LAVOISIER: CHEMISTRY EDUCATION JOURNAL
Journal homepage: http://jurnal.iain-padangsidimpuan.ac.id/index.php/Lavoisier/index

Development of Student Worksheets Based on Generic Science Skills on the Concept of Acid and Base

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Received: October 10, 2022; Accepted: December 20, 2022; Published: December 30

Abstract

This research is supposed to develop generic science skill-based student worksheets on chemistry learning materials acid and based. The method used in this research is the following ADDIE models (Analysis, Design, Develop, Implementation, and Evaluation). In the implementation step, the worksheet was used on 11th grade of South Tangerang Banten, Indonesia, general high school which was followed by 29 students. The instrument used is a questionnaire to measure the feasibility of the worksheet by experts (lecturer and teacher), and also student questionnaire response sheets. The findings of this research can conclude that the feasibility in terms of design component, appearance, content, language, and worksheet's appropriate with generic science skills. And the student responses, respectively for 84.13%; 92.26%; 92.41%; 95.95%; and 86.9%. This result shows that generic science skill-based worksheets can be used for the learning process. But still need to develop for bigger responders.

Keyword:

Worksheet, Generic Science Skill, ADDIE models, Acid and Based.

1. Introduction

In the process of learning chemistry, students experience several obstacles, one of which is the process of understanding chemical material which is quite difficult. In the process of understanding the material, Sunyono (2010) suggests developing teaching materials that are oriented to generic science skills (KGS), which can be in the form of student activity sheets (LKS). KGS is a basic skill of students that develops the ability to think and act based on scientific knowledge so that students' difficulties in understanding the material can be helped by the presence of facilitating media. Ramlawati, Liliasari and Wulan (2012) suggest that KGS is a basic skill in the form of the ability to think and act based on scientific knowledge by students.

The development of teaching materials in the form of LKS makes it easy for teachers to build student activity in learning. LKS is a teaching material that is developed independently by educators/teachers taking into account the needs and suitability of school conditions. Setiawan (2007) explained that teaching materials if used and used correctly will be one of the factors that can improve the quality of learning. Student worksheets are one of the supporting teaching materials to support the learning process.

Based on the results of brief observations, LKS is already in schools but has not met students' needs for active learning. Septiania, Ridho, and Setiani (2013) revealed that LKS made by publishers already contains complete material, but the instructions in it still do not facilitate students' role in discovering and understanding material concepts. While the worksheets needed are worksheets that motivate students to study more actively.

The development of KGS-based worksheets is due to generic science skills, namely the skills to think and act based on scientific knowledge by students (Ramlawati, 2012). KGS also encourages the formation of basic skills that assist students in learning various concepts and solving various problems (Samiama, Binadja, and Saptorini, 2012). So that strong basic skills will make it easier to solve more complicated problems.

Besides developing high-level thinking skills, KGS is also in accordance with the demands of two forms of graduate profiles, namely vocational and with mindset abilities (Agustinaningsih, Suparmi, and Sarwanto, 2014), the second skill supports competitive skills in the world of work both regionally and globally. In line with the thought of Stasz (1996) that the skills that must be possessed by an employee besides a good attitude are adequate generic skills.

Based on the identification of the problems mentioned above, the researchers tried to develop LKS teaching materials as teaching materials that increase student learning enthusiasm based on generic science skills. The material used in this LKS teaching material is acid - base because this material is rich in concepts that can be used as a form of activity, both thinking and experimenting. So that learners using KGS-based worksheets are experience-oriented learning and develop skills through acid and base chemistry material.

The purpose of this research is to develop chemistry worksheets based on generic science skills on the concept of acids and bases.

2. Research Method

2.1 Research Design

This research is development research that uses structured steps that must be followed from the beginning to the end of the research. The development model used is the ADDIE model which stands for analysis, design, development, implementation and evaluation. The steps in conducting this research follow the following research design in Figure 1.

2.2 Data Collections

Data collection uses content validation sheets, and student response questionnaires. The content validation sheet was assessed by 2 validators from chemists and 2 educational practitioners, namely teachers. Student response questionnaires were prepared in the form of statements using the Likert scale scoring method.

2.3 instruments

The instrument used was a content validation sheet, as well as a questionnaire to see students' responses to the use of worksheets in class. The content validation sheet consists of several indicators that are assessed in the form of 1) Worksheet Design; 2) Display; 3) Adequacy of content; 4) Language; 5) KGS indicators in LKS consisting of a. direct observation; b. Indirect observation; c. Awareness about scale; d. symbolic language; e. Logic framework; f. Logical consistency; g. The law of cause and effect; h. Mathematical modeling; i. Logical inference, and j. abstraction.

2.4 Data Analysis

The data were analyzed by processing the data obtained from the assessment, then looking for the presentation and analyzing it. The data analysis technique used to measure the legibility of KGS-based chemistry worksheets is by analyzing questionnaires. The data obtained in the fruit can be concluded in the form of a percentage according to Table 1.

Table 1. Criteria for Interpreting Likert Scale scores

No.	Score Interval (%)	Category
1	81-100	Very good
2	61-80	Well
3	41-60	Enough
4	21-40	Not enough
5	0-20	Very less

3. Results

This research is product development oriented where the development process is described as accurately as possible and the final product is evaluated and tested on students so that it can be re-evaluated. The resulting product is a worksheet based on generic science skills on acid-base materials.

The development of this LKS uses the ADDIE development model, namely Analysis, Design, Development, Implementation, and Evaluation.

3.1 Analysis Stage

This stage is carried out in 6 steps, namely analyzing performance gaps, formulating learning objectives, identifying student characteristics, and determining appropriate learning strategies, and preparing plans for the process of developing teaching materials.

From the results of observations at one of the public senior high schools in South Tangerang, it was found that the use of teaching materials at school was using textbooks provided by the school and also assisted with worksheets suggested by the teacher. From the available worksheets, they already contain appropriate material, but not all of the generic science skills indicators have been fulfilled. For this reason, KGS-oriented worksheets are not yet available.

From the results of the analysis of student characteristics, by using a questionnaire to see student responses related to chemistry lessons, it was found that it was low. And so far 85% of the 29 students are dissatisfied with the grades they achieved in chemistry learning.

The method that students like the most is the learning method assisted by media such as displaying pictures, worksheets, practicums and also explanations by the teacher in detail.

In addition to analyzing student characteristics, at this stage identification of the required material sources is carried out, namely acids and bases, instructional objectives, and in the end a lesson plan design is formed.

3.2 Design Stages

This design stage is carried out by making a list of activities in the LKS, determining the objectives of the activity (tasks), determining the assessment strategy, and calculating the capital needed in making the LKS. In Table 2, it can be seen the results of the arrangement of the activities that were made. This list of activities is a prototype in compiling the LKS to be made. Besides the list of activities above, a list of tests that will be added to the LKS is also prepared at this stage. Tests in LKS are arranged in the form of assignments in each activity, practicum, and final evaluation. The formulation of assignments in each activity and practicum is prepared according to the learning objectives and the achievement of indicators of generic science skills, while the final evaluation of the LKS follows the indicators.

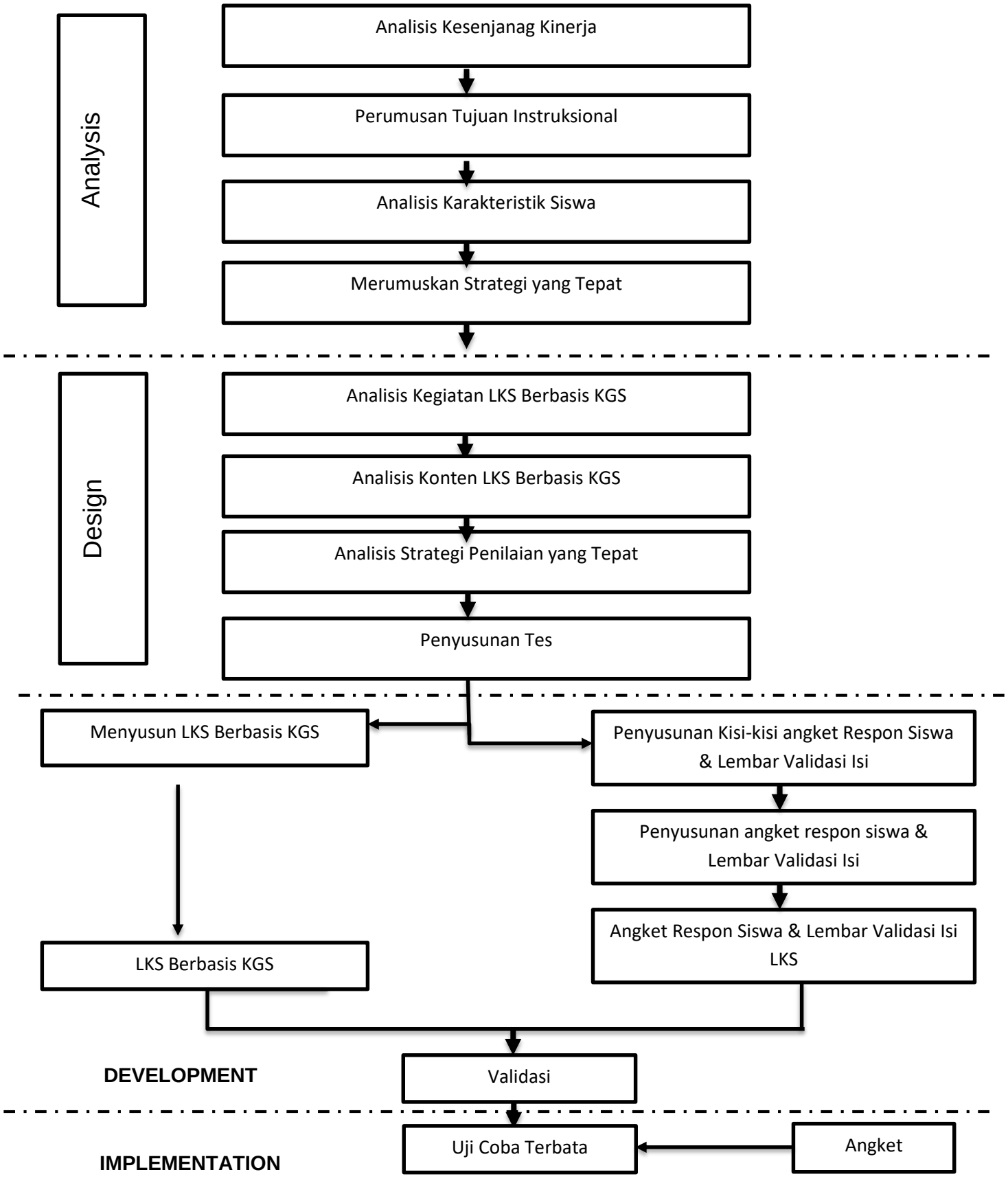

Figure 1. Research Design

Table 2. List of Activities on LKS

No	*Name of activity*	*Activity Function*
1	*Let's Find Out!*	*Preliminary activity to start the next activity.*
2	*Activities 1.1- 1.7*	*The core activities are used to build students' skills in understanding acids and bases and to build Generic Science Skills through these activities.*
3	*Experimental Activities*	*Activities that aim to improve students' psychomotor abilities are practicum.*
4	*ChemJournal*	*Chem Journal is an activity that aims to guide students to think critically about natural phenomena related to acids and bases.*

3.3 Development Stage

This stage aims to produce teaching materials that are developed and then validated. The main procedures are following, preparing concentration material, selecting supporting media, drafting a lesson plan that will be used at the implementation stage, holding formative tests/evaluations in the form of expert validation, namely from the field of chemistry and 2 education practitioners each.

Making worksheets. In the LKS development process, the components that must be included are the basic competencies to be achieved, indicators, material analysis, list of activities, and evaluation of each activity. After all these lists are loaded in the LKS and included with the desired design, the next step is the validation stage from the experts related to the LKS. Of the 2 validators, there are several improvements that need to be made based on validators' suggestions and criticisms. The list of improvements in LKS writing can be seen in Table 3 below.

Changes in the cover from the first to the last can be seen in Figure 2. The suggestions and input obtained from the validation results as a whole are used as a reference in improving the quality of worksheets.

Table 3. Revision of LKS Writing

No	**Before Revision**	**After Revision**
1	*Unattractive cover*	*The color changed to a lighter color with supporting images*

		according to acidic and basic materials
2	*The columns contained in the student activity entry sheet.*	*Columns that are not needed or inappropriate are removed.*
3	*Answer and question column*	*The question editor was changed and the student answer columns were sorted by questions.*

Figure 2. Improved LKS Cover Display Design

3.4 Implementation Stages

To get student responses as a result of the LKS trial, 29 students in grade 11 were asked to fill out a response questionnaire to the LKS. The results obtained from 29 students were then processed into quantitative data which were converted into percentages and criteria values. The results are categorized into five indicator components, namely design, appearance, feasibility of content (material), discussion and KGS indicators.

Based on Figure 3 below, it can be seen that the assessment component with the highest percentage is the language indicator, which is equal to 95.38%, followed by material feasibility of 92.56%, then display 92.38%, and design indicators 90.08%, and generic science skills indicators are 85. 81%.

Figure 3. Questionnaire Results of Student Responses to LKS

3.5 Evaluation Stage

At this stage it is carried out in two forms of evaluation, namely formative and suamtive. Formative evaluation was carried out during and after the research stages. Meanwhile, a positive evaluation is carried out at the end of the stage, namely filling in the student response questionnaire that was previously described.

4. Discussion

Science lessons at school are expected to become a vehicle for students to think about themselves, the environment, and then develop them further so that they can be applied in everyday life based on scientific methods (Zulfiani, *et al.,* 2009). Ramlawati, *et al.,* (2012) explained that generic science skills (KGS) are the skills of thinking and acting based on scientific knowledge by students. With this, one of the solutions that can encourage students to train their SCC is through patterns of using and developing KGS indicators in learning.

Based on the opinion of Sunyono (2010) that KGS-oriented worksheets make students directly involved in learning activities, it is easier to do experiments because worksheets are already arranged in a sequence, and it is easy to find their own concepts and the concepts obtained tend to be easy to remember and understand.

Based on the development process that has been carried out by following the step-by-step flow, there are several notes that need to be underlined to be discussed further in this article.

4.1 LKS development

In the LKS development process, LKS is not directly arranged based on the desired material. However, there are pre-making steps that need to be carried out, such as an analysis of defining what problems to solve, instructional objectives, and learning objectives (Sukenda, Falahah, & Lathanio, 2013).

Analysis of performance gaps (problem definition) which was analyzed in one of the public schools in South Tangerang, Banten, found that 90% of students still found it difficult to learn chemistry. According to Sunyono (2010) this is caused by learning chemistry which is generally carried out by memorizing and nose surgery, so that the basic concepts students do not understand at all but only memorize. Sehigga Sunyono (2010) suggests an alternative solution to student learning problems is to develop teaching materials that are oriented towards generic science skills in the form of student worksheets.

Analysis of student characteristics also needs to be done as an additional reference to review what experience, abilities and student learning motivation are like. So that it can be used as a consideration in the process of making the developed LKS.

At the design stage, the preparation of the list of activities will be *broken down* in the LKS, there are 3 types of activities, namely *Let's Find Out!,* Core Activities which consist of activities 1 to activities 7, and *Chem Journal Activities.* The advantages of the *Let's Find Out!* This is aimed at opening up students' knowledge that the students themselves might not have realized before. Opening questions are given so as to trigger student knowledge to emerge. The core activities in the form of Activities 1 to 7 contain activities that are expected to be able to grow and develop students' generic science skills. Meanwhile , *Chem Journal* is an activity based on the *active learning process,* namely activities that make students devote learning experiences related to their personal lives (Silberman, 2009). Besides the three previous activities, LKS is also equipped with experimental activities which according to Rudiyanto, Cahyono, & Subroto (2013) that teaching materials equipped with practicum will make students' direct observation skills and logical inference higher. Thus, this practicum/experimental activity must be included in one or more activities in the LKS based on generic science skills.

4.2 Student Responses to Science Generic Skills

Based on the student response questionnaire, it was found that the direct observation indicator was at the highest rank. Direct observation is the easiest indicator for students to do. With 96.43% points, students agreed that the LKS used invited students raise students' generic science skills on direct observation indicators.

The second rank is followed by indicators of scale awareness and logical framework. While the lowest ranking in LKS based on student

response questionnaires sequentially are indicators of symbolic language, logical inference and mathematical modeling. Brotosiswoyo stated that the sequence of the three most difficult indicators to develop is starting from symbolic language, causal law, and mathematical modeling. From the results of this study, it can be seen that symbolic language and mathematical modeling are the indicators that are the most difficult to apply in worksheets.

Symbolic language and mathematical modeling are at the lowest level because these two indicators require higher thinking skills. For this reason, in increasing student responses to these two indicators, LKS still needs to be developed in order to be able to hone students' abilities on indicators of symbolic language and mathematical modeling. According to Sunyono (2010) to be able to improve indicators of symbolic language, teaching materials must often provide assignments in the form of writing chemical formulas and writing reaction equations. Meanwhile, in improving the indicators of mathematical modeling, it can be used by giving assignments in the form of managing chemical formulas. Therefore , this LKS still needs to be improved in order to maximize the overall KGS indicators.

Judging from the orientation of generic science skills, towards indicators that can be developed, this worksheet has an advantage over the SLC-based worksheet on chemical equilibrium material developed by Sunyono (2010) because it can only develop 3 out of 10 SCC indicators, namely symbolic language, mathematical modeling, and the law of cause and effect. Meanwhile, the worksheet developed in this study integrates almost all indicators of generic science skills except abstraction indicators on sub-indicators create visual-animation simulations. This is because print-based teaching materials cannot be made in the form of visual animation. Animation media must be supported by adequate supporting devices such as adequate laboratories (Sunyono, 2010).

5. Conclusion

From this development research, the development of worksheets based on generic science skills can use the ADDIE development model with student responses to worksheets in the limited trial, namely in terms of design, the response is very good in terms of size, page density, and clarity. Likewise in terms of appearance, content feasibility, language, and achievement of generic science skills indicators in worksheets. However, additional and further

research is still needed to carry out large-scale and sustainable trials to analyze changes in students' generic science skills after using this KGS-based LKS.

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