Validation of Student Worksheets Using Problem Based Learning in Meteorology and Climatology Learning

Muhammad Arif , Alexander Syam
Geography Education, High School of Teacher Training and Education Sciences of Pesisir Selatan
muhammad.arif838@gmail.com

Abstract – Geography learning as a science learning requires appropriate teaching materials to help students learn by studying and analyzing natural phenomena that exist on earth. Appropriate teaching materials are teaching materials that are integrated with student centered learning such as problem based learning. Therefore, every development of teaching materials needs to be validated. The type of research carried out is R&D with the focus outlined is the validation of student worksheets for meteorology and climatology courses. The data collection instrument used was a questionnaire filled by three experts in geography education. Validation is done through discussions to obtain suggestions for improvement and filling out a questionnaire to assess student worksheets. Validation carried out includes four assessment indicators namely content, construct, language, and graphic validation. The selection of suitable phenomenon images and attractive color combinations is needed in developing a teaching material. Assignments given and learning objectives must be aligned and the task of identifying measuring instruments should be complemented with the task of determining how to use the tools. Based on the results of the validation assessment, it was stated that the students' worksheets on meteorology and climatology that were developed are valid for use in learning.

Keywords: Geography Learning, Problem Based Learning, Student Worksheets, Validation.

1. Introduction

Learning is more effective when it is packaged in the form of interesting activities (Kibara & Ayas, 2010). Geography as one part of science examines phenomena related to the earth needs a teaching material to direct learning activities. The essence of geography learning is learning activities that are able to encourage students to learn natural phenomena and solve problems related to natural phenomena that exist on earth. Therefore, learning geography will be more directed if it is equipped with appropriate teaching materials. One of the teaching materials that are often used in science learning is student worksheets.

The use of student worksheets aims to optimize the achievement of learning objectives. The use of student worksheets in learning can increase student interest in science learning (Sládek, Milér, Benárová, 2010). Student worksheets allows students to be more active in learning activities (Celikler & Aksan, 2012). It helps the implementation of geography learning as science learning becomes more meaningful.

Learning activities contained in student worksheets are oriented towards student centered. Interactive learning models that encourage student participation in learning need to be integrated into study worksheets. One suitable learning model is the problem based learning (PBL) model. PBL is a methodology for developing students' new knowledge based on problems (Moutinho et al., 2015). Problem based learning effectively builds basic skills and understanding of science concepts (Gorghiu et al., 2015) and improves long-term knowledge recall (Yew & Goh, 2016). Contextualization and independent learning that is trained through PBL is very important to increase student motivation (Harun et al., 2012). Therefore, it is necessary to develop student worksheets based on problem based

learning by providing contextual problems to be solved by students because the development of teaching materials based on scientific contextual can improve student learning outcomes (Martiningsih, Lisdiana, Susilowati, 2019).

One of the stages in development that aims to show the extent to which research produces accurate data is the validation stage. Through validation activities, it is expected that a research development will produce appropriate teaching material for a teaching material. The validation stage is one of the important stages and must be carried out to produce good teaching materials.

Meteorology and climatology is one study of geography that discusses weather and climate, elements of climate weather, and atmosphere. The development of student worksheets for meteorology and climatology courses based on problem based learning needs to be done to produce good teaching materials used in learning. The purpose of this study was to determine the validity of the developed student worksheets.

2. Methodology

This type of research is research and development (R&D) research. This study explains about the validation of student worksheets products that are developed which include the validation process to the validation results. Validation was carried out by three geography education experts. Validation is done through discussion and asking experts to fill in the validation questionnaire. Validation indicators that are used to evaluate student worksheets validation are content, construct, language and graphic validation. The validation results obtained will be presented by descriptive methods. Validation results are then converted into validation criteria shown in Table 1.

Table 1. Product Validation Criteria

No	Persentase	Kriteria
1	$3,4 \leq R \leq 4,0$	High Valid
2	$2,8 \leq R \leq 3,4$	Valid
3	$2,2 \leq R \leq 2,8$	Enough Valid
4	$1,6 \leq R \leq 2,2$	Less Valid
5	$R \leq 1,6$	Invalid

Source : Zulfaneti, Rismen, Suryani, 2016.

3. Result and Discussion

The first validation is instrument validation. Student worksheets must be assessed using valid instruments so that validation activities actually produce student worksheets that are appropriate for learning moreteology and climatology. The results of the instrument validation for the content validation indicators, constructs, language, and graphics are all in the range of 3,4-4,0. All indicators are considered valid and there is no suggestion for instrument validation. Content validation is done by analyzing the relationship between learning indicators and activities in the lecture program unit with the material and activities in student worksheets. Constructive validation focuses on how student worksheets express the theoretical construct to be measured and measure symptoms according to the definition or theory obtained. Language validation focuses on the writing procedure and the meaning that results from the writing that was made. Graphic validation focuses on the layout and proportions of images and colors.

The next validation is the validation of student worksheets using instruments that are already valid. Validation assessed consists of four indicators namely content validation, construct, language, and graphic. The final validation results through a questionnaire assessment by experts stated that the developed student worksheets are in the category of very valid with the value of each of these validation indicators are 3,8 for content validation, 3.16 for construct validation, 3,8 for language validation, and 3.41 for graphic validation. All suggestions given by experts in the first and second discussions all lead to content validation. Furthermore, the developed student worksheets were revised on the basis of suggestions given by the validator. In the final discussion the validator was asked to rate the revised student worksheet as an assessment of the developed student worksheets. Rating validation indicators are shown in Figure 1.

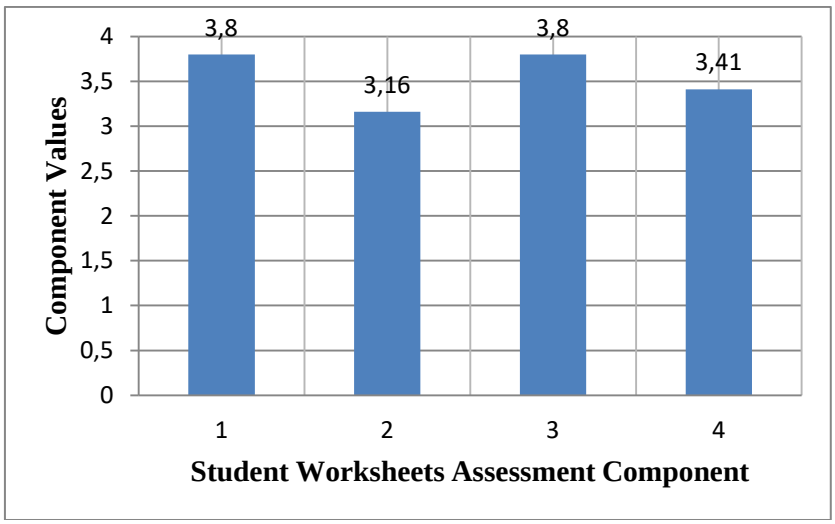

Figure 1. Rating Validation Indicators

Information:

1. Content validation
2. Construction validation
3. Language validation
4. Validation of graphics

The results of the validation through discussions with three experts in the field of geography education gave the result that the student worksheets that were developed were valid, which meant that this study in general had produced valid teaching material for use in learning meteorology and climatology. Discussions were conducted 2-3 times with each validator. Through this discussion, it was found that the urgency of student worksheets is learning activities to construct the process skills competencies, knowledge, and scientific attitude. For this reason, activities that support these competencies are needed.

The validator suggests adding activities by adding a column to the activity table on the material elements of weather and climate. The addition of the column in question is the column to write how to use weather and climate gauges. This aims to overcome the limitations of practicum tools so that although students have never used several weather and climate gauges, they at least know how to use them. The results of this discussion are included in suggestions for improving content validation. The addition of a column for using tools is expected to develop student worksheets to help accelerate the achievement of learning objectives.

In the cloud classification material also requested the addition of other additional tasks that aim to deepen students' ability to do cloud classification. In addition, cloud images used are suggested that can be distinguished and have good color quality to make it more interesting. This is in line with the opinion of Yasir et al., (2013) where the appearance of good student worksheets is supported by variations in colors, images, and descriptions and relevant phenomena that can attract students' attention.The results of the revision of student worksheets on cloud classification material are shown in Figure 2.

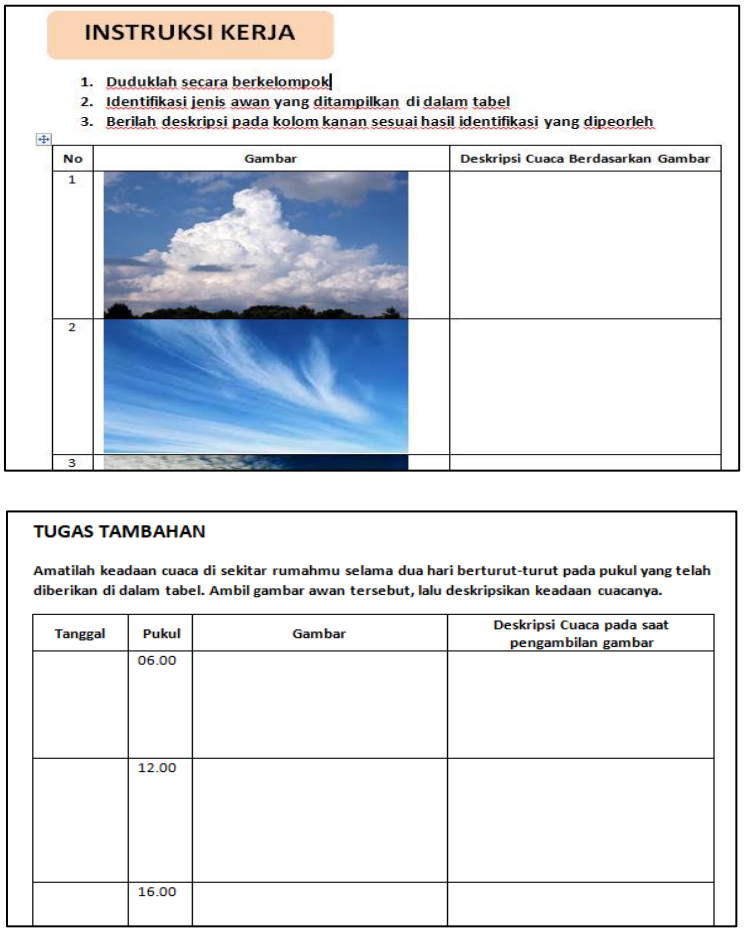

Figure 2. Revised Student Worksheets based on Validator Suggestions;
a) Main Activities in Problem Based Learning, b) Additional Activities

In Figure 2 it appears that the suggestions given by the validator are included in the additional task rather than the main task, this conclusion is the result of discussions with the validator. The reason is the task given by the principle validator suggestions such as project based learning, while what is being developed is student worksheets integrated problem based learning. However, to enrich students' knowledge and enhance their skills, this task is still included in the developed student worksheets, it's just not as a main task but an additional task.

One important validation indicator in increasing user interest in using teaching materials is display validation or graphic validation. Attractive and varied appearance and color combination can also make the teacher interested in explaining it to students. Display pictures of phenomena that are

appropriate to the material needed to increase the interest of teachers and students in using teaching materials (Khabibah, Jalmo, Suyatna, 2018).

The results of the content validation in the rainfall analysis material are regarding the rainfall analysis method. At first students were only asked to analyze the rainfall from the data given to student worsheets using only one method, the polygon (Thiesen) method. However, the validator agreed that students should be asked to analyze rainfall using three methods, namely Arithmetic, Polygon, and Ishoyet (Isohyet), because in the lecture event unit is written in the student activity column where students analyze rainfall in an area using several methods. According to Nyamupangedengu & Lelliot (2012), student worksheets must contain assignments and topics that are aligned with the objectives and learning activities.

4. Conclusion

Validation of student worksheets is obtained through assessment of validation indicators such as content, constructs, language, and graphics validation. Content validation is done by analyzing the relationship between learning indicators and activities in the lecture program unit with the material and activities in student worksheets. The construct validation focuses on how student worksheets express the theoretical construct to be measured and measure symptoms according to the definition or theory obtained. Language validation is more focused on the writing procedures and meanings that result from the writing made. Graphic validation focuses on the layout and proportions of images and colors. The selection of suitable phenomenon images and attractive color combinations is needed in making or developing a teaching material, especially on materials such as cloud classification and weather and climate gauges. Assignments given and learning objectives must be aligned, so the teaching material developed is expected to help the achievement of learning objectives on the material. Activities in teaching materials about measuring devices should be added to the column how to use them so students understand how to use these tools. Based on the results of the validation assessment, it was stated that the students' worksheets that were developed are very valid for use in learning.

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