Journal on Mathematics Education
Volume 15, No. 4, 2024, pp. 1115-1130

Which is better between gold and its share? A context for designing a financial mathematical task

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Received: 15 January 2024 | Revised: 9 September 2024 | Accepted: 20 September 2024 | Published Online: 1 October 2024

Abstract

Financial mathematics is a crucial discipline for students, mainly when taught using real-life contexts such as gold and its share. It can help students develop practical solutions to financial problems. This study aimed to design a financial mathematics task for vocational high schools (VHS) that is valid, practical, and demonstrates potential effects utilizing the *Pendidikan Matematika Realistik Indonesia* (PMRI) approach in the context of gold and its share. The research employed a design research methodology, specifically a development study involving two primary phases: preliminary and formative evaluation. The latter included multiple stages of prototype development, beginning with self-evaluation, then expert review, one-on-one sessions, small group trials, and culminating in a field test. The study was conducted with 44 eleventh-grade accounting students at VHS 1 Jambi City, consisting of 3 students for the one-to-one phase, 6 for the small group phase, and 35 for the field test phase. Data were collected through tests, interviews, documentation, and observations. The findings indicate that the financial mathematics task designed using the PMRI approach, contextualized in gold and its share, was valid, practical, and positively impacted student learning. Students not only developed a deeper understanding of real-world financial issues but also enhanced their decision-making abilities in financial contexts. Additionally, teachers expressed a greater willingness to adopt the PMRI approach in their instruction, suggesting that this context can effectively support the teaching of financial mathematics in vocational high schools.

Keywords: Financial Mathematical Task, Gold, PMRI, Share, Vocational High Schools

How to Cite: Ramadhan, M. H., Zulkardi, Putri, R. I. I., & Resti, Y. (2024). Which is better between gold and its share? A context for designing financial mathematical task. *Journal on Mathematics Education, 15*(4), 1115-1130. http://doi.org/10.22342/jme.v15i4.pp1115-1130

The current government aims to maximize the potential of human resources (HR) to promote national welfare. One effective approach to achieving this goal is by improving the quality of education, as it helps individuals become more skilled and responsible in their professions (Damai et al., 2019). In Indonesia, the education system comprises various levels, from elementary to high school, with Vocational High Schools (VHS) being a key component at the upper level, focusing on specialized fields. The revitalization of VHS, as outlined in the Ministry of Education and Culture's (MEC) Regulation No. 22 of 2020 regarding the Strategic Plan for 2020–2024, seeks to enhance the quality and competitiveness of Indonesia's human resources. The MEC is committed to ensuring that vocational school graduates are well-prepared

and highly qualified for employment in business and industry. Furthermore, VHS must be equipped to meet the demands of both regional and international markets, such as the ASEAN Economic Community. This indicates that VHS graduates must excel in their areas of expertise to actively contribute to the workforce.

VHS offers specialized fields of study, with the accounting major (AM) focusing primarily on financial topics, which are addressed in the financial mathematics course. This subject is essential for students as it equips them with the necessary tools to solve financial problems encountered in everyday life (Butuner & Baki, 2020). In the eleventh grade of AM, financial mathematics covers topics such as growth, decay, annuities, compound interest, and simple interest (Ediyanto & Harsasi, 2022). These concepts are frequently applicable to daily activities. Therefore, financial mathematics problems should be framed in real-world contexts to foster student engagement and encourage active participation in the learning process (Hikmah et al., 2021; Almaida & Gallego, 2023; Latifah et al., 2023; Nuryadi et al., 2023).

Nevertheless, Indonesian financial mathematics education encounters several significant challenges. Sutiaharni and Armiati (2020) assert that the financial mathematics problems presented in VHS lack relevance to everyday tasks and do not necessitate specialized knowledge. Additionally, Joo and Chatterjee (2012) contend that because financial mathematics relies solely on basic arithmetic skills, its study may be unnecessary. This approach does not enhance students' comprehension of fundamental financial concepts (Lusardi, 2012; Sole, 2014; Bansilal, 2016). A further issue is that the contextual framework of financial mathematics education is outdated and poorly aligned with real-world scenarios (Sutiaharni et al., 2021). In contrast, integrating relevant contexts related to everyday issues can facilitate students in developing effective problem-solving abilities, making informed financial decisions, and improving their overall mathematical education (Makonye, 2019; Ferreira & Bisognin, 2020; Muñoz et al., 2023; Sujiono et al., 2023). Consequently, to address these challenges, it is imperative to adopt a strategy that motivates students to engage with mathematics through real-world applications. The Pendidikan Matematika Realistik Indonesia (PMRI) approach is an educational methodology utilized in Indonesia that emphasizes real-world issues (Zulkardi & Putri, 2019).

PMRI approach is an adaptation of the Realistic Mathematics Education (RME) learning theory, which begins with real-life problems and encourages student-centered learning. Through this approach, students actively seek, discover, and construct the necessary knowledge based on their activities (Zulkardi et al., 2020; Wijaya et al., 2021; Ramadhan et al., 2022). A key element of PMRI is the careful selection of contexts that align with everyday issues. This strategy enables students to deepen their understanding of financial mathematics, recognize the practical relevance of mathematical concepts, and improve their problem-solving skills (Bansilal & Mkhwanazi, 2012; Pournara, 2013; Althauser & Harter, 2016). Since its implementation in Indonesia in 2001, PMRI has aimed to enhance students' learning outcomes, interests, and attitudes toward mathematics (Zulkardi, 2009). Despite this, the evaluation methods in Indonesia continue to utilize low-level problems that are not closely related to real-world situations, resulting in students' limited ability to apply their knowledge (Permatasari et al., 2018; Pratiwi et al., 2019; Putri & Zulkardi, 2020). Thus, employing the PMRI approach, which integrates real-world contexts into tasks, can help students become more competent and knowledgeable.

In addition to applying the PMRI approach, this research focuses on designing high-quality mathematical tasks. According to de Lange's theory, mathematical tasks can be categorized into three levels: lower, middle, and higher (de Lange, 1995). This study specifically develops tasks at the higher level. What distinguishes higher-level mathematical tasks is that they require both creativity and critical thinking, and the tasks are meaningful. For example, a lower-level task might be, "What is 25% of

$1,000?" While this seems like a financial mathematics problem, it lacks depth and does not engage students in creative or critical thinking. Similarly, many financial mathematics textbooks feature tasks like, "If you save $100 with 10% compound interest per annum, how much will your savings be after 3 years?" This is considered a middle-level task, as it only involves applying a formula without requiring deeper thought.

To encourage students to think creatively and critically, higher-level tasks can be designed using real-life contexts, such as brochures or images, combined with short, open-ended questions. Why short questions? The brevity of the question encourages students to independently seek out the necessary information, promoting creative and critical thinking. The next key consideration is determining the characteristics of the images or brochures that can effectively serve as contexts for financial mathematics problems.

There are six essential characteristics of financial mathematics contexts that should be taken into account when designing tasks. As outlined by Mbobo and Ekpo (2016), these characteristics include timeliness, relevance, representational faithfulness, verifiability, understandability, and comparability. Relevance refers to the usefulness of information for decision-making in financial processes. Representational faithfulness denotes the degree to which information accurately reflects a company's assets, transactions, or financial data. Verifiability is the extent to which information can be reproduced using the same data and assumptions. Timeliness relates to how promptly information is available for use, while understandability indicates how easily the information can be comprehended. Lastly, comparability refers to the consistency with which financial standards and regulations are applied, allowing for detailed analysis of trends and performance over time.

In this study, the higher-level financial mathematics task focuses on gold and its shares. This context was chosen for two main reasons: first, it is a novel area that has not been previously explored in financial mathematics, representing the unique contribution of this research. Second, financial mathematics textbooks used in VHS seldom address real-life issues, such as the prices of gold and shares, which are relevant to daily financial decision-making. Introducing such tasks allows students to engage with practical problems and deepen their understanding of real-world financial concepts. The central mathematical idea is to help students compare the prices of gold and its shares over a given period and independently derive the necessary information. Gold, being a valuable asset, whose price typically appreciates over time, presents an interesting context for comparison. Students will be tasked with analyzing which investment—gold or its shares—yields better financial outcomes. This leads to the research question: "How do students' abilities in choosing between two options relate to context-based financial mathematics?"

METHODS

This research aimed to design financial mathematics tasks using the context of gold and shares for vocational high schools that are valid, practical, and demonstrate potential effects. The research employed a design research methodology, specifically the development studies approach. Development studies consist of two key stages: the preliminary stage and the formative evaluation stage, which are used to develop and refine the prototype. In the preliminary stage, the researcher identified the research site, time frame, participants, and their needs, along with preparations such as aligning the curriculum and materials with the research objectives.

The formative evaluation stage followed a progressive resistance approach, moving from low

resistance to high resistance for revisions. This stage involved several steps, including self-evaluation, expert review, one-to-one trials, small group trials, and field testing (Zulkardi, 2002; Plomp, 2013; Bakker, 2018). Each step was designed to iteratively refine the prototype, ensuring that the tasks developed were valid and practical, while also assessing their potential effects on student learning.

Preliminary Stage

At the preliminary stage, the researcher identified the location and research subjects for the study. The research took place at VHS 1 Jambi City, targeting eleventh-grade students majoring in AM. The participants were divided across different stages: 3 students from XI AM 3 for the one-to-one stage, 6 students from XI AM 2 for the small group stage, and the entire class of XI AM 1, consisting of 35 students, for the field test stage. Prior to the implementation, the researcher held discussions with the teachers and conducted a thorough review of relevant literature, including the curriculum, learning materials, student potentials, and classroom activities. These discussions also included the application of the PMRI approach and de Lange's theory of task design.

Following the review and discussions, the researcher and teachers collaboratively designed financial mathematics tasks based on the PMRI approach and de Lange's theory, using the context of savings and stocks. For gathering and organizing materials, the researchers employed the Miles and Huberman techniques, which consist of three key steps: data collection, data presentation or reduction, and subsequent data analysis (Miles et al., 2014). This process ensured that the designed tasks were aligned with the learning goals and catered to the students' needs.

Formative Evaluation Stage

The formative evaluation phase was divided into several stages: self-evaluation, expert review, one-to-one, small group, and field test. During the self-evaluation stage, the researcher and the teacher collaboratively designed the financial mathematics tasks using the PMRI approach and de Lange's theory, resulting in the development of the first prototype. This prototype was subsequently subjected to validity checks at the expert review stage, which examined three key aspects: content, language, and construction.

The content aspect focused on ensuring that the tasks and activities related to gold and its shares were relevant and 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 gold and its shares. Simultaneously, the first prototype was tested with 3 students from XI AM 3 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 the creation of the second prototype, which incorporated improvements in content, language, and task design.

The second prototype underwent testing in the small group stage, which involved 6 students from XI AM 2. 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.

The subsequent stage, the field test, aimed to assess the potential impact of the third prototype. This stage included all students from XI AM 1, totaling 35 participants. Data collection for this research

was conducted through a combination of observation, documentation, interviews, and testing. Observations were utilized during the implementation of financial tasks in the prototyping phase, while documentation was carried out during the initial needs analysis in the early stages. Interviews were conducted following the completion of students' financial assignments to gather insights on their experiences and understanding. Finally, a test was administered to evaluate the potential effects of the intervention. The collected data were analyzed and described qualitatively, providing a comprehensive understanding of the implementation and outcomes associated with the third prototype.

RESULTS AND DISCUSSION

Preliminary Stage

During the preliminary stage, researchers engaged in discussions with teachers to review relevant research literature. It was noted that the curriculum in use was Curriculum 13 (K13) for eleventh-grade students. A thorough examination of the textbooks revealed that the topics presented were not aligned with real-world problems. Furthermore, the questions provided failed to stimulate students' creative and critical thinking abilities. Upon inquiring whether the PMRI approach had ever been applied, it became clear that the teacher had not utilized this methodology previously. Consequently, based on the discussions and reviews, the researcher and the teacher collaboratively designed financial mathematical tasks grounded in the PMRI approach and de Lange's theory. The selected context for these tasks centered around gold and its shares, which were organized into three distinct activities.

Formative Evaluation Stage

Self-Evaluation Stage

In the self-evaluation stage, the researcher and teacher outlined the activities for learning about gold and its shares. Three activities were developed, each with specific primary objectives. The activities involved calculating the prices of gold and gold shares, followed by a comparative analysis between the two. Each activity was designed with the intent to help students understand pricing through graphical representations, while also fostering their ability to independently seek out necessary information. The structured activities are detailed in Table 1.

Table 1. The activities for learning gold and its share

Activities	Main Goals
A. Calculating the Gold Price	- Students are able to know the price of gold in some period. - Students are able to calculate the price of gold.
B. Calculating the Price of Gold Shares	- Students are able to understand all of information in share. - Students are able to predict and calculate the lots of shares that must be purchased along with the taxes.
C. Comparing Gold and Gold Shares	- Students are able to compare the profit between gold and its share. - Students are able to know the risk between gold and its share.

Following the development of the activities, the researcher and teacher collaboratively designed the financial mathematical tasks based on the PMRI approach and de Lange's theory, resulting in the

creation of the first prototype. To facilitate data gathering, the researchers employed the Miles and Huberman techniques. Initially, data related to the context of gold and shares were sourced using the Google search engine. After collecting various datasets, the researchers compared them against the curriculum, theoretical frameworks, and student needs.

Data that did not align with the six essential characteristics of the financial mathematical context were excluded from consideration. Conversely, data deemed appropriate were further analyzed according to the formative evaluation stage. Figure 1 illustrates the process of how the real-context data were analyzed through the combined application of Miles-Huberman techniques and formative evaluation design.

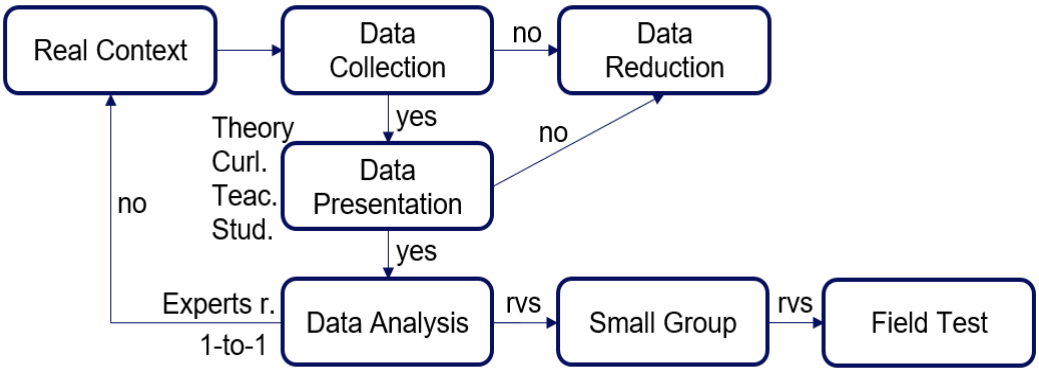


Figure 1. Miles-Huberman formative evaluation design

Expert Review and One-to-One Stage

Once the first prototype was developed, it underwent a comprehensive review by experts, focusing on three key aspects: content, language, and the construction of the tasks. Simultaneously, the prototype was tested with three students from XI of AM 3 during the one-to-one stage. The objectives of both evaluations were to gather constructive feedback and suggestions from experts and students, which are summarized in Table 2. This feedback was crucial for refining the tasks to ensure their validity and effectiveness in enhancing students' understanding of financial mathematics.

Table 2. Commentary and suggestions from expert and student

No	Commentary/ Suggestions	Revised
	Expert	
1	Add taxes on buying and selling shares.	1. Giving the taxes on buying and selling shares.
2	Provide illustrations that are educational, not consumerist or hedonistic.	2. Provide appropriate illustrations.
3	Use time interval in more detail.	3. Provide detailed time interval, because researcher only put the year in activity A and B before.
	Student	
1	Questions should be written using more understandable language for students.	1. Revise questions that can be understand by students.

The validity provided by experts is essential for refining the initial prototype (Adillah et al., 2022). Following the feedback and suggestions from both experts and students, the researcher made several revisions to the first prototype. This included incorporating additional information that was previously omitted, such as the taxation involved in buying and selling shares. Furthermore, the question construction was adjusted to ensure that it was educational rather than consumerist or hedonistic, and a more detailed time interval was implemented. Additionally, students from the one-to-one stage suggested that the language used be more accessible and understandable. After these revisions based on the expert review and one-to-one stage feedback, the first prototype was deemed valid, resulting in the development of the second prototype.

Small Group and Field Test Stage

The second prototype was evaluated with a small group of six students from XI of AM 2 to assess its practicality. This assessment focused on the students' ability to answer questions using their chosen strategies. Students demonstrated their proficiency by applying formulas to compare the prices of gold and shares, aligning with findings from previous research by Sari et al. (2021), which emphasized that practicality is reflected in students' answers derived from their own strategies. Following this evaluation, students provided feedback and suggestions for improving the second prototype, leading to revisions that culminated in the creation of the third prototype.

The third prototype was then implemented in the XI of AM 1 class, comprising a total of 35 students, with the aim of examining the potential effects of the designed tasks. The third prototype of the financial mathematical task, set in the context of gold and shares, was organized into three distinct activities.

The Activities of Context-based Financial Mathematics

Activity A: Calculating the Gold Price

This activity aimed to enhance students' understanding of gold price fluctuations over an extended period. Initially, the researcher, in collaboration with the instructor, gathered gold price data from goldprice.org, covering a five-year period from October 17, 2018, to October 17, 2022, with prices denominated in Indonesian Rupiah (IDR). The resulting gold price data is illustrated in Figure 2, while students' responses to Activity A are presented in Figure 3.

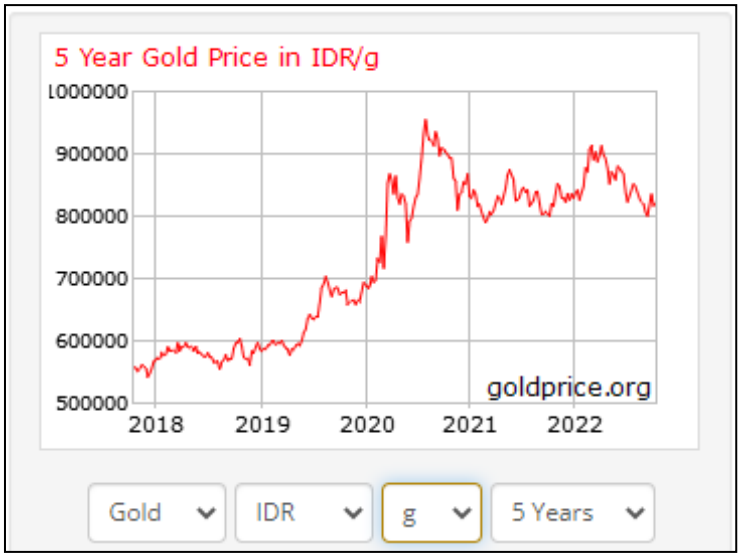
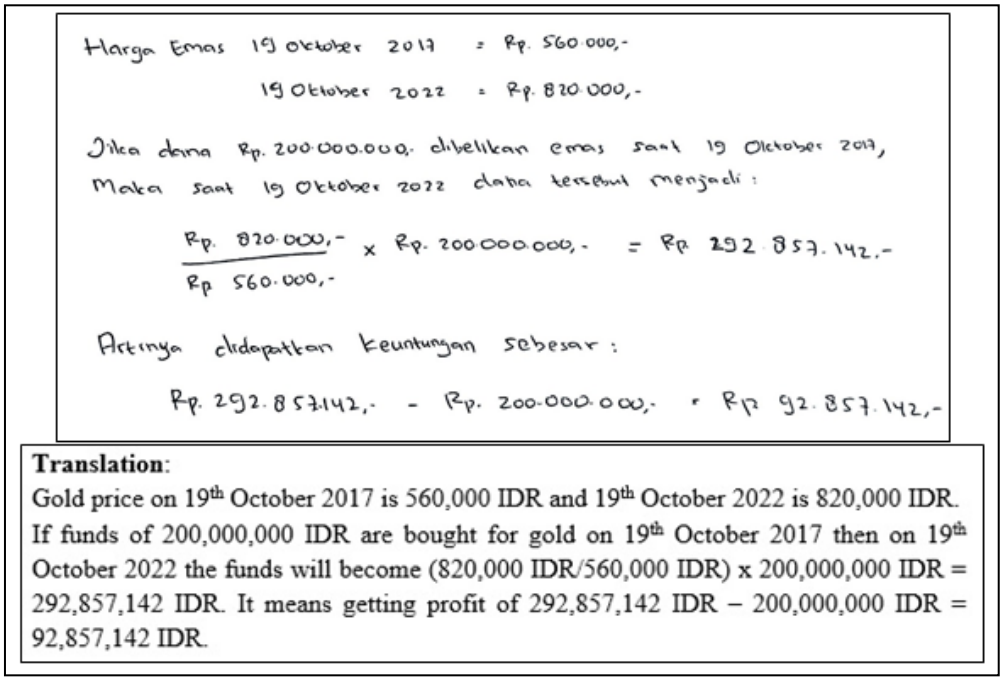


Figure 2. Gold price trends

The specific inquiry posed to the students was as follows:

"If you purchase gold for a total of 200,000,000 IDR on October 17, 2018, what profit will you realize upon selling it on October 17, 2022?"

From the students' responses illustrated in Figure 3, it is evident that they were able to identify both the initial and final prices of gold during the specified timeframe. Furthermore, students demonstrated proficiency in calculating the total monetary value of their gold investments over the five-year period, as well as the profits accrued from these transactions. Consequently, it can be concluded that Activity A effectively facilitated students' comprehension of gold price trends over multiple periods.



Translation:
Gold price on 19th October 2017 is 560,000 IDR and 19th October 2022 is 820,000 IDR. If funds of 200,000,000 IDR are bought for gold on 19th October 2017 then on 19th October 2022 the funds will become (820,000 IDR/560,000 IDR) x 200,000,000 IDR = 292,857,142 IDR. It means getting profit of 292,857,142 IDR – 200,000,000 IDR = 92,857,142 IDR.

Figure 3. Student's answer for Activity A

The analysis of student responses indicates a successful engagement with the learning objectives related to understanding economic principles through the context of gold investment. By examining the price dynamics of gold over five years, students not only recognized the importance of historical price data but also developed essential skills in financial literacy, including investment valuation and profit calculation.

The specific question regarding the hypothetical purchase of gold for 200,000,000 IDR served as a practical application of their learning, reinforcing their ability to synthesize data and make informed financial decisions. Overall, the activity appears to have achieved its intended educational outcomes, fostering a robust understanding of gold price fluctuations and their implications for investment strategies among students.

Activity B: Calculating the Price of Gold Shares

This activity aimed to provide students with an understanding of gold share prices. The specific gold company analyzed was PT Aneka Tambang Tbk, identified by the stock code "ANTM." The researcher, in collaboration with the teacher, utilized the RTI Business application to retrieve data for ANTM shares from October 17, 2022, extending back five years to October 17, 2018, with prices expressed in

Indonesian Rupiah (IDR). The share price data is depicted in Figure 4, while the students' responses to Activity B are presented in Figure 5.

Figure 4. ANTM share prices

Before students began their calculations, the teacher informed them that the minimum purchase for shares is one lot, equivalent to 100 shares. Additionally, students were made aware of the tax implications involved in trading: a buying tax of 0.17% and a selling tax of 0.27%. As noted by Dituri et al. (2019), comprehensive financial information is essential for problem-solving in financial mathematics.

The specific question posed to the students was:

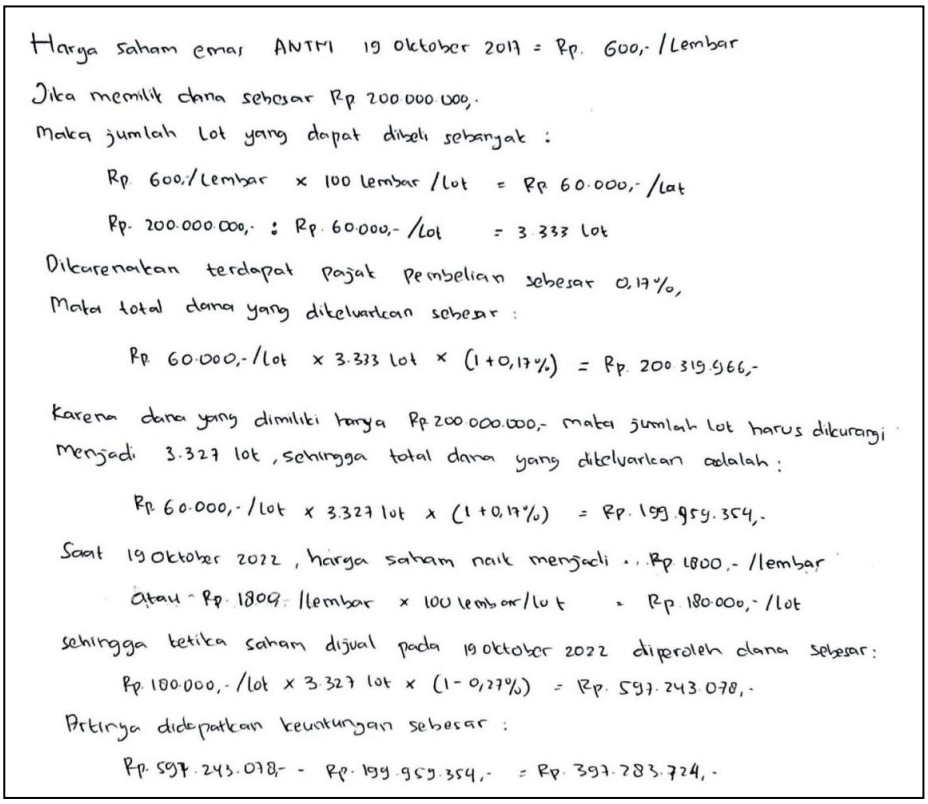
"If you purchase gold shares for 200,000,000 IDR on October 17, 2018, what profit will you realize upon selling them on October 17, 2022?"

Analysis of student responses as shown in Figure 5 reveals that they effectively understood the information provided and were able to estimate the number of lots of shares required for purchase, inclusive of the applicable taxes. Ultimately, they were also capable of calculating the profits generated after a five-year investment in the shares. Thus, it can be concluded that Activity B successfully enhanced students' comprehension of gold share pricing and investment strategies.

The results of Activity B indicate a significant level of engagement and understanding among students regarding the complexities of investing in gold shares. By analyzing the share price trends and incorporating relevant taxation, students developed essential skills in financial mathematics, including the calculation of share quantities, tax implications, and profit estimation.

The inquiry regarding the hypothetical purchase of shares for 200,000,000 IDR provided a practical context for applying their knowledge, enabling students to synthesize data and make informed financial decisions. Overall, Activity B appears to have successfully met its educational objectives, equipping

students with a deeper understanding of gold share prices and the financial acumen necessary for investment evaluation.



Harga saham emas ANTM 19 Oktober 2017 = Rp. 600,- /Lembar

Jika memilik dana sebesar Rp 200.000.000,-

Maka jumlah lot yang dapat dibeli sebanyak :

Rp 600,-/Lembar x 100 Lembar /Lot = Rp 60.000,- /Lot

Rp. 200.000.000,- : Rp. 60.000,- /Lot = 3.333 Lot

Dikarenakan terdapat Pajak Pembelian sebesar 0,17%,

Maka total dana yang dikeluarkan sebesar :

Rp 60.000,- /Lot x 3.333 Lot x (1+0,17%) = Rp 200.319.966,-

Karena dana yang dimiliki hanya Rp 200.000.000,- maka jumlah lot harus dikurangi menjadi 3.327 lot, sehingga total dana yang dikeluarkan adalah :

Rp 60.000,- /Lot x 3.327 lot x (1+0,17%) = Rp. 199.959.354,-

Saat 19 Oktober 2022, harga saham naik menjadi Rp 1800,- /lembar

atau Rp. 1809,- /lembar x 100 lembar/lot = Rp 180.000,- /Lot

sehingga ketika saham dijual pada 19 Oktober 2022 diperoleh dana sebesar:

Rp 100.000,- /lot x 3.327 lot x (1-0,27%) = Rp. 597.243.078,-

Artinya didapatkan keuntungan sebesar :

Rp. 597.243.078,- - Rp. 199.959.354,- = Rp. 397.283.724,-

Translation:

ANTM's gold share price on 19th October 2017 is 600 IDR/share. If you have funds of 200,000,000 IDR, the number of lots that can be purchased is as much 600 IDR/share x 100 share/lot = 60,000 IDR/lot, then 200,000,000 IDR : 60,000 IDR/lot = 3,333 lots. Since there is a purchase tax of 0.17%, so the total funds spent is 60,000 IDR/lot x 3,333 lots x (1+0,17%) = 200,319,966 IDR. Because the funds owned are only 200,000,000 IDR, then the number of lots must be reduced to 3,327 lots, so the total funds issued are 60,000 IDR/lot x 3,327 lots x (1+0,17%) = 199,959,354 IDR. On 19th October 2022, gold share price goes to 1,800 IDR/share or 1,800 IDR/share x 100 share/lot = 180,000 IDR/lot. So that when the shares are sold on 19th October 2022, we get 180,000 IDR/lot x 3,327 lots x (1 – 0,27%) = 597,243,078 IDR. It means getting profit of 597,243,078 IDR – 199,959,354 IDR = 397,283,724 IDR.

Figure 5. Student responses to Activity B

Activity C: Comparing Gold and Gold Shares

Following the calculations of gold prices and share values over five years, students were tasked with comparing the profitability of these two investment options. The inquiry posed was: "*In your opinion, which is more profitable, buying gold or investing in its shares?*" Figure 6 presents the students' responses regarding the comparative profitability of gold and gold shares.

Based on the students' answers, it can be concluded that purchasing gold shares was perceived as more profitable than buying gold when evaluated over the period from October 17, 2018, to October 17, 2022. Subsequently, the teacher posed an additional question: *"Will buying gold shares always be profitable?"* The students' responses to this question are illustrated in Figure 7.

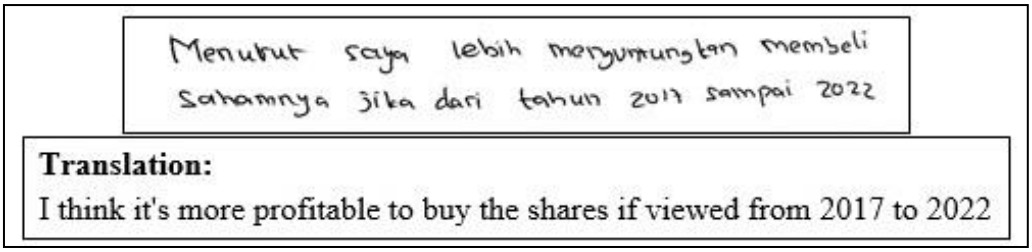


Figure 6. Student opinions on the profitability of gold vs. gold shares

From the students' explanations, it is evident that they recognize that buying gold shares is not invariably profitable. This sentiment is further supported by the share price trends, which do not consistently exhibit upward movement. Factors influencing share prices, such as inflation, supply and demand dynamics, and global health crises like pandemics, contribute to this variability.

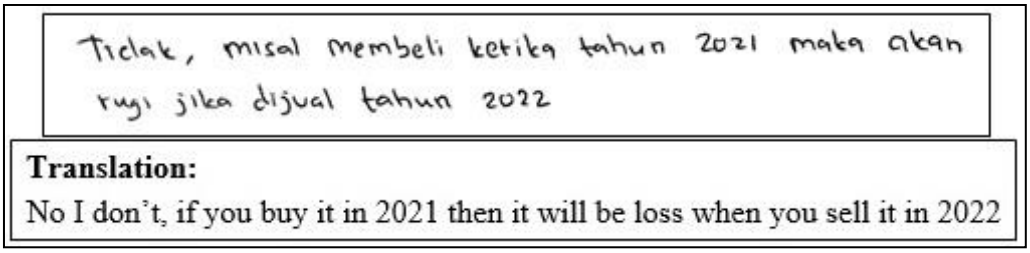


Figure 7. Student explanations regarding gold share prices

Moreover, students were invited to express their opinions on learning financial mathematics within the context of gold and gold shares. The responses collected are depicted in Figure 8.

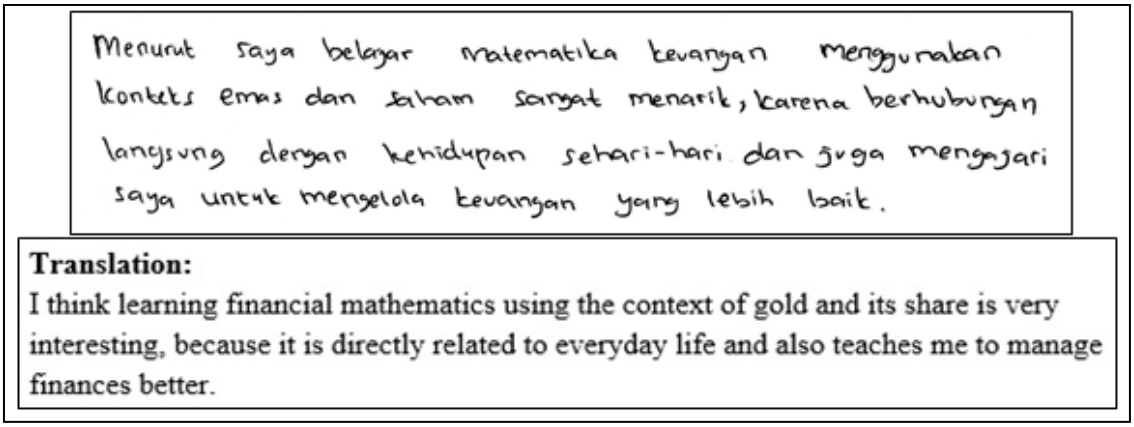


Figure 8. Student opinions on learning financial mathematics

Analysis of the students' opinions indicates a strong interest in learning financial mathematics, particularly when contextualized with gold and gold shares, as these subjects are directly relevant to everyday financial decisions. This relevance fosters a better understanding of financial management. Additionally, incorporating real-world contexts in financial mathematics education plays a crucial role in enhancing students' knowledge and comprehension (Cavalcante & Huang, 2022).

The findings from Activity C highlight the effectiveness of comparative analysis in fostering critical thinking among students regarding investment strategies. By evaluating the profitability of gold and its shares, students developed a nuanced understanding of market dynamics and the factors influencing investment

returns. The acknowledgment that investing in gold shares may not always yield profits reflects an advanced level of financial literacy, as students can critically assess the risks associated with different investment types. Furthermore, the positive feedback on the relevance of financial mathematics in everyday life underscores the importance of practical applications in educational settings. Overall, Activity C successfully achieved its objectives, equipping students with valuable insights into financial decision-making and investment evaluation.

Findings and Impacts

Through the implementation of the three activities, students demonstrated enhanced understanding in making comparisons between two elements related to context-based financial mathematics. In Activity A, students were tasked with calculating the profit from gold purchased between 2017 and 2022. By analyzing the initial and final prices of gold, they applied their strategies to determine the profit effectively.

Similarly, Activity B focused on calculating the profit from gold shares over the same period. Students identified the initial and final prices of the shares, and through predictions regarding the number of lots and consideration of applicable taxes, they successfully calculated the profit from the gold shares.

Activity C prompted students to engage in comparative analysis between gold and its shares by addressing questions regarding profitability. They recognized that investing in gold shares was generally more profitable than purchasing physical gold during the 2017–2022 timeframe, with the exception of the period from early 2021 to early 2022. Additionally, students were surveyed about their experiences learning financial mathematics within a real-world context, expressing significant interest in the subject as it equipped them with valuable skills for better financial management.

Utilizing the PMRI approach and de Lange's theory, the financial mathematical tasks developed were validated as effective, practical, and capable of yielding significant impacts within the contexts of gold and shares. An appropriate context enables students to engage in mathematical thinking by relating to various real-world scenarios (Nusantara et al., 2021). This aligns with previous studies emphasizing that financial mathematical learning problems must connect to daily life to foster informed decision-making (Ferreira & Bisognin, 2020).

During the expert review stage, the initial prototype was deemed valid concerning content, language, and task construction. The content was designed to be pertinent to the tasks and activities provided, ensuring its relevance to students' learning experiences. The language adhered to the enhanced Indonesian Spelling Guidelines, ensuring clarity and comprehension. Furthermore, the task construction was carefully evaluated to align with educational objectives. Feedback obtained from students during the one-to-one testing phase, along with insights from experts, as detailed in Table 2, served as crucial references in refining the initial prototype and affirming its validity.

The second prototype was deemed practical during the small group stage, as evidenced by students' ability to answer questions using their own strategies. Students effectively utilized formulas that facilitated their responses to the given tasks. Following the collection of student feedback, including their answers, comments, and suggestions, the second prototype underwent revisions, resulting in the development of the third prototype.

Lastly, the third prototype demonstrated a significant potential impact on students' understanding of real-world problems, particularly within the financial domain, enhancing their decision-making skills. The elevated level of mathematical tasks designed in accordance with de Lange's theory encouraged students to independently seek out necessary information, fostering creative and critical thinking. Furthermore, the implementation of the PMRI approach motivated teachers to adopt this method in their instruction. This process also equipped educators with new skills to design higher-level mathematical tasks, enhancing their teaching practices and contributing to an enriched learning environment.

CONCLUSION

This study successfully designed a financial mathematical task centered on the contexts of gold and shares, enabling students to make informed choices in context-based financial mathematics. The research produced a task that is validated, practical, and demonstrates potential effects, grounded in the PMRI approach and de Lange's theory. The validity of the task was established through expert reviews and feedback collected during the one-to-one stage. Practicality was evidenced in the small group stage, where students exhibited a solid understanding of the questions and effectively employed their own strategies to arrive at answers.

The potential effects of the designed tasks were highlighted by student feedback, with many expressing that learning financial mathematics through the lens of gold and shares was engaging and relevant to real-life scenarios. This relevance not only enhanced their comprehension of financial issues but also cultivated their decision-making skills, allowing them to make wiser choices. Additionally, teachers reported increased motivation to employ the PMRI approach and gained new skills in designing higher-level mathematical tasks aligned with de Lange's theory.

Despite the promising results, this study encountered several limitations. The research was conducted in a single vocational high school, which may limit the generalizability of the findings to other educational contexts. Furthermore, the sample size, particularly in the small group and field test stages, may not fully represent the diverse learning needs of all students in vocational high schools. Additionally, the study primarily focused on quantitative measures of student understanding, which may not capture the depth of their learning experiences or the nuances of their engagement with the material.

Future research should aim to expand the context of financial mathematical tasks to include a broader range of real-world applications, thereby enhancing the relevance and appeal of the subject for students. Investigating the implementation of the designed tasks across multiple vocational high schools could provide insights into the effectiveness and adaptability of the PMRI approach and de Lange's theory in diverse educational settings. Additionally, qualitative studies could be conducted to explore students' and teachers' experiences in greater depth, examining how contextual factors influence engagement and learning outcomes. Finally, longitudinal studies could assess the long-term impacts of utilizing context-based financial mathematics tasks on students' financial literacy and decision-making skills.

Acknowledgments

The authors would like to express their heartfelt gratitude to Universitas Sriwijaya for funding this research through professional grant number 0016/UN9/SK.LP2M.PT/2024. We also extend our sincere appreciation to all the teachers at VHS 1 Jambi City and the students in classes XI of AM 1, XI of AM 2, and XI of AM 3 for their participation and support in completing this research.

Declarations

Author Contribution : MHR: Conceptualization, Writing-Original Draft, Methodology; Formal analysis, Editing-Visualization; and Writing-Review & Editing.
Z: Writing-Review & Editing, Validation, and Supervision.
RIIP: Writing-Review & Editing, Validation, and Supervision.
YR: Writing-Review & Editing, Validation, and Supervision.

Funding Statement : This research was funded by profession grant of Universitas Sriwijaya with contract number 0016/UN9/SK.LP2M.PT/2024.

Conflict of Interest : The authors declare no conflict of interest.

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