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# Development of Mathematics Teaching Materials on Statistics with A Problem-Solving Approach

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**Abstract**

This study aims to develop mathematics teaching materials on statistics material that is practical, effective, and valid, and suitable as a student learning module. The type of research used is Research and Development (R&D), which involves developing teaching materials in the form of modules on the subject of statistics. The model used in this teaching material research is the 4-D development model (four D models). This research model has four stages of research, namely 4-D development (four D Models), including define, design, develop, and disseminate. Based on this study, it was found that the Module with a problem-solving approach to statistics material developed by researchers with the 4D model modified into 3D was declared valid by material experts, and media experts with Very Good criteria, and based on the assessment of education experts, namely teachers and students. A module with a problem-solving approach to statistics material, developed by researchers, was declared practical. This means that the Module developed by researchers makes it easier for students to learn and can increase students' interest and motivation in learning mathematics, especially statistics material.

Keywords: Problem-solving; Research and Development; Statistics; Teaching materials.



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## 1. Introduction

Education is expected to be able to form individuals who are competent in their fields, so that they are in line with the development of science and technology. Regulation of the Minister of National Education (Permendiknas) Number 41 of 2007 concerning process standards, among others, is expected that teachers can develop teaching materials as one of the learning resources. Arifin (2017) states that mathematics learning in the 21st century has goals with 4C characteristics, namely: communication, collaboration, critical thinking and problem solving, creativity, and innovation.

Mathematical learning, as described by Pujiastuti et al. (2020), involves students engaging with teachers to understand structured mathematical knowledge. This knowledge is built upon logical deductions from established or foundational truths, expressed precisely through symbolic language. Furthermore, Zuin et al. (2018) highlight the crucial role of problem solving in this process, as it allows students to apply mathematical concepts and develop the reasoning skills that make school mathematics so vital. According to Nurdin (2016), an important problem that teachers often face in learning activities is when choosing or determining the right learning materials or teaching materials in order to help students achieve the expected competencies. This is due to the curriculum or syllabus, teaching materials that are only written in outline form as "subject matter". With teaching materials, teachers will be more guided in delivering the material to students. The view of Prastowo (2015) states that, teaching materials are a set of materials arranged systematically, which are used by teachers and students in the learning process. With these teaching materials, it is intended to assist students in learning the things needed in an effort to achieve learning objectives.

Learning resources serve as fundamental and indispensable elements within educational frameworks, carefully crafted and developed with precision to ensure coherence with established curricular standards and to accomplish predetermined educational objectives. When these instructional materials are organized and arranged through systematic and effective approaches, they transform into highly influential pedagogical instruments that facilitate the transmission and delivery of academic content to learners (Berharu & Sheferaw, 2022). In essence, the structural effectiveness and design quality of educational resources play a pivotal role in determining the success of knowledge transfer processes and the attainment of desired educational goals.

One of the innovative learning models that can meet the demands of the Merdeka Curriculum, as well as models that can be applied by teachers during the learning process, is the problem-solving model. Problem-solving can help learners develop their new knowledge and take responsibility for their learning. A teacher must be good at stimulating students to try to express their opinions, so that students are expected to be more independent and more active, because they do not only listen to explanations from the teacher, but also actively solve the problems discussed. In addition, mathematics learning becomes more fun and has a positive effect (Kilic, 2013), namely, students become more active in learning. Problem-solving is not just a teaching model but also a method of thinking, because in problem-solving, you can use methods that start by looking for data and then proceed to check the answer. Polya (1973) defined problem-solving as the act of finding a solution when faced with a challenge. Similarly, Maryam

(2013) research highlighted that a key aspect of problem-solving is its ability to connect with real-life situations. The stages of problem solving, problem solving, and rechecking. These abilities align with the demands of 21st-century mathematics education (Mcgrath & Fischetti, 2019). To enhance math proficiency in the classroom, teaching should prioritize conceptual understanding (Zaslavsky, 2019).

In developing teaching materials in the form of modules, researchers focus on the subject matter of statistics. Statistics is one aspect of mathematics that must be given to students in junior high school / MTs education units in accordance with the Content Standards of Permendiknas No. 22 of 2006. Statistics material itself has been studied by students since elementary school in grade six and further deepened in junior high school / MTs. Statistics is one of the subjects in mathematics that is less liked and considered difficult by students, because in this material students are bored to calculate the data presented, and often of them make mistakes in calculations.

## 2. Methods

This research was conducted at SMP Pancakarya Tangerang for the 2024/2025 academic year, which is located at Jl. Perintis Kemerdekaan I No. 1, Tangerang. The type of research used is Research and Development (R&D) development research by developing teaching materials in the form of modules on the subject of statistics. The model used in this teaching material research is the 4-D development model (four D models) suggested by Thiagarajan et al. (1947). Research (R&D) is a research method used to produce certain products and test the effectiveness of these products. To be able to produce certain products used research that is needs analysis and to test the effectiveness of these products so that they can function in the wider community, research is needed to test the effectiveness of these products. The resulting product is a module on learning math material, Statistics.

This research uses the 4-D model as the steps in this research. According to Thiagarajan (Hamdani, 2011), it consists of four stages of development. The first stage is define or often referred to as the needs analysis stage, the second stage is design, which is preparing a conceptual framework of learning models and devices, then the third stage is develop, which is the development stage involving validation testing or assessing the feasibility of the media, and the last is the disseminate stage, which is the implementation on the real target, namely the research subject. The model used in this study is more detailed in its steps and more extensive in its development, namely up to the deployment in the field. However, the development and dissemination stages require a lot of money and time to be provided. However, there are several advantages of using this model, namely that the stages of implementation are divided in detail and systematically and in its development involve expert judgment, so that the teaching materials have not been tested in the field and revisions have been made based on the assessment, suggestions, and input of experts.

## 3. Results and Discussion

The process of developing this Module uses the 4D model (Define, Design, Develop, and Dissemination), but this research only reaches the develop stage because the time is not

possible for researchers. The Module development stage begins with the Define stage, Design stage, and ends with the Develop stage.

## 3.1 Define

This stage is the initial stage that must be done before developing a Module with a problem-solving approach. There are several analyses that must be done in this stage, namely, curriculum analysis, learner analysis, material analysis, and formulating objectives.

### *3.1.1 Curriculum Analysis*

This analysis was conducted to determine the curriculum used at the school. This research was conducted at SMP Pancakarya Tangerang. The results of the curriculum analysis show that the curriculum used is the Merdeka curriculum. Here are some of the results of the curriculum analysis:

1) The curriculum used at SMP Pancakarya Tangerang, especially class VIII, is the Merdeka Curriculum.
2) The syllabus used is Learning Outcomes (CP), Flow of Learning Objectives (ATP), Learning Objectives (TP).
3) In the Merdeka Curriculum, there are 4 Core Competencies (KI), namely KI-1 (Spiritual), KI-2 (Social), KI-3 (Knowledge), KI-4 (Skills).

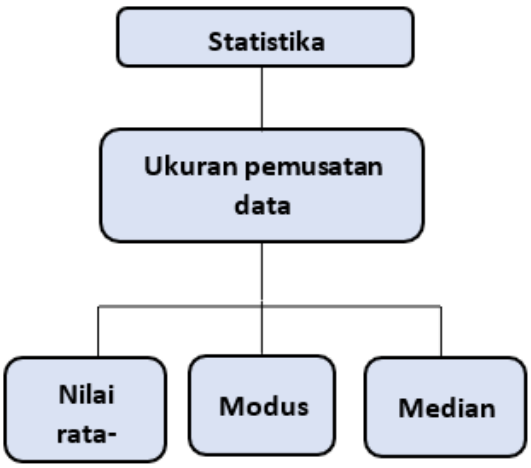



**Figure 1** Module concept map

### *3.1.2 Learner Analysis*

After analyzing the curriculum, the next step is to analyze the learners. In the learner analysis, it is found that students do not actively participate in learning. Students sometimes do not pay attention to the teacher who is explaining. Students' interest and enthusiasm in learning math are also still low. Students also lack focus in class learning, and in learning the material, students are still unable to relate the material they have learned to everyday life. They have difficulty understanding and solving material that is related to everyday life, such as solving story-shaped problems. Even just understanding the questions is difficult for them. Based on this, a problem-solving-based product was developed that familiarizes students with discussion, problem solving, asking questions, and linking the material learned to everyday life.

### *3.1.3 Material Analysis*

Material analysis, based on the above analysis, the material to be used in the Module was chosen, namely Statistics material. This material was chosen because it is difficult material for students, as it is usually related to everyday life and presented in the form of story problems, whereas students still have difficulty relating the material studied to everyday life. So it is hoped that this research can help students relate the material to everyday life. The material used is focused on group data. With KD analyzing group data statistics.

### *3.1.4 Formulating Objectives*

Formulating these objectives is done to determine the learning objectives of the developed Module. Based on the results of the analysis that has been done, the Module to be developed has 2 learning objectives, namely:

1) Identifying the Mean, Median, and Mode of group data.
2) Solve real problems related to Mean, Median, and Mode of group data into everyday life.

## 3.2 Design

This stage means designing the developed Module. In this stage, there are several things that must be done, namely media selection, format selection, and initial design.

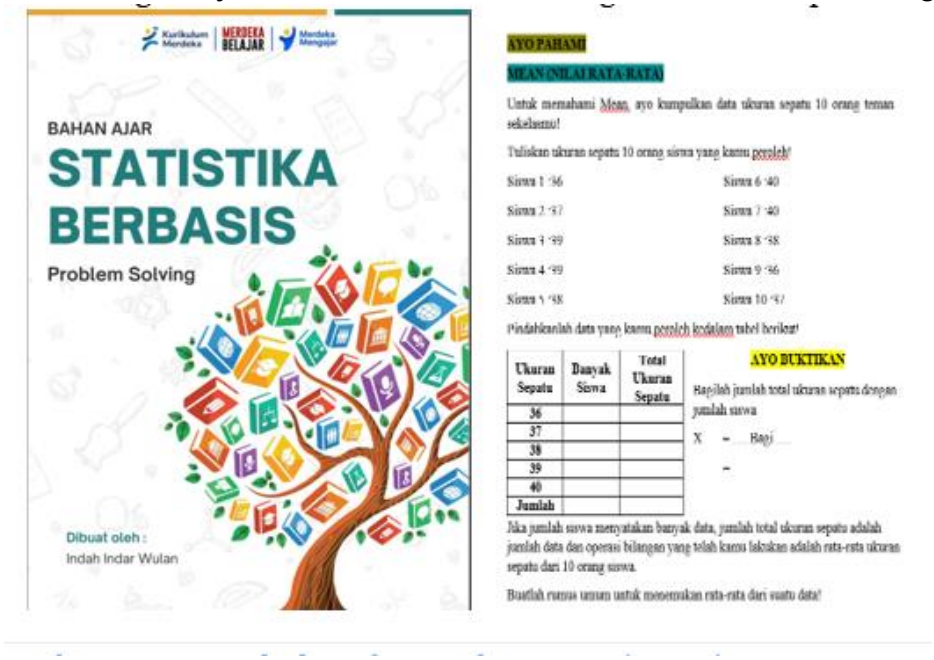



**Figure 2** Module Cover and Table of Contents

### *3.2.1 Media Selection*

Selecting media to be developed in accordance with the material and the needs of students. Based on the analysis that has been done, it is found that the media needed by students is the Module. This module was developed in order to assist students in learning while increasing student interest and motivation.

### *3.2.2 Format Selection*

Format selection is done by selecting learning strategies and learning resources and then designing the learning content of the Module as interesting as possible. The format used

in the form of teaching materials, in this case Problem Solving-based Modules on statistics material, refers to the Merdeka Curriculum which is prepared by adopting a Problem Solving-based learning system in which there is a problem-solving process both individually and in groups. Students learn by solving problems relevant to real life or subject matter, which encourages critical, creative, and collaborative thinking.

### *3.2.3 Initial Design*

At this stage, we began to compile content including SK, KD, material objectives, examples of exercise questions, both individual and group, and so on to be included in the Module. After this initial design is complete then given input by the supervisor. This initial design is called draft I. The following is the initial product design.

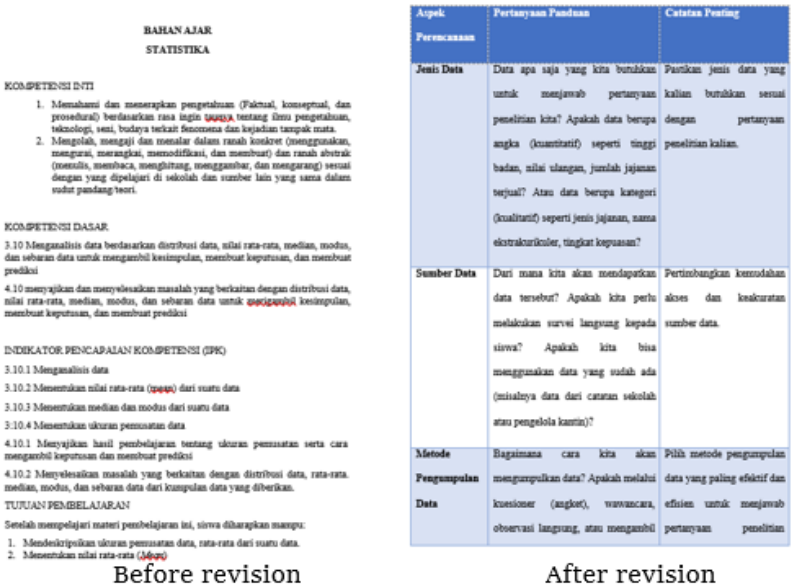
## 3.3 Develop (Development)

The development stage includes original validation, namely material, media, and education experts, followed by revisions and product trials.

### *3.3.1 Expert validation*

This validation is carried out to determine the quality of the product before being tested. Validation was carried out by 3 experts, including material experts, namely M. Arie Firmansyah, S.Pd, M.Pd, media experts, namely Barra Pradja, M.Pd., and Education experts who are mathematics teachers at SMP Pancakarya Tangerang, namely Fenny Lestari, S.AG. This stage aims to obtain input and suggestions for the developed Module. From the validation sheet data obtained an assessment of the material expert of 3.5, media experts obtained a result of 4 and for education experts obtained a result of 4.

Furthermore, after validation, namely revising the Module according to the suggestions given by the expert, the researcher revised the Module in several parts as can be seen below.



BAHAN AJAR
STATISTIKA

KOMPETENSI INTI

1. Memahami dan menerapkan pengetahuan (Faktual, konseptual, dan prosedural) berdasarkan rasa ingin tahunya tentang ilmu pengetahuan, teknologi, seni, budaya terkait fenomena dan kejadian tampak mata.
2. Mengolah, mengaji dan menalar dalam ranah konkret (menggunakan, mengurai, merangkai, memodifikasi, dan membuat) dan ranah abstrak (menulis, membaca, menghitung, menggambar, dan mengarang) sesuai dengan yang dipelajari di sekolah dan sumber lain yang sama dalam sudut pandang/teori.

KOMPETENSI DASAR

3.10 Menganalisis data berdasarkan distribusi data, nilai rata-rata, median, modus, dan sebaran data untuk mengambil kesimpulan, membuat keputusan, dan membuat prediksi

4.10 menyajikan dan menyelesaikan masalah yang berkaitan dengan distribusi data, nilai rata-rata, median, modus, dan sebaran data untuk mengambil kesimpulan, membuat keputusan, dan membuat prediksi

INDIKATOR PENCAPAIAN KOMPETENSI (IPK)

3.10.1 Menganalisis data

3.10.2 Menentukan nilai rata-rata (mean) dari suatu data

3.10.3 Menentukan median dan modus dari suatu data

3.10.4 Menentukan ukuran penusatan data

4.10.1 Menyajikan hasil pembelajaran tentang ukuran pemusatan serta cara mengambil keputusan dan membuat prediksi

4.10.2 Menyelesaikan masalah yang berkaitan dengan distribusi data, rata-rata. median, modus, dan sebaran data dari kumpulan data yang diberikan.

TUJUAN PEMBELAJARAN

Setelah mempelajari materi pembelajaran ini, siswa diharapkan mampu:

1. Mendeskripsikan ukuran pemusatan data, rata-rata dari suatu data.
2. Menentukan nilai rata-rata (Mean)

Before revision

| Aspek Perencanaan | Pertanyaan Panduan | Catatan Penting |
|---|---|---|
| **Jenis Data** | Data apa saja yang kita butuhkan untuk menjawab pertanyaan penelitian kita? Apakah data berupa angka (kuantitatif) seperti tinggi badan, nilai ulangan, jumlah jajanan terjual? Atau data berupa kategori (kualitatif) seperti jenis jajanan, nama ekstrakurikuler, tingkat kepuasan? | Pastikan jenis data yang kalian butuhkan sesuai dengan pertanyaan penelitian kalian. |
| **Sumber Data** | Dari mana kita akan mendapatkan data tersebut? Apakah kita perlu melakukan survei langsung kepada siswa? Apakah kita bisa menggunakan data yang sudah ada (misalnya data dari catatan sekolah atau pengelola kantin)? | Pertimbangkan kemudahan akses dan keakuratan sumber data. |
| **Metode Pengumpulan Data** | Bagaimana cara kita akan mengumpulkan data? Apakah melalui kuesioner (angket), wawancara, observasi langsung, atau mengambil | Pilih metode pengumpulan data yang paling efektif dan efisien untuk menjawab pertanyaan penelitian |

After revision

**Figure 3** Design revision by material experts

Then the assessment was carried out by education experts to find out the practicality data. Based on the Education expert's suggestions, the researcher made

revisions by adding practice questions at the end of the lesson as shown in Figure 7 below.

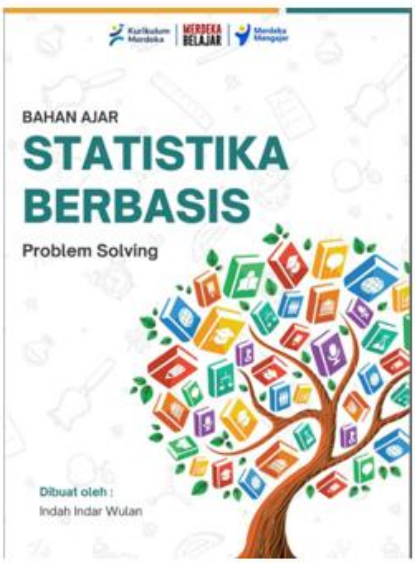
***Latihan Soal Tahap 2:***

1. Bayangkan kelompokmu memilih Misi Data 1 (Misteri Jajanan Favorit di Kantin Kita). Sebutkan minimal tiga jenis data kuantitatif dan tiga jenis data kualitatif yang mungkin relevan untuk misi ini!
2. Untuk Misi Data 2 (Jejak Pertumbuhan Tinggi Badan Siswa Kelas VII dan VIII), metode pengumpulan data apa yang paling tepat menurut kelompokmu? Jelaskan alasannya dan sebutkan alat yang dibutuhkan!
3. Dalam Misi Data 3 (Rahasia Sukses Belajar Matematika), sebutkan dua ukuran pemusatan data dan satu ukuran penyebaran data yang menurut kelompokmu

berguna untuk menganalisis hubungan antara waktu belajar dan nilai ulangan! Jelaskan mengapa kalian memilih ukuran-ukuran tersebut!

**Figure 4** Design revision by education experts

As seen above, the researcher revised in several parts then the revised design according to this expert's suggestion was called draft II.





Before revision After revision

**Figure 5** Design Revision

## 3.4 Limited Testing

The testing phase in this study was a limited testing on students in grade VIII of SMP Pancakarya Tangerang. This trial was conducted on 10 students at the school. This trial was carried out by giving the Module to students and then giving a student response questionnaire to the Module developed by the researcher. The questionnaire was given to be filled in by students to find out students' responses and suggestions for the Module with a problem solving approach to statistics material developed by researchers. From the results of the student response questionnaire, it is known that the average score is

3.4. So, it can be said that the Module with a Problem Solving approach to statistics material has a very good assessment.

### *3.4.1 Validity Analysis*

The assessment of the validity of the developed Module was carried out by mathematics material experts and media experts. This stage was carried out to test the validity of the Modules developed by researchers. The validity of the Module in terms of content feasibility, agreement feasibility, language feasibility and problem solving-based Modules was assessed by material expert validators. The average validity score by material expert is 4.5. This shows that the Module has good criteria. And it can be said that "Module with Problem Solving approach on statistics material" has a good assessment in terms of material quality.

Furthermore, the validity of the Module, which will be reviewed from the Module size, Module cover design, and Module content design, is assessed by media expert validators. According to Validity results by media experts, the average score obtained is 5. Based on the validity table, the developed Module has very good criteria. This shows that the "Module with a problem-solving approach to statistics material" has a very good assessment in terms of the Module's graphics.

### *3.4.2 Practicality Analysis*

The assessment of the practicality of the Module can be seen from the validation of Education experts, namely teachers and student response questionnaires to the developed Module. Based on the results of the practicality analysis assessment, the average score is 4. So it can be said that "Module with problem solving approach on statistics material" has good criteria in terms of technical Module. Furthermore, the practicality assessment is also obtained from the results of the student response questionnaire to the Module developed by the researcher. Based on the questionnaire results, the average score was 3.3 with very good criteria. Thus, the Module with a problem solving approach to statistics material can be said to be practical with good criteria.

### *3.4.3 Product Revision*

Product revision is carried out based on the results of the questionnaire assessment of material, media, education and student responses to the Module developed by researchers. From the results of the material expert assessment obtained a score of 4.5, and the media expert obtained an average score of 5. Based on the calculations of the two validators above, an average score of 4.75 was obtained which showed very good criteria. Then the Module with the Problem Solving Approach on statistics material can be said to be Valid.

For the practicality assessment obtained from the questionnaire assessment of education experts, namely teachers. Based on the education expert, the average score is 4 with good criteria. Furthermore, the practicality assessment was also obtained from the student response questionnaire through the product trial stage where students were asked to fill out an assessment questionnaire for the Module developed to find out the practicality data. In the questionnaire, students were asked to give an assessment with a score of 4-1 with a description of strongly agree, agree, disagree, and strongly disagree,

and students were also asked to fill in the improvement suggestion column if they gave an assessment with disagree or strongly disagree.

From the results of the student response questionnaire, an average score of 3.3 was obtained. Based on the practicality table, the Module with a problem-solving approach on statistics material has very good criteria. Through the trial phase, it can be seen that students are interested and happy with this Module. So that the enthusiasm, interest, and motivation of students towards learning this Module is high. Based on the student response questionnaire, there are no revised parts.

## 4. Conclusions

The conclusions derived from this research and development are as follows that modules with a problem solving approach to statistics material developed by researchers with the model of S. Thiagrajan, Dorothy S. Semmel, and Melvyn I. Semmel, namely 4D modified into 3D, was declared valid by material experts, and media experts with Very Good criteria. Based on the assessment of education experts, namely teachers and students. The Module with a problem-solving approach to statistics material developed by researchers is declared practical. This means that the Module developed by researchers makes it easier for students to learn and can increase students' interest and motivation in learning mathematics, especially statistics material.

## Acknowledgments

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## Conflict of Interest

The authors declare no conflicts of interest.

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