of Guttman in Table 3.

Table 3 Scale Guttman

Response	Scale Score
Yes	1
No	0

The data obtained then calculated by using the formula:

$$P = \frac{f}{N}\ x\ 100\ \%$$

f is the number of answer Yes or No and N is the number of respondents.

The scores were then interpreted in Table 4.

Tabel 4 Interpreting score

Value Scale	Category
0%-2%	Not appropriate
25%-40%	Less appropriate
41%-60%	Enough appropriate
61%-80%	Appropriate
81%-100%	Very appropriate

Adaptation [9]

Based on Table 4, the students' activity sheet is categorized as feasible if the percentage gained is 61%.

RESULTS AND DISCUSSIONS

The students' activity sheet developed is examined by two chemistry lecturers of FMIPA UNESA and one chemistry teacher from SMA Negeri 1 Manyar Gresik. The reviewers give suggestions or comments for the students' activity sheet based on the criteria of the content, presentation, linguistic and graph.

The result of the revision by the researchers then submitted to the validator from chemistry lecturers and chemistry teacher to be assessed in order to determine the validity of the students' activity sheet developed.

Internal validity of learning sheet

Internal validity of the students' activity sheet can be known through the data validation results. The validation carried out after the students' activity sheet is revised according to the results of the expert reviewers. The validation is done by the first lecturer of chemistry FMIPA UNESA and two chemistry teachers from SMA Negeri 1 Manyar Gresik. The internal validity of the students' activity sheet is oriented based on guided discovery learning method in Redox material for exercising science process skills in terms of the criteria of content, presentation, linguistic and graph. Learning sheet validity criteria developed is assessed on the criteria of content, presentation, and language with the percentage for each of the criteria: the criteria of the content is 92.00%, the criteria of presentation is 89.75%, and the criteria of the language used is 90.52%.

Based on the result of the validation criteria of the students' activity sheet developed, the first the students' activity sheet get the lowest percentage that is 73.3% which the aspect of "illustrations or pictures presented clearly and suitable with the subject" in the first students' activity sheet. That is because the image of the phenomenon on the first

students' activity sheet is not match with the description of the phenomenon. On the first students' activity sheet contained description of the phenomenon of "drop fireworks" but the picture presented is the "original fireworks". That is why the assessors say that it is not match with the phenomenon described. Indeed, the students' activity sheet is still categorized as valid.

The aspect that get the same percentage on the first, second and the third students' activity sheet is the aspect of "providing the space for student to write the answer on the learning sheet, which is seen in the features'. The score on this aspect get the low percentage since the fact that the space to write the answer is not enough, for example in the space of "designing the working steps" so that before the data retrieval of the students' activity sheet, it has been edited to wider the space for the answer. But the students' activity sheet is still valid.

80% also occurred in the first students' activity sheet on the aspect of "the presentation of illustrations or images that relevant to the subject matter, which is seen in the feature." In regarding with the result on the aspects of the linguistic criteria related to the pictures on the first students' activity sheet, the descriptions related to the phenomenon of " drop fireworks " but the picture presented the "original fireworks" the assessors say that is not in accordance with the phenomenon described. But the students' activity sheet is still valid.

In the aspect of "the students' activity sheet material relevant to the indicator of learning and learning objective are presented clearly, visible on the feature". It gets a percentage of 93.3% of all the first, second and third students' activity sheet. This is because the learning material (a summary of the material) only consist of the important concepts that can help the students in the process of discoveries by observing, experimenting and answering the questions of the students' activity sheet. Learning material is served as the information supporting the concept of oxidation-reduction reactions. This is suitable with the National Education Ministry [10] i.e. the students' activity sheet can be as the supporting information contains a general description or the scope of the substance to be studied. Also the learning objective written in the students' activity sheet is arranged based on the rules of ABCD (Audience, Behavior, Condition, and Degree) [11].

In the aspect of "suitability of the students' activity sheet is presented with basic competence and indicators of 2013 curriculum" also categorized as very valid in all the first, second and third students' activity sheet. This is because the materials written on the students' activity sheet are presented based on the basic competencies existing in K-13 revision on the KD 3.9 Determining the oxidation numbers of the elements to identify the oxidation and reduction as well as the naming of compounds. The students' activity sheet developed consist of the Basic competence which is in the first students' activity sheet discusses about the development of the concept of oxidation reactions material, the second students' activity sheet is related to the determination of the redox numbers and the third students' activity sheet discusses auto-redox and application of the redox reactions in daily life. It is suitable with the basic competence that has been described in K-13 revision. While at the basic competence of 4.9 which is require the students to be able to differentiate reactions involving and not involving a change in oxidation number through the experiment. This basic competence also written in the students' activity sheet since there is a practicum related with the determination of the oxidation number and there are questions on data analysis and independent tasks related to the question

that distinguishes the redox and not redox reactions in the second students' activity sheet.

The criteria are very valid on all aspects of the students' activity sheet also occur in "the variety of common look is interesting, which is seen in the features" on the criteria of presentation. In this aspect, the percentage obtained is 93.3%.

External Validity of the students' activity sheet

The external validity of the students' activity sheet can be known through data obtained during the limited trial toward the students' activity sheet developed which includes the results of student questionnaire responses that are supported by the result of observations during students' activity sheet developed used.

The Results of student questionnaire responses

Student responses related to the validity of students' activity sheet that are developed based on the criteria of content, presentation, linguistic and the graph. Student questionnaire responses are given to determine the validity of students' activity sheet developed so that the students are taking part in its response associated with the students' activity sheet developed. This students questionnaire responses given to the students to determine the external validity of students' activity sheet developed. The student questionnaire responses carried out by answering the number of questions with the answer "Yes" or "No".

The Results of students' questionnaire responses is supported by observational data. The Observations were conducted during the limited trial toward students' activity sheet developed. The students' activity sheet trials is conducted in SMA Negeri 1 Manyar for 30 students who have gotten material oxidation-reduction reaction. Based on the result of student questionnaire responses are described in the table shows that all aspects obtain a percentage of 88.24% to 97% to the category of appropriate and very appropriate. In this case the students' questionnaire responses consist of 24 statement. The statement on the number 1 to 5 are the aspect that supports the content criteria which is each aspect get a very appropriate criteria and only one aspect is categorized as appropriate in the aspect of "The phenomenon presented is suitable with the level of development of my understanding". This happens because the students have not been used to obtain learning materials confronted directly with the phenomenon. Based on the questionnaire the students also found that students' activity sheet presented is arranged systematically so it is easily to be understood by students. Students also state that there is a link between the materials in students' activity sheet. This is because the arrangement of students' activity sheet is arranged based on core competence and basic competence existed on the K-13 revision. Based on some statements that get a very appropriate criteria, it can be concluded that the students' activity sheet can help students understand the material oxidation-reduction reaction. It is also consistent with the observation sheet that can support student questionnaire responses when the students do the questions that exist on students' activity sheet. The function of students' activity sheet as a teaching materials can ease the students to understand the material provided. It can be said that students' activity sheet developed is appropriate [12].

In the statement number 6 to 10 are the statements that support all aspects of the criteria for the presentation and get a very appropriate criteria. The components of presentation include clarity of the objectives to be achieved, the order of presentation, motivation and

attractiveness, interactivity and completeness of the information [10]. Judging from the presentation component of the aspect "Presentation of students' activity sheet attracted me to do it" gets a percentage of 100%. It shows that many students want that the students' activity sheet used in the learning process is more interesting in terms of presentation. While the components of the order of the presentation, students' activity sheet have component such as: introduction, table of contents, bibliography, concept maps, objective and instructions for use. This is evidenced by the percentage obtained in this aspect is 100% so the students' activity sheet is already have completeness of the information.

In the aspect of numbers 11 to 16, which is the aspect that supports linguistic criteria showed that the students' activity sheet developed is categorized as a very appropriate in all aspects with a percentage of 97% of feasibility. This is also supported by the observation of the observer that the students are able to understand the information presented in the students' activity sheet. This shows that the students' activity sheet developed is prepared by using the appropriate language of EYD, the language used is unambiguous and easy to understand. Also the questions in the students' activity sheet is clear and easily to be understood by students. This was reinforced by the observation sheet of observers that students are able to work on the problems that exist in the students' activity sheet developed. This is suitable with the opinion of Steffen-Peter Ballstaed in Depdiknas states that in the preparation of the students' activity sheet, one aspect that must be considered is the ease of reading, which involves good letters, not too small and readable, in addition to the font size of the text should be structured and easy to be read.

In the aspect of numbers 17 to 24 which supports compliance with science process skill and guided discovery component, most of them get very appropriate criteria and only 2 aspect are said appropriate which is the aspect of the number 20b which is the students' activity sheet can help collect the data and achieve clarity and aspects of the number 22 which is the students' activity sheet led me to think critically and logically. This is because the students' activity sheet are designed to exercise science process skills of students so the students' activity sheet less helpful in critical thinking. There are several aspects that get a very appropriate ratings with a percentage above 81% starting from the students' activity sheet can solve the problem through the invention of the students, the students' activity sheet can also stimulate the curiosity of students. This result is also consistent with the observation of the students on aspects of the students were able to do the planning problem gets percentage of 100%, data collection also gets a percentage of 100%, analyze and conclude also gets a percentage of 100%. The result showed that the students are responding the components of the science process skills and guided discovery where students are able to work on existing questions on the worksheet according to their own finding and sustainable. One of the benefits exercise of the science process skill is for students to master the scientific skills required in learning teaching of science [14]. Discovery is a series of learning activities that involve maximum entire ability of learners to search and investigate in a systematic, critical and logical, so that they can find their own knowledge, attitudes and skills. On the guided or guided discovery learning, the teacher asks questions with the aim to direct learners to the point of the expected conclusion [13].

Furthermore, the students conducted an experiment to prove the opinion put forward. These activities help students understand the concept of the material being studied, since the ability to involve students directly to investigate and learn gradually, along with learning activities which is interesting and fun like doing experiments, that material will be processed and stored in long term memory, so that students will continue to remember the material that has been found.

The data results from students' responses to the students' activity sheet developed can be seen that the students gave positive responses to the criteria of content, language, presentation with the criteria of very appropriate and appropriate so that the students' activity sheet can be said to be valid.

CLOSURE

Conclusion

Based on the correspondence between the results and the aims, it can be concluded that student activity sheet oriented guided discovery to practice science process skills on redox reaction subject for tenth-grade senior high school student deserve to be used as teaching material in the material oxidation-reduction reaction with the following details:

1. The validity of students' activity sheet developed is considered in terms of internal validity for each of the criteria that is the criteria of the content is 91.96%, presentation criteria is 90.35%, language criteria is 93.33%, graph criteria is 90.52%.
2. The students' activity sheet is categorized as valid in terms of external validity include the student responses obtained percentage between 88.24%-97.00% for each criterion.

Suggestion

The suggestion is given for further research are:

1. When applying activity sheets that have been developed to consider the problem of time, because in the activity sheet there are plenty of activities ranging from designing the study up to analyze data through some questions and there is work to be done at home so it took time efficiency needs to be estimated.
2. Based on trial results students sheets that have been developed, the result is low on skills to analyze the data. Therefore, when applying worksheets that have been developed are expected to be focused on those skills.

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