

# P12

*by* P12 Darmawijoyo

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## The development of math model student worksheet using transportation context of one variable linear inequality

Y Anastasya<sup>1</sup>, Darmawijoyo<sup>1\*</sup>

<sup>1</sup>Mathematics Education Department, Universitas Sriwijaya, Palembang, South Sumatra, Indonesia

\*Corresponding author's email: [darmawijoyo@ilkom.unsri.ac.id](mailto:darmawijoyo@ilkom.unsri.ac.id)

**Abstract.** This study aims to produce the student worksheets based on learning Mathematics modeling using a valid and practical transport context on one variable linear inequality material for class VII students, and can Aware of the potential effects of learners' mathematical perception of the development of the student worksheet based on mathematical modeling learning using the transport context of a single variable linear matter in class VII. The type of research used is the ADDIE model development method. This method consists of Analysis, design, Development, Implementation, and evaluation. The evaluation stage used is formative evaluation, namely: expert review, one to one, small group, and field test. The subject of this study was the students of grade VII at 33 Palembang State Junior High School year 2019/2020 which amounted to 28 people. Data collection techniques with walkthroughs, observations, interviews, and polls. The results of this research are the student worksheet based learning Mathematics modeling using the context of valid and practical transport and learning using the student worksheet developed to have a potential effect on participants' mathematical perception Students.

### 1. Introduction

Mathematics learning in the 2013 curriculum requires students to have a high level of thinking, ability to solve problems, and play an active role in the learning process, and can apply the knowledge and skills In school in everyday life [1]. Based on this, the role of learning mathematical modeling is very important. Mathematics modeling study as a process of using mathematics to illustrate, analyze, and provide insight into real-world situations using mathematical language to improve students' understanding of real-world problems [2]. In mathematics modeling Learning There is a critical thought interaction process to enable the problem-solving process.

The curriculum serves as a guideline for the implementation of school activities. In the implementation of the curriculum is currently different from the previous curriculum because many obstacles greatly affect the outcome of one of them in terms of media used [3].

Judging from the international program to assess the learning outcomes of each student in the form of knowledge and skills called PISA. The ability of students in PISA is still relatively low. Judging from the year 2015, Indonesia is ranked at 62 in mathematics from 70 countries in the world with a score of 386, but the score is still under the international average score of 490 [4]. While the year 2012 mathematics score of 375, and also the score is still under the international average score of 494 [5]. The average of Indonesian students who can achieve mathematics levels 5 and 6 is only 13%, especially students who are struggling to solve real problems to form mathematical models related to the one-variable linear inequality material that Contains algebraic material [5].



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The results have not been satisfactory if viewed from the results that the teacher too much dominates during the learning process, the student worksheets used there are very short materials, and the sentence used does not understand the understanding Students primarily on the one-variable linear inequality material. Students are also accustomed to memorizing formulas, and always passing on examples of problems so that students are not accustomed to finding their solutions and they also cannot apply the learning that can be In everyday life [6].

The ability of mathematical literacy can be increased by providing problems that require a high level of ability (HOT's) and problem-solving skills with mathematical modeling-based Learning [2, 7, 8]. MOE argues that mathematical modeling is one of the ways to develop the competency and level of thinking of students through problem-solving in the real world [10]. Therefore, the development of the Student worksheet based on mathematical modeling learning which is the completion stage supports the ability of students ' mathematical literacy, so that the student worksheet is created with the problem of high-level thinking That students can love, can make social interactions to increase their ability, and are useful because they are relevant to everyday life. Therefore, researchers are interested to research under the title "The development of math model student worksheet using transportation context of one variable linear inequality".

## 2. Method

This research is development research. The research procedure used in this research is referring to the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model aimed at producing student worksheets based on learning modeling and practical and have a potential effect on the student's mathematical perception for mathematical learning on a single-variable linear inequality material. The subject of his research is students of Grade VII.5 at 33 Palembang State Junior High School with a total of 28 students. Development research using the model of ADDIE consisting of 5 stages, namely analysis, design, development, implementation, and evaluation [11].

First, the analysis stage consists of learners ' analysis, curriculum analysis, global analysis, and mathematical modeling context analysis. Student analysis is conducted to view students ' skills and learning outcomes. Curriculum analysis is done to adjust the curriculum used by the school with student worksheets to be developed. Global analysis is done to know the very low PISA data, therefore, developed student worksheet to train high-level thinking students, and also see the attitude of students to mathematics. Context analysis is done for the student worksheet to be developed with the transport context with mathematical modeling-based learning, which can make students interested and motivated to solve their problems.

Secondly, the design phase consists of the problem design phase and the student worksheet design stage. The design phase of the problem developed contains problems with real context based on the learning characteristics of mathematical modeling. The student worksheet the design stage is made with the display of "landscape" orientation, choosing the appropriate cover, student worksheet made in color to increase the interest and problems contained in the student worksheet is already by the ability of grade VII at 33 Palembang State Junior High School.

Then the third stage of development was done by making student worksheets which was revised by 3 expert reviews, namely experts in mathematical modeling produced the first prototype. Then, tested one to one by grade VIII students as much as 2 people then get a valid second prototype student worksheet. Then the second prototype student worksheet tested on the small group stage then a third valid and practical.

The fourth stage is implementation, at this stage of the third prototype student worksheet tested on the test field stage is to students of grade VII. 5 at 33 Palembang State Junior High School as many as 28 people and students are given a questionnaire of mathematical perception to see the potential effect To the student's perception when after mathematical modeling-based learning on a single-variable linear matter.

The last stage is the evaluation conducted analysis based on the results of revisions gained from expert review and comments and suggestions gained when testing in the one to one and small group stage to revise the worksheets of better learners.

### 3. Result and Discussion

This research resulted in learning materials in the form of student worksheets based on a mathematics modeling study using the context of transport of one variable Linear matter for grade VII students at 33 Palembang State Junior High School. This research is development research using the ADDIE model consisting of 5 stages, namely analysis, design, development, implementation, and evaluation.

#### 3.1. Analysis

The analysis phase consists of a learner's analysis, curriculum analysis, global analysis, and mathematical modeling context analysis. At the student analysis stage, the ability of students at 33 Palembang State Junior High School is still categorized as low when viewed from the mathematical subjects, the lack of understanding the concept of one variable linear inequality material, and still not accustomed to To solve problems requiring high levels of thinking and solving problems. Besides, teachers only give the questions that the student handbook alone does not use any other reference books. Students are also not accustomed to making assumptions from problems so that the student worksheet based learning of mathematical modeling in question contains assumptions and resolutions the require critical thinking. Next curriculum analysis, the curriculum used in 33 Palembang State Junior High School in class VII is the curriculum 2013 revised 2017. Researchers see based on core competencies, basic competencies, competency achievement indicators, and time allocation used. In the 2013 curriculum one variable Linear matter, there is an I, the student worksheet made using core competencies 3 and 4 which are knowledge and skills. The student worksheet which developed already based on basic competencies contained in the curriculum 2013 revision 2017 on PtLSV material. Mathematics lessons at 33 Palembang State Junior High School are taught 2 meetings for 5 JP, ie the first meeting of 3 JP and the second meeting 2 JP.

The global analysis of views from PISA was conducted to see the skills of mathematics, reading and science as well as the PISA measure as the students understand the material and can apply in real life, then developed the student worksheet Based on mathematical modeling to improve students ' mathematical skills by solving problems in everyday life, and also can change students ' positive perception of mathematics.

Analysis of the mathematical modeling context, the context used in the student worksheet problem of real problems is the transportation context, especially on airline issues to determine the lowest cost, and requires good time management. The technological age is growing with the online system. It will be easier, quicker and more practical to use online services. Thus the student worksheet is developed using the transport context so that students feel close and can apply the learning learned to the community.

#### 3.2. Design

The Design phase consists of the design phase of the problem, the student worksheet design stage, and activity sheet design. First, the design of the problem is developed in the form of the student worksheet based on learning mathematical modeling that contains problems with the context of transport that compares the cost of cheaper than one airline and other airlines. In this issue is Lion Air and Citilink. The material used is a single variable Linear pure qualities. Both the student worksheet designs, the student worksheet developed in it are designed to contain the student's workshop manual and the hope of resolving the problem. The main information is designed to arm landscape, and the information used to solve the problem is made in contrast and zoom in for more clarity. In the third design of the activity sheet, the activity sheet is created with a table view in which it contains questions based on stages of mathematical modeling.

#### 3.3. Development

The development stage is carried out the creation of the student worksheet based on mathematical modeling learning which was later revised by expert review, the revised material obtained the student worksheet prototype 1. Further tested one to one by students of 2 grade VIII students, suggestions and comments made for revised the student worksheet material named with a valid prototype 2 the student worksheet. Then the student worksheet prototype 2 tested on a small group stage consisting of 2 groups





each 2 people, suggestions and comments are used as a revision material named the valid prototype 3 the student worksheet.

3.3.1. Expert Review and One to One

At this stage, it is validated by experts in advance as many as 3 mathematical modeling experts, to see the suitability of the content, the contrast, and the language used. After it validated the experts, the student's worksheet was tested on 2 students to solve the problem in the student worksheet. Researchers share the student worksheet based mathematical modeling to each student to observe the problems, understand, and solve the problem on the student worksheet individually. While they are working on the student worksheet, researchers observe seeing the working process of each student solving the problem and conducting interviews on the difficulties experienced by learners of language And questions poorly understood by learners. The results of revisions obtained at the expert review and one to one stage are shown in Table 1 and Table 2 respectively.

Table 1. Suggestion/comment and revision decision stage expert review.

Comments/Suggestions	Revision Decision
<p>Maukapa mana yang akan dipilih Fini dengan keberangkatan Palembang menuju Batam berdasarkan berat bagasi agar biaya yang dikeluarkan lebih murah?</p> <p>Peraturan lebih lanjut:</p> <p>Berikut informasi lebih lanjut Fini yang akan berangkat dari Palembang menuju Batam untuk memilih maskapai mana yang memiliki pengeluaran (biaya) yang lebih murah!</p> 	<p>Maukapa mana yang sebaiknya dipilih Fini agar biaya yang dikeluarkan lebih murah dengan menentukan berat bagasi yang dibawa?</p> 
<p>Question on the initial issue was replaced "which airline was chosen to be less cost by determining baggage weight"</p>	<p>It has been fixed, the question replaced "which airline was chosen to be less cost by determining baggage weight".</p>
<p>Mendefinisikan Variabel</p> <p>4. Buatlah simbol / lambang / notasi / huruf dari masing-masing informasi pada jawaban nomor 2 dan 3! ..... (Buatlah simbol / lambang / notasi / huruf yang menyatakan besaran / nilai yang terdapat pada masalah)</p>	<p>4. Informasi apa saja yang tidak ada di data biaya penerbangan tetapi diperlukan untuk menyelesaikan permasalahan nomor 3?</p>
<p>Question Number 4 is changed</p>	<p>Fixed (question replaced)</p>
<p>Merumuskan Model Matematika</p> <p>5. Buatlah hubungan masing-masing simbol pada jawaban nomor 4! ..... Buatlah persamaan / fungsi (model matematika) pada masalah di atas?</p>	<p>5. Buatlah simbol / lambang / notasi / huruf yang menyatakan besaran / nilai yang terdapat pada masalah!</p>
<p>Question Number 5 is changed</p>	<p>Fixed (question replaced)</p>
<p>Add other hint questions in the issue identification</p>	<p>Already added the question in the number 2 "what determines the total amount of costs issued to depart from Palembang to Batam based on Figure 1 and figure 2?"</p>

**Table 2.** Revision result stage one to one.

Before		After	
6. a. Berapa biaya Palembang menuju Batam menggunakan pesawat Lion Air? (Catatan: Gunakan simbol pada nomor 5)	c. Berapa biaya Palembang menuju Batam menggunakan pesawat Citilink? (Catatan: Gunakan simbol pada nomor 5)	6. a. Bagaimana caramu untuk menghitung jumlah biaya yang dikeluarkan saat berangkat dari Palembang menuju Batam menggunakan pesawat Lion Air? (Catatan: Gunakan simbol pada nomor 5)	c. Bagaimana caramu untuk menghitung jumlah biaya yang dikeluarkan saat berangkat dari Palembang menuju Batam menggunakan pesawat Citilink? (Catatan: Gunakan simbol pada nomor 5)

### 3.3.2. Small Group

At the small group stage preceded by sharing the student worksheet learning Mathematical modeling prototype 2 for each group. Students are required to read the instructions in advance, information and resolve the problem given by discussing. When students work on the student worksheet, the hatchling performs observations about the students' difficulties, the attitudes of confusion and the questions posed by the students. After students have worked on the student worksheet, researchers conducted interviews. After that, the researcher provides the comments/suggestions that must be filled by the students in the sheets that have been provided to provide comments or suggestions about the student worksheet they have been working on. The revised results of the small group trials are shown in Table 3.

**Table 3.** Suggestion/comment and revision decision stage small group.

Comments/Suggestions	Revision Decision						
Students have difficulty determining the amount of paid baggage on Citilink aircraft.	Added the question at number 6, determining the paid baggage on Citilink aircraft.						
6. a. Bagaimana caramu untuk menghitung berat bagasi yang dibayar jika menggunakan pesawat Citilink?	<table border="1"> <tbody> <tr> <td>6. a. Bagaimana caramu untuk menghitung berat bagasi yang dibayar jika menggunakan pesawat Citilink?</td> <td></td> </tr> <tr> <td>b. Bagaimana caramu untuk menghitung jumlah biaya yang dikeluarkan saat berangkat dari Palembang menuju Batam menggunakan pesawat Citilink? (Catatan: Gunakan simbol pada nomor 5)</td> <td>Bagasi Berbayar</td> </tr> <tr> <td></td> <td>Bagasi Tidak Berbayar</td> </tr> </tbody> </table>	6. a. Bagaimana caramu untuk menghitung berat bagasi yang dibayar jika menggunakan pesawat Citilink?		b. Bagaimana caramu untuk menghitung jumlah biaya yang dikeluarkan saat berangkat dari Palembang menuju Batam menggunakan pesawat Citilink? (Catatan: Gunakan simbol pada nomor 5)	Bagasi Berbayar		Bagasi Tidak Berbayar
6. a. Bagaimana caramu untuk menghitung berat bagasi yang dibayar jika menggunakan pesawat Citilink?							
b. Bagaimana caramu untuk menghitung jumlah biaya yang dikeluarkan saat berangkat dari Palembang menuju Batam menggunakan pesawat Citilink? (Catatan: Gunakan simbol pada nomor 5)	Bagasi Berbayar						
	Bagasi Tidak Berbayar						

### 3.4. Implementation

The implementation stage is a test field testing stage for learners of Class VII. 5 as many as 28 people. In the field test, the student is formed into 7 groups, each group consists of 4 to 5 people with a time allocation of completing the student worksheet for 3 JP. Each group was given a the student worksheet, then given the time to observe the information and answer the questions in the student worksheet according to the stage indicators of mathematical modeling. In the next meeting with a time allocation of 2 JP, students were given a poll to find out the potential effects of students' perception of mathematics after a study based on mathematical modeling.

Kategori	Cilik	Lain Air
Harga Tiket / penumpang	1.030.700	638.000
Lama Berangkat	1 Jam 5 menit	1 Jam
Berat Bagasi Berbayar (kg)	> 20kg	Per kg
Berat Bagasi tidak Berbayar (kg)	< 20kg	0 kg
Harga Bagasi berbayar / kg	Rp. 25.000,00	Rp. 21.000,00

3. Informasi apa saja pada data biaya penerbangan yang diperlukan untuk menyelesaikan masalah nomor 1?

4. Informasi apa saja yang tidak ada di data biaya penerbangan tetapi diperlukan untuk menyelesaikan permasalahan nomor 1?

berat bagasi: 5 kg

**Figure 1.** Students' answers can identify problems and make assumptions.

Kategori	Cilik	Lain Air
Harga Tiket / penumpang	1.030.700	638.000
Lama Berangkat	1:05 jam / menit	01:00 jam / menit
Berat Bagasi Berbayar (kg)	bagasi > 20kg / 20 kg	bagasi < 20kg / 20 kg
Berat Bagasi tidak Berbayar (kg)	0 kg	1 kg
Harga Bagasi berbayar / kg	Rp. 25.000	Rp. 21.000

3. Informasi apa saja pada data biaya penerbangan yang diperlukan untuk menyelesaikan masalah nomor 1?

4. Informasi apa saja yang tidak ada di data biaya penerbangan tetapi diperlukan untuk menyelesaikan permasalahan nomor 1?

Jumlah seluruhnya 10 kg / 5 kg

**Figure 2.** Results of students who have not been able to identify problems and make assumptions.

Figure 1 shows result of the student's answer to the indicator identifying the problem and making assumptions, student can already gather the information that is known correctly and thoroughly. On the indicators of making assumptions, students can also make assumptions well. In Figure 2 The results of the answer students who still cannot collect the known information in the stage identify the problem, and cannot make the assumption because it is visible from the results of the answer using the '/' sign, meaning that the student has not to Understand the questions in the indicator make assumptions.

At the second meeting, the students were asked to fill in the students' mathematical perception when after learning the previous lesson using mathematical modeling-based learning to see the students' perception of mathematics. Here are the poll analysis results.

**Table 4.** Category student mathematics perception

Category	Interest	General Utility	Need for High Achievement	Personal Cost
Very Good	12	17	12	4
Good	16	11	15	17
Enough	0	0	1	7
Less	0	0	0	0
<b>Amount</b>	<b>28</b>	<b>28</b>	<b>28</b>	<b>28</b>

Description:

Interest : Students' interest in the math  
 General Utility : Mathematics provides benefits/usability for students  
 Need for High Achievement : Students need math for high achievement  
 Personal Cost : The impact of mathematics on students



From the results of the analysis, it appears that students' interest in mathematics was good when after learning based on mathematical modeling. The perception of mathematics provides benefits to students is good, meaning mathematics is very beneficial. The perception of mathematics gives students higher achievements already good. The perception of the mathematical impact of students has been good because it is a lot of thought that mathematics has a positive impact.

### 3.5. Evaluation

The evaluation stage is the last step, the evaluation used is a formative evaluation of mathematical modeling problems that analysis based on the results of revisions gained from the expert review, one-to-one, small group, and field test. Revision results are:

- The language that is less understandable for students of class VII.
- Add questions to help students do calculations so get a solution.
- The required information is made in more contrast.

### 4. Conclusion

This research is development research. The research procedure used in this research is referring to the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model aimed at producing student worksheets based on learning modeling Mathematics using the transport context on a single variable linear matter. The student's worksheets were developed then validated by 2 expert mathematical modeling fields and 1 person in mathematics teachers. Validation viewed from the content aspect, the construct, and the language used.

Then tested to the students at the one to one and small group to submit a valid and practical student worksheet. The results of comments and suggestions given at the expert review stage, one to one, and small group revised then the student's spreadsheet was tested at the Test field stage and given the math perception poll to see the potential effect on perception Student mathematics after performing a math-based learning modeling.

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