

Learning Trajectory of Percentage Profit and Loss using Selling New Math Pempek Context

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Abstrak

Berawal dari ketidakpahaman peserta didik tentang menentukan persentase untung atau rugi. Peserta didik mengalami kesulitan dalam menghubungkan konsep persentase dengan situasi nyata, sehingga pembelajaran menjadi kurang bermakna. Penelitian ini bertujuan untuk menghasilkan lintasan belajar menggunakan pendekatan PMRI dengan konteks menjual *new math* pempek untuk membantu peserta didik memahami konsep persentase untung dan rugi secara lebih mendalam. Penelitian ini melibatkan 25 siswa di MTs Darul Ulum dan menggunakan metode penelitian desain: preliminary design, experimental design, dan retrospective analysis. Data dianalisis secara retrospektif melalui jawaban lembar kerja siswa, video, dokumentasi berupa foto, dan wawancara. Hasil dari penelitian ini adalah lintasan belajar yang terdiri dari tiga kegiatan: (1) memperkirakan dan menghitung persentase keuntungan, (2) memperkirakan dan menghitung persentase kerugian, dan (3) menyelesaikan masalah persentase keuntungan dan kerugian yang lebih rumit. Dengan menggunakan pendekatan kontekstual, siswa lebih tertarik dan percaya diri dalam memahami materi, sehingga pembelajaran menjadi lebih bermakna.

Kata Kunci: design research, lintasan pembelajaran; *new math* pempek; pendidikan matematika realistik; persentase keuntungan dan kerugian

Abstract

It all started with students' lack of understanding of determining profit or loss percentages. Students had difficulty connecting the concept of percentages to real-life situations, making learning less meaningful. This study aimed to create a learning trajectory using the PMRI approach in the context of selling New Math Pempek to help students understand the concept of profit and loss percentages more deeply. This study involved 25 students at MTs Darul Ulum and employed design research methods, including preliminary design, experimental design, and retrospective analysis. Data were analyzed retrospectively through student worksheet answers, videos, photo documentation, and interviews. The results of this study were a learning trajectory consisting of three activities: (1) estimating and calculating profit percentages, (2) estimating and calculating loss percentages, and (3) solving more complex profit and loss percentage problems. By adopting a contextual approach, students became more engaged and confident in understanding the material, thereby making learning more meaningful.

Keywords: design research, learning trajectory, New Math Pempek, realistic mathematics education, profit and loss percentages

I. INTRODUCTION

Financial learning is not new and has become an internationally recognized topic (Fürstenau & Hommel, 2019; Ramadhan, 2024). Students need to understand the importance of financial education, but it must continuously improve to prepare them for the increasingly complex financial challenges they will face (Sawatzki & Goos, 2018; Sari et al., 2023). In Indonesia, financial education has been integrated with mathematics learning, one of which is through the material of profit and loss percentages (Abadi et al., 2016; Sadiyah & Afriansyah, 2023). As citizens, people must be competent in choosing the right financial product as a form of future investment. One of the efforts that can be made is to train students to be entrepreneurs through sales activities. Sherraden et al. (2011) revealed that learners' financial capability can improve with early financial learning. Integrating financial education into mathematics learning is a strategic approach to developing a deeper conceptual understanding of financial management. Through this approach, students master numeracy skills and develop the ability to apply these concepts to real-life situations.

However, another problem arises when learners understand that percent means per hundred (Siligar et al., 2022). Students still have difficulty solving contextual problems related to sales, especially in calculating the percentage of profit or loss accurately (Nuraeni et al., 2020; Firdausi & Suparni, 2022). This condition is primarily caused by students' limited understanding of how to calculate profit or loss percentages (Rahayu et al., 2021). In

addition, the fact that the problem does not arise in everyday life also affects their difficulties (Abdullah et al., 2015; Fauzan et al., 2018; Ramdhani, Suryadi, & Prabawanto, 2023). Sheldon et al. (2011) revealed that when faced with a familiar problem context, students will find it easier to identify problems and solve them. With a context that is relevant to learners' lives, they will be more confident in their knowledge and create learning that is fun and interesting for them (Sawatzki & Goos, 2018; Jupri & Drijvers, 2016; Astria & Kusno, 2023). Based on these problems, the Realistic Mathematics Education approach offers a solution in the form of learning that uses contexts according to the lives of students (Zulkardi et al., 2020; Wijaya et al., 2021). This approach makes the context a starting point in learning mathematics, with the aim that students experience for themselves how the mathematical process is discovered and applied (Zulkardi & Putri, 2019; Rianasari & Guzon, 2024). New math pempek is a real context that can be used in learning mathematics (Putri et al., 2025). One of the innovations in this study is the use of New Maths Pempek Sales as a context that represents buying and selling activities closely related to students' lives. This context has not been widely used in previous studies, but it offers great potential for making mathematical theory more tangible and contextual by connecting it with everyday financial practices.

Thus, the importance of this study lies in its contribution to bridging the gap between mathematics learning and financial education by taking a relevant,

contextual approach. The study designs meaningful activities and a systematic learning trajectory to help students understand profit and loss percentages more deeply and practically.

II. METHOD

This study aims to develop a learning trajectory on the topic of profit and loss percentages by applying the Indonesian Realistic Mathematics Education (PMRI) approach in the context of selling New Math Pempek. The study employs a design research methodology of the validation study type, consisting of three main phases: preliminary design, design experiment, and retrospective analysis. Twenty-five seventh-grade students from MTs Darul Ulum in Belitang, Indonesia, participated in the study. The steps are explained as follows:

A. Preliminary Design

This stage began with a literature review that focused on identifying the concepts of percentage gain and percentage loss, the Indonesian Realistic Mathematics Education approach, and analyzing the curriculum used by the school.

This review aims to formulate a hypothetical learning trajectory (HLT) that can help students understand the concepts of percentage gain and percentage loss.

In addition, this study also explored pempek recipes and the process of making and serving them. Informed by the literature review, the researcher formulated a sequence of learning activities structured into three main components, namely: making new math pempek, estimating profit and calculating

profit percentage, estimating loss and calculating loss percentage, and solving buying and selling problems related to profit and loss percentage. In addition, researchers also designed learner worksheets, developed teaching modules, and compiled teacher instructions. All of these instruments were approved based on the perspectives of university lecturers and experienced teachers. The following Table 1 is the HLT designed by the researcher.

Tabel 1.
HLT Materials Percentage of Profit and Loss

No	Activity	Main Goals	Conjectures
1.	Estimating profit and calculating profit percentage.	1. Learners can estimate profit. 2. Learners understand that profit percentage is the ratio of profit to capital and is converted into a percentage.	1. Learners understand that profit occurs when there is more money than sales. 2. Learners realize that the percentage of profit is obtained by dividing the profit by the capital and multiplying by one hundred percent.
2.	Estimate losses and calculate loss percentage.	1. Learners can estimate losses. 2. Learners understand that percentage loss is the ratio of loss to capital and is converted into a percent.	1. Learners understand that a loss occurs if the money earned is lower than the capital. 2. Learners realize that the percentage loss is obtained by dividing the loss by the capital and multiplying by

No	Activity	Main Goals	Conjectures
			one hundred percent.
3.	Solve buying and selling problems related to profit and loss percentages	Learners understand the concept of capital, estimating profits and losses, and their percentages, and learners can apply effective strategies in solving problems.	Learners can solve problems using effective strategies based on their experience in completing previous activities.

B. Design Experiment

This stage consists of two phases, namely a pilot experiment and a teaching experiment. The hypothetical learning path, New Math Pempek recipe, and student worksheets were tested on 10 students in class VII-A. The purpose of this trial was to evaluate the research instruments that had been designed, in terms of their suitability, clarity of instructions, and readability in supporting students' understanding of the concepts of profit and loss percentages. Based on the results of the initial trial, several revisions and improvements were made before the teaching experiment phase was implemented. During the teaching experiment phase, learning activities were conducted in class VII-B, which consisted of 25 students. At this stage, hypothetical learning paths, student worksheets, New Math Pempek recipes, and instructions for making pempek were implemented. These activities were designed to guide students in finding ways to calculate profit and loss percentages. During the learning process, data were collected through interviews

with students, video recordings, observations of student collaboration in groups, answers on worksheets, photo documentation, and student presentation outcomes.

C. Retrospective Analysis

This stage aims to examine in depth the correspondence between the hypothetical learning trajectory and actual learning in learning the percentage of profit and loss. The analysis is conducted to understand students' responses, how they solve problems, and the level of concept understanding achieved during the learning process. In addition, this stage also evaluates various difficulties faced by students, such as difficulties in interpreting problems, calculating percentages, or linking mathematical concepts with the context of selling new math pempek. Based on these findings, appropriate solutions were identified to address students' difficulties and to enhance the learning trajectory in supporting their understanding of profit and loss percentages. The outcomes of this analysis not only contribute to refining the initial learning trajectory but also offer valuable insights for the development of more relevant and contextual learning strategies within the framework of the Indonesian Realistic Mathematics Education (PMRI) approach.

III. RESULT AND DISCUSSION

This article discusses research that produced a learning trajectory for percentage profit and loss material through the context of selling new math pempek in class VII-B MTs Darul Ulum, Belitang, South Sumatra, Indonesia, involving 25 learners.

Before learning the material on percentage profit and loss, learners collaborated with their group members to make new math pempek, which are pempek with new shapes such as cubes, cuboids, cones, and trapezoidal prisms. In this activity, learners learn the concepts of cost price, selling price, and profit with their group members. The learning then continues with the activity of estimating profit and determining the percentage of profit. The process of making pempek by learners can be seen in Figure 1.



Figure 1. Pempek Making Process by Learners.

Figure 1 shows the moment when the teacher distributed recipes to each group for making new maths pempek with various shapes, namely cubes, cones, trapezoidal prisms, and cuboids. After receiving the recipe and instructions, learners are given time to watch an instructional video explaining the steps for making each type of pempek. Once all the ingredients are available, learners begin to make the dough, mold it according to the predetermined shapes, and then cook until ready to serve. Throughout this process, the model teacher continues to oversee and provide guidance to learners who are

experiencing difficulties, helping them to develop their conceptual understanding of mathematics in the context of creating new math pempek through hands-on project experience. Through this activity, learners will learn about cost price, selling price and profit.

A. Activity 1: Estimating Profit and Calculating Profit Percentage

In the next activity, learners are given a problem designed to train them in the purpose of estimating profit and calculating profit percentage. This problem requires learners to discover their understanding of the concept of percentage in a real context so that they can develop critical thinking skills and concept understanding. In the following, Figure 2 shows the problem that learners have to solve.

Cek Mita is a pempek seller who produces four types of pempek: cone pempek, cuboid pempek, cube pempek, and trapezoid prism pempek. The cost price for a pack of 10 vacuum pempek, whether it contains one type of pempek or mixed pempek, is estimated at Rp28,000, while the selling price is Rp40,000.

Figure 2. Profit Percentage Problems.

Figure 2 presents a problem related to profit percentage that must be solved by learners. In this problem, learners are asked to analyse and determine the amount of profit earned by Cek Mita from selling her vacuum pempek. After calculating the amount of profit, they must also determine the percentage of profit earned based on the initial capital spent. Through this activity, learners are expected to solve mathematical problems systematically and logically. The following

figures 3-4 show learners' answers for this activity.

1. Berapa estimasi modal yang dikeluarkan cek Mita untuk satu pak pempek vakum isi 10 biji?

Rp 28.000

2. Berapa keuntungan yang diperoleh Cek Mita untuk penjualan satu pak pempek kemasan vakum isi 10 buah?

Keuntungan = $40.000 - 28.000$
 $= 12.000$
 Jadi Keuntungan Rp 12.000

Figure 3. Learners' Answer for Numbers 1-2.

Figure 3 shows the results of learners' answers for numbers 1 and 2. Based on the figure, learners have correctly answered that the cost price for one pack of vacuum pempek owned by Cek Mita is IDR28,000. Furthermore, for answer number 2, learners have also correctly answered that the profit earned is IDR12,000. This answer is obtained by subtracting the selling price from the initial cost price, namely IDR40,000-IDR28,000, so that the profit earned by Cek Mita is IDR12,000. This calculation shows that learners have understood the basic concept of determining profit from the difference between cost price and selling price.

3. Tuliskan bentuk perbandingan antara keuntungan dengan modal.

Perbandingan = $\frac{\text{Keuntungan}}{\text{Modal}}$
 $= \frac{12.000}{28.000}$

4. Nyatakan perbandingan tersebut ke dalam bentuk persen.

$\frac{12.000}{28.000} = \frac{12}{28}$ $7/30 : 0,428$
 $\frac{12}{28} \times 100\% = \frac{3}{7} \times 100\%$
 $= 0,428 \times 100\%$
 $= 42,8\%$

5. Berdasarkan aktivitas tersebut, jelaskan yang dimaksud dengan persentase keuntungan?

Persentase Keuntungan adalah Perbandingan Keuntungan yang diperoleh dengan modal dan dikali dengan 100%

Figure 4. Learners' Answer for Numbers 3-5.

Figure 4 shows the results of students' answers for numbers 3 to 5. Based on the figure, learners have correctly answered question 3, which is to determine the form of comparison between profit and capital as $12.000/28.000$, then learners are asked to express the comparison in percent. Because they understood that percent means 'divided by one hundred', they immediately multiplied the result of the comparison by 100%. To simplify the calculation, they first simplified the fraction $12.000/28.000$ to $12/28$. Then, they simplified again by dividing the numerator and denominator by 4, resulting in a fraction of $3/7$. After multiplying by 100%, they get a final result of 42.8%. After multiplying by 100%, they got the final result of 42.8%. This calculation process demonstrates that learners have grasped the concepts of comparison and percentages and can apply them to solve problems. Next, learners were asked to conclude the meaning of profit percentage. They answered that the percentage of profit is the ratio between the profit

earned and the capital, then multiplied by one hundred percent.

B. Activity 2: Estimating Loss and Calculating Loss Percentage

After learners have completed Activity 1, they are asked to complete Activity 2, which aims to enable them to estimate losses and calculate loss percentages. Figure 5 shows the problems that learners need to solve in Activity 2.

When producing the cubes pempek, Mang Rian used too much tapioca flour and kneaded the dough for too long, resulting in hard pempek. With a cost price of Rp100,000 for 100 pempek, only 30 pempek were sold at Rp2,000 per pempek. What is the percentage of Mang Rian's loss?

Figure 5. Problem Percentage of Loss.

Figure 5 presents a problem related to percentage loss that learners must solve. In solving this problem, they are asked to utilise their experience from the previous activity related to percentage gain. This aims to strengthen their understanding and train their ability to apply the concepts they have learnt. The following figures 6 - 7 show the learners' answers.

1. Berapa modal yang dikeluarkan Mang Rian? Dan Berapa uang yang diperoleh Mang Rian dari penjualan pempek?

Modal = 100.000
Uang yang Diperoleh adalah = 60.000
 $30 \times 2.000 = 60.000$

2. Berdasarkan permasalahan tersebut, menurut pendapatmu apakah Mang Rian memperoleh keuntungan atau kerugian? Jelaskan.

Mengalami kerugian, alasannya modalnya 100.000 untuk 100 pempek namun hanya 30 pempek yang berhasil terjual dengan harga 2.000. Modal 100.000 sedangkan yang diperoleh adalah 60.000 jadi mengalami kerugian sebesar 40.000

Figure 6. Learners' Answer to Question Numbers 1-2.

Figure 6 shows the results of learners' answers for numbers 1 and 2. Based on the picture, we know that learners can calculate and conclude that Mang Rian has a loss. the capital spent by Mang Rian is IDR100,000, but the pempek sold only gets IDR60,000, so Mang Rian's loss is IDR40,000.

3. Tuliskan bentuk perbandingan besar kerugian dengan harga modal.

$\frac{40}{100}$

4. Berapa besar persentasenya?

$\frac{40}{100} \times 100\% = 40\%$

5. Berdasarkan aktivitas tersebut, jelaskan yang dimaksud dengan persentase kerugian?

Persentase kerugian adalah bentuk perbandingan antara kerugian dengan modal yang dinyatakan ke dalam bentuk persen

Figure 7. Learners' Answer for Question Numbers 3-5.

Figure 7 shows the results of learners' answers related to the percentage loss problem. Based on these results, no

significant difficulties were found in the answers given by learners. This demonstrates that learners can solve this problem effectively thanks to their experience of working on similar problems related to profit margins. Their existing understanding of concepts helps them apply the same calculation method to solve percentage loss problems. Thus, learners can develop their analytical thinking skills and gain a deeper understanding of the relationship between profit and loss in mathematical concepts.

C. Activity 3: Solving problems, Profit and Loss Percentage

After learners have completed activities 1 and 2, they are asked to complete activity 3, which aims to enable learners to solve more complicated buying and selling problems. The problem can be seen in the following pictures 8 and 9.



Figure 8. Sale and Buy Problems Related to Percentages.

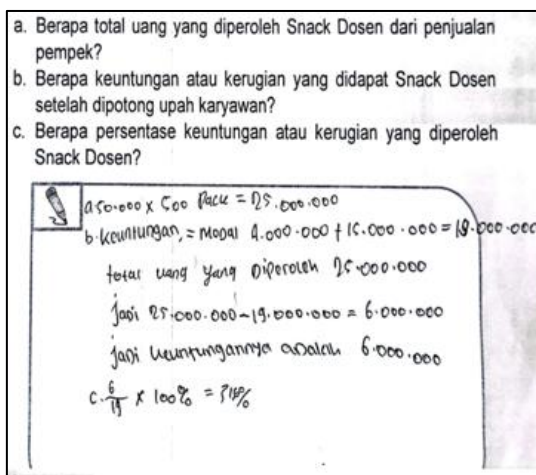


Figure 9. Learners' Answer to Buying and Selling Problems.

Figure 9 shows the results of learners' answers related to buying and selling problems. In question (a), learners successfully calculate that the total revenue earned by Snack Dosen is IDR25,000,000. This value is obtained by multiplying the price of one package of 24 pempek by the number of orders, namely $50,000 \times 500 = \text{IDR}25,000,000$. Furthermore, in question (b), learners concluded that Snack Dosen made a profit. to determine this, they first calculated the cost price by adding up the production costs and wages for four employees, namely $\text{IDR}4,000,000 + \text{IDR}15,000,000 = \text{IDR}19,000,000$. Thus, the profit earned from selling pempek is calculated by subtracting the total revenue from the cost price, $\text{IDR}25,000,000 - \text{IDR}19,000,000 = \text{IDR}6,000,000$. Then, in question (c), students can calculate the percentage of profit earned by Snack Dosen from capital, which is 31.6%. This calculation is done by comparing the profit with the cost price and then multiplying it by one hundred percent. This shows that learners have understood the concept of calculating cost price, profit, and percentage. A learning trajectory comprising three activities was developed based on the findings of a study examining the role of the Indonesian Realistic Mathematics Education (PMRI) approach in supporting learners' understanding of profit and loss percentages in the context of New Math Pempek. In the first activity, students are guided through estimating and calculating the percentage of profit. This phase presents a problem intended to help

students grasp the concept of profit and learn how to calculate its percentage. The second activity focuses on estimating and calculating the percentage of loss. Together with the previous activity, this enables learners to differentiate between situations that result in profit and those that lead to loss. Thus, they can understand the profit and loss concept more deeply and be able to analyze the factors that affect both. In the third activity, learners are given more complex and challenging problems.

The objective of this activity is to encourage students to apply their knowledge and experience from previous tasks to solve more complex problems. At this stage, learners will deepen their understanding of profit and loss percentages by analysing and applying these concepts in different situations. This process is intended to develop their critical thinking, problem-solving, and decision-making skills in realistic business and buying-and-selling scenarios. Through this activity, students should connect mathematical theory to real-life contexts, develop independent thinking skills, and build a more robust conceptual understanding of profit and loss percentages.

Based on the overall process, from designing the Hypothetical Learning Trajectory (HLT) and student worksheets, to implementing teaching experiments in a larger classroom setting involving 25 students and comparing the HLT with the Actual Learning Trajectory (ALT) it can be concluded that the learning process, grounded in the Indonesian Realistic Mathematics Education (PMRI) approach

and contextualised through selling New Math Pempek, embodies three core principles: guided reinvention and progressive mathematisation; didactical phenomenology; and the use of self-developed models (Zulkardi, 2002). First guided reinvention and progressive mathematizing, learners are allowed to make new math pempek by calculating and measuring the needs of pempek ingredients, printing according to the desired size and shape, cooking, and presenting their products, as well as acting as sellers to understand the profits, losses, and percentages directly. The second principle of didactical phenomenology, the context of new math pempek, is part of the culture and local wisdom relevant to learners' real world, as a phenomenon that helps them understand the concept of profit, loss, and percentage in everyday life. The principle of self-developed models is demonstrated through tasks that guide students in identifying capital, computing profit or loss, analysing the relationship between outcome and initial investment, and expressing the result as a percentage. In the end, learners can find the general pattern of profit and loss percentage. Thus, this research provides great benefits in learning mathematics, especially in understanding the concept of percentage of profit and loss, as well as improving problem-solving skills, critical thinking, and students' independence in learning.

Project learning not only makes learners more active and collaborative (Marleny et al., 2024) but also provides an opportunity for them to understand more about pempek, one of the traditional foods that is

a local cultural heritage (Wargadalem et al., 2023). This is in line with Kuhnlein & Receveur's (1996) statement that learning that utilizes the culture and context of traditional food not only increases knowledge, but also serves as a means of introducing history, this approach can also increase self-confidence (Sawatzki & Goos, 2018), learning using traditional contexts will provide opportunities for learners to explore wisdom so that learning becomes more meaningful (Nursyahidah et al., 2020; Sari et al., 2022), motivate learning (Stacey & Turner, 2015), and develop learners' numeracy skills (Isamer et al., 2023). Several studies have integrated pempek as a context for learning mathematics. For example, pempek lenjer is used to help learners understand the concept of fractions (Meryansumayeka et al., 2019), while the development of pempek-based PISA questions has been conducted to increase the relevance of questions to local culture (Ningsih & Rohana, 2016). In addition, pempek is also utilized in the development of algebra questions to measure students' problem-solving skills (Putri et al., 2022). However, these studies are still limited to the packaging and price list aspects of pempek. Unlike the previous studies, this research is designed so that students directly create new math pempek and connect it with learning the concepts of profit, loss, and percentage. With this approach, learners not only learn maths contextually but also play a role in preserving traditional food.

IV. CONCLUSION

The learning trajectory, which was designed using the Indonesian Realistic

Mathematics Education (PMRI) approach in the context of selling New Math Pempek, consists of three main activities: estimating and calculating profit, estimating and calculating loss percentages, and solving more complex buying and selling problems. This series of activities helps students to gain a deeper understanding of how mathematical concepts are applied in real life and to develop their problem-solving and decision-making skills. Additionally, this approach contributes to preserving local culture by using traditional food, such as pempek, as a context. Thus, this study makes an important contribution to the development of more applicable, contextualised, and meaningful innovations in mathematics education. Mathematics education focuses not only on mastering abstract concepts but also on strengthening financial literacy and instilling entrepreneurial values from an early age. The findings of this study are expected to serve as a reference for teachers when designing meaningful, innovative, and collaborative learning experiences, thereby motivating students and helping them to gain a deeper understanding of the culture in which they live.

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