Interactive Task Development of The Area and Perimeter of Rectangle to Reduce The Anxiety of Secondary Students in Doing Mathematics Task

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Abstract. This article discussed the interactive task development of the area and the perimeter of a rectangle to decrease the anxiety of secondary students in doing Mathematics task. The purpose of this development was producing an interactive task of rectangle area that was valid and effective to decrease the students’ anxiety in doing mathematics task. The development consists of three phases, they were: (1) Analysis phase, (2) design phase, and (3) development phase. The product that developed was validated and tested in a small scale with five trial subjects. The validator concluded that the validation product was valid. Furthermore, the trial result in small scale concluded that the product could decrease the anxiety of secondary students in doing Mathematics task.

1. Introduction
Mathematics problem divided into two problems, they were the problem that was solved by usual procedure or called routine procedure and problem that could not be solved by the usual procedure or called nonroutine problem. Commonly, a problem in task form was made with presenting data description that was known and supported by picture illustration. Students were asked to finish that problem by their knowledge.

Students often feel to be anxious when they tried to solve mathematics problems. Anxiety in mathematics that happened to students called Math Anxiety. [1] described: “Math anxiety is commonly defined as a feeling of tension, apprehension, or fear that interferes with math performance”. Anxious feeling and nervous that faced by students could disturb them in solving mathematics problem and number manipulation. [2] in his research found that the students’ anxiety of mathematics has a negative correlation to the study result of junior high school students. It was shown that when the students gave a massive worried about mathematics, then the result that gotten to solve the mathematics problem was not good. Mathematics anxiety has a negative correlation to students’ motivation and achievement [3]. For those reasons, the level of mathematics anxiety that was faced by students needed to be decreased.

One of the ways to reduce the student's mathematics anxiety was making tasks based on daily context and enclosed interactive simulation. Giving interactive simulation was hoped able to decrease the level of students anxiety since students could do experiment or simulation to solve the problem that was given. From those explanations, the researcher wanted to develop an interactive problem to decrease students anxiety when they solved mathematics task, especially that related to the area and
perimeter of a rectangle. This material was chosen because it was the basis for determining the other area of the shape. Moreover, area measurement is an important material of school mathematics [4,5].

2. Method
The development of an interactive task was through three phases: analysis phase, design phase, and development phase. Prototype interactive task that had been developed would be validated by a material expert, a media expert, and a practitioner that his profession as a secondary teacher. Prototype interactive task that had been validated would be tested on a small scale with five-person of subject trials.

In the analysis phase was done study KI/KD, determination indicator and the learning purpose. After that, arranging the task that measured learning accomplishment. One of the purposes that wanted to be gained in rectangle area material was students could decide the rectangular area and applied it to solve the problem that related to the rectangle area. So that, tasks that would be arranged was tasks which measured the student's capability in deciding the rectangle area concept and planning. In design phase was done design and interactive task design. Then, the design that had been gained would be realized, so that it became a prototype interactive task. Prototype interactive task that had been generated would be validated by material expert/media expert.

Technical data analysis of validity test was done by calculating the validation score. There were five steps to get the validation score : (1) recap the assessment data model validity to the table that involve \( I_i \), assessment phase \( (A_i) \), and the validity score, (2) deciding the validation result of average score from all validators for each indicator, (3) deciding average score in every aspect, and (4) deciding the validity score. Validity score formula \( (V_a) \) could be seen as bellow.

\[
V_a = \frac{\sum_{i=1}^{n} A_i}{n}, \quad A_i = \frac{\sum_{j=1}^{m} I_{ij}}{m} \quad \text{and} \quad I_i = \frac{\sum_{j=1}^{k} V_{ij}}{k}
\]

\( V_{ij} \) is the score of data with \( V_{ij} \) was data of validator score to- \( j \) for indicators to- \( i \), \( k \) was the total of validators, \( A_i \) was the average score for aspect to- \( i \), \( I_{ij} \) was the average for aspect to- \( j \), \( m \) was the total of indicators in aspect to- \( i \), dan \( V_a \) was the score total of all aspects, \( A_i \) was the average score for aspect to- \( i \), \( n \) was the total of aspects. The criteria of validation score was presented as Table 1 below.

| Interval | Validity Criteria | Explanation   |
|----------|------------------|---------------|
| \( 1 \leq V_a < 1.75 \) | Invalid | Revise all |
| \( 1.75 \leq V_a < 2.5 \) | Less valid | Don’t revise all |
| \( 2.5 \leq V_a < 3.25 \) | Valid enough | Don’t revise all |
| \( 3.25 \leq V_a < 4 \) | Valid | Did not need to be revised |
| \( V_a = 4 \) | Very Valid | Did not need to be revised |

After been validated, a prototype interactive task would be tested on small scale with five trial subjects. Then, the researcher would give anxiety mathematics questionnaire to the trial subjects when they had finished to do their interactive task. The questionnaire consists of eight statements about anxiety aspect with score anxiety 1 until 5 in every aspect. Score 5 for the highest of anxiety level, score 4 for high anxiety level, score 3 for average anxiety level, score 2 for low anxiety level, and score 1 for the lowest anxiety level. Total of anxiety score \( (x) \) was used to decide the anxiety level with criteria as presented in Table 2 below.
### Table 2. The Criteria of Anxiety Level

| Interval Anxiety score | Anxiety Level |
|------------------------|---------------|
| $36 < x \leq 40$       | Highest       |
| $28 < x \leq 36$       | High          |
| $20 < x \leq 28$       | Average       |
| $12 < x \leq 20$       | Low           |
| $0 \leq x \leq 12$     | Lowest        |

3. **Result and Discussion**

3.1. **Development Result**

The interactive task was developed by using the Learning Management System (LMS) Moodle and GeoGebra. Moodle was used to manage a test and GeoGebra used to an interactive simulation. There were three tasks with five questions that would be presented. Every task had an interactive simulation that could be used by students.

The first task was presented about a problem that was planting grass in a place (field) that was provided. Grass swath claimed $1 \text{ m}^2$. Those problems measured the students’ ability in the area of the rectangle. Problem number one consists of three questions. **Figure 1** was an illustration display and interactive simulation task number one.

![Figure 1. Interactive Task Display Number 1](image)

The questions that were asked to number one as below:

- **a.** If the total of grass swath that needed to cover the field was field area, how square-feet the area of Mr. Budi’s field that could be planted grasses?
- **b.** How did you get the answer from point (a) above? Explain.
- **c.** From questions (a) and (b) above, if there was a rectangle that had size length $p$ and width $l$, how to decide the area of a rectangle?

The second question presented about deciding how much the rectangle that could be made with a requirement the area had to 24 unit area. Those problems measured the students’ capability about the rectangle area. In second question students able to do a simulation to decide the answer from a
problem that was given by dragging and dropping the blue box into the green box. Interactive simulation number two was presented into Figure 2.

![Figure 2. The Display of Interactive Task Number 2](image)

The third question examining the students’ capability about the perimeter of the rectangle and the used of rectangle area in daily life. A problem that was given about how to make a rectangle garden that had perimeter 24 meters, with minimum and maximum cost that was needed if that garden was planted grass with cost Rp. 15,000/m². In the question was presented interactive simulation that could be used by students to help they answered the question. An interactive simulation that was given was a slider that could be swept by the students. Those sliders stated the length and the width of a rectangle, so the rectangle that was shaped had a size which appropriated with the score of the slider. Interactive task number three was presented in Figure 3.

The questions number three as below:
A garden would be made as rectangle shape. The length and the width of those garden were integers. If the perimeter of those garden must be 24 meters,

- **a.** How many rectangle gardens that could be made with different size?
- **b.** If those garden would be planted grass and if the cost each square-meter Rp. 15,000, how much minimum and maximum money that needed?

![Figure 3. The Display of Interactive task](image)
3.2. Validation and Trial Result
In this research there were two validators who validated prototype interactive task, one person as a material expert (a lecture with doctorate title) and the other person as a practitioner (teacher). The aspect that would be rated by the validators were assessment contents, picture, and animation, language and symbol, and the last was the assessment used. The validation result of a prototype interactive task was presented into Table 3 as below.

| No | Aspect                        | V1 | V2  |
|----|-------------------------------|----|-----|
| 1  | Assessment content           | 4  | 4   |
| 2  | Language and symbol          | 3.67 | 3.83 |
| 3  | Picture and animation        | 4  | 4   |
| 4  | Assessment used              | 4  | 3.75 |

Score average: 3.92 | 3.89

Explanation
V1 : Practitioner (teacher)  
V2 : Material expert/media (lecture)

The average of validity score \( (V_a) \) from the two validators was 3.91. Based on the validity criteria in Table 1, concluded that the prototype that was developed was valid and not need revision. The validators’ comments were presented as Table 4 below.

| No | Comments                                                                 |
|----|--------------------------------------------------------------------------|
| 1  | Generally, the assessment was valid                                      |
| 2  | All questions were right. The language was easy to be understood.        |
|    | The animation that appeared in questions helps the student to finish the |
|    | task and able to decrease the students’ anxiety.                        |

After prototype interactive task was validated, the researcher did trial prototype interactive task to a small group that consists of 5 students as a trial subject. The trial was done to know was the prototype interactive task could decrease anxiety. After the student did the task, the researcher gave the anxiety questionnaire. The anxiety questionnaire was presented as Figure 4 bellow.

Figure 4. The result of Prototype Trial to Subject
Based on Table 2 about the level of students’ anxiety and the trial result of a prototype interactive task to the trial subject has gotten the level of students’ anxiety data as Table 5 below.
Table 5. The Level of Trials Subject Anxiety

| Trial Subject | Score | Criteria of Anxiety Level |
|---------------|-------|----------------------------|
| S1            | 9     | Lowest                     |
| S2            | 12    | Lowest                     |
| S3            | 9     | Lowest                     |
| S4            | 13    | Low                        |
| S5            | 10    | Lowest                     |

Based on Table 5 concluded that four students (80%) had the lowest anxiety level and one student (20%) had low anxiety level. It could be said that the prototype interactive task that was developed could decrease the students’ anxiety. After finishing an interactive task, trial subject gave comments as Table 6 below.

Table 6. Trial Subject’s Comment to Prototype Interactive Task

| Subject | Comments                                                                 |
|---------|--------------------------------------------------------------------------|
| S1      | I was happy with this task. If it was impossible, the mathematic task was better like this. |
| S2      | The task was challenging but it was ok since there was a helper.          |
| S3      | I was not afraid if the task like this. The simulation helped me when I did the task |
| S4      | The task was interesting, firstly I was confused to use the animation but then I could handle it. |
| S5      | The task was challenging.                                                |

4. Conclusion

This interactive task area material and the perimeter of the rectangle were developed by three phases, they were analysis phase, design, and development. The interactive task was completed with the simulation that could help the students to finish the task that was given. Interactive task development combined software LMS Moodle to manage the course and GeoGebra software to make an interactive simulation. Based on the validation result done by expert and practitioner, prototype interactive task that was developed was valid, either the construction or the content. It could be concluded that the prototype that was developed able to reduce student’ anxiety when they did mathematics task. Furthermore, based on small scale trial with five junior high school students, prototype interactive task that was developed could make students’ anxiety were lowest (80%) and low (20%). For further research, it would be better if this interactive task tested on a bigger scale. The interactive task that was developed could be added audio/video to help the task more clear and decrease the level of students’ anxiety in doing a task. In addition, the interactive task could be developed in android mobile.

References

[1] Ashcraft MH. Math Anxiety: Personal, Educational, and Cognitive Consequences: *Current Directions in Psychological Science* 2002;11:181–5.

[2] Puteh M, Khalin S Z. Mathematics Anxiety and Its Relationship with the Achievement of Secondary Students in Malaysia. *International Journal of Social Science and Humanity* 2016;6:119–22. doi:10.7763/IJSSH.2016.V6.630.

[3] Effandi Zakaria, Norazah Mohd Nordin. The Effects of Mathematics Anxiety on Matriculation Students as Related to Motivation and Achievement. *EURASIA J Math, Sci Tech Ed* 2008;4:27–30. doi:10.12973/ejmste/75303.

[4] Lehrer R. Developing Understanding of Measurement. A Research Companion to Principles and Standards for School Mathematics, *Reston*: National Council of Teachers of Mathematics; 2003, p. 179–92.

[5] Kemdikbud. Peraturan Menteri Pendidikan dan Kebudayaan RI Nomor 24 Tahun 2016 Tentang Kompetensi Inti dan Kompetensi Dasar Pelajaran pada Kurikulum 2013 pada Pendidikan Dasar dan Pendidikan Menengah 2016.