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THE DEVELOPMENT OF STUDENT ACTIVITY SHEETS (SAS) BASED ON GUIDED DISCOVERY TO PRACTICE SCIENCE LITERACY IN ACID BASE MATERIALS

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Abstract

Student Activity Sheet (SAS) based on guided discovery learning model is needed to improve students' scientific literacy. The purpose of this study is to analyze the feasibility (validity, practicality, and effectiveness) of SAS based on guided discovery to train scientific literacy in acid-base material. The type of research used in this study is research and development (R & D). The instruments used in this study are the contents and construct validation sheets, student response sheets, student activity observation sheets, and the pretest-posttest sheet. The results showed that: (1) The validity content and construct validity obtained Highly Valid criteria with a percentage range between 83.4% -86.7% in all aspects; (2) Practicality includes the activities and responses of students. In the activity obtained very practical criteria with a percentage range of 91.67% -100%. In the students response, practical and very practical criteria were obtained with a percentage range of 66.7% -100%; (3) Effectiveness includes tests of student learning outcomes and students' scientific literacy tests. In the learning outcomes test, all students are declared complete with a value range of 80-100. In the scientific literacy test, getting the N-gain value with a range of 0.8-1 with the gain score criterion is at high criteria.

Keywords: Guided Discovery, Science Literacy, Acid Base

INTRODUCTION

2013 curriculum emphasizes that science learning is expected to deliver students to meet the capabilities of the 21st century. Based on the 21st Century 2013 Skills Implementation Guide in High School, 21st Century learning is learning that integrates literacy skills, knowledge skills, and attitudes, and mastery of technology[1].

Science literacy is a person's ability to understand science, communicate science, and apply science knowledge to solve problems so that they have a high attitude and sensitivity to themselves and their environment in making decisions based on scientific considerations [2].

Indonesia is one of the countries which partipitate in the literacy study conducted by PISA. The average score of Indonesian scientific literacy based on the results of the 2012 PISA study showed that the average scientific literacy of Indonesia students was 382 with an average of 501 and ranked 64 out of 65 participating countries[3]. While in 2009 the results of the PISA survey showed the average scientific literacy of Indonesian students was 383 with an average of 501 and was ranked 59 out of 65 participating countries[4]. This figure is still far below other countries that have reached 500 for the average score of scientific literacy.

This shows that the scientific literacy abilities of Indonesian students are still very low. According to Hendry[5] revealed that the most appropriate learning model to building scientific literacy of students is problem solving, inquiry, and discovery because the concept of scientific literacy consists of dimensions of inquiry processes, namely dimensions that show understanding and competence to understand and follow arguments about science and matters relating to media technology policy[6].

Based on the pre-research results, it was found that 62.9% of students were interested in learning chemistry, 96.2% of students stated that acid-base learning was still based on learning in the classroom without experiment, 92.5% of students knew the chemical concepts in daily life, 37% of students knew the concept of acid base based on pH value, 14.8% based on the concept of Bronsted Lowry acid base, 18.5% based on the concept of Arhenius acid base, 3.8% based on examples of acid base in everyday life, and 25.9 % reveals the wrong answer.

As many as 81.4% of students also knew the concept of acid base in the surrounding environment, 59.3% of students stated that they had done simple experiment about acid base, 92.5% of students stated that learning in the class used SAS given by the teacher. However, as many as 92.5% of students stated that the learning done so far was only centered on learning in the classroom. Futhermore, 66.7% of students stated that they were not familiar with scientific literacy and SAS that had been used so far not to contain scientific literacy. From 27 students, 22 of them had low levels of scientific literacy. This is indicated by the value of the pre-research questions that are less than KKM.

So it can be concluded that only 18.51% of students who have a good level of scientific literacy and 81.49% are still low.

Based on the explanation above, the researchers developed Guided Discovery Student Activity Sheet (SAS) to Practice Science Literacy in Acid-Based Material.

METHOD

This research was conducted using the Research and Development (R & D) method until the limited testing phase[7]. This research was conducted at SMA 1 Krian in class XI as many as 12 students who had received acid-base material. The stages carried out in this study include review and revision, validation, and limited trials. The research instruments used are validation sheets for Student Activity Sheets (SAS), observation sheets for student activities, student response sheets, scientific literacy tests, and acid base test. Feasibility of Student Activity Sheets (SAS) is reviewed based on validity, practicality, and effectiveness.

The validity of SAS was viewed from content validity and construct validity. Validation was carried out by two chemistry lecturers and one chemistry teacher who were then analyzed by quantitative descriptive method through percentages. Percentages are obtained by comparing scores from the results of data collection from all validators with criteria scores. Assessment uses calculations from the Likert scale in Table 1.

Table 1. Likert Scale

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

[8]

Furthermore, the calculated data with a Likert scale is calculated using the formula:

$$\text{Percentage (\%)} = \frac{Total\ score}{\text{Scoring criteria}} \times 100\%$$

Scoring criteria were obtained from criteria scores = highest score × number of aspects × number of respondents. The results of the analysis from the validation sheet are used to determine the feasibility of the Student Activity Sheet (SAS) developed using interpretation of the scores in Table 2.

Table 2. Score Interpretation Criteria

Percentage (%)	Category
0 – 20	Not valid
21 – 40	Less valid
41 – 60	Valid Enough
61 – 80	Valid
81 – 100	Highly Valid

[8]

The content validity of SAS are the suitability of the material with the curriculum, suitability of learning material substance, conformity with scientific literacy, and conformity with guided discovery and construct validity which includes criteria for presentation, language, and graphics. The Student Activity Sheet (SAS) that was developed was said to be valid if the validator's assessment fulfilled the percentage results of $\geqslant$61% with a valid to Highly Valid category.

SAS practicality is viewed from the student responses and student activities during the learning process. Assessment uses calculations from the Guttman scale presented by Table 3.

Table 3. Guttman Scale

Answer	Positive answer score	Negative answer score
Yes	1	0
No	0	1

[8]

Then the Guttman scale calculation data is calculated using the formula:

$$\text{\% Positive answer} = \frac{\text{Total score of YES}}{\text{Maximum score}} \times 100\%$$

$$\text{\% Negative answer} = \frac{\text{Total score of NO}}{\text{Maximum score}} \times 100\%$$

The results of the analysis of the students' response questionnaire were used to determine the responses of students to SAS developed using interpretations of the scores in Table 4. SAS was declared practical if the percentage obtained was $\geqslant$ 61%.

Table 4. Score Interpretation Criteria

Percentage (%)	Criteria
0 – 20	Not practice
21 – 40	Less practice
41 – 60	Practice Enough
61 – 80	Practice
81 – 100	Highly practice

[8]

Analysis of the student activity sheet descriptive analysis. Assessment uses calculations from the Guttman scale presented by Table 5.

Table 5. Guttman Scale

Answer	Score
Yes	1
No	0

[8]

Then the Guttman scale calculation data is calculated using the formula:

$$\text{Answer percentage} = \frac{\text{Total score}}{\text{Maximum score}} \times 100\%$$

The results of the analysis from the students' observation sheet are used to determine the activity of students during the learning process by using the score interpretation in Table 4. SAS is declared practical if the percentage obtained is ⩾61%.

The effectiveness of SAS in terms of improving student learning outcomes. Analysis of student learning outcomes is done by analyzing the results of the pre-test and post-test. Data on student learning outcomes then analyzed using the Gain Score. The amount of improvement is analyzed using the following formula [9].

$$g = \frac{\text{S post} - \text{S pre}}{100 - S\ pre}$$

Description :
g (gain): improvement in student learning outcomes
S pre: average Pre-Test (initial test)
S post: Average Post-Test (final test)

Table 6. Categories of Gain Score

Gain score	Category
$> \mathbf{0,7}$	High
$0,7 > \boldsymbol{g} > \mathbf{0,3}$	High enough
0,3	Low

SAS is said to be effective if the criteria for n-gain are ≥ 0.3, with high or high enough criteria.

RESULTS AND DISCUSSIONS

This study uses Research and Development (R & D) research methods adapted from Sugiyono (2015). This research is only carried out until the limited testing phase and does not reach the stage of mass production. The research stages (R & D) are: (1) Potential and Problem Studies; (2) Data Collection; (3) Product Design; (4) Draft I Products; (5) Design Review; (6) Product Revision; (7) Draft II Products; (8) Design Validation; (9) Limited Testing. These stages are described as follows :

Potential and Problems Studies

Potential studies and problems are carried out by collecting relevant journals and books that contain theories which support research. The purpose of this stage is to provide an overview of the potential and problems of students in acid base material. The first step taken at this stage is curriculum analysis. The curriculum used in SMAN 1 Krian is a revised 2013 curriculum. The curriculum analysis carried out Core Competencies, Basic Competencies, Competency Achievement Indicators, and subject matter and learning models used. Whereas to find out the problems that occur in learning at SMAN 1 Krian. At this stage, pre-research data collection was carried out with a pre-research questionnaire.

Data Collection

At this stage, data collection is carried out to determine the problem. This was done by interviewing SMAN 1 Krian teachers and giving science literacy questions to the students to find out the level of scientific literacy of students. The question for testing scientific literacy contains four domains namely (1) Science context; (2) Science knowledge; (3) Science competencies; (4) Science attitude.

Based on the problem of scientific literacy, it is known that from 27 students, 22 of them had low levels of scientific literacy. This is indicated by the value of the pre-research questions that are less than KKM. So it can be concluded that only 18.51% of students who have a good level of scientific literacy and 81.49% are still low.

Product Design

At this stage the aim is to design a SAS based on guided discovery to practice students' scientific literacy in acid-base material that will be developed before being reviewed by the reviewers. The design of the SAS can be described through the following stages: (1) Determining the learning objectives to be achieved; (2) Material collection; (3) Preparation of Elements. SAS based on Guided Discovery is arranged based on Guided Discovery phases, namely: (1) Invitation to learn; (2) Explorations, Discoveries, and Creation; (3) Proposing Explanation and Solutions; (4) Taking Action. The scientific literacy skills trained on the SAS include four domains, namely: (1) Science context; (2) Science knowledge; (3) Science competencies; (4) Science attitude. Front cover or cover.

Review the SAS as draft I

The SAS study was conducted to get advice and input on the Guided Discovery based SAS developed. The reviewers were conducted by 1 chemistry lecturer and 1 chemistry teacher. The results of the study were obtained based on a review sheet which included the suitability of the material with the curriculum, suitability of the substance of the learning material, conformity with Guided Discovery, compatibility with Science Literacy, presentation criteria, linguistic criteria, and graphic criteria.

Revised SAS as draft I

After review, further improvement and improvement of SAS based on Guided Discovery is based on suggestions and inputs that have been obtained.

Validation of the SAS

The revised SAS based on the review results will be validated. The aim is to get the value of the feasibility of the SAS based on Guided Discovery developed. SAS based on Guided Discovery was validated by 2 chemistry lecturers and one Chemistry teacher. The validity of the SAS is viewed in terms of content validity and construct validity. Content validity included the suitability of the material with the curriculum, the suitability of the learning material substance, the suitability of the SAS with guided discovery, and the suitability of the SAS with scientific literacy. While for construct validity includes the criteria for presentation, language, and graphics. The validation results are as follows in Table 7.

Table 7. The results of the SAS Validation

Nu	Assessment Aspect	Percentage and Criteria SAS 1	SAS 2	SAS 3
1	**Content Validity**			
a	The suitability of material with the curriculum	86,7% (Highly Valid)	86,7% (Highly Valid)	86,7% (Highly Valid)
b	The suitability of the learning material substance	84,5 % (Highly Valid)	84,5 % (Highly Valid)	84,5 % (Highly Valid)
c	The suitability of the SAS with guided discovery	83,4% (Highly Valid)	83,4% (Highly Valid)	83,4% (Highly Valid)
d	The suitability of the SAS with scientific literacy	86,7% (Highly Valid)	86,7% (Highly Valid)	86,7% (Highly Valid)
2	**Construct Validity**			
a	Presentation criteria	85,3% (Highly Valid)	85,3% (Highly Valid)	85,3% (Highly Valid)
b	Language criteria	84,5 % (Highly Valid)	84,5 % (Highly Valid)	84,5 % (Highly Valid)
c	Graphics criteria	84,5 % (Highly Valid)	84,5 % (Highly Valid)	84,5 % (Highly Valid)

Based on the results of validation, it is known that all components of validation, namely content validity and construct, have a percentage with a range of 83.4% -86.7%. So that the developed SAS can be said to be valid because the percentage of the overall component is $\geqslant$ 61% and is in a Highly Valid category.

Limited Testing

The practicality of SAS is viewed from the activities and responses of students. The activities of students are observed by 3 observers using the observation sheet of the students activity. While the response of students is measured through a response sheet filled out by students after the learning process using the developed SAS.

The response of students to the developed SAS was measured through the questionnaire responses of the students. Some aspects assessed from the response sheet of students include components of scientific literacy and guided discovery. The results of the questionnaire responses of students are presented in table 8.

Table 8. The result of Student Responses

Nu	Assessment Aspect	Percentage	Criteria
1	Does this SAS make you feel curious and interested in learning ?	91,67%	Highly Practice
2	Is this SAS interesting?	91,67%	Highly Practice
3	Does this SAS motivate you to study?	100%	Highly Practice
4	Does the experimental activity in this SAS provide a real picture of the material?	100%	Highly Practice
5	Is this explanation in the SAS difficult to understand?	66,7%	Practice
6	Is the explanation in this SAS consistent with the material being studied?	100%	Highly Practice
7	Is the language used in this SAS too complicated to understand?	75%	Practice

Nu	Assessment Aspect	Percentage	Criteria
8	Can this SAS help you to be more active in the classroom?	91,67%	Highly Practice
9	Is the use of images in this SAS appropriate?	100%	Highly Practice
10	Can this SAS make you collaborate in groups?	100%	Highly Practice
	Science Literacy		
11	Can this SAS guide you to understand the application of the acid-base material concept to problems that exist in everyday life?	100%	Highly Practice
12	Can this SAS help you to find information from various literatures that are used to understand the phenomena that exist?	100%	Highly Practice
13	Can this SAS guide you to design and conduct scientific investigations?	100%	Highly Practice
14	Can this SAS foster an attitude of care for the environment in yourself?	91,67%	Highly Practice
	Guided Discovery		
15	Can you meet the phenomena in this SAS in everyday life?	100%	Highly Practice
16	Can this SAS help you to connect material in school to everyday life?	91,67%	Highly Practice
17	Can this SAS help you to solve problems in your environment based on the knowledge you get from school?	100%	Highly Practice
18	Can this SAS guide you in conducting an experiment and write a table of observations?	100%	Highly Practice
19	Can this SAS guide you in analyzing the experimental data and connecting it with the existing theory?	100%	Highly Practice
20	Can this SAS guide you in making conclusions?	100%	Highly Practice

The activities of students on the developed SAS were measured through observation sheets of student activities which were filled by 3 observers, with each group observed by 1 observer. Some aspects assessed from the observation sheet of student activities include components of scientific literacy and guided discovery. The results of the observation sheet of student activities are presented in table 9.

Table 9. The Result of Student Activity Sheet

Nu.	Assessment Aspect	Percentage and Criteria		
		SAS 1	SAS 2	SAS 3
1.	Working in groups	100% (Highly Practice)	100% (Highly Practice)	100% (Highly Practice)
2.	Discuss / question and answer to the teacher / students	100% (Highly Practice)	100% (Highly Practice)	100% (Highly Practice)
Science Literacy				
3.	Write down important points regarding the application of acid-base material concepts in personal, local / national and global problems (science context)	100% (Highly Practice)	100% (Highly Practice)	100% (Highly Practice)
4.	Looking for information from various literatures that are used to understand existing phenomena (science knowledge)	100% (Highly Practice)	100% (Highly Practice)	100% (Highly Practice)
5.	Designing and carrying out scientific investigations (science competencies)	100% (Highly Practice)	100% (Highly Practice)	100% (Highly Practice
6.	Give opinions that reflect environmental care (science attitude)	100% (Highly Practice)	91,67% (Highly Practice)	100% (Highly Practice)
Guided Discovery				
7.	Write important points related to the phenomena presented in the SAS (invitation to learn)	100% (Highly Practice)	100% (Highly Practice)	100% (Highly Practice)
8.	Design and experiment (exploration, discoveries, and creations)	91,67% (Highly Practice)	100% (Highly Practice)	100% (Highly Practice)
9.	Writing data on observations (exploration, discoveries, and creations)	100% (Highly Practice)	100% (Highly Practice)	100% (Highly Practice)
10.	Analyze experimental results, interpret data and scientific evidence (proposing explanations and solutions)	91,67% (Highly Practice)	100% (Highly Practice)	91,67% (Highly Practice)
11.	Communicating the conclusions of the experiment and connecting matter with phenomena in taking action	100% (Highly Practice)	100% (Highly Practice)	100% (Highly Practice)

Based on the analysis of the results of the questionnaire responses and activities of students it is known that SAS based on guided discovery to practice practical scientific literacy is practically to used. From all aspects it is known that the percentage obtained is $\geqslant$ 61%.

The effectiveness of SAS developed in terms of improving student learning outcomes was

assessed based on the value of the pretest and posttest. There are two components that are assessed in the given test, namely an increase in students 'scientific literacy and the completeness of learners' learning outcomes for acid-base material. The pretest and posttest questions given to students contained 26 multiple choice questions with details, 16 questions about scientific literacy with each question containing 4 domains of scientific literacy and 10 other questions to find out the completeness of student learning outcomes on acid-base material. The limited product testing conducted on 12 students of class XI of SMAN 1 Krian who have received acid-base material. The test results to find out the scientific literacy of students are shown in table 10.

Table 10. Student Science Literacy Test Results

Nu	Name	Pretest	Posttest	N-gain
1	IHA	31.25	93.75	0.909091
2	EAK	12.5	87.5	0.857143
3	AA	18.75	93.75	0.923077
4	AG	64.06	93.75	0.826099
5	ER	12.5	87.5	0.857143
6	NZ	18.75	87.5	0.846154
7	VA	59.37	93.75	0.846154
8	SA	68.75	93.75	0.8
9	LAB	68.75	100	1
10	SAR	65.62	100	1
11	RDR	62.5	93.75	0.833333
12	AP	51.56	93.75	0.870974

Based on table 10 above, it is known that the N-gain value obtained by 12 students> 0.7 with high criteria. So that it can be said that the developed SAS can help to practice students' scientific literacy. The use of guided discovery based SAS has an influence on students' scientific literacy. Based on table 4.8 above, the developed SAS can be declared effective.

CLOSURE

Conclusion

Based on the formulation of the problem and guided discovery based SAS discussion to practice scientific literacy in acid-base material, it can be concluded that the developed SAS is deemed feasible because it has obtained a percentage of ⩾ 61% for all aspects. The conclusions can be described as follows:

1. The validity of the content and construct validity obtained Highly Valid criteria with a percentage range between 83.4% -86.7% in all aspects in the SAS validation sheet.
2. Practicality includes the activities and responses of students. In the activity obtained very practical criteria with a percentage range of 91.67% -100%. In the response of students, practical and very practical criteria were obtained with a percentage range of 66.7% - 100%.
3. Effectiveness includes scientific literacy test, getting the N-gain value with a range of 0.8-1 with the gain score criterion is at high criteria.

Suggestion

Based on the results of the discussion and conclusions above can be conveyed some suggestions from the author, among others.

1. Development SAS based on guided discovery with other chemical materials so that scientific literacy of students is increasing.
2. Development SAS based on guided discovery to practice scientific literacy in acid-base material is only limited to the limited testing phase. Therefore, it is recommended for further research to apply SAS to the extensive usage testing phase.
3. For scientific literacy in the attitude domain, it is necessary to add an observation sheet to students' scientific attitude as supporting research data.
4. Development SAS based on guided discovery to practice scientific literacy in acid-base material is more enhanced in the domain of science context, namely personal, local/national and global problems that demand understanding of science, by providing additional columns of questions related to the phenomena presented in the SAS.
5. Development SAS based on guided discovery to practice scientific literacy in acid-base material is more enhanced in the knowledge domain of science content, namely facts, concepts and theories relating to nature and technology, by providing additional columns for examples of concepts and theories in everyday life.

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