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Development of Mathematics Teaching Materials for Junior High School Based on Ethnomathematics

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Abstract

The world of education is required to equip students with 21st-century skills to achieve learning goals and compete. One important component that supports learning activities is through teaching materials. Teaching materials will be meaningful if they are related to real-life contexts and take advantage of local potentials that exist in the surrounding environment. This study aims to develop ethnomathematics-based mathematics teaching materials for junior high school students. This research was a research development. The research stages used refer to the ADDIE development model (Analysis, Design, Development, Implementation, and Evaluation). Based on the needs analysis of teaching materials carried out in the first year of research, students need ethnomathematical-based teaching materials. The type of development research used in this research was intended to produce mathematics teaching materials in the form of e-modules based on ethnomathematics for junior high school students, especially on the material of flat-sided geometry. Data collection techniques used validation sheets, questionnaires, and test instruments. Data analysis in this study was carried out to get an overview of the e-modules of good quality, namely meet the aspects of validity, practicality, and effectiveness. The results of data analysis showed that based on the aspect of validity, the module was included in the very valid category; based on the student response questionnaire, the module was practical, and the post-test results showed that learning with the module was effective.

Keywords: Ethnomathematics, modules, teaching materials

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INTRODUCTION

In the world of education, teaching materials are the most important part of the learning process because problems are often associated with learning materials (materials) and learning resources (Gazali, 2016). Chalkiadaki (2018) explains that the use of electronic media is the main demand and characteristic of 21st-century learning. Apart from being a strength, it should also be a concern regarding the use of electronic media. In this advanced era, most students are prone to forgetting the culture that exists in Indonesia. Students tend to prefer learning through electronic media such as the internet and gadgets, which mostly allow them to access foreign cultures. There is a need for an attitude of respect and incorporation of cultural knowledge into the practices of life so that the community cannot be separated from the original Indonesian culture, which is full of noble values. One way to teach culture to students is through learning mathematics. Ethnomathematics is a form of learning approach that links local culture to learning mathematics. This is in line with the view of Knijnik (2017) that mathematics is a cultural knowledge that grows and develops to connect human needs.

There have been several previous studies that have developed teaching materials based on ethnomathematics by regional or local ethnic culture (Agustin, et al., 2018; Suwanto & Mulyadin, 2019; Amsikan & Deda, 2020; Pathuddin, et al., 2021; Afriliziana, et al., 2021; Wurdani & Budiarto, 2021). With the existence of ethnomathematical-based teaching materials and the development of an e-module, it is hoped that it can help students in the learning process. Teachers can manage learning activities effectively and efficiently, and students can be actively involved in the learning process. According to Rakhmawati (2016), developing innovative and fun teaching materials is needed to improve students' learning abilities. The implementation of innovative textbooks improved the character and learning outcomes of students (Rahmawati & Marsigit, 2017). Thus, it is clear that the need for teaching materials is an important part of achieving good learning outcomes. Based on this explanation, research is needed to develop ethnomathematical-based teaching materials for junior high school students. In addition to improving the concepts that students must master, it is hoped that with the existence of ethnomathematical-based mathematics teaching materials, students can gain learning that links local culture in learning mathematics more pleasantly. Thus, the purpose of this study is to develop ethnomathematical-based teaching materials for junior high school teachers and students and also to describe the quality of ethnomathematical-based teaching materials for junior high school students in terms of validity, practicality, and effectiveness.

METHODS

The type of research used is research and development (Research and Development), which refers to the ADDIE development model, which is divided into five stages, namely the analysis stage, the design stage, the development stage, the implementation stage, and the evaluation stage. The research, especially in the implementation stage, was conducted in one of the state junior high schools in Magelang, with the research subjects being grade VIII students. Data collection techniques in this study used a questionnaire (validation and student responses) and tests. Data analysis in this study was carried out to get an overview of the e-modules of good quality, namely meet the aspects of validity, practicality, and effectiveness.

RESULTS & DISCUSSION

Results

Based on the ADDIE development model, this research is divided into five stages, namely the analysis stage, the design stage, the development stage, the implementation stage, and the evaluation stage. The stages of research that have been carried out are as follows.

a. Analysis stage

This stage was carried out in four junior high school level partners in Magelang City in the first year of research, with these results: 1) teaching materials were available for the learning process; 2) teaching materials that were often used were in the form of textbooks and videos; 3) all existing teaching materials were following KI and KD; 4) students still had difficulty understanding the material in the available teaching materials; 5) teaching materials still needed to be improved by providing concrete examples; 6) the ethnomathematics-based learning model had not been applied; and 7) students agreed to

the development of ethnomathematics-based textbooks as learning resources that made it easier for students to understand the material.

b. Design stage

At this stage, researchers began to design mathematics teaching materials in the form of e-modules based on ethnomathematics for junior high school students, with the following stages: 1) developing a map of the needs of junior high school students, 2) determining the e-module framework to be made by compiling the e-module outline and systematic preparation of the material. The material discussed in this module is the shape of a flat side space, which is divided into four chapters, namely cubes, blocks, prisms, and pyramids. Each chapter has the same system and uses the steps of a scientific approach, and 3) designing an ethnomathematics-based junior high school mathematics e-module.

c. Development stage

This stage was a form of realization from the previous stage, namely design, to produce an electronic prototype of the learning module. Before being implemented in the field, the e-learning module was validated first by each 6 material and media validators or experts. Validation of experts was done by providing an assessment questionnaire that contained several aspects that were tested from teaching materials. Opinions and suggestions on the assessment obtained from the validator were used as a guide to improve the design of teaching materials that had been made. After being validated by the validator, the researcher revised the e-module according to the validator's suggestions and also analyzed the validation results from the validators to determine the level of validity of the e-learning module so that it was feasible to be implemented in the field.

d. Implementation stage

Teaching materials in the form of ethnomathematical-based e-modules that had been validated and revised (valid and feasible) were then implemented in partner schools. This implementation aims to obtain data to assess the practicality and effectiveness of ethnomathematics-based e-modules for junior high school students.

e. Evaluation stage

E-modules that had been implemented in a partner school would be evaluated to provide an assessment of the validity, practicality, and effectiveness of the product. The practical aspect was seen from the student's assessment of the learning module, while the effectiveness aspect was seen from the average score of the students' post-test results.

Data Analysis

a. Validation Data Analysis

The ethnomathematics-based module validation sheet was assessed using a questionnaire given to six validators. This questionnaire consisted of a material validation sheet covering aspects of the feasibility of the content and presentation of the e-module, as well as an e-module media validation sheet in the form of the feasibility of graphics and language. The data from the questionnaire was then analyzed to determine whether or not the teaching materials were suitable for use in learning. Here are the results of the validation.

Table 1. Results of the Validation Value of Teaching Materials' Content

Aspect of Evaluation	Maximum Score	Validator						Average Score	Category
		V1	V2	V3	V4	V5	V6		
Content	**75**	73	52	64	65	70	61	**64.17**	**Very Good**
Presentation	**40**	39	30	35	38	30	32	**34**	
Total Score	**115**	112	82	99	103	100	93	**98.17**	

Table 2. Results of the Validation Value of Teaching Materials' Media

Aspect of Evaluation	Maximum Score	Validator						Average Score	Category
		V1	V2	V3	V4	V5	V6		
Graphics	**105**	105	91	90	104	92	90	**95.33**	**Very Good**
Language	**60**	58	47	51	56	47	51	**51.67**	
Total Score	**165**	163	138	141	160	139	141	**147**	

The total overall average score for material validation was 98.17, which was in the X-score range of > 96.54 with a very good category. The average value obtained from the validator's questionnaire, when converted into percentage form, got 85.37% results. On the other hand, the total average score for media validation was 147, which was in the X score range of > 138.6, or 89.09% with a very good category. According to the calculations that had been carried out in the steps above, it could be concluded that the testing of teaching materials to material and media validators got a very good category.

b. Data Analysis of Students' Responses

Student response questionnaires were used to determine the practicality of the products developed. The student response questionnaire was filled out after the module implementation process for students in one of the classes at one of the state junior high schools in Magelang City. The implementation stage is the stage of using a product that has been declared valid based on the validity test of material experts and media experts. At this stage, tests were also carried out to measure the effectiveness of the product, and a questionnaire was filled out to measure the practicality of the product being developed. The following are the results of filling out student response questionnaires. The results of student responses are given as follows.

Table 3. Results of Student Responses Questionnaires

No	Evaluation Aspect	Maximum Score	Average Score	Category
1.	Feeling happy	**25**	20.26	
2.	Novelty	**25**	19.03	
3.	Motivation	**20**	15.93	
4.	Clarity	**10**	8.3	
5.	Understanding	**10**	8.63	
6.	Interest	**10**	7.87	
Total of Average Score		**100**	**80.03**	**Good**

The total average score of the user response assessment was 80.03, which was in the score range of $67.98 < X < 83.94$, which was included in the good category. The average value obtained from the user's questionnaire, when converted into percentage form, got 80.03% results with a good category. In this study, the ethnomathematics-based e-mathematics module was said to be practical if 75% of students were assessed with a minimum of good category.

Based on the analysis results that have been described above, teaching materials in the form of ethnomathematics-based e-modules showed a very good category on validity testing by material and media validators, and get good responses from student response questionnaires, so it can be said to be a practical product. Thus, it could be concluded that the ethnomathematics-based module on the flat-sided geometrical material is one of the

junior high school mathematics teaching materials that are suitable for use in learning activities for class VIII junior high school students.

Furthermore, to test the effectiveness of teaching materials, a post-test was carried out after students used the module as learning material related to one of the materials tested during the study, namely the cube. From the results of the students' post-test, the class average was 77.5, which could be categorized as effective according to Efrialinda et al., (2020). Thus, in terms of quality, namely aspects of validity, practicality, and effectiveness, the developed e-module met the criteria of being very valid, practical, and effective.

Discussion

This study was developmental research (R&D) with an implemented ADDIE model that consisted of the analysis stage, the design stage, the development stage, the implementation stage, and the evaluation stage. In this study, the analysis stage was conducted in the first year of research to determine the research purpose and analyze the need for ethnomathematics-based teaching material for junior high school students. It is in line with Borg and Gall (1983) who collect information in the initial of research such as need analysis. Furthermore, in the design stage, the product in the form of e-modules based on ethnomathematics was designed based on the results of problem identification and need analysis. Based on research findings, the design of e-modules based on ethnomathematics consisted of four chapters, namely cubes, blocks, prisms, and pyramids. Each chapter had the same system and used the steps of a scientific approach to make users (students) interested. Moreover, the students could be directed to learn independently and mastered the learning materials (Gay, et al., 2018).

In the development stage, an electronic prototype of the learning module was validated by a validator or a team of experts of material and media validators. After being validated, the researcher revised the e-module according to the validator's suggestions. The results of the testing of teaching materials to material and media validators got a very good category, so that it was feasible to be implemented in the field. Moreover, in the implementation stage, the product was declared practical based on student response questionnaires and effective based on the average of the students' post-test results. In the evaluation stage, the developed e-module based on ethnomathematics met the criteria of being very valid, practical, and effective. The findings of this research are consistent with previous research which generally reports that the development of teaching materials, especially a digital module, can improve student outcomes (Dio, 2020; Setiyani, et al., 2020).

CONCLUSION

The conclusions of this research are 1) the final result of the product developed is teaching materials in the form of ethnomathematics-based e-modules on flat-sided building materials using the ADDIE development model and 2) the results of the assessment of the feasibility level or quality of teaching materials carried out through testing of material and media validators obtained very good scores and trials conducted by junior high school students as users obtained good responses, and aspects of the effectiveness of teaching materials based on the average learning outcomes were at effective category. Thus, the teaching materials developed meet the criteria of being valid, practical, and effective.

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