DESIGN OF TEACHING TOOLS FOR SPATIAL ABILITY IN STUFFED SPACE BUILDING MATERIALS

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ABSTRACT

The low mathematical ability of students in spatial geometry material is due, in part, to the low spatial abilities of students, so the researcher designed a learning media in the form of a betel prop. This study aims to produce a design for the development of tepak betel teaching aids for students' spatial abilities in truncated geometric shapes. This research is a development (RnD) using a 4-D development model which is modified into 3-D namely the define stage, the design stage, and the develop stage. The research instrument was an expert feasibility test questionnaire and an instrument for evaluating learning outcomes. Based on the results of the expert validation, the results of the final assessment on IPPP-1 by the three experts with an average score of 3.72 with a percentage of 93.0% met the eligibility criteria. The results of the final assessment on IPPP-2 by the three experts with an average score of 3.83 with a percentage of 95.8% met the feasible criteria. As well as the results of the final IPPP-3 assessment by the three experts with an average score of 3.69 with a percentage of 92.4% meeting the feasible criteria. Based on these data, it can be concluded that the design of the tepak sirih teaching aid development on students' spatial abilities in the material of truncated geometric shapes is feasible to use.

Keywords: Design Development, Props, Tepak Sirih

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1. INTRODUCTION

Character education is an effort to change and build the habits of students who are not good at first to be good and what are good at first will be even better, character education is intended to build students who are more faithful, pious, noble and responsible (Sutisna et al. , 2019) [1]. With the occurrence of a character crisis in students, the world of education still has many problems. The program that has been made so far has not shown a real visible impact. Human character can be formed with education that is oriented to the formation of a spirit of courage. One of the formation of a spirit of courage that needs to be developed with character education is character that originates from the nation's own culture.

Education based on national character and culture is education that implements the basics and methods towards structuring the character of the nation's children in students through a curriculum developed by the school. Therefore, between character and culture have a close relationship. In simple terms, culture can be interpreted as a way of life, which includes ways of thinking, ways of planning, ways of acting, in addition to all real works that are considered useful, correct, and can be fulfilled by community members in shared opportunities. According to EB Taylor in (Rosana, 2017) culture is a complex which involves knowledge, belief, art, morals, laws, customs, abilities, and other habits acquired by humans as members of society. The thing that is concerning at this time is that cultural values are showing a decline which has caused some students not to know the culture of their own region. [2]

In order to revive culture in this study, we are waiting for a cultural object, namely tepak betel. Tepak Sirih is a cultural object originating from the Malay tribe, usually used to welcome wedding guests or used for traditional ceremonies within the Malay tribe. This cultural object has a shape resembling a truncated flat pyramid. It turns out that there is a connection between Tepak Sirih cultural objects and mathematics, namely in the material of spatial geometry.

The ability to understand mathematics is not born by itself, but is processed through the order of learning life. The order of learning life in schools is formally the most dominant is learning. Means, learning practices in schools can ideally improve students' understanding abilities. However, there are some teaching aids in mathematics that have not been seriously developed based on correct principles to provide opportunities for students to learn intelligently, critically, creatively, and solve problems. Most of the practice lessons in schools still use old ways that were developed using intuition, or based on peer experience (arief Aulia, 2018) [3]. Spatial geometry is an element of geometry that discusses spatial shapes such as cubes, beams, and so on, but it also discusses abstract objects such as points, lines, and planes, these objects are obtained from abstract processes of concrete objects in real life (Novita et al. al., 2018) because the object is abstract, there are still many students who have difficulty working on spatial geometry problems [4]. According to (Nasution, 2017) students' difficulties in learning geometry which can result in low students' spatial abilities. In addition, there are still not many teachers who create conditions and situations that train students to develop students' spatial abilities, students' spatial abilities can also be said to be still low [5]. According to (Armstrong, 2018) spatial ability is the ability to see the visual-spatial world accurately and the ability to make changes with sight or imagine. This spatial ability is related to color, line, shape, shape, space, and relationships. This includes the ability to imagine, draw visual ideas and accurately describe spatial arrangements. Therefore, there is a very close relationship between spatial geometry material and spatial abilities. [6]

Low spatial ability will affect student learning outcomes in mathematics. Student learning outcomes have an important role in the learning process because they will provide information to the teacher about student progress in an effort to achieve their learning goals through the process of further teaching and learning activities. Learning outcomes are influenced by internal factors and external factors. From the description of the problems above to develop culture- and nation-based education in mathematics learning on truncated geometrical material that can develop students' spatial abilities there is learning related to Tepak betel showing many mathematical concepts in it. Every part of the object that resembles a decapitated pyramid shows a mathematical concept, one of which is the concept of a decapitated geometric shape.

2. RESEARCH METHOD/MATERIAL AND METHOD/LETERATURE REVIEW

The research was conducted at MTs Amaliyah Tanjung Tiga which is located at Jl. KH. Ahmad Dahlan No. 1 Tanjung Tiga Karang Gading, Secanggang District, Langkat Regency, North Sumatra. The subjects in this study used small group research, namely 10 students at MTs Amaliyah Tanjung Tiga and had three experts, consisting of one lecturer and two mathematics teachers as validators for the eligibility of teaching aids. While the object in this study is the betel slapping prop.

This research is included in research and development (Research and Development). In research and development methods there are several types of models. The model used in this research is 4-D (four D model). The 4-D learning device development model was developed by S. Thiarajan. The reason for using the Thiagarajan development model is because the model steps are able to provide detailed directions so as to provide clear information about the media applied. In (Puspita et al., 2019) the steps of this 4-D development model consist of 4 stages, namely define, design, development, and disseminate. However, in this study modifications were made and only reached the 3-D stage because the application medium was not distributed [7]. The teaching aids that were applied were then tested for their feasibility by expert feasibility tests and limited field media trials to determine the feasibility of the Tepak Sirih teaching aids after learning on the truncated space construction material.

Table 1. Research Procedures and Stages

No	Development Procedure	Name of activity	Execution time
1	Deficiency Stage	a. Preliminary analysis b. KI and KD analysis c. Concept Analysis d. Analysis of Learning Objectives	March
2	Design Stage	a. Making assessment instrument grids	April

		b. Design of lesson plan and teaching aids for Tepak Sirih	
3	Floating Stage	a. Making lesson plans and teaching aids for Tepak Sirih b. Validation c. Revision d. The final result	July

In the research that will be carried out, validation of the feasibility of the teaching aids will be carried out through the opinion of an expert. Technically according to (Sugiyono, 2018) instrument validity testing can be assisted by using instrument grids. The indicators contained in the expert validation instrument grid and learning outcomes test can be used as benchmarks. [8]

3. RESULTS AND DISCUSSION

Research result

Deficiency Stage

At the definition stage, the researcher made observations of one of the teachers at MTs Amaliyah Tanjung Tiga about the process of teaching and learning mathematics. Initial observations were made on 11 April 2022 and further observations on 26 July 2022 at the MTs Amaliyah Tanjung Tiga Private School.

From the stages of analysis carried out by researchers, it can be concluded that the results of the analysis obtained are:

a. Preliminary Analysis The need for visual aids is fundamental in the learning process in classes, especially for mathematics. During the research at school, there was one of the teachers at MTs Amaliyah Tanjung Tiga who was told by the teacher to only use books and blackboards as media. Some teaching aids related to culture have not been fully introduced to students so that many students do not know that mathematical concepts exist in their culture.

b. Analysis of KI and KD Based on the analysis of KI and KD on spatial geometry material at MTs Amaliyah Tanjung Tiga, the researcher was interested in using the Tepak Sirik teaching aid where the shape of the tepak betel resembles a rectangular pyramid shape. Based on an analysis of the curriculum used, it provides information that materials that can be developed in accordance with the RPP contained in Appendix 2 are:

Table 2. Mathematical Syllabus Basic Competency Geometry space

Core Competencies (IC)	Basic Competency (KD)
3. Understanding knowledge (factual, conceptual, and procedural) based on curiosity about science, technology, art and culture related to visible phenomena and events.	3.9 Distinguish and determine the surface area and volume of flat side shapes (cubes, blocks, prisms, and pyramids)
4. Trying, processing, and presenting in the concrete realm (using, parsing, stringing, modifying, and creating) as well as the abstract realm (writing, reading, counting, drawing, and composing) in accordance with what is learned in school and other sources in the same point of view/theory.	4.9 Solving problems related to the surface area and volume of flat side shapes (cubes, beams, primes and pyramids), as well as their combinations

c. Concept Analysis Based on the analysis of the tepak betel props and spatial geometry material, the next step is the researcher will analyze the design of the material content in the RPP so that it

matches what is contained in the tepak betel props with the spatial geometry material (solving problems related to surface area and the volume of flat side shapes (cubes, beams, primes and pyramids), as well as their combinations. This concept analysis aims to identify the main concepts being taught, arrange them in hierarchical form, and detail relevant concepts. Concept analysis is related to the analysis of the material being studied , namely by designing a concept map to make it easier for students to explore the subject matter. This concept analysis aims to identify the main parts that will be learned by students in spatial geometry material (Solving problems related to the surface area and volume of flat sided spaces (cubes, beam, pri ma and limas), as well as their combinations)).

d. Analysis of Objectives Learning objectives to be achieved are:

Table 3. Learning Objectives in Solving Problems Related to Surface Area and Volume of Flat Side Spaces (Cubes, Blocks, Primes and Pyramids), and Their Combinations.

No	Learning objectives
1	Understand the concept of space geometry
2	Improving the attitude of discipline, confidence, active, and work together.
3	Determine the surface area and volume of the flat side of a truncated rectangular pyramid
4	Solving problems related to the surface area and volume of the truncated rectangular pyramid flat sides.

Design Stage

In the process of designing the tepak betel props, in this case the display design, it is necessary to have an initial design that is used to describe the making of the media. this is to determine the design. These are as follows:

a. Making Tepak Sirih Teaching Aids This teaching aid can be used by students independently or by teachers in explaining learning material. This tepak betel prop is used to assist the teacher in explaining learning material to students during the learning process. This can also increase the enthusiasm for learning of students and students can also learn independently using this teaching aid, because, the curiosity of students is high, this teaching aid can be used for materials to solve problems related to surface area and volume of side-space shapes. flat (cubes, blocks, primes and pyramids). The tepak betel props were originally inspired by a typical Malay dance offering, in which this dance contained cultural objects, namely tepak betel. If you look at it from the betel palm above, if you draw a line at each corner of the betel palm, you can produce a truncated rectangular pyramid. After the design of the props is carried out, then the selection of materials for the props is carried out. In this props used material, namely Acrylic with a thickness of 2mm. The use of these materials is considered because the material is sturdy and transparent. The tepak sirih teaching aid is a learning media for mathematics that can be used to prove the volume of a truncated rectangular pyramid. To stimulate the students' spatial abilities, the tepak betel teaching aid is equipped with an animated video showing a truncated or beheaded rectangular pyramid.

b. Making RPP Development in the 4-D modeling process consists of product realization activities. Currently, the material used is spatial geometry to solve problems related to the surface area and volume of flat side shapes (cubes, beams, primes and pyramids), and the combinations have been adapted to KD and indicators integrated into the RPP. Sources of information for teachers when implementing curriculum such as mathematics textbooks for class VIII MTs Amaliyah Tanjung Tiga with the internet.

c. Making Student Evaluation Sheets. In making material evaluation sheet documents, KD, and Values are adjusted to the RPP. Problems obtained from educational sources become information for teachers when carrying out education, for example the Mathematics textbook for the MTs Amaliyah Tanjung Tiga class and the internet. Discussion of questions and answers was also obtained from the Mathematics package book for class VIII MTs Amaliyah Tanjung Tiga, the internet and other sources

Floating Stage

The next stage in the modified 4-D development model is development

a. Expert Validation The data collected from the research on the development of tepak betel teaching aids are quantitative as primary data and qualitative data in the form of suggestions and input from validators. Validation is the stage of evaluating teaching aids before being tested on students. The validation of tepak betel teaching aids was carried out by two expert lecturers and one expert teacher. The validation of expert teaching aids on spatial geometry material, namely Mr. Dr. Lilik Hidayat Pulungan, S.Pd,.M.Pd (Expert Lecturer), Mrs. Nurafifah, S.Pd,.M.Pd (Expert Lecturer), and Mr. Suwanto, S.Pd (Expert Teacher). The validation carried out by experts is related to aspects of material relevance, evaluation aspects and effect aspects for learning strategies developed by filling out questionnaires on a scale of 1 – 4 through IPPP-1, IPPP-2, and IPPP-3 assessments. A complete recapitulation of Validation Results by Experts can be seen in the Appendix. Expert validation in addition to feasibility assessment, expert validation also provides comments and suggestions for improving teaching aids.
b. The Design of Learning Planning The development stage is to make a lesson plan which is used as a reference in the learning steps. Development in the 4-D development model contains expert validation. Validation is the stage of evaluating the RPP whether the RPP media is appropriate or not to be used in learning as a support for the media.
c. The Development Stage Assessment Tool is to make an assessment tool that is used as a reference to see the level of success of the tepak sirih teaching aid. Development in the 4-D development model contains expert validation. Validation is the stage of assessing whether the assessment tool is appropriate or not for use in learning to support the presence of media.

Quality of Learning Devices

Feasibility Analysis

The material expert who conducted the assessment was Dr. Lilik Hidayah Pulungan, S.Pd., M.Pd as validator 1, Mrs. Nurafifah, S.Pd., M.Pd as validator 2 and Mrs. Sri Kusmini,S.Pd. The assessment of each statement item uses a score from 1 to 4. The results of the expert lesson plan assessment can be seen in

1. The results of the assessment for tepak betel props

Table 4 The results of the final assessment of the tepak betel props by experts

No	Assessment Stage	Total score	Average Value	Category	Percentage	Criteria
1	Validators	56	3,7	B	93.30%	L
2	Validators	56	3,7	B	93.30%	L
3	Validators	57	3.77	B	95%	L
		Average	3.72	B	93.8%	L

Description: B= good and L= Decent

2. Assessment Results for RPP

Table 5 The results of the final assessment of the RPP by experts

No	Assessment Stage	Total score	Average Value	Category	Percentage	Criteria
1	Validators	78	3,9	B	97.5%	L
2	Validators	76	3,8	B	95%	L
3	Validators	76	3,8	B	95%	L
		Average	3.83	B	95.8%	L

Description: B= good and L= Decent

3. Assessment Results For Assessment Tools

Table 6 Assessment Results for Assessment Tools by Experts

No	Assessment Stage	Total score	Average Value	Category	Percentage	Criteria
1	Validators	45	3.75	B	93.75%	L

2	Validators	43	3.58	B	89.5%	L
3	Validators	45	3.75	B	93.75%	L
		Average	3.69	B	92.4%	L

Description: B= good and L= Decent

4. Small Trial Assessment Results

Table 7 Small Trial Assessment Results

No	Student's name	Class	Student Grades After Research	Complete or not Complete
1	Agus Renaldi	VIII-A	75	COMPLETE
2	Aldi	VIII-A	100	COMPLETE
3	M. Dicka Novri	VIII-A	100	COMPLETE
4	M. Revan	VIII-A	75	COMPLETE
5	Obama raft	VIII-A	75	COMPLETE
6	Rizki Fahmi	VIII-A	100	COMPLETE
7	Dwi Sekar	VIII-A	100	COMPLETE
8	Devani	VIII-A	75	COMPLETE
9	Naila	VIII-A	100	COMPLETE
10	Nur	VIII-A	100	COMPLETE
Average Total Grades of Students			90	COMPLETE

Based on the table above, it can be concluded that the results of the small trial assessment by 10 students of MTs Amaliyah Tanjung Tiga obtained an average total score of 90 including the "COMPLETE" category. So we can say this little trial was successful.

Discussion of Research Results

Based on the description of the research results that have been described in the research results, the development design of the Tepak Sirih Teaching Aid is obtained which is based on the 4-D development model with the stages of defining, designing, developing, and disseminating. Due to time constraints, this research was carried out until the development stage (develop).

The learning development stage starts from the define stage. Defining stage (define) serves to analyze the needs in the learning process implemented. This stage consists of initial analysis, analysis of KI and KD, concept analysis and analysis of learning objectives. Preliminary analysis is used to find out common problems encountered in mathematics learning activities, KI and KD analysis aims to detail the Core Competencies (KI) and Basic Competencies (KD) that will be used, concept analysis has the aim to identify the main concepts taught in the material spatial geometry, and finally the analysis of learning objectives has the goal of formulating learning objectives that must be achieved by students during the learning process in accordance with the KI and KD used.

The next stage is the design stage (design). Selection of media to identify media that are relevant to the characteristics of the material and suitability for needs. So, in this study the media used was tepak betel props. Furthermore, this research instrument was designed to be used to measure the quality of the Tepak Sirih Teaching Aid, lesson plans, and Evaluation Sheets that were developed. The final stage in this research is development, the research instrument is validated for its feasibility before being used to measure the feasibility of the Tepak Sirih Teaching Aid, RPP, and Evaluation Sheet. The aspect of validity according to Nieveen in (Rochmad, 2012) refers to whether the learning that is developed is in accordance with the theory and to the internal consistency of each component, the Tepak Sirih Teaching Aid, Lesson Plans, and Evaluation Sheets are validated for feasibility by expert lecturers and mathematics teachers.

Based on the analysis of the assessment of Tepak Sirih Teaching Aid by the validator, namely 2 lecturers and 1 math teacher, it shows that the Development of Tepak Sirih Teaching Aid designed is in accordance with the principles of developing Tepak Sirih Teaching Aid in terms of several aspects assessed. The aspects assessed are the suitability of the type of media with the competencies to be achieved, the suitability of the type of media with the material being discussed, the suitability of the

type of media with the characteristics of the students, the clarity (can be seen or heard clearly) of the images/video/audio/animation in the media, the readability of writing (type and size of letters) in the media, the coherence of presentation of the material in the media, the completeness of the scope of the material presented in the media, the level of ease of use of the media, the level of simplicity in presenting material/images/illustrations, the harmony of the layout and colors of the media, the level of enthusiasm of students in participating in learning when media is used, truth in using language conventions (Indonesian and/or foreign), effectiveness of images/illustrations/animations/videos in supporting explanations of concepts (material), and effectiveness of media in conveying subject matter. And through the revision stage and input provided by lecturers and teachers so that a total average score of 3.77 was obtained with the criteria of "Good" and a percentage of 93.5% so that the tepak sirih teaching aids were categorized as "Decent". In addition, the RPP assessment by the eligibility validator, namely 2 expert lecturers and 1 mathematics teacher obtained an average total score of 3.73 with the criteria of "Good" and a percentage of 93.25%. Based on the analysis of the Evaluation Sheet assessment by expert validators, namely 2 expert lecturers and 1 math teacher, a total average score of 3.69 was obtained with a "Good" percentage of 92.37%.

Based on the description that has been presented above, it is concluded that the Design of the Tepak Sirih Teaching Aid with spatial geometry material is feasible for use in learning. Besides being appropriate for application in mathematics learning, the author also observes that the Tepak Sirih Teaching Aid has another advantage, namely that it can make students familiar with Indonesian culture and make learning more meaningful. By using tepak betel props, students are more responsive and happy in learning mathematics.

4. CONCLUSION

Based on the results of the research and discussion, the researcher can discuss where the design of the Development of the Tepak Sirih Teaching Aid Against the Spatial Ability of Students in Stumped Spatial Materials was carried out by observing 3 validators, namely 2 mathematician lecturers and 1 math teacher.

By calculating the feasibility of teaching aids through teaching aids, lesson plans and assessment tools by experts as a whole using the same formula, an average score of 3.73 is obtained on 47 indicators so that they are included in the "Good" category. If calculated by the feasibility percentage, it is obtained 93.04% so that it is included in the "Appropriate" criteria for use as learning media. Why was the Tepak Sirih Teaching Aid made to make it easier for students in the learning process in spatial geometry material. And also the researchers hope that this Tepak Sirih Teaching Aid can be used to help complete the teaching aids. In the percentage above the percentage level it can reach feasible, that is, validation is carried out 2 times so that it is suitable for use.

REFERENCES

[1] Sutisna, D., Indraswati, D., & Sobri, M. (2019). Keteladanan Guru sebagai Sarana Penerapan Pendidikan Karakter Siswa. JPDI (Jurnal Pendidikan Dasar Indonesia), 4(2), 29. https://doi.org/10.26737/jpdi.v4i2.1236

[2] Rosana, E. (2017). Dinamisasi Kebudayaan dalam Realitas Sosial. Al-AdYaN, 12(1), 16–30.

[3] Rahman, A. A., Kristanti, D., & Wahid, N. (2018). Pengaruh penggunaan alat peraga batang Napier terhadap kemampuan pemahaman matematika siswa kelas VII SMP Negeri 4 kuala. *Genta Mulia: Jurnal Ilmiah Pendidikan*, *9*(1).

[4] Novita, R., Prahmana, R. C. I., Fajri, N., & Putra, M. (2018). Penyebab kesulitan belajar geometri dimensi tiga. Jurnal Riset Pendidikan Matematika, 5(1), 18. https://doi.org/10.21831/jrpm.v5i1.16836

[5] Nasution, E. Y. P. (2017). Meningkatkan kemampuan spasial siswa melalui pembelajaran geometri berbantuan Cabri 3D. Mathline: Jurnal Matematika Dan Pendidikan

[6] Armstrong, T. (2018). Multiple Intelligences in the Classroom (V. Alexandria (ed.); 4th ed.). ASCD.

[7] Puspita, V., Mulyati, A., & Maielfi, D. (2019). Implementasi Pendidikan Karakter Pada Matakuliah Matematika Sekolah Dasar Menggunakan Model CTL. Jurnal Cendekia : Jurnal Pendidikan Matematika, 3(2), 504–512. https://doi.org/10.31004/cendekia.v3i2.131

[8] Sugiyono. (2018). Metode Penelitian Pendidikan (Pendekatan Kuantitatif, Kualitatif dan R & D) (12th ed.). Cv. ALFABETA