The Development of Students Worksheets Based on Guided Inquiry on The Topic of Materials Buffer in High School

R.Okta Rise armis1*, H. Asmadi M Noer2, Rasmiwetti2

1PostGraduate Program of Chemistry Education, Faculty of Teaching and Education Science, Universitas Riau, Pekanbaru, Indonesia
2Chemistry Education, Faculty of Teaching and Education Science, Universitas Riau, Pekanbaru, Indonesia

rajarisarmis@gmail.com, Amnoer2007@yahoo.com, rasmiwetti.19@gmail.com

*Corresponding Author
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Abstract: This research is an early stage research of three stages of development. The study aimed to develop guided inquiry-based Student Worksheets (LKPD) on the topic of Buffer. Guided inquiry is a learning model that requires students to find concepts from a problem proposed by the teacher. This research was a research and development with 4-D development model. The research was designed based on needs analysis (front end analysis, student analysis, concept analysis and task analysis). Student worksheets assessment was validated by validators and the percentage of validation values was calculated. The overall average validation score of guided inquiry-based student worksheets on the topic of Buffer is 96.79% with a valid feasibility category. It means that guided inquiry-based student worksheets developed is suitable to be used for the topic of Buffer.

Keywords: Buffer, Student Worksheet and Guided Inquiry.

1. Introduction

The development in education field is increasing rapidly along with the increase in intellectuality and quality of human life. This development includes the application of new curriculum i.e. the 2013 curriculum. The 2013 curriculum is a student-centered learning which is carried out based on the scientific approach and authentic assessment [1].

The scientific approach requires students to actively learn through observing, asking, trying / collecting data, associating / reasoning, and communicating. A guide or learning resource that can be developed is required by educators as facilitators in learning activities. One guide or learning resource that can be used is the student worksheet.

Student worksheets covers a summary of the material and tasks that students do. Student worksheets is a means to help and facilitate teaching and learning activities [2]. Student worksheets is designed and developed according to the situation and conditions of the real learning activities.

Based on the observation, some teachers got difficulty in making characterized student worksheets in scientific model. Student worksheets from the publishers were not yet suitable with student needs in achieving learning goals. Student worksheets used in schools included a summary of material, practical instructions and questions that did not lead students to compile and find their own concepts, and connect the materials with everyday life. Students felt that learning was less meaningful, less attractive and less motivated to learn. The lack of students’ learning motivation would weaken learning activities. As a result, the quality of learning outcomes became low.

The buffer is the subject which requires memorization, calculation, experimentation and understanding of concepts. Understanding of a concept is important and absolute for students in the learning buffer. After analyzing the buffer, it was found that the concept of this material was
interrelated. Accurate understanding in this concept becomes the foundation to possibly master more interconnected or more complex concepts.

On the other hand, guided inquiry is a type of inquiry that can be applied to students. Students are given opportunities to do some activities such as formulating problems, analyzing results and drawing conclusions independently. During the practice, the teacher provides directions or guidance for students to find information or concepts with teacher’s help. Students autonomously find a concept so that they will get better understanding and always remember the concept [4]. Guided inquiry can be applied to student worksheets. In the early stage of teaching, guidance, such as directive questions, made in student worksheets is provided in order to make students able to find their own strategy to solve the problems. In guided inquiry, the teaching presentation begins with an explanation of an enigmatic event. Individual learners will be motivated to solve the puzzles and to guide them in a disciplined search and investigation.

Guided inquiry-based student worksheets are expected to enable students to construct the understanding of chemical concepts, especially in the buffer, gradely, effectively and systematically, and in accordance with the 2013 curriculum.

2. Literature Review

Several studies on guided inquiry learning model were conducted previously. One of them was a study conducted by Nurfidianty Annafi et al (2015) [7]. She conducted a study on the development of guided inquiry-based student worksheets about thermochemical on grade XI SMA/MA. The results showed that using guided inquiry-based student worksheets on learning thermochemical effectively improved the learning outcomes of students' knowledge, attitudes and skills. The average score of students learning outcomes after using guided inquiry-based student worksheets on thermochemical was higher than those who did not use guided inquiry-based student worksheets [7].

After that, Fitri Wahyuningsih et al (2014) conducted a research on the development of guided inquiry-based student worksheets in the topic of salt hydrolysis for SMA/MA [3]. This research revealed that the coefficient of variation (CV) of the product was 0.79. This indicates that student worksheets can be continuously applied to the trial stage, and it obtained an average rating of "very good". The average responses of students’ and teachers’ questionnaire obtained was a "very good" score. Moreover, the percentage of student mastery learning of grade XI IPA 1 SMA Batik 1 Surakarta was 94.12% and grade XI IPA 2 SMA Batik 2 Surakarta was 82.86%. It can be concluded that classically, both could achieve the mastery criteria.

Moreover, Juniar Afrida et al (2015) also conducted a research on the development of guided inquiry-based student worksheets to improve the ability of science process skills and student interest in learning static fluid at SMAN 11 Banda Aceh. The results showed that using student worksheets inquiry on learning static fluid could improve students' understanding (KPS) and students' interest in learning [6].

Finally, research related to the development of student worksheets guided inquiry learning based has been carried by Irham (2016) on colligative solution, found that the percentage of students' mastery learning before using guided inquiry-based worksheets was 16.67% and after using guided inquiry-based student worksheets increased to 70% [9].

3. Material & Methodology

3.1. Data

The data were collected by validating the learning device by three validators. The results from the validator were calculated to obtain data analysis results.

3.2. Method

The research was conducted at the Chemistry Education Study Program of FKIP Universitas Riau starting from December 2017 to February 2018 academic year 2017/2018. The design of this research was research and development referring to 4-D development model. The 4-D model consists of Define, Design, Develop and Disseminate. The research was conducted until the development stage,
The Development of Students Worksheets Based on Guided Inquiry on The Topic of Materials Buffer in High School

considering that the research objective was to develop a valid teaching material. The steps of the research are in Figure 1.

![Figure 1. The model of 4D learning device development](image)

The technique of data analysis was descriptive analysis; it was conducted by calculating the average score of each aspect of assessment contained in the guided inquiry-based student worksheets validation sheet on the topic of buffer.

The criteria for making decisions in the validation of student worksheets can be seen in the Table 1 [10].

**Table 1. Assessment Category by Validators**

<table>
<thead>
<tr>
<th>Assessment Score</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>SS: Very Appropriate</td>
</tr>
<tr>
<td>3</td>
<td>S: Appropriate</td>
</tr>
<tr>
<td>2</td>
<td>KS: Less Appropriate</td>
</tr>
<tr>
<td>1</td>
<td>TS: Not Appropriate</td>
</tr>
</tbody>
</table>

Validity results were calculated by the average score formula below:

\[
\text{Percentage} = \frac{\text{Score Obtained}}{\text{Score Maximum}} \times 100\%
\]

The criteria to decide the validation of student worksheet are displayed in Table 2. The Student Worksheet is used if the average score from validator is categorized as good and very good.
The Development of Students Worksheets Based on Guided Inquiry on The Topic of Materials Buffer in High School

Table 2. Feasibility Criteria for Percentage Analysis [8]

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>80.00 – 100</td>
<td>Valid</td>
</tr>
<tr>
<td>60.00 – 79.99</td>
<td>Valid Enough</td>
</tr>
<tr>
<td>50.00 – 59.99</td>
<td>Valid Less</td>
</tr>
<tr>
<td>0 – 49.99</td>
<td>Invalid</td>
</tr>
</tbody>
</table>

4. Results and Discussion

4.1. Result

The research on teaching material development aimed to produce appropriate guided inquiry-based student worksheets in order that it could be used in learning chemistry. This research followed four steps of development: the defining stage, the design stage and the development stage.

a. Define Stage

The define stage covers 4 steps, namely front end analysis (teacher needs), student analysis, task analysis (curriculum) and concept analysis. The results of the front end analysis (teacher's needs) showed that there was no student worksheets that facilitated students to develop various scientific skills in the learning process according to the scientific approach in order to find the concept of buffers. The result of student analysis found that student worksheets users for the topic of buffer were at the age of 16-17 years. According to Piaget the main feature of development at this age is that children are able to think logically by using scientific thinking patterns and the ability to draw conclusions, interpret and develop hypotheses. Based on the observations and interviews, it was found that students (the users of student worksheets) were still passive in the learning process. They could not analyze well, especially in understanding abstract concepts. Moreover, the results of task analysis were curriculum analysis based on the material being developed, which was buffer. The development of buffer materials was based on core competencies and basic competencies. Meanwhile, concept analysis resulted in producing a concept map of buffers.

b. Design Stage

At this stage, the initial design of student worksheets and student worksheets validation sheet were produced. student worksheets draft which was developed contained the structure of student worksheets according to the Guidelines for the Development of Teaching Materials. It covered the titles, instructions, material, and student activities in student worksheets. Student activities in guided inquiry-based student worksheets are: 1) orientation; 2) formulating the problem; 3) formulating a hypothesis; 4) collecting data; 5) test the hypothesis; and 6) conclusions.

c. Develop Stage

This stage generated the initial draft of guided inquiry-based student worksheets on the topic of buffer. This draft was consulted with the advisors to get input for the development and improvement of student worksheets before validation. student worksheets validation aimed to determine the feasibility of student worksheets used in learning activities. student worksheets validation was conducted by 3 validators. It covered 4 aspects; they were the content feasibility aspect which aimed to assess the content in student worksheets whether it is in accordance with the guided inquiry-based approach, the linguistic aspect which aimed at whether the language used in student worksheets is in accordance with the Indonesian dictionary (KBBI) and enhanced spelling. After that, the graphic and presentation aspects aimed to assess student worksheets presentation. The validation process was repeated until a valid student worksheets was produced.

The validation results from three validators are presented in the Table 4.
Based on the recap of the validation results in Table 3, a bar diagram can be drawn as in Figure 2.

![Bar Diagram of Validation Results](image)

**Figure 2. Student Worksheets Validation Results**

### 4.2. Discussion

Guided inquiry-based Student Worksheets was developed using a 4-D model which has four stages, namely Define, Design, Develop, and Disseminate.

The results were the average validation which were conducted by the validator team at the final stage of the development of student worksheets. Student worksheets was validated by three validators. In the validation process, the researcher discussed with the validator team to correct the errors contained in student worksheets and the result was classified as low. It was due to the errors found in student worksheets, for example: there was no clear information in each picture so that students felt confused. After that, there was no clear direction about the questions that the students should work on. Discussion and validation activities were done until the validators reached an agreement that the developed student worksheets suited valid criteria.

The development of student worksheets conducted by researchers received a lot of constructive suggestions and inputs from the validators. student worksheets was made to suit the 2013 curriculum. Based on the 2013 curriculum, learning activities should reflect the scientific approach, which is characterized by 5M activities (observing, asking questions, collecting data, associating and communicating). In addition, student worksheets must describe activities based on the scientific approach. In formulating the problem, the validators suggested that the discourse presented should associate with problems that could be used as a formulation of the problem. Student worksheets was
The Development of Students Worksheets Based on Guided Inquiry on The Topic of Materials Buffer in High School

designed in such a way as to attract students' interest in the learning process so that learning became more meaningful.

5. Conclusion

Based on the results of the study, it can be concluded that the development of guided inquiry-based student worksheet has been through a validation process. Student worksheets about the topic of buffer solution that was developed was valid and feasible to be tested with validation values of 94.51%, 98.17%, and 93.29% respectively. The overall average of validation score of Guided Inquiry-based student worksheets on buffer solution is 96.79%.

References