Development of media model based on hands-on activity to improve conceptual understanding abilities of junior high school students in Bandung district

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Abstract. This study aims to (1) develop a media model based on hands-on activity and instrument to improve conceptual understanding. (2) conducting an instrument test to improve conceptual understanding abilities. The research method is used of this study is developmental research which is conducted by thought experiment and instruction experiment. The population of this study is the seventh-grade students of SMP Bandung. The results of trials of 210 junior high school students from 6 schools that have obtained flat building materials are obtained as follows: (1) all items about multiple choice conceptual understanding and validity test developed valid, (2) multiple choice questions conceptual understanding and description test developed reliable, (5) 90 mathematics teacher's opinion on hands-on activity-based media model developed to construct a conceptual understanding of students.

1. Introduction
Mathematics is an abstract science of space and numbers [1]. Mathematical objects that are abstract in nature are their own difficulties that must be faced by students in learning mathematics. Not only students, teachers also experience obstacles in teaching mathematics related to its abstract nature.

The nature of mathematical material is not easy to understand, mathematics has a strict and rigid hierarchy [2], mathematics applications are less real, learning mathematics needs to focus causing mathematics to be disliked by students. Based on the description above, it is necessary to have a medium to bridge the process of thinking students from concrete to abstract.

Learning media used in the process of learning mathematics is emphasized not only can be seen, heard, or read, but also can be manipulated by students, so learning mathematics becomes meaningful to him. This is in accordance with the understanding of Confucius who stated that what I heard, I forgot. What I see, I remember and what I do, I understand. The nature of this learning media that can be manipulated is hands-on activity-based media.

According to Haury & Rillero [3] Hands-on activity is all activities and direct experience of students with objects (living things or inanimate objects), students practice things thoroughly. In line with the above understanding Krismanto [4] hands-on activity is defined as learning by touching hands or manipulating objects by hand, hands-on activity is an activity of learning experiences in order to discover concepts through exploratory activities, investigation and conclusions involving physical activity, mental and emotional. Furthermore, Manurung [5]. Hands-on activity is a model designed to involve students in digging up information and asking questions, doing activities and discovering,
collecting data and analysing and making their own conclusions. Cunningham & Herr [6] suggested hands-on science is an approach that involves direct activities and experiences with natural phenomena or educational experiences that actively involve students in manipulating objects to gain knowledge and understanding. The problems in this study are "How to design and develop a hands-on activity-based media model to improve students' conceptual understanding abilities in Bandung district?" 

2. Methods
This research is a developmental research proposed by Borg et al. [8] with stages: (1) data and information collection, (2) planning, (3) product design, (4) small group trials, (5) initial product revisions, (6) large group trials, (7) final product revision and, (8) dissemination. The stages above can be summarized into 4 stages, namely Define, Design, Develop and Disseminate, called the development model (4D) [9]. The population and sample in this study were junior high school students in Bandung who were selected by purposive sampling. This research was carried out in the city of Bandung, with the main subject being junior high school students in three schools. The three schools represent schools with high, medium and low categories. The data needed in this study will be captured through documentation, observation, filling in questionnaires, written tests, interviews, analysis of the data used is done qualitatively, and other parts are analyzed quantitatively.

3. Result and Discussion
3.1. Hands-On Activity Based Media Model Development
Hands-On Based Media Model Activity used in this study is arranged in the form of rectangular material learning consisting of rectangles, squares, parallelogram, rhombus, kites, and trapezoidal. Media models that need to be considered in the concept of hands-on activity [10], namely: 1) Students are actively involved; 2) there are teacher-made teaching aids used in the learning process; 3) There is an effort from the teacher to stimulate the development of process skills; 4) Learning is not dominated by teachers.

The stages in the learning model are hands-on activity [11] consisting of four stages, as follows:

- Explore information and ask questions. The teacher starts learning by giving worksheets that contain questions that arouse students' curiosity, and guide students to submit hypotheses.
- Activity and find. After students hypothesize the teacher guides students to conduct an investigation or experiment to test the hypothesis.
- Collect and analyse
- After students conduct the experiment or investigation, students collect data obtained from the results of their experiments, while discussing students analysing data for discussion of the observed data.
- Make conclusions

This media model has been validated by 8 experts consisting of 4 mathematics education experts and 4 practitioners in the field. The results of the validation state that, (1) the media is made durable, the shape and color are attractive, and easy to function, (2) can present mathematical concepts well so that it can be a frame of mind for students to obtain mathematical concepts, (3) this media can be visualized well.

The following is one example of hands-on activity-based media that has been validated by 8 mathematics education experts and 90 mathematics teachers.
This teaching aid helps students to understand the trapezoidal area using a rectangular approach. In this field, student still need concrete objects to understand concepts that are still abstract, such as in this broad field of proving the trapezoid area. Student will experience the use of square props, so that student can construct their own knowledge based on the experience they get. From 90 mathematics teacher's opinion on hands-on activity-based media model developed to construct a conceptual understanding of students.

3.2. Research Instruments
The instrument used in this study is a conceptual understanding ability test. To test the validity of the instrument theory developed, the researcher asked the consideration of 4 learning experts (lecturers) and 4 practitioners (teachers). This means that there are 8 experts involved in conducting validation of the contents of the instruments developed. To test the comparison of the results of the experts' validation, the following analysis is carried out. The entire hypothesis tested in the comparison test results from the consideration of 8 experts involved in assessing the validity of the instrument contents are as follows:

- $H_0$: there is no difference in the results of the conceptual understanding test contents (Multiple choice, Description)
- $H_1$: there are at least two different conceptual understanding content validation results (Multiple choice, Description).

Because the score given by experts in giving validation is 0 to be invalid/valid and 1 to valid, then the statistical test used is Q-Cochran’s by selecting the significance level of rejecting the null hypothesis is 0.05.
3.2.1. **Content Validity.** The calculation results for the validity of multiple-choice contents are as follows:

| Table 1. Validation of multiple-choice contents |
|----------|----------|----------|----------|
| N  | Cochran’s Q | Df | Asymp. Sig. |
| 10 | 9.970* | 7 | 0.190 |

The Asymp value. Sig = 0.190 is greater than 0.05, then the null hypothesis which states there is no difference in the results of the validation of the content of the understanding of multiple-choice questions is accepted. Thus, it can be concluded that theoretically multiple-choice questions that measure understanding can be said to fulfill content validity. The same results were also obtained in the calculation of the content validity of the Conceptual Understanding test, namely as shown in the following table.

The same results were also obtained in the calculation of the content validity of the Conceptual Understanding test, namely as shown in the following table:

| Table 2. Validation Fill in the description of the problem |
|----------|----------|----------|
| N  | Cochran’s Q | Df | Asymp. Sig. |
| 4  | 5.526* | 7 | 0.596 |

The Asymp value. Sig = 0.596 which is greater than 0.05. This shows that experts give the same scales to the conceptual understanding problem. Based on the results of the calculation of the validity of multiple-choice Conceptual Understanding questions and a description, it can be concluded that the question meets the content validity.

3.2.2. **Face validity.** As in the content validity analysis that has been carried out, the entire hypothesis tested in the comparison test results from the consideration of 8 experts involved in assessing the instrument's face validity are as follows:

H₀: there is no difference in the results of the advance face validation (Multiple choice, Description)

H₁: there are at least two different results of advance validation of understanding tests (Multiple choice, Description).

3.2.3. **Test of Conceptual Understanding.** The results of the calculation of the comparison of experts for the conceptual test face validity understanding multiple choices and descriptions can be seen in the following table:

| Table 3. Multiple choice face validity |
|----------|----------|----------|
| N  | Cochran’s Q | Df | Asymp. Sig. |
| 10 | 6.576* | 7 | 0.474 |

| Table 4. Essay Face Validity |
|----------|----------|----------|
| N  | Cochran’s Q | df | Asymp. Sig. |
| 4  | 10.333* | 7 | 0.170 |

Based on the two tables it is known that the Asymp value. Sig multiple choice questions and descriptions respectively 0.474 and 0.170. Both of these values are greater than 0.05. Thus, it can be concluded that 8 experts who provide advance validation of conceptual test questions on understanding both multiple choices and descriptions provide scales that are no different.
Table 5. Validity of Conceptual Understanding Questions

| Question | Correlation | Significance | Information |
|----------|-------------|--------------|-------------|
| I        | 0.5213      | 0.000        | Valid       |
| I        | 0.2834      | 0.002        | Valid       |
| I        | 0.3293      | 0.000        | Valid       |
| I        | 0.4574      | 0.000        | Valid       |
| I        | 0.6468      | 0.000        | Valid       |
| I        | 0.6398      | 0.000        | Valid       |
| I        | 0.6777      | 0.000        | Valid       |
| I        | 0.3211      | 0.000        | Valid       |
| I        | 0.3639      | 0.000        | Valid       |
| I        | 0.3305      | 0.000        | Valid       |

From the table above, it can be seen that all items of understanding that are developed are valid.

3.2.4. Reliability. Analysis used to calculate the conceptual understanding multiple choice reliability was obtained $t_{\text{count}} = 4.485$. If taken $\alpha = 0.05$ and with $d_{k} = 103$, then obtained $t (103; 0.05) = 1.66$. Because the value of $t_{\text{count}} = 4.485$ is greater than 1.66, it is concluded that conceptual understanding multiple choice questions are developed reliable.

3.2.5. Difficulty Index. From the table 6 it can be known that the developed comprehension questions consist of 2 easy questions, 6 moderate questions and 2 difficult questions. In order to distribute proportional level of difficulty, it is better if the question number 9 is made easy, so proposition easy: medium: difficult = 3: 5: 2.

Table 6. Difficulty Index.

| No Question | IK   | Description |
|-------------|------|-------------|
| 1           | 0.2762 | difficult   |
| 2           | 0.8476 | easy        |
| 3           | 0.1429 | difficult   |
| 4           | 0.4667 | medium      |
| 5           | 0.7238 | easy        |
| 6           | 0.4190 | medium      |
| 7           | 0.6000 | easy        |
| 8           | 0.1810 | medium      |
| 9           | 0.6857 | medium      |
| 10          | 0.2095 | difficult   |

3.3. Description Test

3.3.1. Item validity. The description test consists of 4 questions. The results of the calculation of the validity of the items are shown in the following table 7.

Table 7. Validity of Description Test.

| Question | Correlation | SIG | Description |
|----------|-------------|-----|-------------|
| U_1      | 0.8156739   | 0.000 | Valid       |
| U_2      | 0.8603516   | 0.000 | Valid       |
| U_3      | 0.7042323   | 0.000 | Valid       |
| U_4      | 0.4741246   | 0.000 | Valid       |

From the table above, it can be concluded that the description of the understanding that was tested was all valid.
3.3.2. Reliability. The description test reliability uses the Cronbach alpha rule. The calculation results obtained a correlation value of 0.721. Thus using $\alpha = 0.05$ and deck = 103, $t (103; 0.05) = 1.66$. Because the value of $t$ count = 4.485 is greater than 1.66, it is concluded that description test of understanding is developed reliable.

3.3.3. Difficulty index of conceptual understanding. From the table 8, it is known that the conceptual understanding problem consists of 2 medium questions and 2 difficult questions. for that it needs to be considered so that problem number 1 is made easy and one of the questions number 3 or number 4 becomes of medium quality.

![Table 8. Difficulty index.](image)

| Question | IK       | Description |
|----------|----------|-------------|
| U₁       | 0.62143  | Medium      |
| U₂       | 0.46548  | Medium      |
| U₃       | 0.18452  | Difficult   |
| U₄       | 0.18929  | Difficult   |

4. Conclusion
The Hands-on Activity-Based Media Model that is produced is learning media in the form of flat-wake props (parallellogram, rhombus, kite and trapezoid) with proof of rectangles and triangles. Of the 8 validators and 90 math teachers stated that the hands-on activity-based media model was made very well because of, (1) can build students' understanding of the concept of flat building, (2) can facilitate/understand the concept of the area of flat building so that students can construct/build their own knowledge, (3) the use of media is more easily understood by students than through teacher explanations, (4) can affect the power of children's visualization, (5) fun making students active learning and not bored, (6) making students more creative and exploring their psycho-motor skills, (7) learning while playing, (8) facilitating student abstraction in mathematics learning. This is in line with the opinion of Martignon and Krauss [12] revealing that learning by using the touch of a hand and tampering with an object by hand can make students longer to remember the material being taught. Similarly [13] states that Hands-On Activity makes science more clear, meaningful, and enjoyable for most students.

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