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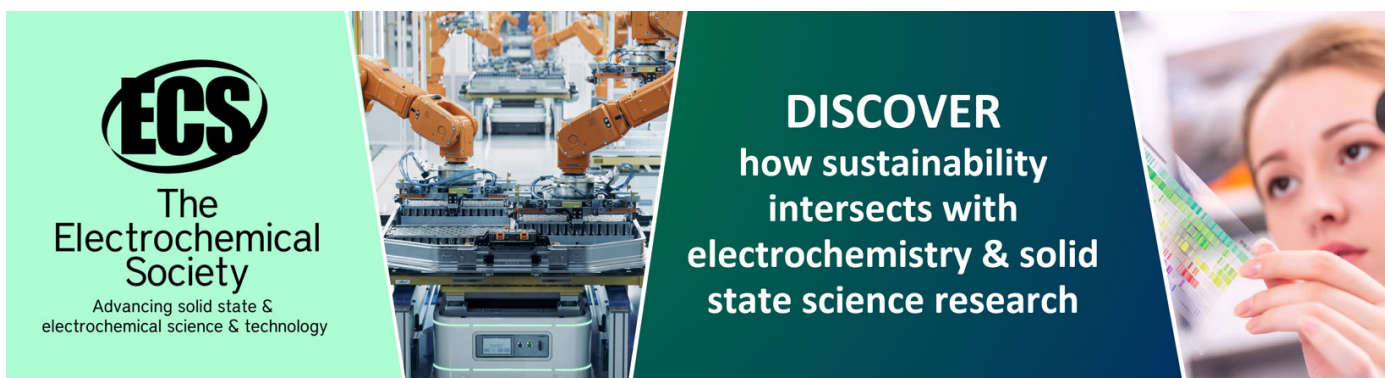
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Development of student worksheet of mathematical modeling learning using a financial context for senior high school students

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Abstract. This study aimed to produce a valid and practical Student Worksheet of Mathematical Modelling Learning using a financial context for senior high school students. In addition, it aimed to find out its potential effects on students' mathematical modelling abilities. The study was conducted in the XI IPA Grade of Public Senior High School No.11 of Palembang City, 2018/2019 Academic Year involving 39 students. This was a development study consisting of a preliminary stage covering the stages of analysis, design, and development, the formative evaluation stages covering self-evaluation, prototyping (expert reviews, one-to-one, and small group), and field tests. The data collection techniques used walkthroughs, observations, and interviews. The result of this study is a valid and practical Student Worksheet Mathematical Modelling Learning using a financial context of compound interest learning material. The validity was based on context, construct and language viewed from the results of expert review and one to one, small group, and analysis of the student answers in the field test stage.

Keywords: Student Worksheet, mathematical modelling, finance

1. Introduction

Based on the TIMSS survey, conducted by IAE (International Association for Educational Evaluation and Achievement), the cognitive domain includes knowledge, implementation, and reasoning. In the field of mathematics, the TIMSS results (2015) also showed that the Indonesian students tended to work on memorizing questions and they had low ability of reasoning a problem and applying it (Kompas, 2016). Rahmawati (2016) also stated that the 2015 TIMSS results indicated that the Indonesian students were still weak in high-level abilities. Most students were not able to combine several facts and concepts, apply them, and communicate the results of reasoning. In line with this, the study of PISA conducted every three years by the OECD (Organization for Economic Cooperation and Development) aims to investigate students' mathematical literacy abilities. Its focus is the ability of students to identify, understand, and use the basic mathematics needed in everyday life. The PISA results (2015) showed that the Indonesia's ranking was still in the low level (Mullis, I.V.S et al and OECD, 2015).

The focus of the results of the TIMSS and PISA studies is in the form of students' mathematical reasoning and their abilities in implementation in daily life. This shows that students' weaknesses formally link mathematical concepts to real-world problems. Therefore, a tool is needed to help students solve problems related to the real world. The standard expected for high school students is in accordance with the National Education Standards Agency (NESA-BSNP), i.e. understanding and using concepts



in solving problems, using reasoning, solving and understanding problems, completing and interpreting solutions, presenting mathematical ideas with symbols, tables, diagrams or other media, and having an attitude of appreciating the usefulness of mathematics in life. This is also in line with the 2013 curriculum regarding understanding knowledge related to real-world phenomena. Some things and learning approaches relating to the 2013 curriculum in mathematics are problem-solving, discussing HOTS (Higher Order Thinking Skills) questions, and also discuss mathematical modeling. One of the new things in learning mathematics using curriculum 2013 is the implementation of the HOTS concept. It aims to make students think critically, logically and systematically and have high-level thinking skills. Learning mathematics-based modeling can guide students to have high-level thinking skills.

Achieving competencies in mathematics learning requires an innovation, one of which is mathematical modeling. Bliss (2016) states that 21st-century skills are creativity and innovation, critical thinking and problem-solving and collaboration in communication achieved through modeling. Dawn, N.K.E, and Lee, N.H (2015) also point out that mathematical modeling is one way to achieve the competency goals of primary and secondary school graduates by developing mathematical skills by studying mathematical modeling at school. Definition of mathematical modeling itself according to COMAP & SIAM (2016) is a process that uses mathematics to represent, analyze, make predictions or provide insight into real-world phenomena (problems). The process of converting problems in the real world into mathematical forms is to find solutions to a problem (Ang, 2011).

Hidiroğlu & Guzel (2016) state that the process of mathematical modeling systematically involves the cognitive actions of students in the learning process to find solutions to real problems. Ferreira & Jacobini (2009) point out that mathematical modeling is a mathematical tool to solve problems in real life. Mathematical modeling according to Rellensmann, J. et al (2017) even becomes an important topic in mathematics education because it is very relevant and suitable for provoking student participation in social life. Similarly, English (2006) states that mathematical modeling activities are students' own social experiences in which students work alone to solve problems that often arise and then communicate the solutions to these problems. In more detail, Lowe, Carter & Cooper (2018) explained that the mathematical modeling process is a cycle that starts with a real problem (usually based on reality) that requires a model to describe, explain, or predict the solution of a process. In conclusion, mathematical modeling has relevance to the real world. Many problems in real life make mathematics as a tool of finding solutions to real problems.

The importance of students' abilities in mathematics learning is closely related to solving real problems through modeling mathematics-based learning (Niss, et al., 2007). According to Blum & Ferry (2009), the important mathematical modeling is taught to students in schools to support mathematics learning and develop students' mathematical competencies in the world. Arseven (2015) even states that mathematical modeling is a very important topic for the competition such as PISA and TIMMS conducted at the international level and measures the success of students in mathematics. Therefore, mathematical modeling-based learning is very necessary in schools so that students can develop mathematical competencies and compete in world activities such as the Program for International Student Assessment (PISA) and TIMMS Trends International Mathematics and Science study. Mathematical modeling is needed at school so students are accustomed to dealing with real problems like PISA and TIMMS and are able to compete at the international level.

The process of mathematical modeling uses mathematical concepts found in the curriculum as an approach in mathematics learning. The following is a figure of steps in solving a real problem through mathematical modeling.

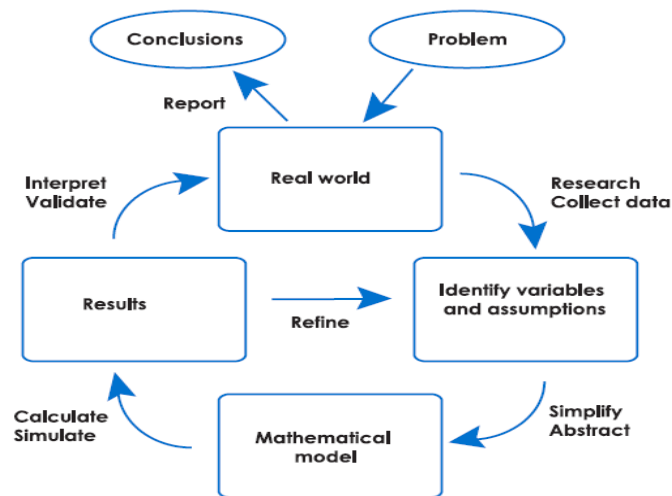


Figure 1. Process of Mathematical Modeling

From the figure it is clear that several processes must be carried out in mathematical modeling, namely identifying variables, forming models of variables, conducting operations using models, interpreting results, validating mathematical models, and interpreting conclusions (Lowe, J., et al, 2018).

One instrument that can be used in modeling mathematics-based learning is a student worksheet (LKPD). Learning by using LKPD makes students focus on understanding subject matter (Rahmadani, A, et al, 2012). In addition, good use of context can also facilitate students' abilities in learning mathematical modeling. Learning mathematics using context can guide students to find the relationship between material and situations in everyday life and focus on the purpose of lowering the mathematical formula (Wyll, 2011). Therefore, this study discusses the economic context of finance. This is very helpful for someone to learn more about financial problems related to everyday life. By studying a good financial context one can provide financial knowledge in the form of insight into how important financial education is in improving one's financial well-being (Huston, SJ 2010). The financial context is one of the trends in the 2013 mathematics learning curriculum to maximize students' potential regarding financial problems.

The background of this study referred to the following question "how were the characteristics of student worksheet mathematical modeling learning using the financial context for high school students and the potential effects of its use on students' mathematical modeling abilities?"

In line with the above problems, optimizing students' ability to understand mathematical problems related to the real world to the form of mathematics was to produce LKPD of learning mathematical modeling using financial context. In this article, it will be discussed development research in producing a valid and practical LKPD of mathematical modeling learning using financial context and having a potential effect on students' mathematical modeling abilities.

2. Research Method

This study used a design research type of development study on developing student worksheet (LKPD). The development of LKPD consisted of the preliminary stage producing prototype 1 and the formative evaluation stage (Tessmer 1993; zulkardi 2006).

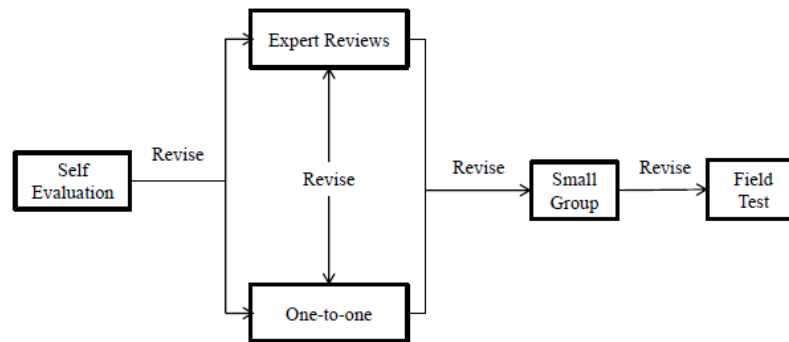


Figure 2. Flow design with formative evaluation,

2.1. Research Focus

The focus of this study was to develop an *LKPD* of mathematical modeling learning using the financial context of compound interest learning material for high school students of grade XI IPA. The descriptors of the modeling-based *LKPD* development in table 1 are as follows:

Table 1. *LKPD* Indicators and Descriptors based on mathematical modeling

Indicator	Descriptor	
	Student Worksheet 1	Student Worksheet 2
Identifying and understanding problems	Students are able to write known information of the value of savings, travel costs to Europe, the inflation rate of 5 years, and JCI index of 5 years	Students are able to write known information of the value of savings, the price of Daihatsu Ayla cars, top up costs every year, the inflation rate, and the JCI index in the last 5 years
Making assumptions	Students are able to determine the information to limit problems such as the inflation rate of the last 5 years that had the same value in the future. Compound interest of the last 5 years index data considered the same as that of the future.	Students are able to determine the information to limit problems such as the inflation rate of the last 5 years that had the same value in the future. Compound interest of the last 5 years index data considered the same as that of the future.
Defining a variable	Students are able to state information whose values change and are expressed by mathematical symbols such as average inflation, initial savings, compound interest, and the initial price of tourism costs to Europe.	Students are able to state information whose values change and are expressed by mathematical symbols such as average inflation, initial savings, compound interest, and the initial price of the Daihatsu Ayla car
Working out mathematical calculations	Students are able to determine the relationship between variables of initial savings and savings after an investment movement (CSPI)	Students are able to determine the relationship between variables of initial savings and savings after an investment

	as well as the initial cost of tourism to Europe and tourism costs after being affected by inflation.	movement (CSPI) as well as the initial cost of tourism to Europe and tourism costs after being affected by inflation.
Analyzing and judging	Students determine the average inflation and compound interest from the data, Students examine the parts of the problem solution	Students determine the average inflation and compound interest from the data, Students examine the parts of the problem solution
Iterating (repeating/checking again)	Students check again the steps in solving the problem of travel to Europe	Students check back the steps in solving the problem of buying a Daihatsu Ayla car
Interpreting results	Students determine what year a person can travel to Europe	Students determine what year a person can buy a car Daihatsu Ayla

2.2 Research subject

The research subject in this study was *LKPD* based on the mathematical modeling using the financial context of compound interest learning material for grade 11 IPA students of SMA N No. 11, Palembang. It was conducted in the even semester of the 2018-2019 Academic Year.

The problem that was taken as learning material in the *LKPD* which was financial problems related to Inflation and Investment. The part of the instrument designed by the researcher became the *LKPD* mathematical modeling learning with a financial context meeting the valid and practical criteria of and having a potential effect in the form of items with completion using the stages of mathematical modeling. The design of the *LKPD* continuously underwent revisions to get good calculation results. Whereas in completing mathematical modeling items, the modeling steps were used as follows, identifying problems, making assumptions, making variables, working on mathematics, analyzing and providing solutions, and finally validating (COMAP and SIAM, 2016). This way, the item's instrument was feasible to be developed into a student worksheet (*LKPD*) in mathematical modeling learning with a financial context.

2.3 Data collection technique

Data collection techniques were carried out as follows:

- Walkthrough was conducted at the expert review stage by 5 experts as a validator consisting of 1 mathematics modeling expert lecturer, 3 science lecturers, and 1 education lecturer. The experts were Prof. Dr. Stevanus Budi Waluya, Dr. Indigo Kesumawati, M.Sc, Dr. Yulia Resti, M.Sc, Dr. Bambang Suprihatin, M.Sc and Dr.Destiniar, M.Pd.
- Interview was conducted directly to students to see the validity and practicality of the *LKPD* in the stages of one to one, small group, and field tests,
- Observations/field notes were conducted to see the difficulties of students during the discussions of working on *LKPD* learning mathematical modeling, and
- Documentation of student answers obtained from the *LKPD* answers for each group during the learning.

2.4 Data analysis technique

2.4.1. Walkthrough Data Analysis.

The walkthrough data analysis was used to obtain the validity of the developed *LKPD*. The data were obtained from the validators' suggestions and comments on the *LKPD* prototype 1. The data were analyzed qualitatively. The validity of the *LKPD* was measured by the way the validators providing responses/suggestions/comments on the developed *LKPD*.

2.4.2. Analysis of Observation Data. The analysis of the observation data was carried out by analyzing the observations from observers in the form of a description of student activities while working on the *LKPD*. The observation results were obtained by observing the learning process or student activities when using *LKPD* based on mathematical modeling.

2.4.3. Interview Data Analysis. The results of the interviews with students at the one-to-one and small group stages were analyzed descriptively to gather information about the students' difficulties of using the *LKPD* and the practicality of the *LKPD*. And the interview results of the field test stage were analyzed to determine the potential effects of value-based *LKPD* on mathematical modeling abilities.

2.4.4. Analysis of Student Document Data. The results of the student answers to the *LKPD* were analyzed by correcting student answers according to the indicators of mathematical modeling abilities that the researcher wanted to find out.

3. Results and Discussion

3.1 Results

This study was development research producing a valid and practical *LKPD* of mathematical modeling learning using the financial context for senior high school students of grade XI IPA and having potential effects on students' mathematical modeling abilities.

3.1.1 The results of the preliminary stage. At the analysis stage, the number of the obtained respondents was 39 students of Grade XI IPA of SMA Negeri No. 11, Palembang. The results of the curriculum analysis showed that the concept of HOTS in the 2013 curriculum was relevant to the characteristics of the mathematical modeling approach. At this stage, the *LKPD* learning mathematical modeling to be developed was suitable to be applied to the 2013 curriculum. Next, a material analysis was conducted by looking at the compulsory mathematics learning textbooks used by the respondents. From this stage, the compound interest learning materials were chosen to be used in the *LKPD*.

At the design stage, the activities of the researcher included formulating problems to be used in the *LKPD* questions and designing the *LKPD* form. The result of the design phase was the problem formulation in the form of stories equipped with informative visuals with the problems related to the financial context, namely the relationship between inflation and investment. In addition, this stage produced the *LKPD* design in accordance with the steps of compiling the *LKPD* according to the Ministry of National Education, designing the cover, figures, and learning material writing based on the stages of mathematical modeling of COMAP & SIAM (2016). The stages of mathematical modeling were 1) Identifying and understanding problems, 2) Making assumptions, 3) Defining variables, 4) Performing mathematical calculations, 5) Analysis and assessing solutions, and 6) Interpreting results.

In the last stage of the preliminary, a development phase was conducted by producing 2 mathematical modeling questions using the financial context with the issue of vacation to Europe and the purchase of a Daihatsu Ayla car. The first problem was how someone could invest for a vacation to Europe with tourism costs having the impact of inflation in order to get the right mathematical model (formulation) as the solution to the problem. The second problem was how one could buy a Daihatsu Ayla car with investment plus top up every year with the car prices affected by inflation every year.

3.1.2 Results of the Formative Evaluation Stage. In the stage of self-evaluation, the researcher conducted his own assessment and research group discussions with the supervisor and the discussion forum. The results of the self-evaluation in the form of suggestions and comments listed in table 2 are as follows:

Tabel 2. Results of stage self-evaluation

Suggestions and Comments	Revision Decision
There were a few changes to the Student worksheet's design:	
1. Based on the layout of the image	The layout of the image was fixed Ambiguous images were deleted
2. Erasing unclear words or sentences (that would create ambiguities)	
On this worksheet, changes to the design appeared	in: Already changed

1. Points in the word "recapitulation were converted into precipitation"; arrows that had no function were deleted.
2. The picture of someone who was thinking about something was replaced by a question in the sentence before the image so that the image had meaning.

Already deleted

The picture on the brochure had too little writing, so it was illegible. It was better to draw all the brochures and writings in addition to the travel cost to Europe

The picture was not changed, because the researchers had the opinion that the brochure was only intended to see the cost of "travel to Europe" only. And it was in accordance with the cost asked for the given problem.

The results of the suggestions and comments derived from the group discussions showed that there was a change in the LKPD based on the developed mathematical modeling. The changes in the LKPD as a result of the self-evaluation stage are as follows.

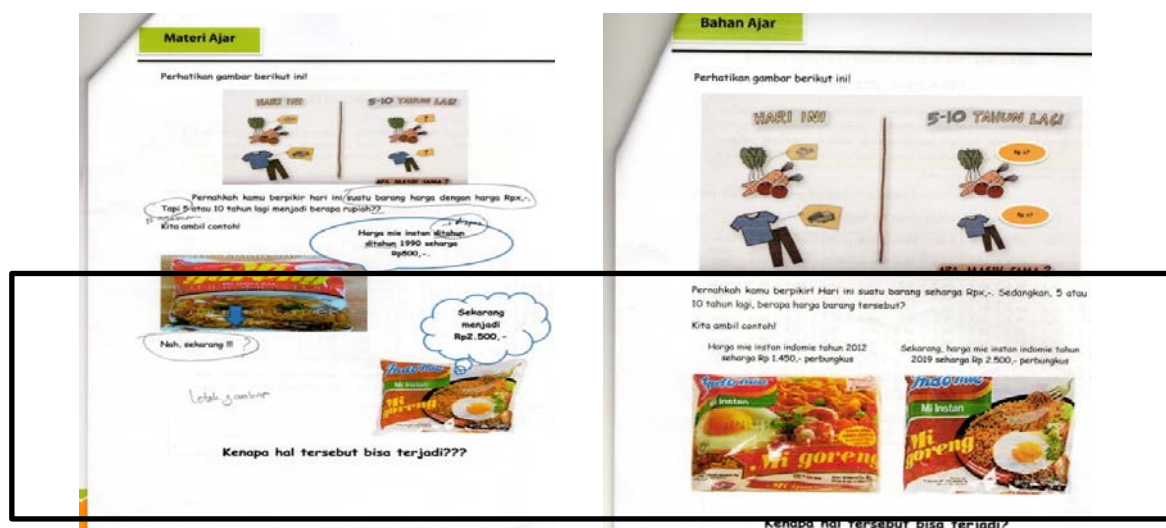


Figure 3. Changes in the LKPD results of the self-evaluation stage

3.1.3 Results of the Expert Review Stage. In the expert review stage, the LKPD of mathematical modeling learning was validated by 5 experts to see its validity based on mathematical modeling. The results of the expert review are as follows:

Table 3. Evaluation Results and Expert Review Revision decisions

Validators' comments and suggestions	Revision Decision
1. (1) The drawings are not just additions, but rather illustrations	The selected pictures presented in the problems were improved to make them not just as illustrations but meaningful and clear.

2,3,4 (1) & (2)	
It needs to add core competency, basic competency and learning objectives	They would be added; the learning media components would also be added on the cover page
2,3,4,5 (1) & (2)	Information on CSPI and compound interest would be added (the information would be added in a separate booklet from the LKPD)
Adding supporting information for example about the CSPI (Composite Stock Price Index) and compound interest	
2,3 (1) & (2)	
The book sources have to be written clearly.	Book sources were added.
1,2,3 (1) & (2)	
All taken images have to be written by the names of the images and the sources	They were already written.
1,2,4 (1) & (2)	
Some non-meaningful images have to be deleted.	They were deleted and changed.
4,5 (1) & (2)	
Some posts that are not yet suitable can be corrected. For example, inflation flow → inflate rate (because the presented data fluctuate, not just rising)	They were corrected and changed.
2,3,4,5 (1) & (2)	
Foreign language writing is italicized	It was italicized
4,5 (1) & (2)	
Repeated words are deleted.	They were reworded and made simple
2,3,4,5 (1) & (2)	
Be consistent with symbol writing at several important points in the student worksheet items	They would be fixed
1,2,3,4,5 (1)&(2)	
Important supporting information is separated from the student worksheet (LKPD). For example, they are made in a booklet/ teaching material separate from the LKPD.	One booklet had been made (containing the supporting teaching materials for one student worksheet).

Note:

1. Prof. Dr. Stevanus Budi Waluya, M.Si
2. Dr. Nila Kesumawati, M.Si
3. Dr. Destiniar, M.Pd
4. Dr. Yulia Resti, M.Si
5. Dr. Bambang Suprihatin, M.Si
- 1) LKPD 1
- 2) LKPD 2

The above suggestions and comments were used as the material revision for the LKPD Prototype.

3.1.4 The results of one-to-one stage. The one-to-one stage was carried out with trials of 2 students aiming to find out the difficulties experienced by them, the degree of language clarity, and the students' understanding of the command questions in the LKPD. The results are as follows:

Tabel 4. One-to-One Results

Students' comments	Revision Decision
	LKPD 1 & 2

1. Students did not understand how to make assumptions
2. Students were confused and did not understand the meaning of the formulation questions

Assumptions were given directly to students.

Adapted and revised

In Table 4, there were some suggestions and comments of one to one provided by the expert review. They were used for the material revision of LKPD Prototype 1. The changes from the LKPD Prototype 1 to LKPD Prototype 2 are as follows:

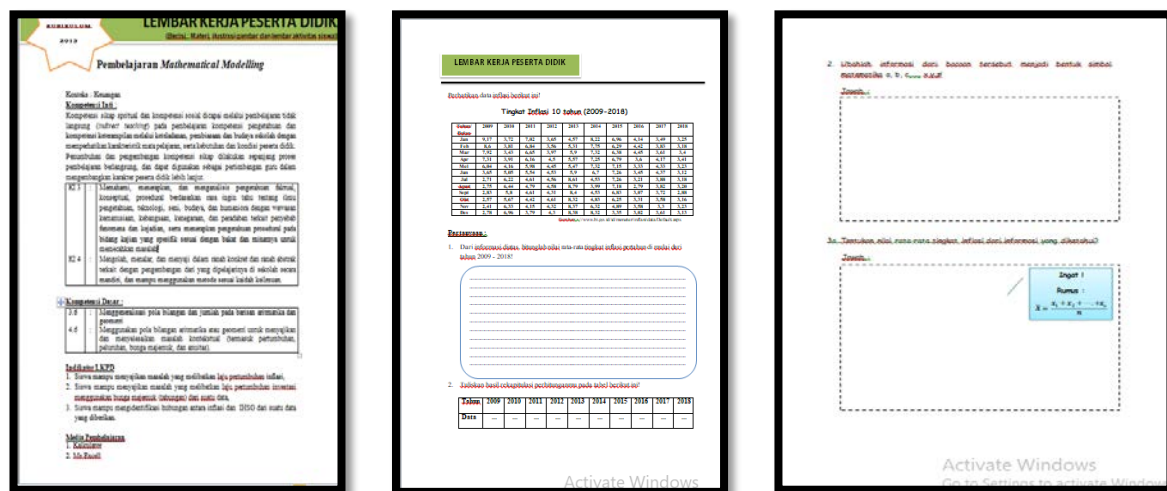


Figure 4. Change of LKPD to Prototype 2

3.1.5 Small group stage results. The small group stage was carried out by conducting trials on 2 groups of students with the aim of looking at the practicality of the revised LKPD at the stage of expert reviews and one to one. The results in the small group stage derived from interviews and observations are as follows:

Table 5. Small group result

Students' comment	Revised Decisions
LKPD 1	
1. Students still did not understand the command about the formulation section	The formulation questions were revised
2. The sections of question command interpreting the results were not understood by the students	The questions of interpreting the results were revised.
3. The problems to solve mathematically were too much	They were deducted.
LKPD 2	
1. Students still did not understand the command from the formulation section; 2. Students did not understand the command questions at the stage of interpreting the results	The formulation questions were revised The questions of interpreting the results were revised.

- | | |
|---|---|
| 1. Students still did not understand the command from the formulation section; | The formulation questions were revised |
| 2. Students did not understand the command questions at the stage of interpreting the results | The questions of interpreting the results were revised. |
-

The suggestions and comments derived from the small group stage were used as material for the revision of the LKPD Prototype 2.

3.1.6 Results of stage field test

At this stage, the valid and practical LKPD Prototype 3 was tested as a result of trials and revisions from various stages, namely the stage of expert review, one-to-one to a small group in grade XI IPA students of SMA Negeri No. 11, Palembang. This stage aimed to find out the potential effects of the LKPD developed on mathematical modeling capabilities. The results in the field test stage were seen from the results of the analysis of observation data, student answers, and interviews at three meetings in grade XI IPA 3.

The results of the observation analysis on group 1 and group 9 were LKPD based on the mathematical modeling having a potential effect on mathematical modeling abilities. While the results of the analysis of student answers were concluded that the LKPD learning mathematical modeling had a potential effect on students' mathematical modeling abilities.

3.2 Discussion

3.2.1 Preparation stage. The SMA Negeri 11 was observed before the study was conducted. Pak Sukri, S.Pd. was met for the arrangement of collecting all needed information covering a one-week mathematics learning schedule, time allocation for each meeting, subject and time of the study, and administration requirement.

3.2.2 Preliminary stage. This study aimed to produce a valid and practical LKPD of mathematical modeling learning using the financial context of compound interest learning material for senior high school students of grade XI IPA and to have a potential effect on mathematical modeling abilities. The study design was a development study consisting of two stages, namely the preliminary stage (preparation and design of teaching materials) and the formative evaluation stage. The formative evaluation phase covered self-evaluation, prototyping (expert review, one-to-one, small group), and field tests (Tessmer 1993; Zulkardi 2006).

The preliminary stage consisted of analysis, design, and development as the preparation and designing of teaching materials. The stage of the analysis of the characteristics of students selected the grade XI IPA students as the respondents of the study in working on the LKPD learning mathematical modeling and financial contexts. In the curriculum analysis, it showed that the 2013 curriculum was relevant to learning using mathematical modeling. The characteristic of the 2013 curriculum refers to a high-level thinking ability (HOTS) which is one of the characteristics of mathematical modeling problems. Therefore, the LKPD based on the mathematical modeling was suitable to be applied in the 2013 curriculum. In the material analysis, the operating material algebraic form was contained in the 2013 curriculum and could be related to the financial context and closely related to students' daily life phenomena.

The design phase was then continued. First, a real problem was designed and it would be used on mathematical modeling problems. It was used to connect the material of inflation and investment using the concept of compound interest. After that, the form of LKPD using mathematical modeling criteria was designed. It contained a cover design, images, and attractive color selection. It was designed in accordance with the structure and components of the LKPD.

At the development stage, the form of LKPD using mathematical modeling criteria was developed based on the problems previously formulated. There were two mathematical modeling questions. The first question was how one went on vacation to Europe with investment savings whose tourism prices to Europe were affected by the inflation every year. The second question was buying a car with

investment savings plus top up every year whose car prices were affected by inflation too. The designed mathematical modeling questions were those related to compound interest learning material using financial contexts. In addition, the designed questions contained problems of activities attracting students' attention in daily life regarding detail financial concepts. Next, the LKPD was developed by implementing mathematical modeling questions into the LKPD design with completion steps based on the stages of mathematical modeling. Finally, the designed questions and LKPD were consulted with the supervisors.

3.2.3 Formulative Evaluation Stage. After the preliminary stage, the next step was conducting formative evaluation. The formative evaluation phase covered self-evaluation, prototyping (expert review, one-to-one, and small group) and field tests (Tessmer 1993; Zulkardi 2006). In the stage of self-evaluation, the researcher worked on his own designed LKPD. The LKPD was also adjusted with the stages of mathematical modeling according to COMAP & SIAM consisting of 6 stages, namely identification and understanding of problems, making assumptions, defining variables, performing mathematical calculations (formulations), analyzing and evaluating solutions, and interpreting results. In the stage of self-evaluation, group discussions with supervisors were conducted to get input of the developed LKPD. The LKPD produced in the self-evaluation stage was called the LKPD Prototype 1.

The LKPD Prototype 1 was validated by five experts, namely a mathematics modeling lecturer (Prof. Dr. Stevanus Budi Waluyo, M.Sc.), three lecturers of Science (Dr. Nila Kesumawati, M.Sc., Dr. Yulia Resti, M.Sc., and Dr. Bambang Suprihatin, M.Sc.), and one Lecturer of Evaluation (Dr. Destiniar, M.Pd.). The expert review phase aimed to find out the validity of the LKPD based on contents, constructs, and languages. According to the content validity, this LKPD was in accordance with the learning material of grade XI IPA as stipulated in the 2013 curriculum applied in the school. According to the construct validity, this LKPD was in accordance with the stages of mathematical modeling according to COMAP & SIAM (2016). Meanwhile, according to the language validity, the LKPD used the standard language according to the standard spelling (*Ejaan Yang Disempurnakan*-Enhanced Spelling). Based on the validation, the validators provided some input to establish the validity of LKPD based on the mathematical modeling.

In addition to being validated at the expert review stage, LKPD Prototype 1 was piloted at the one-to-one stage to two students. It aimed to find out the difficulties experienced by students while working on the LKPD and to correct students' understanding of the language used in this LKPD. Then, interviews were conducted to get comments and suggestions of the students on the LKPD and the difficulties they had. The LKPD Prototype 1 was revised based on the suggestions and comments obtained from the expert review and one to one stage. The revision would be used in the LKPD Prototype 2.

To find out the practicality of LKPD Prototype 2, a trial was conducted again on students in the small group stage. The LKPD Prototype 2 was tested on 6 students divided into 2 groups. Based on the results of the interviews, this LKPD contained a context that attracted the students and was suitable if discussed with the group. Students' comments in the interview and the results of student answers in the LKPD in the small group stage would be used as learning material to revise the LKPD Prototype 2 to produce a valid and practical LKPD Prototype 3.

Regarding the potential effects of LKPD on valid and practical mathematical modeling learning on mathematical modeling capabilities, the LKPD was tested in the field test phase. The field test was conducted three times. In the first meeting, students were asked to discuss in their group to work on LKPD 1 regarding the basic concepts of inflation and investment using the composite stock price index (CSPI). In the second meeting, the students discussed to work on LKPD 1 regarding the relationship between the concept of inflation and investment using the issue of vacation to Europe. While in the third meeting, the students discussed to work on LKPD 2 regarding the relationship between the concepts of inflation and investment plus top ups every year with the problem of buying a Daihatsu Ayla car.

At the first meeting, the context used was the financial context with the problem of LKPD 1 being a vacation to Europe. In this case, students were asked to understand the initial concept of inflation and investment using CSPI. At the second meeting, students were asked to determine the cost of tourism to Europe which got the impact of inflation each year with investment savings having fluctuating indices

using the concept of compound interest. At the third meeting, the context used was also the financial context with the problems of LKPD 2 on purchasing a Daihatsu Ayla car. Students were asked to determine the purchase price of the car with investment plus top up annually with the price of cars having the impact of inflation. The context and problems used in the two LKPDs were the real contexts relevant to everyday life phenomena.

3.2.4. Analysis of Observation Data. The following are the results of observations of student activities when using LKPD at the first meeting and the second meeting. The observer who observed group 1 found out that at the first meeting, Group 1 was able to identify and understand problems, make assumptions, and define variables. But there were still errors in the stages of doing mathematical calculations or finding the right formulation as a solution to the problem and interpreting the results. As for group 6, students were able to identify and understand problems, make assumptions, and define variables. As for the stages of doing mathematical calculations or finding formulations, analyzing solutions and interpreting results, the students still made mistakes in writing down their answers. At the second meeting, Group 1 did not discuss the material properly and ran out of time. The members of the group had different opinions. As a result, the group only wrote the answers up to the stage of doing mathematical calculations. In contrast, Group 6 was able to answer correctly every stage of mathematical modeling. This group, in conclusion, had the potential for mathematical modeling capabilities.

3.2.5. Analysis of student answers. The analysis of the results of the student's answers provided the information on the potential effects of LKPD mathematical learning modeling on mathematical modeling abilities. The results were analyzed based on the indicators of mathematical modeling.

(Indicator 1 : Identifying and understanding the problem)

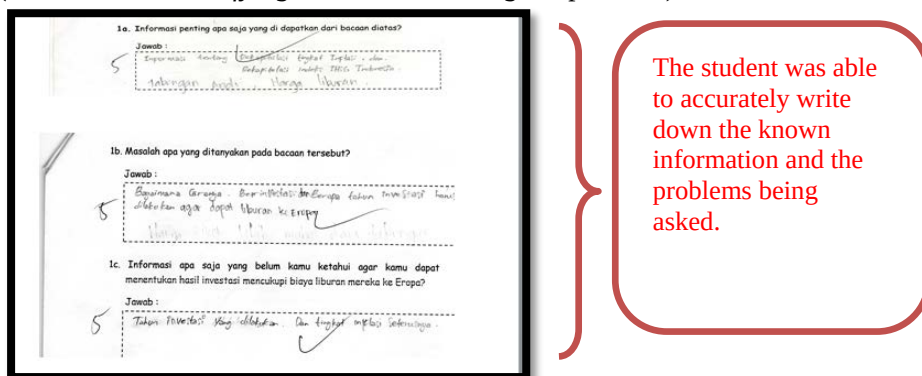


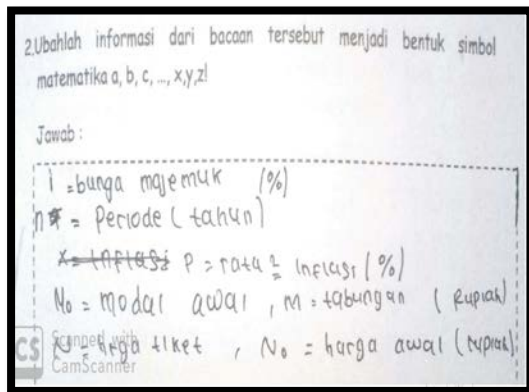
Figure 5. Result of the student's answers to indicator of identifying and understanding the problems

Based on the analysis of students' answers in Figure 4, the students were able to accurately write down the known information and the problems being asked. At the first meeting, almost all groups could determine indicators of identification and understanding of problems, making assumptions, and defining variables. While at the second meeting, almost all groups were able to understand the steps in modeling and completing each question order in the LKPD. However, there were groups still making mistakes in answering the instructions for each step in the LKPD and did not understand the steps in mathematical modeling.

(indicator 2 : making assumptions)

Students were still confused in making assumptions. Therefore, in order to be able to do mathematical modeling properly in the next stage, the students were invited to discuss together with the researcher on how to solve it.

(indicator3 : defining the variable)

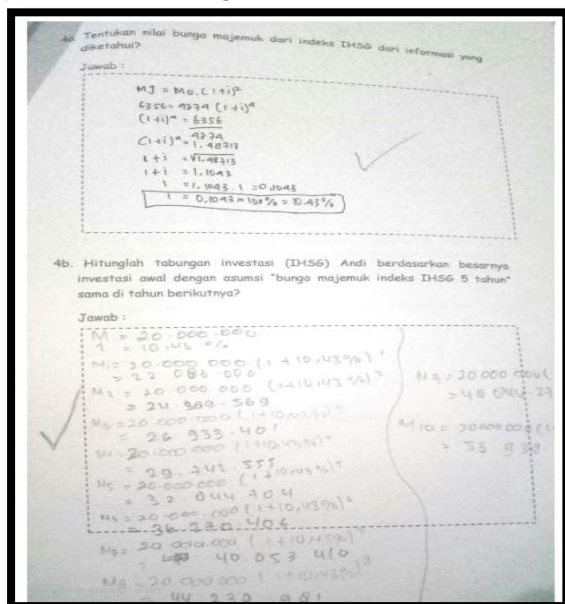


The student was able to state the information into the forms of mathematic symbols.

Figure 6. Result of the student's answers to the indicator of defining the variable

Figure 6 shows that students were able to state the information whose values changed and were expressed by mathematical symbols (the variables). In the LKPD 1 of the first meeting, there were only two groups being able to define the variables completely and precisely, namely groups 1 and 2. The other groups had the answers but incomplete. At the second meeting in learning LKPD 2, almost all groups could define variables correctly and completely. There were only three groups having wrong and incomplete answers in defining the variables, namely groups 1, 2 and 3.

(indicator 4 : Doing the mathematical calculations)



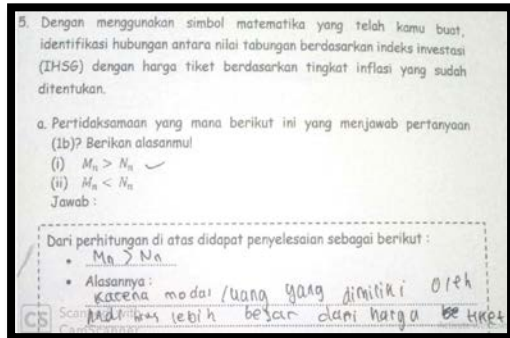
Students were able to completely and appropriately associate between the variables as the solution to the problems.

Figure 7. Results of student's answers to the indicator of doing the mathematical calculations

Figure 7 shows that the students could determine the relationship between the variables. This variable was the one made before the stage of defining the variables. At the first meeting in learning the LKPD 1, there was only one group being able to find mathematical models to solve problems, namely group 2. The other groups made mathematical models or were able to connect between the variables; yet, they still made mistakes that the mathematical model they found was incorrect. Similarly, there were also groups that did not make correct formulations so that their mathematical model was incorrect. Whereas for the LKPD 2 at the second meeting, there were 5 groups being able to get the right mathematical

model as a solution to the problems in LKPD 2, namely groups 2, 4, 6, 7, and 8. While the other 3 groups still made mistakes in inputting the variables.

(indicator 5 :analyzing and assessing the situations)



Students were able to solve other problems appropriately using the mathematical model obtained previously at the stage of doing the mathematical calculation.

Figure 8. Result of student's answer to the indicator of analyzing and assessing solutions

Figure 8 shows that the students were able to determine the completion of each part of the whole other problems. For indicators of mathematical solution analysis, at the first meeting, almost all groups answered incorrectly. Group 1 who was able to find the formulation at the stage of doing mathematical calculations also had incorrect answers. There were 4 groups who had the answers at the analysis stage of mathematical solutions by working manually or based on their experience or knowledge carried out in everyday life. Whereas in the second meeting, there were 5 groups being able to analyze and assess solutions, namely groups 2, 4, 6, 7, and 8. Whereas the other three groups did not complete the answers at the analysis stage of the mathematical solution. Among the 5 groups, there were 2 groups using the formulation in solving the problem and 3 groups did not rewrite the formulation obtained in the previous step but the group's answers was in accordance with the formulation found.

(Indicator 6 :interpreting the results)

Tahun	n	p(%)	q(%)	(1-p) ⁿ	(1-q) ⁿ	Na	Nb	Mc	Mn
2018	1	5,42%	1,0542	1,0542	29,500.000	3,068400	20.000.000	22.068.000	
2019	2	5,42%	1,1113	1,1113	29,500.000	32,3044608	20.000.000	24,369.568	
2020	3	5,42%	1,1716	1,3463	1,1716	29,500.000	34,561.346	17.20.000.000	26.934.0143
2021	4	5,42%	1,2351	1,4841	1,2351	29,500.000	36,434.694	16.000.000	29.942.555,95
2022	5	5,42%	1,3020	1,6422	1,3020	29,500.000	38,093.601	14.000.000	32.044.040,42
2023	6	5,42%	1,3726	1,8135	1,3726	29,500.000	40,49.1147	12.000.000	34.270.406,88
2024	7	5,42%	1,4470	2,0013	1,4470	29,500.000	42,68.536,38	10.000.000	36.645.000,63
2025	8	5,42%	1,5253	2,1115	1,5253	29,500.000	44,999.336,72	8.000.000	39.123.000,33
2026	9	5,42%	1,6081	2,2442	1,6081	29,500.000	47,378.000,62	6.000.000	41.684.471,17
2027	10	5,42%	1,6952	2,3969	1,6952	29,500.000	50,009.054,51	4.000.000	44.430.200,00
2028	11	5,42%	1,7872	2,5718	1,7872	29,500.000	52,393.99,94	2.000.000	47.364.500,63

Students tried to conclude the solution to the problems but they still found incorrect solution.

Figure 9. Results of student's answer to indicator of interpreting the results

Figure 9 shows that the students were able to determine the choice of minimarkets based on the completion of the previous mathematical model. For the indicator of interpreting the results, in the first meeting there was only 1 group having correct and complete answers, namely group 2. At the second meeting in LKPD 2 learning, there were 4 groups answering correctly, namely groups 2, 4, 6, and 7. The other 4 groups had not solved the problem at the stage of interpreting the results.

The results of the analysis of student answers showed that almost all groups were able to work on the problems at each stage of mathematical modeling. This means that the developed LKPD had a potential effect on mathematical modeling capabilities. In other words, the students could work on HOTS problems.

3.2.6. Analysis of interview results. Some of the interview results can be concluded that the sentences contained in the LKPD were effective because students could understand the intent of each question properly. In addition, based on the interviews with students, the images contained in the LKPD were familiar to students, questions and information in the LKPD used effective sentences, and the sequence of questions was arranged systematically that made it easier for students to complete the LKPD. Students also stated that the context contained in the LKPD was interesting because it was close to real life so students focused on working on the LKPD. Students also said that the context contained in LKPD was interesting because it was close to real-life so students focused on working on LKPD.

The interview in this study aims to look at the potential effects of the Student Worksheet (LKPD) on mathematical modeling learning on students' mathematical modeling abilities. As for some of the interviews of students (from representatives of several groups), that can be seen from the prominent indicators with one of the research subjects are as follows:

(In indicator 1: problem identification)

- Researcher: In question No.1, what information do you know from the problem above, can you possibly not answer it?
- Student (HRD): Yes you can. Inflation data for the past 5 years, JCI index data for the past 5 years, Andi's savings, the cost of a vacation trip to Europe contained in the brochure.
- Researcher: Continue to the next problem, what is the problem with the problem above? What did you guys answer?
- Student (HRD): In what year can the investment cost be sufficient for Andi's trip to Europe?

From the interview excerpt from one of the groups above, it can be seen that students are able to explain the information that is known and not yet known and also explain the problems contained in the given LKPD. So by discussing between groups, students can conclude that students understand the sentences and questions in the LKPD. Besides that, it can also be seen that the information contained in the LKPD makes it easy for students to solve problems.

Then in the indicators making assumptions and defining variables some groups can already follow the stages of the given LKPD indicators. The interview footage on the next indicator with one of the research subjects is as follows:

(In indicator 4: Perform mathematical calculations)

- Researcher: Then what about the formula to calculate in what year did Andi get a vacation to Europe?
- Students AGS: Try our group ma'am (one of the students raised their hands), if our group answers. First of all, we calculate the average inflation data for the last 5 years and then determine the compound interest (i) of the stock price index using the CSPI for the past 5 years. So after getting the average value from the data, our group made the assumption that the data can be used to make a calculation pattern, determining the cost of the ticket based on the inflation rate using the average and the value of Andi's savings that can be changed using compound interest from the stock index counted.
- Researcher: Then, how do the groups of sentences determine the pattern to formulate the mathematical calculations?
- Students DW (from the same group help answer): After our group determines the calculation, we use the same calculation pattern with the compound interest formula (i), using our calculator we calculate the manual from the first year to the nth year of the ticket cost experiencing movement based on inflation and also calculating the cost of tickets in the first year up to the value of the n-year saving of Andi who experiences movement because of the changing investment value (CSPI).

From the interview excerpts, only a handful of groups were able to carry out detailed calculations on LKPD that were given using the stages of mathematical modeling. This is also consistent with the field notes conducted by researchers.

From some interviews, it can also be concluded that the sentence structure contained in the LKPD is said to be effective because students can understand the intent and purpose of each question well. In addition, based on student interviews also concluded that the pictures and videos provided by researchers into LKPD are familiar and interesting to students, questions and information in LKPD use effective sentences, and the order of questions is arranged systematically making it easier for students to complete LKPD. Students also said that the financial context contained in LKPD was interesting because it explored their curiosity about current investment issues that often relate to real-life so that students are focused and happy in working on LKPD.

4. Conclusion

This study produced a valid and practical LKPD of learning mathematical modeling using the financial context of compound interest learning material for Grade XI students and had a potential effect on mathematical modeling abilities. Valid and practical seen based on context, construct and language used. This was done starting from the expert review, one to one and small group stages. Interesting contexts, effective sentences, familiar images, and systematic arrangements of LKPD made the students happy to learn the mathematical modeling and it developed the HOTS students' abilities as well. There is also the potential of students in working on the given Student Worksheet (LKPD), seen from the analysis of student answers at the field test stage.

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