How Students Learn Mathematical Modeling through a Financial Context

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Abstract. Many prior studies were conducted related to designing learning activities using financial contexts. However, the context used is less interesting among students in learning mathematics in school. This study aims to design students' interest in learning to model using financial contexts. The financial context used is closely related to economic conditions in Indonesia, namely inflation and investment. The research design was chosen as the research methodology in this study and involved 39 senior high school students of class XI Science. Data collection consists of student worksheets, observations, and interviews. The results showed that the financial context triggers students' interest in learning mathematical modeling using financial contexts, most students use calculators and Ms. Excel as an aid in calculations on student worksheets. Some of them can follow each step in modeling-based learning.

Keyword: financial context, modeling, inflation and investment

1. Introduction

Finance is one context that can be used in learning mathematics in schools. Using a good financial context will provide knowledge and insight into the importance of financial education at an early age and can also improve one's financial well-being (Huston, SJ, 2010). In (OECD, 2005) also explained that education regarding financial problems must begin in the school environment. That is because, International Studies such as PISA in 2012 have begun to make an assessment of financial literacy in learning mathematics in schools, and it is also expected that young people can show variations in financial concepts in depth. As a contribution to solving a problem, the financial context is one of the important needs in learning mathematics in schools (OECD, 2005). Financial problems can be applied using one of the approaches to the process of learning mathematics in schools. One of them is mathematical modeling. Modeling as a tool to support the details of decision making in investing (Petter, O.A and Dong, x, 2016: 13).

One of the efforts in implementing school-based modeling of mathematics learning that is relevant to the 2013 curriculum has the aim to develop abstract structures in mathematics to a higher level. To develop these structures, students must plan and carry out the process of solving problems (Ferri, B, 2011 and Greefrath, 2004). To process problems and their solutions, modeling has its own characteristics in producing mathematical solutions and is interpreted by students (Greefrath, 2004). In (Ang, 2001) also said that the effort in finding solutions to problems in modeling is a form of simplification in turning real-world problems into mathematical forms.

One of the relevant goals in the process of the importance of teaching mathematics-based modeling at school is the change in the education curriculum for the better (Eric, C.C, et al, 2015). The 2013 curriculum is currently in line with modeling-based mathematics learning in developing students' abilities and understanding in solving a problem. Modeling perspective aims to solve mathematical problems focusing on student representation through the use of mathematical ideas in describing mathematics to real-world contexts (Griesel, 2005).

The situation of real-world phenomena is used as a context in learning mathematics based on modeling in this study. Financial problems presented by researchers in developing learning products are inflation and investment rates. One of the needs in learning mathematics is the importance of learning more about financial concepts. In learning more deeply the concept of finance in the form of inflation and investment certainly cannot be separated from the difficulties experienced by students. The first thing that is done is to guide students to have basic knowledge in generating interest in issues related to finance (Petter, O, A and Dong, X, 2016: 13).

The thing that supports students recognizing financial-related problems in this research is the presentation of instruments and learning media during the learning process. The instrument used by researchers was in the form of student worksheets (LKPD). The LKPD contains economic problems that are rife in Indonesia today. The level of inflation and investment is a problem taken by researchers in presenting the form of LKPD. The problems presented at LKPD aim to develop students' interest in understanding financial concepts in depth.

2. Methodology

This research was conducted using a research design that aims to design financial context-based problems in learning mathematics-based modeling. Students 'answers and comments were analyzed by researchers in seeing students' interest in understanding financial concepts in depth. This study involved 39 students majoring in natural sciences in Palembang 11 Public High School.

The stages of this research focus on designing the LKPD as an instrument to generate student interest in the financial context. This stage consists of analysis, designing and product development. Then it is tested on one to one cycle, small group and field test. Research data were collected using analysis of expert notes (walkthroughs), comments and students' responses when the workload took place.

3. Result and Discussion

Before field trials, researchers conducted an analysis of the relationship of what material is in accordance with the financial context used. There are 2 items using the modeling approach stage. The modeling stage consists of 6 indicator descriptors in the process. Material related to financial problems presented by researchers is compound interest. After being analyzed, the items designed were developed into student worksheets (LKPD). 2 LKPDs were developed by researchers. Problems with LKPD 1 are in the form of a relationship between inflation and investment (CSPI) associated with "holidays to Europe". And the LKPD 2 is a relationship between inflation and investment (IHSG) plus top-ups every year.

The problems presented are found at the beginning of the LKPD sheet. Where from these problems students must have assumptions relating to solving the problems presented.
In addition, before researchers tested the LKPD developed through the stages of one to one, small groups and field tests. Testing the appearance, design, language, and prediction of the answers conducted by researchers with colleagues in a mathematics modeling class. The results of the discussion forum serve as suggestions and improvements in the form of revisions before the testing takes place.

Then, the improved LKPD was given to the experts to give input on the development of modeling-based mathematics learning LKPD. The experts provided consisted of 5 experts.

Comments and suggestions from experts in the good category with results above 78.76. In addition, the prototype 1 LKPD was tested on a one to one cycle of 2 students.

To see the practicality of the LKPD that has been improved, the researchers tried again to small groups. During the learning process, the researcher uses a model of eliciting activities (MEA), which is one model that is relevant to the modeling approach. As for the stages of the results of the small group cycle students' answers, there is still confusion in determining the appropriate assumptions in solving the given problem.

As for the excerpts from the problems presented in the LKPD sheet, namely:

Figure 1. LKPD 1

Figure 2. LKPD 2

Figure 3. Describe the variables

Figure 4. Data interpretation use Ms. Excel

In addition in the work and discussion in groups, researchers allow students to use Ms.Excell and calculators as calculation tools. From the results of students 'answers, the researchers saw the students' interest in working on LKPD 1 and 2 in their work on the problems of financial concepts presented. Plus the comments of students from the results of the interview responded positively. So from the presentation and expected results stated that the LKPD has practicality and is easily understood by students in these small groups.

Table 1. 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; 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.

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

One indicator at the stage when the field test group takes place.

The analysis of the results of the students 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.

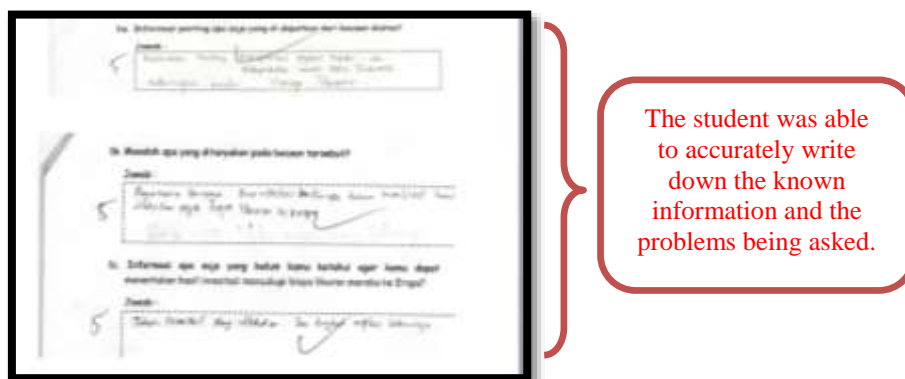*(Indicator 1 : Identifying and understanding the problem)*

The student was able to accurately write down the known information and the problems being asked.

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

And other indicators also displayed from the work of students solving the problems presented
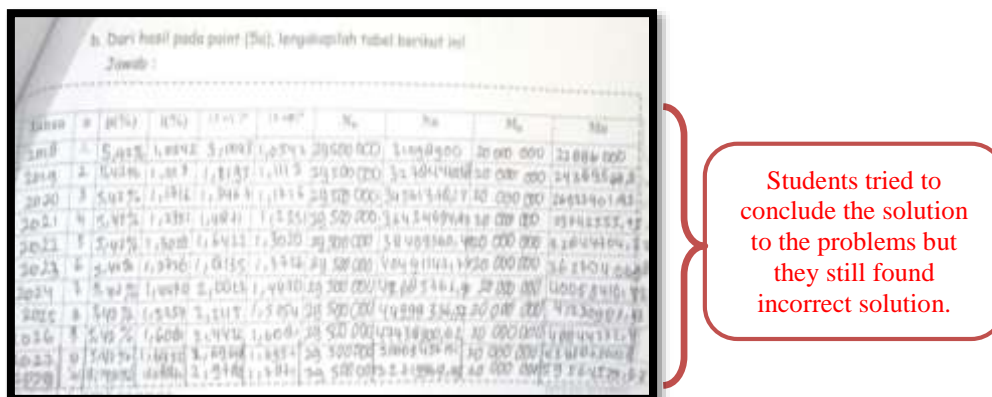
(Indicator 6 :interpreting the results)

Figure 6. Results of student's answer to indicator of interpreting the results

Figure 6 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.

On these indicators, students can complete the phases using calculating tools such as a calculator and Ms.Excell. The response of the interview results also said positively from the appearance, studies and problems given.

4. Conclusion

This study produces a valid and practical LKPD for learning mathematics modeling using the financial context of learning materials of compound interest for class XI students and has potential effects on mathematical modeling abilities. Legitimate and practical seen based on the context, construct and language used. This is done starting from the expert review, one to one and the small group stage. An interesting context, effective sentences, familiar drawings, and systematic arrangement of LKPD make students enjoy learning mathematical modeling and also develop HOTS students' abilities. There is also the potential for students to work on a Student Worksheet (LKPD) given, seen from the analysis of student answers at the field test stage.

5. Acknowledgments

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