Jurnal Pendidikan Matematika
https://doi.org/10.22342/jpm.v18i2.pp149-162

Designing a Financial Mathematical Task for Vocational High School Using Saving and Stock Context

M Hasbi Ramadhan[1], Zulkardi[1,*], Ratu Ilma Indra Putri[1], Yulia Resti[2]

[1]Department of Mathematics Education, Universitas Sriwijaya, Palembang, Indonesia
[2]Department of Mathematics, Universitas Sriwijaya, Palembang, Indonesia
*Email: zulkardi@unsri.ac.id

Abstract

In daily life, banks usually not only offer their saving programs but also their stocks. This research focuses on designing a financial mathematical task for vocational high school (VHS) which is valid, practical, and has potential effects using saving and stock context. *Pendidikan Matematika Realistik Indonesia* (PMRI) is the approach used in this research. For the method, we used design research with a type of development studies. This research was conducted at VHS 1 at Jambi City with research subjects were the eleventh-grade students of accounting major. This research produces three financial mathematical tasks with the context of saving and stock. The results of research also found that by using saving and stock context, students became more understanding of real-world problems and wise in making decisions regarding financial problems. This research can also be used as a reference for financial mathematics teaching materials, especially for vocational high school teachers.

Keywords: Financial Mathematical Task, Saving, Stock, PMRI, Design Research

How to Cite: Ramadhan, M. H., Zulkardi, Putri, R. I. I., & Resti, Y. (2024). Designing a financial mathematical task for vocational high school using saving and stock context. *Jurnal Pendidikan Matematika, 18*(2), 149-162. https://doi.org/10.22342/jpm.v18i2.pp149-162

INTRODUCTION

Many people acknowledged that mathematics is an important and main subject in many national education curricula (Fathurrohman et al., 2022). Mathematics is also viewed as a learning foundation for studying other scientific disciplines to solve problems in our daily lives (Junpeng et al., 2020; Kesorn et al., 2020). Mathematics, as an academic discipline, is systematically studied across educational levels ranging from elementary school to higher education, encompassing vocational high schools (VHS). According to Regulation No. 22 of 2020 issued by the Minister of Education and Culture of the Republic of Indonesia, which delineates the Strategic Plan of the Ministry of Education and Culture for the period 2020-2024, efforts are outlined to revitalize VHS with the aim of enhancing the quality and competitiveness of Indonesia's human capital. These efforts entail ensuring that vocational school graduates possess high proficiency in their respective fields, aligning with the demands of business-industrial sectors, and enabling them to effectively engage with global and regional competition, such as that presented by the ASEAN economic community. Consequently, VHS graduates are expected to adeptly master their disciplines to actively contribute to the workforce.

There are some specific fields at VHS, one of them is accounting major (AM) which specifically discusses financial matters. Generally, to find solutions in daily activities especially in financial problems, humans usually use mathematics as a tool to solve it (Butuner & Baki, 2020). In other words, learning financial mathematics involves acquiring formalized knowledge of financial concepts to understand the world and participate actively in it (Cavalcante & Huang, 2022). In VHS especially AM,

Received September 13, 2023; Revised November 21, 2023; Accepted April 26, 2024

financial mathematics is found in the application of sequence and series in eleventh grade that includes single interest, compound interest, growth, decay, and annuity (Ediyanto & Harsasi, 2022). These concepts are often encountered in daily activities. Therefore, in designing financial mathematical learning, the problems given must be oriented to daily activities. In addition, Joo & Chatterjee (2012) stated that learning financial mathematics that only involves basic arithmetic skills and does not require special skills should be avoided. Since, it does not improve student's abilities (Lusardi, 2012); understanding about finance (Sole, 2014); and differentiate financial concepts in everyday life (Bansilal, 2016).

Previous research found that financial mathematics learning implementation program in VHS was still too general and not oriented toward daily activities. The problems given also do not require special skills (Sutiaharni & Armiati, 2020). Then, because VHS graduates are prepared to work like financial technicians, they must be trained and educated based on problems in daily activities to increase their abilities. On the other hand, in previous research, the context used was irrelevant and less appropriate to daily problems (Sutiaharni et al., 2021). It means that we need an approach that encourages students to learn from the real word problems. In Indonesia, a learning approach that is oriented to daily activities is known as the Indonesian Realistic Mathematics Education or PMRI approach in Bahasa (Zulkardi et al., 2020; Van den Heuvel-Panhuizen & Drijvers, 2020).

PMRI, or the Realistic Mathematics Education approach, has been a significant part of mathematics education in Indonesia since 2001. Rooted in the belief that mathematics is a human activity and should be connected to real-world contexts, PMRI has garnered attention for its effectiveness in enhancing student understanding, improving mathematical abilities, and boosting academic achievement. Several studies have supported the efficacy of PMRI. Ramadhan et al. (2022) found that it leads to better student comprehension, while Tamur et al. (2020) demonstrated its positive impact on mathematical proficiency. Additionally, Aksu and Colak (2021) reported increased academic achievements among students who were taught using PMRI methods. Moreover, Zakaria and Syamaun (2017) observed improvements in the overall quality of mathematics education through the implementation of PMRI. An essential aspect of PMRI is the selection of contexts that align with real-world problems. This approach enables students to develop their understanding of financial mathematics (Bansilal & Mkhwanazi, 2012), grasp the relevance of mathematical concepts in practical situations (Pournara, 2013), and enhance their problem-solving skills (Althauser & Harter, 2016). Overall, PMRI stands as a comprehensive framework that not only enhances mathematical learning but also equips students with essential skills for navigating real-world challenges.

In this research, we used the context of saving and stock as a real-world problem, and it is a novelty because no previous research had used this context. For instance, in previous research developed HOTS with type of financial mathematics questions but did not use real context like comparing saving and stock (Ramadhan et al., 2023). In daily life, banks commonly provide not only savings programs but also opportunities for investment in stocks. This presents individuals with two

viable options: depositing funds in a bank account or purchasing stocks issued by the bank. By saving money over certain periods, individuals stand to accrue profits based on interest rates. Similarly, investing in bank stocks offers potential returns if the stock prices appreciate. With this premise in mind, researchers and teachers have crafted tasks aimed at comparing the merits of saving versus investing in bank stocks, posing the question of which option is superior. Therefore, this research focuses on designing a financial mathematical task for VHS which is valid, practical, and has potential effects for student understanding in financial mathematics using saving and stock context. Apart from that, it aims to make students wiser in choosing the best investment in the future as a real-world problem.

METHODS

This research adopts a design research methodology within the framework of development studies. Development studies typically encompass two distinct phases: the preliminary phase and the formative evaluation phase, aimed at prototyping (Plomp, 2013; Bakker, 2018; Purwitaningrum & Prahmana, 2021). In the preliminary phase, the researcher determines the place, research subjects, subject needs, and other preparations like schedule for doing research and so on. Next, the formative evaluation phase is divided into several stages from low resistance to revision toward high resistance to revision, namely self-evaluation, expert review, one-to-one, small group, and field test.

Preliminary Phase

At the preliminary stage, in addition to determine the location and research subjects, researchers also reviewed literature, including curriculum, learning materials, the PMRI approach, and learning activities. Subsequently, the researcher engaged in discussions with teachers, reviewed learning tools, and assessed the needs and potential of the students. Based on these discussions and identified needs, a financial mathematical task was designed utilizing the context of saving and stocks.

The research conducted at VHS 1 Jambi City aimed to produce financial mathematics tasks that are valid, practical, and have potential effects. This research was conducted in March 2023. The study encompassed several phases. Initially, three students from the eleventh-grade of AM 3 participated in one-to-one sessions, followed by six students from the eleventh-grade of AM 2 in small group sessions, and finally, all students from the eleventh-grade of AM 1, totaling 35 students.

Formative Evaluation Phase

This phase involved several stages, including self-evaluation, expert review, one-to-one, small group, and field tests. During the self-evaluation stage, learning activities were designed by the researcher and teachers to produce Prototype 1. In the expert review stage, Prototype 1 was validated through expert assessment, covering aspects such as content, language, and activity construction. Content assessment ensured the suitability of questions and activities, while language assessment focused on adhering to the Enhanced Indonesian Spelling Guidelines or EYD in Bahasa. The

construction assessment evaluated the appropriateness of the questions. Concurrently, one-to-one sessions were conducted with three students to gather feedback for revision. Following these processes, Prototype 1 was deemed valid, leading to the creation of Prototype 2.

Next, Prototype 2 was tested at a small group stage involving six students. This stage was carried out to determine the practicality of Prototype 2 that can be seen in problem given and students can solve it using various strategies. Prototype 3 was developed based on trials and feedback from students, leading to subsequent revisions. Finally, Prototype 3 was tested at the field test stage. This stage is carried out for all students in one class to see the potential effects of the learning developments made.

The data were collected through observation, documentation, interviews, and tests. Observation was employed when tackling financial tasks in the prototyping phase. Documentation occurred during the preliminary stage's initial needs analysis. Interviews were held after students had completed their financial tasks. A test was administered afterward to gauge potential effects. Data were analyzed and described qualitatively.

RESULTS AND DISCUSSION

Preliminary Phase

In the initial stage, the researcher discussed curriculum, textbooks, student abilities, and the PMRI approach with the teacher. Following these discussions, it was determined that the curriculum utilized remained Curriculum 13, or K13, for eleventh-grade students. Additionally, the textbooks lacked real-world context-based cases for learning financial mathematics, and the PMRI approach had not been integrated into mathematics education. Based on these findings, the researcher and teacher collaborated to design a financial mathematical task for eleventh-grade of AM students, incorporating the context of saving and stock within the PMRI approach.

Formative Evaluation Phase

In this phase, firstly, the researcher and teacher design financial mathematics learning based on the curriculum, materials, PMRI approach, and student needs. In searching for material with a real context, researchers used the Miles-Huberman technique as seen in Figure 1 (Miles, Huberman, & Saldana, 2014). The procedural steps entail, initially, conducting a thorough search for authentic contexts using the Google search engine, specifically tailored to the chosen themes of saving and stock. Subsequently, collating the acquired data and organizing it in alignment with the curriculum, theoretical frameworks, and the identified needs of students. In instances where data inconsistency arises, it is systematically removed from consideration; conversely, data deemed pertinent undergoes analysis in accordance with the formative evaluation phase.

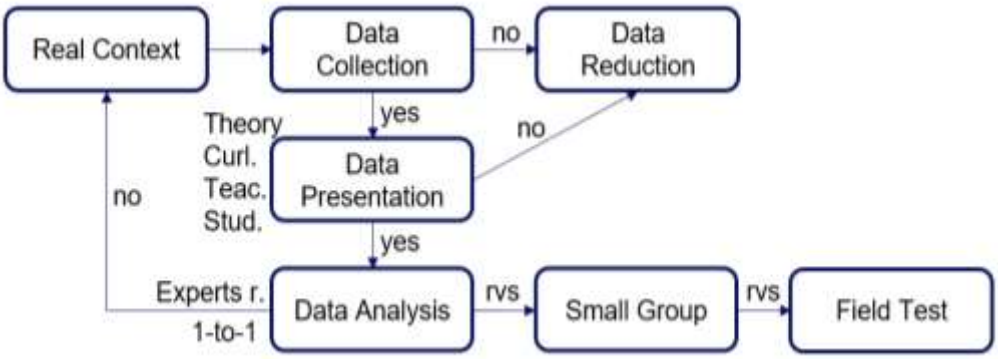


Figure 1. Miles-Huberman formative evaluation design

Figure 1 illustrates the stages of data search, beginning with the identification of real-world contexts and subsequent analysis according to the formative evaluation phase. Upon locating suitable data, the researcher and teacher proceed to develop tasks for learning activities. Three tasks are created, comprising calculating savings, computing stocks, and comparing savings and stocks, as detailed in Table 1.

Table 1. The task for learning financial mathematics using saving and stock context

Task	Main Goals
A. Saving calculation with deposit simulation	• Students understand about interest rates, interest tax, tenor, and so on. • Students are able to calculate the amount of saving based on the deposit simulation given.
B. Buying the stock	• Students understand about stock prices, stock lots, taxes on buying and selling stock, and so on. • Students are able to calculate the purchase and sale prices of stock.
C. Comparing between saving in bank and buying the stock	• Students are able to compare the benefits and risks between saving in bank or buying its stock.

Table 1 shows three tasks designed as initial Prototype. Each task was designed with specific primary objectives, namely enabling students to perform calculations using deposit simulations, engage in stock purchases, and compare the outcomes of both actions. Following the development phase, Prototype 1 underwent validation qualitatively through expert review, encompassing evaluation of content, language, and construction. Subsequently, adjustments were made to address feedback and suggestions provided during this process (See Table 2). At the same time, it was also tested on three students from eleventh grade of AM 3 as one-to-one phase. The commentary can be seen in table 2. It aims to validate the task and produce Prototype 2.

Table 2. Commentary and suggestions from expert review

Commentary/Suggestions	Revised
Task A	
• Given simple question and clear • Use easy amount of money	• Abbreviate the question • Give easy nominal money
Task B	
• Given information especially in buying the stock like lots, tax, etc • Use easy amount of money	• Add the required information • Give easy nominal money
Task C	
• Give questions not only about profit, but also about loss • Give question about the risk between saving and stock	• Add ratio question about profit and loss between saving and stock • Add question about the risk between saving and stock

Table 2 presents several comments and suggestions from experts regarding the three tasks designed from Prototype 1. Revisions were made, such as abbreviating the questions, nominal money, required information, and questions about profit and loss between saving and stock. The validity from expert is needed to revise the Prototype designed (Adillah et al., 2022). After revised based on expert review and one-to-one phase, it produces Prototype 2.

Prototype 2 was tested on six students from eleventh grade of AM 2 in small group phase to determine the practicality. Based on the student's answers, it can be seen that the task given is practice since student can answer it with various strategies. This is same as research by Sari et al., (2021) who argue that practicality can be seen from students' answers based on their own strategies. After receiving comments and revision, it produced Prototype 3 which will be tested on eleventh grade of AM 1 with a total of 35 students. This aims to see the potential effects from task designed. Below is Prototype 3 which was tested in field tests.

Task A: Saving Calculation with Deposit Simulation

This section aims to provide students with an understanding of saving at the bank using deposit simulation. First, researcher and teacher designed a task using deposit simulation of XYZ Bank. Some of the information provided includes interest rates, interest taxes, tenors, and nominal. Then students are asked to calculate the total of savings using deposit simulation in a certain period. The XYZ bank deposit simulation and the question can be seen in Figure 2.

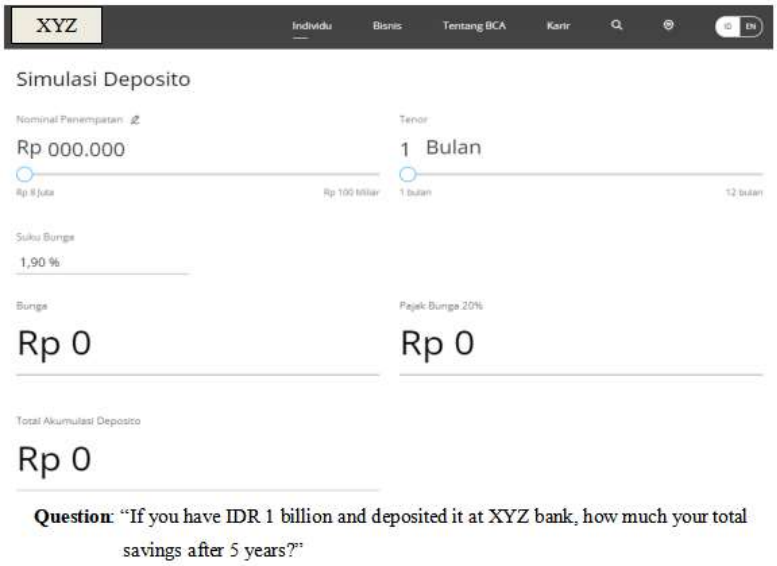
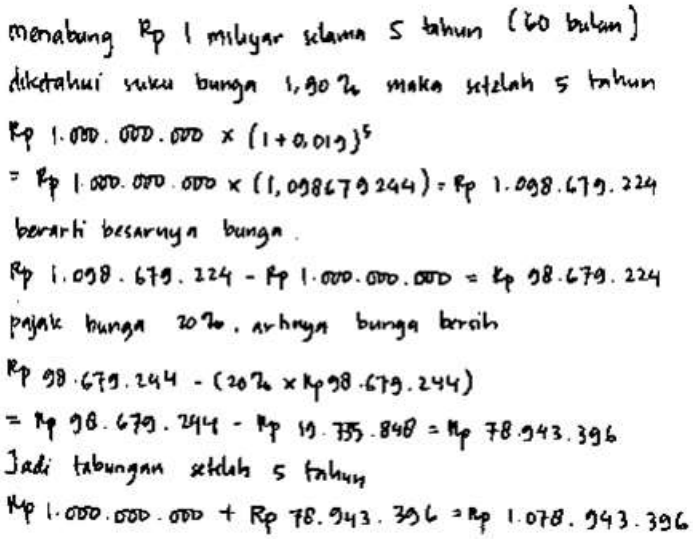


Figure 2. Deposit simulation of XYZ bank and the question for Task A

Figure 2 shows the deposit simulation of XYZ bank. Then from question given, students must determine the length of the tenor, the amount of interest, and utilize the provided interest tax. Figure 3 is the student answer for task A.


menabung Rp 1 milyar selama 5 tahun (60 bulan)
diketahui suku bunga 1,90% maka setelah 5 tahun
Rp 1.000.000.000 x $(1+0,019)^5$
= Rp 1.000.000.000 x (1,098679244) = Rp 1.098.679.224
berarti besarnya bunga
Rp 1.098.679.224 - Rp 1.000.000.000 = Rp 98.679.224
pajak bunga 20%, artinya bunga bersih
Rp 98.679.244 - (20% x Rp 98.679.244)
= Rp 98.679.244 - Rp 19.735.848 = Rp 78.943.396
Jadi tabungan setelah 5 tahun
Rp 1.000.000.000 + Rp 78.943.396 = Rp 1.078.943.396

Translated into English:

Saving IDR 1 billion for 5 years (60 months). Given the interest rate is 1,90%, then after 5 years: Rp 1.000.000.000 x $(1 + 0{,}019)^5$ = Rp 1.000.000.000 x (1,098679244) = Rp 1.098.679.224. It means the amount of interest is Rp 1.098.679.224 − Rp 1.000.000.000 = Rp 98.679.224 . Interest tax is 20%, it means the net interest is Rp 98.679.224 − (20% x Rp 98.679.224) = Rp 98.679.224 − Rp 19.735.848 = Rp 78.943.396. So, the total savings after 5 years is Rp1.000.000.000 + Rp78.943.396 = Rp1.078.943.396.

Figure 3. Student's answer for task A

Based on deposit simulation of XYZ bank, some students answered correctly according to the simulation given, while others were incorrect because they did not include the interest tax (See Figure 3). This is because generally the questions in the textbook do not contain interest tax information. The only thing that is usually given is the amount of interest.

Task B: Buying the Stock

This section aims to give students an understanding of stocks. The researcher and teacher accessed in RTI Business application to find BCA bank stock and set the period needed. After that, the teacher gave some information about stock like stock code, purchase tax and sales tax of stock, stock purchases must be in lots, the fluctuation of stock, and so on. The following is BCA bank stock for period 17th of October 2017 to 17th of October 2022 also with the question that can be seen in Figure 4.

Question: "If you buy BCA bank stock on 17th of October 2017 for IDR 1,000,000,000, how much profit will you get when you sell them back on 17th of October 2022?"

Figure 4. Information of BCA banks stock and the question for task B

Before the students gave their answers, the teacher provided information such as the minimum purchase requirement of 1 lot, where 1 lot consists of 100 stocks. Additionally, students were informed that the stock tax for purchases is 0.17%, while the stock tax for sales is 0.27%. The student answers are presented in Figure 5.


Harga saham awal Rp 3.540 per lembar. Dengan uang Rp 1 Miliyar
Jumlah lot saham yang dapat dibeli sebanyak
Rp 3.540 x 100 per lot : Rp 354.000 per lot
Rp 1.000.000.000 : Rp 354.000 = 2824,85 lot atau 2824 lot
Diketahui pajak pembelian 0,17%, maka total yang dibayar
Rp 354.000 x 2.824 x (1+0,17%)
= Rp 999.696.000 x 1,0017 = Rp 1.001.395.483
Karena uang yang dimiliki tidak cukup, maka jumlah lot dikurangi
Rp 354.000 x 2.820 x (1+0,17%)
= Rp 998.280.000 x 1,0017 = Rp 999.977.076
Setelah 5 tahun harga saham naik menjadi Rp 8.250 per lembar
atau Rp 8.250 x 100 per lot = Rp 825.000 per lot.
Jadi uang kita setelah 5 tahun adalah
Rp 825.000 x 2820 x (1-0,27%)
= Rp 2.326.500.000 x 0,9973 = Rp 2.320.218.450

Translated into English:

The initial stock price is Rp 3.450 per stock. With IDR 1 billion, the amount of lots of stock that can be purchased is Rp 3.540 x 100 per lot = Rp 354.000 per lot so Rp 1.000.000.000 : Rp 354.000 per lot = 2824,85 lot or 2824 lot.
Known purchase tax is 0,17%, then the total to be paid is Rp 354.000 x 2.824 x (1 + 0,17%) = Rp 999.696.000 x 1,0017 = Rp 1.001.395.483 .
Since there is not enough money, the number of lots is reduced Rp 354.000 x 2.820 x (1 + 0,17%) = Rp 998.280.000 x 1,0017 = Rp 999.977.076 .
After 5 years, the stock price rises to Rp 8.250 per stock or Rp 8.250 x 100 per lot = Rp 825.000 per lot . So, our money after 5 years is Rp 825.000 x 2.820 x (1 – 0,27%) = Rp 2.326.500.000 x 0,9973 = Rp2.320.218.450

Figure 5. Student's answer for task B

Figure 5 shows that students could find the initial price for one stock then convert it to the lot. After that, students used the purchase tax known to determine the total to be paid. Then with their strategy, students could determine the amount of money after selling the stock in some period using sale tax correctly.

Task C: Comparing Between Saving in Bank and Buying the Stock

After calculating, students were asked for their opinions on their preference between saving in banks and buying stock. During same period, students were asked to comment regarding the advantages and risks between saving in bank and buying stock.

Teacher	:	*After you calculated between saving in bank and buying the stock, which one is more profitable?*
Student	:	*Buying the stock.*
Teacher	:	*Is it always profitable if we buy the stock?*
Student	:	*No, it does not.*
Teacher	:	*Can you give an example?*
Student:	:	*If we buy the stock in January 2020 and then sell it in March or April 2020, then we will incur losses.*
Teacher	:	*That's good. And what do you think about saving in a bank?*
Student	:	*Saving in a bank always provides benefits because it does not have the risk of decline like stock although sometimes it is not as big as the profit from buying the stock.*
Teacher	:	*Excellent.*

From the given tasks, students gained a heightened awareness of the distinctions between saving money at a bank and investing in stocks. In Task A, students were tasked with calculating the amount of savings based on the deposit simulation presented in Figure 2. Students demonstrated comprehension of the calculation process involving interest, interest tax, and tenor. However, some students made errors by omitting the interest tax. This occurrence can be attributed to the lack of interest tax information in most textbooks concerning saving programs. Typically, textbooks only provide the amount of interest without mentioning the associated interest tax. Nevertheless, in real-life scenarios, when depositing money into a bank, an interest tax is applicable to the saving program. Therefore, utilizing real-life contexts for learning financial mathematics becomes imperative. This notion is corroborated by research conducted by Dituri et al. (2019), which emphasizes the necessity of comprehensive information for solving problems in financial mathematics.

Then in the task B, students were given information about a stock in a certain period. All of students could determine the initial price and the final price of stock based on Figure 4. Students also can put stock tax on buying and selling well. However, the challenge is how many lots can be purchased after purchasing tax? After some trial and error in calculating the number of lots, students computed the total profit based on the selling price. Initially, students needed to devise a strategy for calculating the sales tax. It is essential for students to employ strategies in problem-solving (Hikmah et al., 2021). Consequently, students obtained the net profit value for the specified periods.

In addition, in Task C, students were asked to compare between saving at the bank and buying the stock. Students knew that buying the stock was more profitable than saving using deposit simulation in that period. On the other hand, students also knew that buying the stock was not always profitable. Even though it was more profitable to buy the stock in that period, there was also a risk of price decline. Students gave an example: if the stock was bought in January 2020 and then sold in March or April 2020, there would be a loss. This was different from saving in the bank which always made a profit although sometimes it was not as big as the profit from buying the stock. After the three tasks above, students understood the difference in profitability between saving and buying stock. It was the potential effect in learning financial mathematics that made students more understanding and wiser in making decisions. This was the same as research by Makonye (2019) who believed that learning financial mathematics could make someone wiser in making decisions regarding financial matters.

Learning financial mathematics will be more meaningful by using real context as learning material. In line with research by Ferreira & Bisognin (2020) which stated that the concept created must be appropriate to student's financial life so that in the future, they become responsible and wise in making decisions. Then, Nusantara et al., (2021) stated that a good context can direct students to think mathematically from various real situations given. This means that an approach that is oriented towards daily life, such as the PMRI approach, is needed. Zulkardi & Putri (2019) stated that there are five characteristics of PMRI i.e.: using real-world contexts, using a model, using student' strategies,

interaction, and connections between disciplines. By using these characters, students will understand better and learning activities will be more meaningful. Furthermore, that's the original findings in this research, student more understanding the real financial problems and how to solve and get best decisions.

CONCLUSION

The results of research found that by using saving and stock context, students became more understanding to the real-world problems and wiser in making decisions regarding financial problems. This can be seen in how students are able to compare the benefits and risks between saving in bank and buying the stock. Moreover, financial mathematical tasks made were valid, practical, and has potential effects. It can be found in every stage in formative evaluation phase. This aligns with the characteristic of financial task designed which brings real world problems (real context) to be solved into the mathematics world with any strategies by students. Validity can be found in content (suitability of questions and activities given), language (enhanced spelling of the Indonesian language), and construction (appropriateness questions given) as revision from expert review and one-to-one phase. Furthermore, practicality is viewed in small groups that problem given can be solved using various strategies by students. Through revisions and comments from students, lastly the potential effect in field test can be found in comments and students answer that understand the real problems especially comparison between saving in bank and buying the stock. It means that the task made can be used by teacher and students for learning financial mathematics. Furthermore, PMRI as approach can make learning activities more meaningful and student become more understanding since task used based on real-world problems especially financial problems. As for recommendation to future studies, we may not only compare saving and stock but also the potential outcomes of investing in mutual fund companies.

ACKNOWLEDGMENTS

We would like to thank to all of teachers at VHS 1 Jambi City especially Ms. Dina Anggraini, S.Pd., M.Pd., who helped and supported this research. We also would like to thanks to all of students especially eleventh-grade of AM 1, AM 2, and AM 3 who participated and helped us for complete this research. The study received partial funding from Universitas Sriwijaya through a research profession grant in 2024.

REFERENCES

Adillah, G., Ridwan, A., & Rahayu, W. (2022). Content validation through expert judgement of an instrument on the self-assessment of mathematics education student competency. *International*

Journal of Multicultural and Multireligious Understanding, 9(3), 780-790. http://doi.org/10.18415/ijmmu.v9i3.3738

Aksu, H. H. & Colak, S. O. (2021). The effect of realistic mathematics education on student achievement in 8th grades geometric objects teaching. *African Educational Research Journal, 9*(1), 20-31. http://doi.org/10.30918/AERJ.91.20.205

Althauser, K. & Harter, C. (2016). Math and economics: Implementing authentic instruction in grades K-5. *Journal of Education and Training Studies, 4*(4), 111–122. http://dx.doi.org/10.11114/jets.v4i4.1328

Bakker, A. (2018). *Design research in education: A practical guide for early career researchers*. London: Routledge. https://doi.org/10.4324/9780203701010

Bansilal, S. & Mkhwanazi, T. (2012). Mathematical literacy teachers' engagement with contextual tasks based on personal finance. *Perspectives in Education, 30*(3), 98-109. https://hdl.handle.net/10520/EJC125392

Bansilal, S. (2016). Teachers' understanding of inflation: Developing a crystalline concept. *International Journal of Mathematical Education in Science and Technology, 48*(1), 83–93. https://doi.org/10.1080/0020739X.2016.1238517

Butuner, S. O. & Baki, A. (2020). The use of history of mathematics in the mathematics classroom: An action study. *International Journal of Education in Mathematics, Science and Technology (IJEMST), 8*(2), 92-117. https://doi.org/10.46328/ijemst.v8i2.843

Cavalcante, A. & Huang, H. (2022). Understanding Chinese students' success in the PISA financial literacy: A praxeological analysis of financial numeracy. *Asian Journal for Mathematics Education, 1*(1), 66–94. https://doi.org/10.1177/27527263221091304

Dituri, P., Davidson, A., & Marley-Payne, J. (2019). Combining financial education with mathematics coursework: Findings from a pilot study. *Journal of Financial Counseling and Planning, 30*(2), 313-322. https://doi.org/10.1891/1052-3073.30.2.313

Ediyanto, A. & Harsasi, M. (2022). *Mathematics 2 Technology Cluster for VHS/MAK Class XI (K-Merdeka) [in Bahasa]*. Jakarta: Erlangga.

Fathurrohman, M., Nindiasari, H., & Rahayu, I. (2022). A conventional and digital mathematical board game design and development for use by students in learning arithmetic. *Journal on Mathematics Education, 13*(4), 631-660. http://doi.org/10.22342/jme.v13i4.pp631-660

Ferreira, S.M. & Bisognin, V. (2020). Construction of mathematical and financial concepts based on realistic mathematics education. *ACTA SCIENTIAE, 22*(5), 226-253. https://doi.org/10.17648/acta.scientiae.5925

Freudenthal, H. (2002). *Revisiting mathematics education: China lectures*. Dordrecht: Kluwer Academic Publishers. http://doi.org/10.1007/0-306-47202-3

Hikmah, N. H., Siswono, T. Y. E., & Zahri, M. (2021). Profile of collaborative problem solving among XI students in solving financial mathematics problems. *Journal of Mathematical Pedagogy, 2*(2), 82-91. https://doi.org/10.26740/jomp.v2n2.p82-91

Joo, S. & Chatterjee, S. (2012). Financial education research opportunities. In D. Durband, & S. Britt (Eds.), *Student financial literacy: Campus-based program development*. (pp. 125–140). New York: Springer. https://doi.org/10.1007/978-1-4614-3505-1

Junpeng, P., Marwiang, M., Chiajunthuk, S., Suwannatrai, P., Chanayota, K., Pongboriboon, K., Tang, K. N., & Wilson, M. (2020). Validation of a digital tool for diagnosing mathematical proficiency. *International Journal of Evaluation and Research in Education, 9*(3), 665–674. https://doi.org/10.11591/ijere.v9i3.20503

Kesorn, N., Junpeng, P., Marwiang, M., Pongboriboon, K., Tang, K. N., Bathia, S., & Wilson, M. (2020). Development of an assessment tool for mathematical reading, analytical thinking, and mathematical writing. *International Journal of Evaluation and Research in Education, 9*(4), 955–962. https://doi.org/10.11591/ijere.v9i4.20505

Lusardi, A. (2012). Numeracy, financial literacy, and financial decision-making. *Numeracy, 5*(1), 1 - 12. https://doi.org/10.5038/1936-4660.5.1.2

Miles, M. B., Huberman, A. M., & Saldana, J. (2014). *Qualitative data analysis: A methods sourcebook (3rd Edition)*. Washington DC: SAGE Publications. https://doi.org/10.1177/239700221402800402

Makonye, J. P. (2019). Towards a culturally embedded financial mathematics PCK framework. *Research in Mathematics Education, 22*(2), 98-116. https://doi.org/10.1080/14794802.2020.1752788

Nusantara, D. S., Zulkardi, & Putri, R. I. I. (2021). Designing PISA-like mathematics task using a COVID-19 context (PISAComat). *Journal on Mathematics Education, 12*(2), 349-364. http://doi.org/10.22342/jme.12.2.13181.349-364

Plomp, T. (2013). *Educational design research: An introduction. In T. Plomp & N. Nieveen (Eds)*. Enschede: Netherlands Institute for Curriculum Development. https://ris.utwente.nl/ws/portalfiles/portal/14472302/

Pournara, C. (2013). Teachers' knowledge for teaching compound interest. *Pythagoras, 34*(2), A238. https://doi.org/10.4102/pythagoras.v34i2.238

Purwitaningrum, R. & Prahmana, R. C. I. (2021). Developing instructional materials on mathematics logical thinking through the Indonesian realistic mathematics education approach. *International Journal of Education and Learning*, *3*(1), 13-19. https://doi.org/10.31763/ijele.v3i1.178

Ramadhan, M. H., Zulkardi, & Putri, R. I. I. (2022). Designing learning trajectory for teaching fractions using PMRI approach with a chessboard context. *SJME (Supremum Journal of Mathematics Education)*, *6*(2), 162–170. https://doi.org/10.35706/sjme.v6i2.5866

Ramadhan, S., Arliani, E., Purbaningrum, M., & Azazih, N. L. (2023). The development of HOTS-based financial mathematics question to support student's mathematical communication skill. *Aksioma, 12*(4),3657-3669. https://dx.doi.org/10.24127/ajpm.v12i4.8118

Sari, R. P., Armiati, & Permana, D. (2021). Practicality of learning design based on realistic mathematics education of derivative topic for grade XI senior high school. *J. Phys.: Conf. Ser. 1940 012105*. https://doi.org/10.1088/1742-6596/1940/1/012105

Sole, M. A. (2014). Financial literacy: An essential component of mathematics literacy and numeracy. *Journal of Mathematics Education at Teachers College, 5*(2), 55–62. https://doi.org/10.7916/jmetc.v5i2.655

Sutiaharni, S. & Armiati, A. (2020). Development of mathematics learning devices based on realistic mathematics education for financial accounting expertise program in vocational high school.

Journal of Physics: Conference Series, 1554(1), 012060. https://doi.org/10.1088/1742-6596/1554/1/012060

Sutiaharni, Armiati, & Permana, D. (2021). Practicality of realistic mathematics education-based learning design of linear programming for financial accounting major in vocational high school. *Journal of Physics: Conference Series, 1940*(1), 012104. http://doi.org/10.1088/1742-6596/1940/1/012104

Tamur, M., Juandi, D., & Adem, A. M. G. (2020). Realistic mathematics education in Indonesia and recommendations for future implementation: A meta-analysis study. *JTAM (Jurnal Teori dan Aplikasi Matematika)*, *4*(1), 17-27. https://doi.org/10.31764/jtam.v4i1.1786

Van den Heuvel-Panhuizen, M., & Drijvers, P. (2020). Realistic Mathematics Education. In: Lerman, S. (eds). *Encyclopedia of Mathematics Education*. Singapote: Springer. https://doi.org/10.1007/978-3-030-15789-0_170

Wilburne, J. M., Napoli, M., Keat, J. B., Dile, K., Trout, M., & Decker, S. (2007). Journeying into mathematics through storybooks: A kindergarten story. *Teaching Children Mathematics*, *14*(4), 232–237. https://doi.org/10.5951/TCM.14.4.0232

Zakaria, E. & Syamaun, M. (2017). The effect of realistic mathematics education approach on students' achievement and attitudes towards mathematics. *Mathematics Education Trends and Research*, *1*(1), 32-40. http://doi.org/10.5899/2017/metr-00093

Zulkardi. (2002). Developing a learning environment on realistic mathematics education for indonesian student teachers. *PhD Thesis*. Enschede: Twente University. https://research.utwente.nl/en/publications/developing-a-learning-environment-on-realistic-mathematics-educat

Zulkardi & Putri, R. I. I. (2019). New school mathematics curricula, PISA and PMRI in Indonesia. In: Vistro-Yu, C.P., & Toh, T.L. (Eds.). *School Mathematics Curricula: Asian Perspectives and Glimpses of Reform* (pp.39-49). Singapore: Springer. https://doi.org/10.1007/978-981-13-6312-2_3

Zulkardi, Putri, R. I. I., & Wijaya, A. (2020). Two Decades of Realistic Mathematics Education in Indonesia. Singapore: Springer. https://doi.org/10.1007/978-3-030-20223-1_18