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Mathematical modeling teaching materials using hyperthermia context

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Abstract: The purpose of this paper is to produce teaching materials for mathematical modeling in the context of hyperthermia for students of MTs Negeri 1 Lahat. This research uses design research with the type of development study that has two stages: preliminary and formative evaluation. The preliminary phase is carried out by making product modeling and evaluation teaching materials, data obtained by validating with experts. The success criteria of this study are to obtain valid teaching material, based on input from expert review and analyzing results from one-to-one stages. Based on the results of validation with experts and student answers at one-to-one. Needed, obtained valid modeling teaching materials.

1. Introduction

Studying mathematics in a class that separates mathematics from the real world will make students' perceptions of mathematics unattractive and difficult. Perception is understood as a person's assessment of good and bad of the quality of the surrounding environment [1]. The wrong perception of mathematics begins with the separation between mathematics lessons and their use in the real world. In fact, mathematical applications are used to solve real-world problems [2]. Based on PISA 2018 results, PISA Indonesia scores in mathematics literacy down from 2015. The PISA question expects students at this level to work strategically using broad thinking and reasoning skills, well developed, according to related representations, symbolic and formal characterizations, and insights related to this situation [3]. Therefore, skills are needed to solve mathematical problems. The skills to choose or design a plan or strategy to use mathematics to solve problems arising from the assignment or context and guide their implementation [4]. This ability is generated as a problem-solving process. One of the learning forms of problem-solving character and is relevant to students' lives is learning mathematical modeling. Mathematical modeling can be used by teachers in motivating students about the relevance of mathematics to solving real problems and eliminating fear with a positive approach to realize meaningful learning [5]. Students interpret mathematical knowledge gained from informal, meaningful, and enforceable experiences. In addition, implicit modeling activities familiarize them with mathematical approaches to everyday life situations. In this case, modeling serves as a teaching goal and as a means of helping students in learning mathematics [6].

To get problems that are based on real-world problems in mathematics learning, it requires a context that is close to students. Students can interpret modeling with the context of natural phenomena [3]. The context of natural phenomena that is often encountered is hyperthermia, hyperthermia is defined as a condition where a person's body temperature rises above its normal range [7]. Cases of hyperthermia are particularly common in the United States, in 2019, 34 children died due to hyperthermia [8].



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To help teachers in learning mathematics modeling, it is necessary to approach the learning process. The approach used refers to the resolution of problems related to the real world. Studying mathematical modeling using the Indonesian Realistic Mathematics Education (IRME) approach can produce valid and practical products [9]. The IRME approach in initiating learning use phenomena and real applications to students, the problem given in the case of contextual problems [10].

Looking at the above description, it takes a breakthrough to bring real-world problems into the classroom. Teachers are expected to develop the study of mathematical modeling to solve problems by using the context close to the students. To see the success of the process, it is important to the accuracy of the instrument and the teaching materials to measure the students' mathematical skills [11]. Many studies-link modeling as a framework in their research. Broadly speaking, they write about critical thinking skills and problem-solving abilities [12, 13, 14]. Thus, the authors are interested in developing instruments Mathematical modeling teaching materials that are able to create learning processes in the classroom that are able to create critical thinking space and problem-solving.

Based on the explanation above, the author is interested in conducting thorough research entitled "validation of mathematics modeling teaching materials by using hyperthermia context". The purpose of this study is to make teaching materials valid in language, content, and construction.

2. Method

This study uses design research with the type of development study [15]. This research has 3 stages, namely, analysis, design, and evaluation. In the analysis phase, the authors conducted a literature study, curriculum analysis, and mathematical modeling. In the second stage, the authors designed mathematical modeling products. In the final stage, the authors used a formative evaluation design (Figure 1).

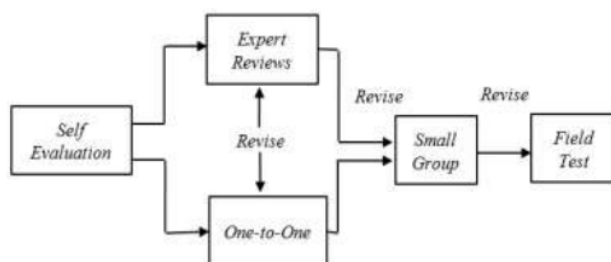


Figure 1. Design of formative evaluation design [16, 17]

The criterion for the success of this study is that the mathematical modeling student worksheet for learning modeling is valid. The subjects of this study were 3 students from 9-grade MTs Negeri 1 Lahat, South Sumatra, Indonesia. In collecting data (1) the writer asks for opinions from expert reviews to get worksheets for students modeling valid mathematics in terms of content, construction, and language, (2) the interview was conducted with 3 students to measure whether the teaching material provided did not have confusing sentences and could be digested by junior high students. The data obtained were analyzed descriptively (1) Based on the comment sheet at the time of the walkthrough analysis, expert comments were used as a basis for obtaining valid student worksheets related to mathematical modeling, (2) analyze the results of one-to-one to obtain the validity of teaching materials.

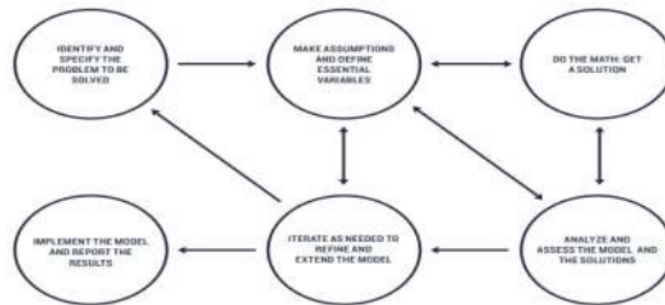


Figure 2. The math modeling process [18]

In compiling teaching materials in mathematical modeling that guide students in critical thinking and problem-solving. Our research follows the definition of mathematical modeling from GAIMME which has 6 completion processes, namely; (1) identifying problems that must be solved, (2) making assumptions and defining variables, (3) doing math to get solutions, (4) analyzing and assessing solutions, (5) iterations to improve and expand the model, and (6) implementing model and report the results. In the process, students will develop models to solve problems of their interest.

3. Result and Discussion

3.1. Result

Based on Figure 1, this study starts from self-evaluation, while the authors make a product design of mathematical modeling teaching materials using the context of hyperthermia. Furthermore, the author will conduct an expert review stage of several experts in the field of mathematical modeling combined with IRME (Figure 2). Based on expert review comments obtained input from Bambang produced teaching materials that guide students to recognize hyperthermia. The next expert Stevanus gives a comment to give a parable of the shape of the human body to matter. So, it can be calculated using mathematics.

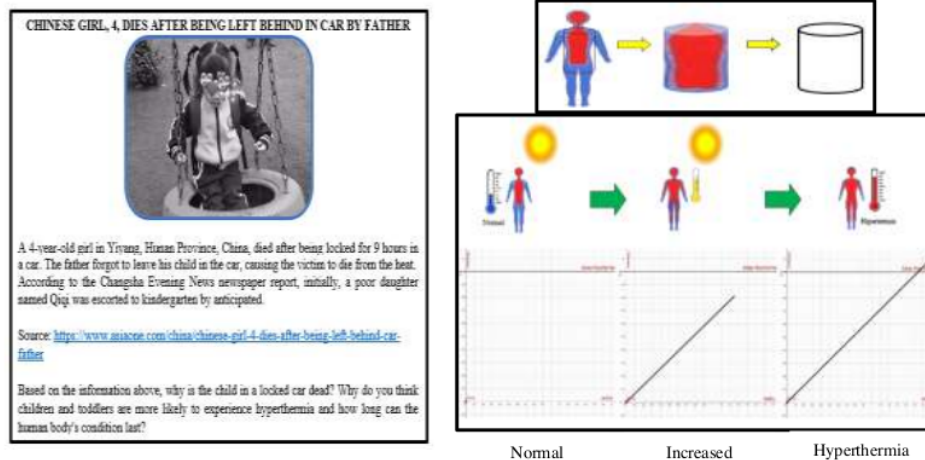


Figure 3. Mathematical modeling problem

Figure 3 is an instrument of teaching materials that have been prepared based on expert comments. As a problem in modeling this time, the authors provide descriptions of online news. That, a child in China died because of being locked in a car for 9 hours on a hot day, it is strongly suspected that the child died due to heat. To facilitate the resolution of these problems the writer directs students to make assumptions. That, the human body is tubular. Then, the writer also included a chart to give students instructions about hyperthermia and each graph changed to the right of the graph, to show the process of moving body temperature from normal to increase body temperature.

In these circumstances, of course, someone needs fluids to make body temperature return to the normal state. Naturally, the body will release fluid from the inside to normalize it, the fluid from the body is excreted through the sweat glands. This condition will last as long as the amount of fluid in the body is still available. However, if this incident occurs continuously for a long time. Then, fluids from the body will run out. Based on the graphs that can be seen, if the ratio of the body to time > 1 , the phenomenon is called hyperthermia.

3.2. Discussion

Based on the results of the one-to-one stage, three high, middle, and low ability students were conducted. Also, the results of the interviews with students showed that in terms of language, content, and construction of mathematics modeling teaching materials can be read and understood well by students. In fact, some students have experienced being in a car with the state of a car engine that died with the hot weather.

R : *Have you ever experienced that incident?*

S : *yes, I have.*

R : *Are you having problems translating the problem?*

S : *yes, the language is so difficult to understand, it's better to explain hyperthermia more towards mathematics.*

R : *If I make lines in graphical form, can you understand this like this?*

S : *yes, I can*

From the results of the conversation between researchers (R) and students (S). hence, the researcher gives the graph written in figure 3 before. So that conclusions can be given, Contextual learning based on experience can help student's pedagogical understanding of modeling learning [19]. Learning that is close to students is needed in the process of solving everyday problems. For this reason, it is necessary to implement from teacher to student [20]. Modeling learning that is linked using theory from IRME also considers a deeper understanding of problem-solving. According to Bahamonde, mathematics modeling learning reflects that the emerging models are not only oriented towards learning design but also promote students' cognitive development [21].

4. Conclusion

Based on the results of self-evaluation, mathematics modeling teaching materials using hyperthermia contexts, which have carried out expert and one-to-one tests with students, produce valid modeling teaching materials. This research can be continued in the next stage, which is a small group to measure the practicality of this teaching material.

5. Acknowledgments

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