

THE DEVELOPMENT OF THE "ULTACO" GAME MEDIA ON MATHEMATICS LEARNING CONTENT FOR BUILDING SPACE SURFACE AREA IN CLASS V ELEMENTARY SCHOOL STUDENTS

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ABSTRACT

This development research aims to produce an Ultaco game media that is suitable for use in mathematics learning on the surface area of geometric shapes for fifth-grade elementary school students. The use of media is very necessary for learning mathematics because it helps students to understand the material well, does not saturate, can increase student activity and interest during learning. The product feasibility test is based on the results of the assessments of material experts, media experts, fifth-grade teachers and fifth-grade elementary school students as test subjects. The results of research and development of Ultaco game media can be concluded as follows: (1) The results of the assessment of material experts get a percentage of 79.4% is included in the appropriate category, (2) the media expert's assessment gets a percentage of 95% including the very feasible category, (3) the assessment from the fifth-grade teacher gets a percentage of 85.3% including the very feasible category. Meanwhile, from users, Ultaco game media obtained a percentage of 79.4%, so that it can be categorized as feasible and interesting to use as learning media.

INTRODUCTION

Education is a conscious effort to improve the quality of human life. Providing education includes formal, informal, and non-formal, where formal education is carried out through educational institutions such as schools (Yasunaga, 2014). According to Law Number 20 of 2003 Article I paragraph I concerning the National Education System, it is stated that education is a conscious effort to create a learning atmosphere and learning process so that students actively develop their potential and skills needed by themselves, society, nation or state. This means that education is very important for human life because humans will have a clearer and more focused view and direction of life (Pajares, 1992; Plucker et al., 2004). The teacher's role in implementing the 2013 curriculum is to make students more active in participating in learning activities (Maba, 2017; Sumual & Ali, 2017). The teacher does not act as a learning resource that is considered versatile and knows all kinds of things (Ball, 2003). This is in line with the objectives of the 2013 Curriculum in Permendikbud No. 67 of 2013, which is to plan Indonesian people who have faith, active, creative, innovative, and productive personalities to participate in the life of society adequately, nation and state (Gunawan, 2017; Prihantoro, 2015). The use of attractive media provides a motivational boost to students in learning because, in the learning process, students must be directly involved or become the centre of learning in various subject areas, one of which is the content of learning mathematics (Keller & Suzuki, 2004; Przybylski et al., 2013). Mathematics learning is one of the central subjects in the curriculum because mathematics is one of the basic sciences in life and as capital in developing modern technology (Gellert, 2001; Valero, 2017); besides that, it also plays an important role in various scientific disciplines and the power of human thought (Denton et al., 2020; Lubinski & Benbow, 2006). Very important subjects are given to students to equip them with logical, analytical, systematic, critical and creative thinking skills and can work together (Purwitaningrum & Prahmana, 2021). Elementary school-age children prefer learning that is playful or concrete. As stated by Piaget, the development of students is divided into four stages, namely: (1) the sensorimotor stage, (2) the preoperational stage, (3) the

concrete operational stage, (4) and the formal operational stage (Boyle, 2013). In Piaget's theory, elementary school age is included in the concrete operational stage because one of its characteristics is understanding concrete things (Mellon & Sass, 1981).

Developing students' thinking skills can be done by using real objects or visual aids in a learning process: learning media. The researcher observed the learning media used by the fifth-grade elementary school teachers, especially in the Merjosari cluster, in February 2020. In general, the results obtained were that the surface area material used by the teacher was not optimal as the observations made to fifth-grade teachers at SDI Al-Umm, Surya Buana and SDN Merjosari 2. When observations were made to the fifth-grade teacher at SDI Al-Umm, it was found that the teacher at the elementary school chose to use instructional media in the form of textbooks and LCDs, where the teacher emphasized lectures and displayed examples of surface drawings to students. Then it was found that some students did not understand the material seen from the number of questions submitted by students to the teacher. Then the observations made to the fifth-grade teacher Surya Buana are also not much different from the fifth-grade teacher at SDI Al-Umm, where the teacher uses learning media in the form of LKS books. However, teachers at SD Surya Buana use simple media that contains learning materials; the media is used in cardboard boxes. Most of the fifth-grade students of SD Surya Buana followed well, but there were students who brought cardboard boxes that were too big and some that were too small, while those who did not carry cardboard boxes looked passive. Considering the results of observations and interviews that researchers have conducted, the researchers tried to develop innovative media that teachers had never used in learning. Learning can use several teaching aids and teaching models to help students understand the material well and be active in class. One of them is learning with games because elementary school-age children are children who are still active and have high motivation to play.

Media games can increase students' motivation in the classroom; the use of creative media and an attractive appearance will increase student activity in class (Delwiche, 2006). One of them is the snake and ladder game media. The use of snakes and ladders game media is one of the interesting and innovative media in learning. Snakes and ladders is a traditional game that is very popular with children because it is fun and becomes a competition between students and their friends. Previous research related to research conducted, namely research from Siswoyo, showed that in research on the development of an educational game tool, snakes and ladders mathematics, the subject area of flat shapes for fifth-grade elementary school students is appropriate (Siswoyo, 2015). Based on the results of the assessment from media experts, an average score of 4.4 with a percentage score of 87.8% was included in the excellent category. The material expert's assessment got an average score of 4.8 with a percentage score of 96.6%, including the excellent category. The field trial assessment scored 87.5%, which was included in the feasible category. The main field trial scored 96.2%, which was included in the feasible category. Operational field trials get a percentage score of 98% included in the feasible category. Another study conducted by Orowala showed that research on the development of snakes and ladders media on the subject matter of recognizing flat shapes in the sub-theme of my family members for grade I elementary school students is appropriate (Orowala, 2017). Based on the results of the validation of all validators, it shows that from the expert validators of learning media with a score of 4.70 (excellent) and 4.76 (excellent), while the validation from the first-grade elementary school teacher is with a score of 4.47 (excellent) and 4.35 (excellent).

Based on the problem of the availability of learning media that the researchers found in class V, the researchers will carry out research on the development of the barcode snake and ladder game media (Ultaco) on the surface area material at SDI Al-Umm. The researcher chose the barcode game snake and ladder media because the media used by teachers at SDI Al-Umm in learning were still in the form of printed books and LCDs. This game is an interesting medium for students so that it can motivate students' learning, and the barcode game snake and ladder media has never been used as a learning medium, especially in mathematics content at SDI Al-Umm. The problem is, how is the validity and feasibility of Ultaco game media according to media experts and material experts, and how attractive is

Ultaco game media according to users?. This study aims to develop Ultaco Game Media in Mathematics Learning Content for Surface Area Building Materials for Class V Elementary School Students.

RESEARCH METHOD

The research used by the researcher uses a research and development model or Research and Development. A research and development model is a research model that produces a product and tests the effectiveness of a particular product. The development of a product is not used in one field but covers various fields, one of which is in the field of education. Research and development models produce new products or improve existing products. Sugiyono argues that the research and development model has ten steps in research, which include; (1) Potential and problems; (2) data collection; (3) Product design; (4) Product validation; (5) Product improvement; (6) Product testing; (7) Product revision; (8) Usage trial; (9) Product revision; (10) Production (Sugiyono, 2013). In simple terms, R&D can be defined as a research method that is intentionally, systematically, aimed or directed at finding, formulating, improving, developing, producing, testing the effectiveness of products, models, methods or strategies, services, certain procedures that are superior, new, effective, efficient, productive, and meaningful. According to Sugiyono, in research and development developed, there are ten steps to produce a final product. The development research that the researchers developed only included seven steps, namely; (1) Potential problems; (2) Data collection; (3) Product design; (4) Product validity; (5) Product improvement; (6) Product trials; (7) Product revision because of limited time, cost and adapt to needs. According to Sugiyono (2015), research and development steps are as shown in Figure I.

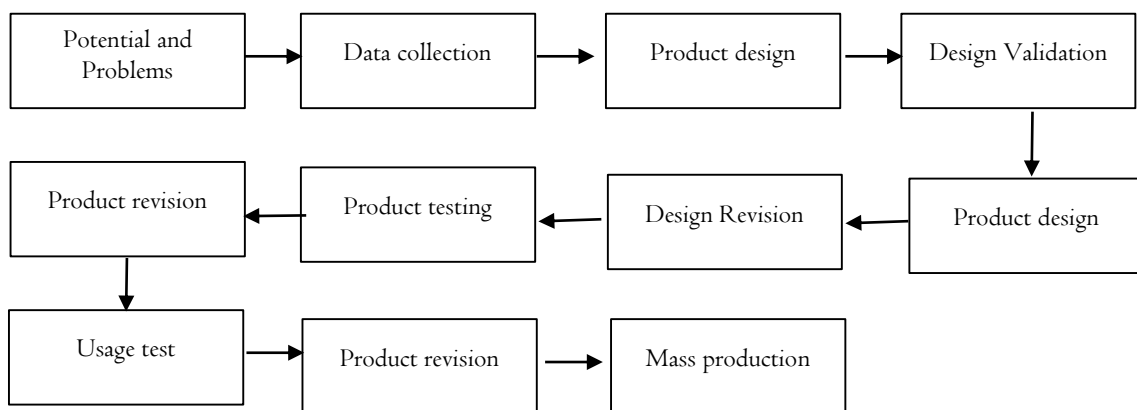


Figure I. Modification of Research and Development Steps (Sugiyono, 2013)

So the researchers used seven of the ten steps proposed by Sugiyono. Namely, the researchers developed the development of the Ultaco game media on the content of learning mathematics on the material surface area of building spaces in fifth-grade elementary school students.

RESULTS AND DISCUSSION

Interview Techniques

Based on the results of the interviews, there are several potentials and problems related to mathematics learning activities in fifth grade. The following are the problems encountered during the learning activities on the surface area of the surface area, namely: (1) in the learning activities, they still use textbooks and use the LCD; (2) there is no media that can be used long term in order to teach the material on the surface area of the building. During the interview, there were also potentials mentioned by the fifth-grade teacher related to mathematics learning on the surface area of space, namely: (1)

learning media can attract students' interest; (2) learning media helps students to understand the material when learning the material on the surface area of the building.

Data collection

Before making a development product, the steps that must be taken are to examine and analyze the basic competencies in Permendikbud No. 24 of 2016 regarding learning mathematics in class V. The following is a description of the basic competencies and indicators that become a reference in making the Ultaco game media which is described in Table I.

Table I Description of Basic Competencies and Indicators

Basic competencies	Indicator	Aim
	Mention the difference in surface area in the shape of the space	By mentioning the difference in surface area in spatial shapes, students can compare the concept of measuring surface area in shapes
Explain, and determine the volume of geometric figures using volume units (such as unit cubes) and the cubed relationship with the cube root	Explain the formula for the surface area of a cube	By explaining the formula for the surface area of a cube, students can determine the formula for the surface area of a cube correctly
	Explain the formula for the surface area of a rectangular shape	By explaining the formula for the surface area of a cuboid, students can determine the formula for the surface area of a cuboid correctly
Solve problems involving the volume of geometric figures using units of volume (such as unit cubes) involving cubes and cube roots	Solve problems related to the surface area of a building	By solving surface area problems on cubes and blocks, students can practice their skills carefully

Product Validity

Material expert validation

Data from material expert one was taken from Yulia Linguistica, M. Ed, who is a Mathematics lecturer at the PGSD Study Program, Faculty of Education, State University of Malang. Validation was carried out on Wednesday, October 13, 2020. And data from material expert two was taken from Umiati, S.Pd.SD who works as a fifth-grade teacher at SDN I Madiredo. The validation process was carried out on Friday, October 16, 2020. The following is quantitative data in the form of Table 2.

Table 2. Quantitative data

No	Rated aspect	Indicator	VI	V2	Average	Description
1	Content Eligibility	Material equipment	4	5	4,5	Valid
		Material scope	3	5	4	Valid without revision
		Concept and definition accuracy	4	4	4	Valid without revision
		Accuracy of data and facts	4	4	4	Valid without revision
		Image accuracy	2	5	3,5	Valid without revision
		The suitability of the material with the development of science	3	4	3,5	Valid without revision
		Pictures of cubes and blocks in daily life	2	5	3,5	Valid without revision
		Encourage curiosity	3	4	3,5	Valid without revision
2	Presentation	Creating the ability to ask questions	3	4	3,5	Valid without revision
		Reasoning	3	4	3,5	Valid without revision

Eligibility	Examples of questions in each learning activity	5	4	4,5	Valid	
	Practice questions for each learning activity	5	4	4,5	Valid	
	Answer key to practice questions	5	4	4,5	Valid	
	Student involvement	4	5	4,5	Valid	
	The relationship between the material being taught and students' real-world situations	4	5	4,5	Valid	
3	Contextual Assessment	Involves higher-order thinking skills and includes a broad knowledge	3	4	3,5	Valid without revision
		The ability to encourage students to make relations between the knowledge possessed by students and their application in students' daily lives	3	5	4	Valid without revision
Total		60	75	67,5		
Final Percentage					79,4%	
Final Description					Valid	

In addition to quantitative data, there are also qualitative data obtained from the validation results by material experts, namely in the form of suggestions and input. Experts' suggestions and inputs will be reconsidered to maximize the use of products that have been used developed. The two material experts' ideas and inputs on the coverage of material on the Ultaco gaming media are shown in Table 3.

Table 3. Material experts' suggestions and feedback

Suggestions and Comments
Some markers, such as "Finding the formula," cannot be met using ultaco media. While ultaco media can only train problem-solving abilities, the finding must be done via discovery activities. According to us, the indication should "explain/mention the formula," according to us.
The difficulty level of the questions is not evenly distributed; there are still too many simple questions (less challenging)
The questions solely depend on mathematics, with little or no exploration of the desired spatial picture.
Overall, it meets the requirements of the present curriculum. The offered information has the ability to engage pupils and pique their interest: basic competency and material correctness in light of contemporary scientific breakthroughs.

Six indicators obtained validation requirements that were eligible for use without alteration based on the validation results from the two material experts. Then 11 indicators receive valid criteria with minor revisions based on material experts' suggestions and comments. Minor revisions include adjusting indicators of related basic competencies and changing the level of difficulty of the questions by providing images of related spatial structures. With acceptable validation criteria, if all scores in each aspect are totalled together and averaged, it results in a percentage gain of 79.4 per cent. Material experts' recommendations might be revised in order to optimize the media that has been developed. According to the results of material experts' validation, the material covered in the Ultaco game media has satisfied the criteria to be tested on students.

Validation from a media expert

Data from media expert I was obtained from Eka Pramono Adi, S.IP., M.Si, a lecturer in Educational Technology at the State University of Malang's Faculty of Education. On Tuesday, October 20, 2020, validation was completed. Data from media expert 2 was obtained from Herlina Ike Oktaviani, M.Pd, a lecturer in Educational Technology at the State University of Malang's Faculty of

Education. On Thursday, October 29, 2020, the validation procedure was completed. The quantitative data from the validation procedure of the first media expert is shown in Table 4.

Table 4. The results of the media validation

No	Rated aspect	Indicator	VI	V2	Average	Description
1	Media Efficiency	Simple to use	5	5	5	Valid
		Storage is simple.	4	4	4	Valid without revision
		Use necessitates special consideration	5	4	4,5	Valid
		The appeal of Ultaco's gaming media box design	5	5	5	Valid
2	Media Accuracy	Given a title/media description	5	5	5	Valid
		The color scheme for the Ultaco game media board	5	5	5	Valid
		The Ultaco game's usage of question phrases is simple to comprehend	4	4	4	Valid without revision
		Use of characters, pictures, spaces, and questions in barcodes on a regular basis	5	5	5	Valid
3	Aesthetics	The Ultaco game media's colour scheme	5	5	5	Valid
		Colour accuracy on each column's bulletin board	5	5	5	Valid
		The precision with which the images used in the Ultaco game material were created	5	5	5	Valid
4	Media Resistance	When utilized, it is difficult to slide off and shatter.	5	4	4,5	Valid
		Stickers are difficult to remove.	5	4	4,5	Valid
5	Students' Security	Is made of a safe material (not sharp)	4	5	4,5	Valid
		Paints that contain compounds that are dangerous to children should not be used.	5	5	5	Valid
Total			72	70	71	
Final percentage						95%
Final description						Valid

There are also qualitative data collected from the validation findings by material specialists, in the form of suggestions and feedback, in addition to quantitative data. Expert advice and feedback will be taken in order to get the most out of the items that have been developed. The two media experts' ideas and inputs on media coverage of the Ultaco game have been offered in the form of Table 5.

Table 5. Material experts' suggestions and feedback

No	Suggestions and Comments
1	Overall, it is relatively nice. Suitable for implementation or continuation at a later stage of development.
2	It is suitable, but supplementary media, such as cards, is required for schools that cannot utilize barcodes.

Based on the assessments of the two media experts, 13 indicators obtained high validation criteria and were very suitable for use without revision. Then two indicators get valid criteria with minor revisions taking into account suggestions and comments from media experts, minor revisions made in the form of supporting media such as cards on the Ultaco game media. When all of the scores in each element are combined together and averaged, a 95 per cent percentage gain with strong validation requirements is obtained, making it highly practical to apply. Media experts' recommendations might be revisited in order to optimize the media that has been developed. The Ultaco game media may be tried on pupils, according to the findings of the validation conducted by media professionals.

Validation of Educators (Teachers)

Umiami, S.Pd.SD, a fifth-grade teacher at SDN I Madiredo, provided the information from the educators. On Friday, October 16, 2020, the certification procedure was completed. The quantitative data from the educator validation process is shown in Table 6.

Table 6. Data on the results of educators' assessments

No	Rated aspect	Indicator	VI	Average	Description
1	Aspects of Learning Materials	The media contains content based on the objectives to be met	4	4	Valid
		Concrete developed media for use in learning	3	3	Valid without revision
		Teachers may teach mathematics on the material surface area of spaces more easily with the use of learning media	4	4	Valid
		As a learning media, Ultaco media has satisfied the requirements	4	4	Valid
2	Aspect of Media Eligibility	Image accuracy with material	5	5	Valid
		Strong and long-lasting media	4	4	Valid
		The medium is simple to use or understand for pupils	5	5	Valid
		Media can be used repeatedly	5	5	Valid
		Students will be able to grasp the surface area material better thanks to the produced medium	4	4	Valid
		The media includes information that can help kids learn more effectively.	4	4	Valid
		Clarity of regulations in the Ultaco game media material surface area of building space	5	5	Valid
		Ultaco learning media has a critical part in education	4	4	Valid
		The usage of barcodes aids learner comprehension.	4	4	Valid
		Students can communicate more easily with the use of learning media	4	4	Valid
	The utilization of this instructional medium motivates pupils to learn	5	5	Valid	
	Total	64	64		
	Final percentage			85,3 %	
	Final description			Valid	

There are also qualitative data gathered from the validation findings by educators, in the form of ideas and feedback, in addition to quantitative data. In order to maximize the use of the things that have been developed, educator ideas and advice will be examined. The following are educator ideas and insights regarding the covering of information on the Ultaco game media, provided in the form of table 7.

Table 7. Educators' suggestions and input

Suggestions and Comments
The medium used to pique kids' interest in learning, particularly the usage of barcodes, makes it simpler for youngsters to access the information anywhere and at any time, particularly when it contains recognisable images. More pictures can be added to the media suggestions.

According to the teacher's judgment, five indicators have strong validation criteria and are extremely acceptable for usage without change. Then 9 indicators receive valid criteria and 1 indicator that receives quite valid criteria with minor revisions based on educator suggestions and comments, such as adding images to the Ultaco game media. When all of the scores in each element are summed together and averaged, it yields an 85.3 per cent increase with strong validation requirements, which is highly practical to utilize. Educators' ideas might be evaluated in order to make the most of the media that have been developed. According to the results of educator validation, the Ultaco game medium is suitable for testing on kids.

Trial of a Product

Product trial findings are a phase in the research and development process. Six fifth-grade pupils were used as research participants. On Monday, November 9, 2020, the trial took place in the researcher's home. This was done in order to collect feedback, recommendations, and comments on the gaming media that the researchers created. Table 8 shows the results of a brief product study.

Table 8. Data on the results of student response assessments

Name	Aspect														Tse	TSh	V (%)
	I	2	3	4	5	6	7	8	9	10	11	12	13	14			
Elia Wulandari	5	4	4	5	5	5	4	5	5	4	5	5	5	5	66	84	79
Claudia Sari	5	5	4	5	5	5	5	5	5	5	5	5	5	5	69	84	82,1
Aisyah Fira D.	4	5	5	5	5	4	5	4	5	5	4	5	5	4	65	84	77,4
Ahmad Zidni K.	5	5	5	4	5	5	5	4	5	4	5	5	5	5	67	84	80
Bilqis Keisya F.	5	5	5	5	5	5	5	4	5	5	5	5	5	4	68	84	81
Shierra Inadya S.	4	5	5	5	5	4	5	5	4	5	5	4	4	5	65	84	77,4
Total	28	29	28	29	30	28	29	27	29	28	29	29	29	28	400	504	79,4
Average Percentage																	

There are several sorts of qualitative data that may be collected during user trials in addition to quantitative data. When completing a limited trial, students provided qualitative data in the form of ideas and comments displayed in Table 9.

Table 9. Student suggestions and input

Suggestions and Comments
The board's hue is already appealing
The design is excellent
The drawing of the Geometry is appropriate

CONCLUSION

Based on the results of research and development of Ultaco game media for learning mathematics, the material for surface area construction can provide suggestions for utilization as follows; (1) It is recommended to use the Ultaco game media when learning mathematics on the surface area of the surface area; (2) Before using this Ultaco game media, it is recommended to read the instructions for

use and use it systematically. So that the use of Ultaco game media is used properly; (3) The teacher also assists students in using the Ultaco game media; (4) Schools can consider the product development of the Ultaco game media for learning mathematics for grade V elementary school to be a source of learning for students. Schools can also use this product development as a reference in developing supporting teaching materials in the form of Ultaco game media.

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