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# THE HIGHER LEVEL ASSIGNMENT OF FINANCIAL MATHEMATICS: HOW TO DESIGN IT?

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***ABSTRACT***

This research aimed to design financial mathematics assignment based on Pendidikan Matematika Realistik Indonesia (PMRI) approach and de Lange's theory to get validity, practicality, and effects of potential. In designing, we also consider the fundamental characteristics of financial mathematics including relevance, representational faithfulness, verifiability, timeliness, understandability, and comparability. We used development studies on design research method. This research was conducted at Vocational High School (VHS) 1 Jambi City in XI grade of Accounting Major. We collected the data through documentation, observation, interview, and tests. As a result, this research products the higher level assignment of financial mathematics based on PMRI approach and de Lange theory that is valid, practical, and have potential effects with consider the fundamental characteristics of financial mathematics. The results of research also found that, students became more understanding in financial activities. Moreover, it also can be used as a consideration to VHS for designing financial mathematics assignments.
**Keywords:** de Lange's Theory, Financial Mathematics Assignment, Fundamental Characteristics, PMRI, VHS

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## PRELIMINARY

Counting, reading, and writing are abilities that humans must master in life (Fitriani, 2018). These three abilities aim to create quality human resources who are responsible for their duties (Damai et al, 2019). By creating quality and responsible human resources, they can contribute directly for advancing the nation by their respective fields (Ramadhan et al., 2024). The rule No. 20 on 2003 chapter 3 states that the national purpose of education is to develop capabilities, characteristics, and national civilizations, which are dignified in the context of the intellectual national life, aims to develop the student's potential to become human beings who believe and pious, healthy, have a noble character, creative, knowledgeable, capable, independent, and become a responsible and democratic human. Education also is one path to hone the potential that exists in oneself (Depdiknas,

2003). Especially for the ability to count, the way to improve it is by learning mathematics (Kurniawan & Hidayati, 2022).

Mathematics can serve human needs and appears to find solutions in daily activities (Butuner & Baki, 2020). This subject taught in educational system in every level, from elementary to higher level education. However, most of students think that mathematics is the most difficult subject and it is not important topic since it does not directly affect for their daily activities (Sutiaharni & Armiati, 2020). This can happen because learning mathematics without providing real models directly does not give students the opportunity to develop their knowledge (Wijaya, 2016). Moreover, in the evaluation system, Indonesia still uses low problem level that's not relevant in daily activity. It makes the ability of students to apply their knowledge still low (Permatasari et al., 2018; Pratiwi et al., 2019; Jannah et al., 2019). So what we need? We need an approach that is oriented to the real world to make student develop their knowledge. According to Zulkardi et al., 2020, the approach that connected with real world problem is *Pendidikan Matematika Realistik Indonesia* (PMRI).

PMRI has been implemented in Indonesia for two decades (Zulkardi et al., 2020). This learning theory that adopted from realistic mathematics education since 2001, starts from real world problem and all learning activities become student-centered to seek, find, and build their own knowledge needed based on student activities (Zulkardi, 2002; Wijaya et al., 2021; Ramadhan et al., 2022; Boru et al., 2024). At least, PMRI has three principles i.e.: 1). guided reinvention and didactical phenomenology, 2). progressive mathematization, dan 3). self-developed models (Zulkardi & Putri, 2010). PMRI has also have five characteristics namely: 1). using contexts; 2). using models; 3). using students' strategies; 4). interactions; and 5). connecting between disciplines (Zulkardi & Putri, 2019). This approach has also been proven to be effective in improving student's mathematical abilities, quality, and achievements (Zakaria & Syamaun, 2017; Tamur et al., 2020; Aksu & Colak, 2021).

Basically, mathematics is divided into two scopes, namely pure mathematics and applied mathematics. Financial mathematics is the part of applied mathematics that deals with financial problems. In high school level, financial mathematics can be found in application of sequences and series material for XI grades. The studied concepts include single and compound interest, annuity, decay, and growth (Ediyanto & Harsasi, 2022). They are useful for solve our daily problems especially in financial fields. In addition, students are able to manage their finances and are capable of making the best decisions

regarding finances (Ramadhan et al., 2024). On the other hand, we might think, "are all financial mathematics assignment at the same level?"

De Lange's theory said there are three level in assessment for mathematics field. They are called lower, middle, and higher level (de Lange, 1995). In lower level, the material concerns about definitions, objects, standard algorithms, and technical skills. Generally, it's not using the context. An example likes "*How much 25% of $10,000?*". It doesn't have any meaning, but in some books, they are treated as standardized exercises. The next is middle level that can be characterized by some keywords as integration, making connections, and problem solving. An example follows "*A person deposits $100,000 in a bank with a simple interest system. After 4 years the money is $117,000. How much the deposit be after 9 years?*". Others will said that example belong to middle level even though all the information is clearly visible. Sometimes this requires mathematical reasoning skills to solve the problem, but in the other hand, it doesn't make students to find information on their own. The last is higher level that agrees with very complex matters: communication, mathematical thinking and reasoning, critical attitude, reflection, interpretation, generalization, creativity, and mathematizing. How about the type and the design of assignment given? This level guides students to find the necessary information by themselves. The information is usually provided through an images etc. The next question is, what kind of information is in an image that meets the characteristics of financial mathematics?

There are six fundamental characteristics of financial mathematics that need to be considered. They are relevance, representational faithfulness, verifiability, timeliness, understandability, and comparability (Mbobo & Ekpo, 2016). Relevance refers to how helpful the information is for financial decision-making processes. Representational faithfulness is the extent to which information accurately reflects a company's resources, transactions, etc. Verifiability is the extent to which information can be reproduced with the same data and assumptions. Timeliness is how quickly information is available to users. The less timely, the less useful information is for decision-making. Understandability is the degree to which information is easy to understand. Comparability is the consistency of the application of standards and policies from one period to another that allows users to draw in-depth conclusions about a company's trends and performance over time.

In this research, we focus to design the higher level assignment of financial mathematics. We used the PMRI approach and de Lange's theory to design it. The context used is savings program to buy a car. Why we design it? Previous research in VHS

regarding the learning implementation of financial mathematics still too general and not require special skills to solve nor oriented toward daily activities (Sutiaharni & Armiati, 2020; Sutiaharni et al., 2021). To design it, we consider the fundamental characteristics of financial mathematics namely relevance, representational faithfulness, verifiability, timeliness, understandability, and comparability. So in this research, the question is: "how to design the higher-level assignment of financial mathematics based on their characteristics?"

## METHODS

This research used development studies on design research method. It aims to develop a sequence of activities in understanding an empirical process of how learning works (Gravemeijer, 2004). Specifically for development studies on design research method, there are two stages namely the preliminary stage and the prototyping stage (Purwitaningrum & Prahmana, 2021; Bakker, 2018).

In the preliminary stage, we determined subjects and place for research. The researcher reviewed pertinent literature, including the curriculum, learning resources, student potential, and classroom activities, and had conversations with the teachers prior to implementation.De Lange's theory of task design and the use of the PMRI technique were also discussed.

Next in the prototyping stage, the evaluation technique used is formative evaluation with several stages namely self-evaluation, expert review, one-to-one, small group, and field test stages as in **Figure 1** (Tessmer, 1993; Zulkardi, 2002; Plomp, 2013). These stages aimed to design and to produce a higher level assessment of financial mathematics that is valid, practical, and has potential effects.

Validity was checked at the expert review stage as the first prototype, which examined three important aspects: content, language, and construction. The content aspect focused on ensuring that the tasks and activities related to the saving program to buy a car were aligned with the educational objectives. The language aspect assessed compliance with the enhanced Indonesian spelling guidelines, ensuring clarity and appropriateness of language use. The construction aspect evaluated the overall structure and coherence of the questions, ensuring they were appropriately designed for the financial mathematics context of the saving program to buy a car. Simultaneously, the first prototype was tested with 3 students in the one-to-one stage to gather preliminary feedback on its effectiveness. Based on feedback from the expert review and one-to-one stages, comments and suggestions

were used to revise the first prototype, leading to create the second prototype, which incorporated improvements in content, language, and construction of task design.

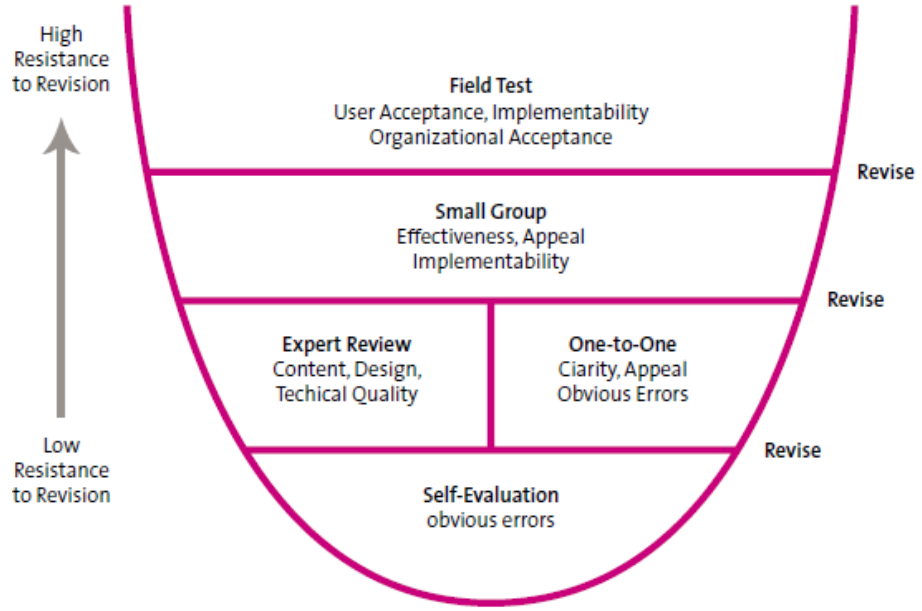



**Figure 1. Formative Evaluation Stage**

Practical can be seen in small group stage that test the second prototype designed. It tested on 6 students. This stage aimed to evaluate the practicality of the second prototype, as evidenced by students' ability to answer the questions using their own strategies. Following this phase and incorporating feedback and suggestions, the second prototype was deemed practical, resulting in the development of the third prototype. Finally, the third prototype 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. This research was conducted in Jambi Province, specifically at VHS 1 Jambi City. The subjects in this research were XI grade students of Accounting Major (AM). The subjects and stages in developing the prototype in detail can be seen in **Table 1**.

**Table 1. Subject and Stage of Developing a Prototype**

| Stage | Subject | Class |
|---|---|---|
| One-to-one | 3 students | XI of AM 3 |
| Small group | 6 students | XI of AM 2 |
| Field test | 35 students | XI of AM 1 |

We collected the data through documentation, observation, interview, and tests. Documentation occurred in all of stage in this research. This is to observe the difficulties and findings of students in the learning process. By using camera and video, student's strategies can be analyzed and measured through the activities they perform both

individually and in groups. Observation was conducted in prototyping phase when developing and revising assignment. Observation is used to assess behavior on the process of an observable activity. Observation is also used to see student's activities during the learning process. Observation conducted to collect the data on student's group discussions. The interview was conducted to gain a deeper understanding of the responses. The interview used in this research aims to identify the difficulties and obstacles faced by students in learning process. The test was conducted to determine the potential effects of the prototype designed. In addition, it aims to determine the learning outcomes of students from the prototype designed. Data were analyzed and described qualitatively.

## RESULT AND DISCUSSION

### The Preliminary Stage

In this stage, we determined the place and research subject and obtained VHS 1 Jambi City with grade XI of AM student. Next, the researcher directly observed the school to discuss with teachers and reviewing research literature including curriculum, learning approaches, learning activities, and student's needs. The following is an interview between researchers (R) and teachers (T) at VHS.

*R* : "*For eleventh-grade students, what curriculum is used for teaching and learning activities?"*
*T* : "*For eleventh-grade students, curriculum used is still Curriculum 13 or K13".*
*R* : "*For financial mathematics topics based on textbook, does it use real context?"*
*T* : *"It doesn't use pure real context yet, it was modified".*
*R* : "*Have you ever applied Pendekatan Matematika Realistik Indonesia?"*
*T* : "*No, I don't".*

Based on these findings, researcher and teachers designed a financial mathematics assignment using real context i.e. savings program to buy a car and consider their fundamental characteristics of financial mathematics. Moreover, we also used PMRI approach and de Lange's theory to design it.

### The Prototyping Stage

At this stage, researcher and teachers designing financial mathematics assignment using savings program at bank to buy a car. The topics are designed from two things. The first is related to buy an HRV car. Students must understand the type of HRV car that will be bought based on its type. On the other hand, students were given a brochure about saving at bank with some interest in period. It can be categorized as a higher level assignment because students are asked to know the amount of interest given in a certain

period without being given instructions. This is to train students to understand problems in the real world. There are three assignments designed based on the context used.

After designing, it produces the 1st prototype. Next, it was validated by experts in expert review stage including appropriate content, construction, and language. In this research, the experts are financial mathematics experts, PMRI experts, and financial accounting teacher. At this stage, one-to-one process was also carried out involving three students with different abilities from class XI of AM 3. Below is comments and suggestions from expert and student.

**Table 2. Expert's and Student's Commentary and Suggestions**

| Comments/Suggestions | Revised |
|---|---|
| **Experts** | |
| ● Provide a clear time for when it starts for saving and when it ends for saving. | ● Give a clear time. |
| ● The questions give the exact time clearly. | ● Giving a question with exact time. |
| **Student** | |
| ● What if the questions were given the right time? | ● Giving a question with right time. |

Based on comments and suggestions from experts (at expert review stage) and students (at one-to-one stage), we made revisions to get validity and to produce the 2nd prototype. The next stage is small group where the 2nd prototype was tested in class XI of AM 2 with six students in various abilities. It was conducted to get the practicality of the prototype designed. It can be seen based on students who are able to solve problems with their own strategies. After being tested, the results, comments, and suggestions at this stage were used for revising the 2nd prototype. The results of this revision produce the 3rd prototype that will be tested at the final stage.

The 3rd prototype was tested at the final stage or field test stage involving thirty five students in class XI of AM 1. It aimed to get the potential effects based on results, comments, and suggestions. The following is an assignment given in the field test stage that has previously been declared valid by expert review and one-to-one, also practice in small groups. The context used is a savings program to buy a car that can be seen in **Figure 2**.



| |
|---|
| Anda ingin membeli mobil HRV 1.5T RS CVT Two Tone secara cash. Oleh karena itu, Anda selalu menabung Rp.85.000.000 di Bank Kencana Mandiri setiap 1 November selama lima tahun dan tabungan kelima dilakukan pada 1 November 2026. |
| **Translation:** You want to buy an HRV 1.5T RS CVT Two Tone car with cash. Therefore, you always save IDR 85,000,000 at Bank Kencana Mandiri every November 1 for five years and the fifth savings is made on November 1, 2026. |

**Figure 2. Savings Program to Buy a Car**

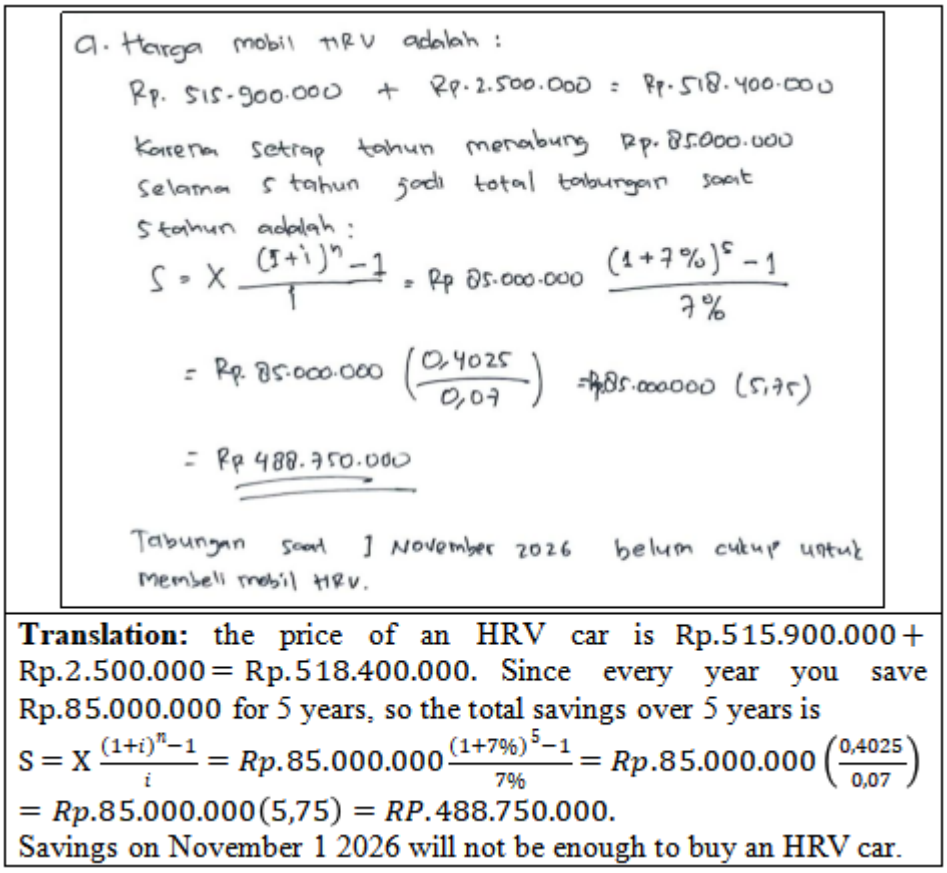
In designing task with this context, 5 characteristics of financial mathematics were considered, including: representational faithfulness, relevance, timeliness, verifiability, comparability, and understandability. It is relevance since the information is helpful for financial decision-making processes. Representational faithfulness because of information accurately reflects a company's transactions. Verifiability because of information can be reproduced with the same data and assumptions. It has timeliness because information is available to users. Understandability because of information is easy to understand. And comparability because it allows users to draw in-depth conclusions about a company's trends and performance over time.

***Assignment A***

In this section, students need to know include the price of an HRV car, the interest given, and the time period used. The strategy that students can use is using the accumulation formula. The following is assignment A in **Figure 3** and the students' answers in **Figure 4**.

| |
|---|
| A. Apakah ketika 1 November 2026 tabungan Anda sudah cukup untuk membeli mobil tersebut? |
| **Translation:** Will your savings be enough to buy the car on November 1, 2026? |

**Figure 3. Assignment A**




**Translation:** the price of an HRV car is Rp.515.900.000 + Rp.2.500.000 = Rp.518.400.000. Since every year you save Rp.85.000.000 for 5 years, so the total savings over 5 years is $S = X\frac{(1+i)^n-1}{i} = Rp.85.000.000\frac{(1+7\%)^5-1}{7\%} = Rp.85.000.000\left(\frac{0{,}4025}{0{,}07}\right)$ $= Rp.85.000.000(5{,}75) = RP.488.750.000.$ Savings on November 1 2026 will not be enough to buy an HRV car.

**Figure 4. Students' Answer For Assignment A**

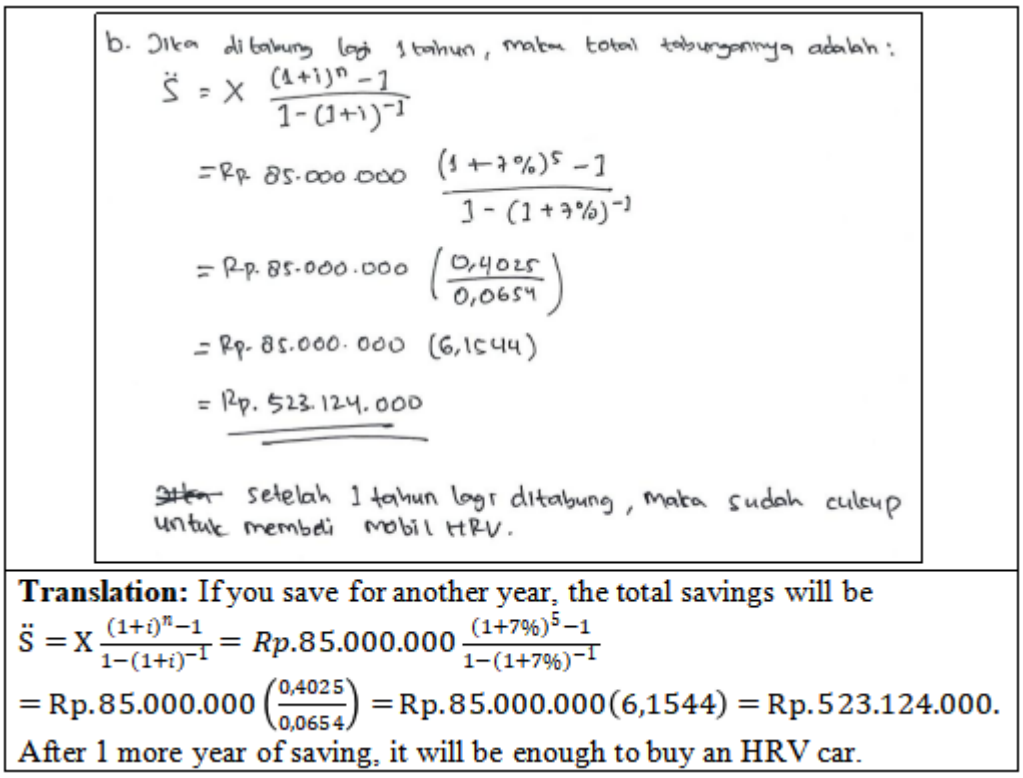
Based on students' answers in assignment A, student understands the determined price of the car (adding the two tone price). Next, by using the accumulation formula, student understands how to calculate the total savings based on interest and period given. Student can also conclude that the money saved is not enough to buy an HRV car.

***Assignment B***

In this section, students calculated the saving's amount if it will be save for one period more. The strategy that students can use is to use the accumulation-due formula or students can also use the accumulation formula and then multiplied by (1+i). The following is assignment B given in **Figure 5** and the students' answers in **Figure 6**.

B. Jika tidak cukup, bagaimana jika total tabungan tersebut disimpan hingga tepat 1 tahun kemudian?
**Translation:** If it's not enough, what if the total savings are saved until exactly 1 year later?

**Figure 5. Assignment B**




**Translation:** If you save for another year, the total savings will be
$\ddot{S} = X \frac{(1+i)^n - 1}{1-(1+i)^{-1}} = Rp.85.000.000 \frac{(1+7\%)^5 - 1}{1-(1+7\%)^{-1}}$
$= Rp.85.000.000 \left(\frac{0,4025}{0,0654}\right) = Rp.85.000.000(6,1544) = Rp.523.124.000.$
After 1 more year of saving, it will be enough to buy an HRV car.

**Figure 6. Students' Answer For Assignment B**

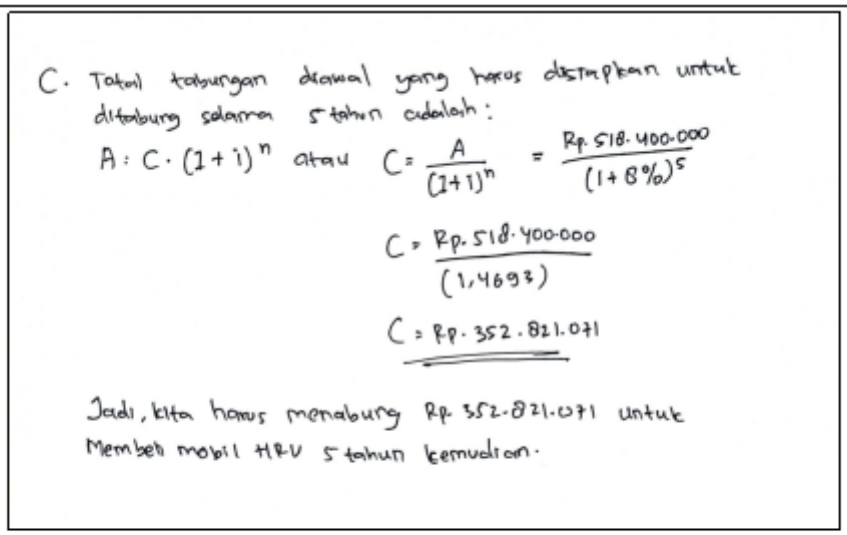
Based on student answers in assignment B, student uses the accumulation-due formula to find total savings after 1 year of savings. Student can also conclude that the money they have saved is enough to buy an HRV car.

***Assignment C***

In this section, students are asked to determine initial savings to be saved in a certain period. Students can use the present value formula by assuming the price of HRV as a price in the future. However, the difficulty experienced by students is determining the the interest. It happens because the interest in assignment C are different from assignments A and B. The following is assignment C given in **Figure 7** and the students' answers in **Figure 8**.

C. Jika Anda ingin membeli mobil tersebut secara cash saat 5 tahun kemudian, berapakah dana yang harus ditabung Anda sekarang?
**Translation:** If you want to buy the car in cash 5 years later, how much money do you have to save now?

**Figure 7. Assignment C**




**Translation:** The total initial savings that must be prepared to be saved for 5 years is $A = C \cdot (1 + i)^n$ or $C = \frac{A}{(1+i)^n} = \frac{Rp518.400.000}{(1+8\%)^5} = \frac{Rp.518.400.000}{(1,4693)} = Rp.352.821.071.$
So, we have to save $Rp.352.821.071$ to buy an HRV car 5 years later.

**Figure 8. Students' Answer For Assignment C**

Based on students' answers in assignment C, student can manipulates the formula to become a present value. Then student can determine which interest to use appropriately, because if it is wrong, the results obtained will exceed the amount of initial savings required. Student also said that they became more understanding financial problems because of this the higher level assignment.

In essence, mathematics can be used as a solution to solve financial problems and participate actively in them (Butuner & Baki, 2020; Cavalcante & Huang, 2022). Previous research also states that we must avoid basic skills in arithmetic in learning financial mathematics since students' ability to understand and differentiate financial concepts in everyday life will not improve (Joo & Chatterjee, 2012; Lusardi, 2012; Sole, 2014; Bansilal, 2016). So higher level assignments by de Lange theory are needed to train students to better understand financial matters.

PMRI also shows an important role since it has attracted attention in its effectiveness in mathematics learning (Freudenthal, 2002; Sembiring et al., 2008; Sembiring, 2010; Zulkardi & Putri, 2019; Wijaya et al., 2021). Several studies have supported the effectiveness of PMRI, for example improving the quality of mathematics education (Zakaria & Syamaun, 2017), then its positive impact on mathematics abilities (Tamur et al., 2020), and increasing academic achievement in students (Aksu & Colak, 2021).

And for the fundamental characteristics of financial mathematematics, we consider relevance, representational faithfulness, verifiability, timeliness, understandability, and comparability (Mbobo & Ekpo, 2016). Relevance refers to the information is helpful, representational faithfulness refers to accuracy of information, verifiability refers information can be reproduced with the same data and assumptions. Next timeliness refers to information is available to users, understandability refers to information is easy to understand, and comparability refers users can allow to draw in-depth conclusions about a company's trends and performance over time.

## CONCLUSION

This research products the higher level assignment of financial mathematics based on PMRI approach and de Lange theory regarding validity, practicality, and effects of potential. It can be found in every stage in formative evaluation phase. In designing it, we also consider the fundamental characteristics of financial mathematics including representational faithfulness, relevance, timeliness, verifiability, comparability, and understandability. Valid can be found in language, content, and construction (Indonesian language spelling, suitability, and appropriateness) based on experts and one-to-one stage. Practice can be found since student can solve the problems using their own strategies in small group stage. Effect of potential can be viewed in result, comment, and suggestion from students about financial mathematics assignment design. The results of research also found that students became more understanding financial problems because of the higher level assignment. In addition, PMRI as an approach can help students to study problems in everyday life, especially financial matters. It also can be used as a consideration to VHS for designing financial mathematics assignments. The recommendation for further research is how to design financial mathematics assignments using the PISA model.

## REFERENCES

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

Bakker, A. (2018). *Design Research in Education: A Practical Guide For Early Career Researchers*. London: Routledge. https://doi.org/10.4324/9780203701010

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

Boru, M. S, Ambarwati, L., & Hidajat, F.A. (2024). Preliminary Research: Development of Digital Student Worksheets Based on Indonesian Realistic Mathematics Education to Improve Deaf Student's Understanding of Mathematical Concepts. *Mathline: Jurnal Matematika dan Pendidikan Matematika, 9*(1), 285-304. https://doi.org/10.31943/mathline.v9il.584

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

Damai, S., Effendi, R., & Sulaiman. (2019). The Teacher Achievement Motivation as an Intervention Variable in Relationship Between Teacher's Professionalism, Principal's Leadership and Teacher's Performance of State High Schools in Banjarmasin City. *Journal of K6, Education, and Management, 2*(1), 23-35. https://doi.org/10.11594/jk6em.02.01.04

De Lange, J. (1995). Assessment: No Change Without Problems. *Reform in School Mathematics and Authentic Assessment*, pp.87–172. https://www.researchgate.net/publication/255041996_Assessment_No_change_without_problems

Depdiknas. (2003). *Ministry of National Education of Republic of Indonesia Law no. 20 of 2003 about Concerning the National Education System*. Jakarta: Ministry of National Education.

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

Fitriani, S., Somakim, & Hartono, Y. (2018). Ethnomathematics Exploration of the Culture of the Jambi Community in Seberang City [in Bahasa]. *Journal of Medives, 2*(2), 145-149. https://doi.org/10.31331/medivesveteran.v2i2.565

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

Gravemeijer, K. (2004). Learning Trajectories and Local Instruction Theories as Means Support For Teachers in Reform Mathematics Education. *Mathematical Thinking and Learning, 6*(2), 105-128. https://doi.org/10.1207/s15327833mtl0602_3

Jannah, R. D., Putri, R. I. I., & Zulkardi. (2019). Soft Tennis and Volleyball Contexts in Asian Games for PISA-Like Mathematics Problems. *Journal on Mathematics Education, 10*(1), 157–170. https://doi.org/10.22342/jme.10.1.5248.157-170

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

Kurniawan, A. & Hidayati, Y. M. (2022). Exploratory Study of the Mojolaban Furniture Industry and Its Integration in Elementary School Mathematics Material[in Bahasa]. *Jurnal Basicedu, 6*(4), 6695-6702. https://doi.org/10.31004/basicedu.v6i4.3342

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

Mbobo, M. E. & Ekpo, N. B. (2016). Operationalising the qualitative characteristics of financial reporting. *International Journal of Finance and Accounting, 5*(4): 184-192. https://doi.org/10.5923/j.ijfa.20160504.03

Permatasari, R., Putri, R. I. I., & Zulkardi. (2018). Uncertainty and Data Content in Bowling: Task Design. *Journal of Physic: Conf. Series.* 1088 012010. https://doi.org/10.1088/1742-6596/1088/1/012010

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/

Pratiwi, I., Putri, R. I. I., & Zulkardi. (2019). Long Jump in Asian Games: Context of PISA-like mathematics problems. *Journal on Mathematics Education, 10*(1),81-92. https://doi.org/10.22342/jme.10.1.5250.81-92

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, 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

Sembiring, R.K., Hadi, S., & Dolk, M. (2008). Reforming mathematics learning in Indonesian classrooms through RME. *ZDM Mathematics Education*, 40, 927-939. https://doi.org/10.1007/s11858-008-0125-9

Sembiring, R.K. (2010). Indonesian realistic mathematics education (PMRI): Developments and challenges (in Bahasa). *Journal on Mathematics Education, 1*(1), 11-16. https://doi.org/10.22342/jme.1.1.791.11-16

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* (2021) 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

Tessmer, M. (1993). *Planning and Conducting Formative Evaluations: Improving the Quality of Education and Training*. London: Kogan Page. https://www.worldcat.org/title/planning-and-conducting-formative-evaluations-improving-the-quality-of-education-and-training/oclc/840284535

Wijaya, A. (2016). Students' Information Literacy: A Perspective From Mathematical Literacy. *Journal on Mathematics Education, 7*(2), 73-82. https://doi.org/10.22342/jome.v7i2.3532

Wijaya, A., Elamini, & Doorman, M. (2021). A Learning Trajectory For Probability: A Case of Game-Based Learning. *Journal on Mathematics Education*, *12*(1),1–16. https://doi.org/10.22342/jme.12.1.12836.1-16

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. (2010). Developing a Support Blog to Help Indonesian Mathematics Students and Teachers Learn Indonesian Realistic Mathematics Education (In Bahasa). *Jurnal Inovasi Perekayasa Pendidikan (JIPP), 2*(1), 1-24. https://repository.unsri.ac.id/6777/1/Prof.Dr.Zulkardi__Dr.Ratuilma_di_JIPP-Balitbang.pdf

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