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Exploring students' understanding based on Bruner's theory regarding the concept of profit and loss

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Abstract

The lack of understanding and skills in solving mathematical problems is now a significant concern in many countries. Other factors, such as learning interests, influence students' understanding of these concepts. Therefore, it is necessary to explore students' understanding of arithmetic (profit and loss) based on Bruner's theory regarding learning interest. The study was conducted at a Vocational School in East Java, Indonesia, with 26 students participating as research subjects. The research methodology used was qualitative, with data collected through questionnaires on learning interests, profit and loss concept tests, and interviews. Data were analyzed using a process of reduction, presentation, and conclusions. The findings revealed that subjects with high and medium learning interest categories can meet the stages of Bruner's theory (enactive, iconic, and symbolic). However, subjects with medium learning interests do not need help understanding what happens in the problem—the subject with low learning interest can only reach iconic and symbolic stages in Bruner's theory. Thus, teachers should design appropriate learning strategies and media for students with medium and low learning interests so that they have a good conceptual understanding.

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Introduction

Mathematics is one of the most important subjects for students because it is often applied in everyday life to solve various real problems. Mathematics is a science or subject matter and an essential human activity (Gazali, 2016). Mathematics in the school curriculum at all levels, especially in primary schools, has become critical and dominant in daily life because of the vastness of application in elementary school (Boye & Agyei, 2023). Mathematics learning is designed to create an atmosphere where students can actively participate in activities related to mathematics learning, allowing them to master competencies through a series of structured exercises (Hamzah & Muhlishrarini, 2014). Math achievement is crucial for scholastic attainment and everyday and professional life prospects. In addition, the continuous further development of technology requires good math skills (Gashaj et al., 2023). The ability to shift attention from the particular to the general, from objects to relationships, is a hallmark of advanced mathematical thinking. It allows individuals to understand the underlying coherence and organization of mathematical structures, paving the way for sophisticated problem-solving abilities (Alam & Mohanty, 2024). In learning mathematics, one factor must be considered, especially the family environment factor. The family environment, a very varied factor, becomes more influential on student learning along with the decline in school influence, such as motivation and appreciation and can increase students' interest in learning (Haser et al., 2022).

Understanding and mastery of mathematical concepts are critical elements in mathematics learning, where the understanding built in each lesson expands existing mathematical knowledge (Susanto, 2014). Basic mathematical knowledge skills include absorbing information, remembering ideas and formulas, and applying them in relevant situations (Khoerunnisa & Hidayati, 2022). Lack of understanding and skills in solving mathematical problems is now a significant concern in many countries, suggesting that how mathematics should be taught to develop student comprehension of concepts and procedures remains a significant focus in educational research (Yimam & Dagnew Kelkay, 2022). Developing students' understanding of mathematical concepts is a long-standing concern in mathematics education, where encouraging students to produce examples has been suggested as an effective way to develop an understanding of concepts (Gashaj et al., 2023). Conceptual knowledge also includes how students react, think, and act according to the definition and essence of mathematics and their capacity to choose the proper method for solving problems (Meidianti et al., 2022) with students who could socialize, expand students' ideas, and encourage the explanation and justification of mathematical concepts (Olteanu, 2022).

Especially for tenth-grade students, conceptual understanding is essential because it will provide higher education levels. Many tenth-grade students at Vocational School in East Java, Indonesia, need help understanding mathematical concepts, especially in solving arithmetic problems, which are the basis of many mathematical operations (Nicomse & Manalu, 2022). A good conceptual understanding allows students to overcome various variations of problems well and improve their ability results (Zhang et al., 2024a). To provide explanations that can help students understand mathematical concepts, mathematics teachers must have good

communication skills, and students must gain an in-depth understanding of mathematical rules or concepts (Murtafiah et al., 2018).

By requiring an understanding of the concepts, students should have a high interest in learning. Learning interest, defined as a student's immediate emotional and cognitive engagement with learning material, plays a crucial role in online learning environments (Zhang et al., 2024b). A strong learning interest is characterized by enthusiasm and curiosity, leading to more active participation in online learning activities (Wu et al., 2021). Changes in learning interests will lead to different learning outcomes (Ernawati et al., 2022). High interest in learning can promote students' willingness to participate in online learning, thereby boosting their online learning satisfaction (Zhang et al., 2024b). A warm and comfortable atmosphere is needed for students to create a good interest in learning students. Related to learning science and interest development, literature shows that interest can mediate the relationship between active, fun learning and student outcomes (Miskahuddin, 2017b).

Bruner's discovery learning theory, which emphasizes intuition to understand meaning and concepts, can be used to analyze students' understanding of arithmetic concepts (Miskahuddin, 2017a). In addition, students' learning interest factors also significantly affect their ability to understand mathematical concepts (Fadillah, 2016). Students interested in lessons need help accepting and mastering the material (Komariyah et al., 2018). Bruner emphasized the importance of the learning process through the mental method, where the individual who learns must experience firsthand what they are learning to record the process uniquely and personally (Amir & Risnawati, 2016).

Bruner's discovery theory can be used to analyze students' understanding of mathematical concepts, emphasizing intuition to understand meaning and concepts (Miskahuddin, 2017a). Bruner emphasized the importance of the learning process through the mental method, where the individual who learns must experience firsthand what they are learning to record the process uniquely and personally (Amir & Risnawati, 2016). Bruner's Constructivist Theory suggests that this theory is practical when faced with new material to follow the development from enactive to iconic to symbolic representation (O'Donovan, 2021). Bruner is involved in how knowledge is represented and organized through different ways of thinking (or representations), proposing three modes of representation: enactive, iconic, and symbolic (Takaya, 2008; Culatta, 2020). Enactive is the stage where children are directly involved in manipulating objects. Iconic stage, children's activities already involve mental processes, which are representations of objects or things they manipulate. During the symbolic stage, children can use notation or symbols without relying on authentic objects, and students begin to use more complex mathematical words and symbols (Kurniasih, 2015).

Previous researchers have conducted several studies related to Brunner's theory. Amalia and Yunianta (2019)have researched the cognitive process of students in solving mathematical problems based on Brunner's theoretical representation. Winarso and Dewi (2017) researched students' cognitive abilities in solving mathematics problems with cube material. Furthermore, research has been conducted on applying Brunner's theory to improve students' understanding of mathematical concepts (Eci & Sinaga, 2021). In addition, research has been conducted on applying Bruner's theory and concept maps, which can improve students' reasoning and

understanding of mathematical concepts (Ardat, 2014). Research related to Brunner's theory has only focused on students' cognitive development and its application in improving students' understanding. However, research related to exploring students' conceptual understanding in solving problems based on Brunner's theory, which was reviewed from the perspective of learning interest, has yet to be conducted.

Exploration related to students' conceptual understanding is important to reveal, especially in solving mathematical problems in everyday life, such as the application of profit and loss to the concept of arithmetic. Especially for vocational school students who have different learning interests and influence their learning outcomes, including in the mathematics subject of profit and loss material. For that, students' conceptual understanding of the material on profit and loss is important to reveal based on Brunner's theory to find out their cognitive development in understanding the application of the concept of the material in everyday life. Thus, this study aims to analyze the understanding of the concept of profit and loss of tenth-grade Vocational School students based on Bruner's theory in terms of student learning interests. This study will provide insight into how the understanding of arithmetic concepts can be improved through the right approach, paying attention to student learning interests and identifying effective teaching strategies and student engagement techniques.

Methods

This study was conducted at a Vocational School in East Java, Indonesia, during the first semester of the 2023/2024 schooling year, involving 26 students. It employed a qualitative descriptive research design to analyze the understanding of profit and loss concepts based on Bruner's theory about students' learning interests. As defined by Harahap (2020), qualitative research aims to study natural phenomena with researchers serving as the primary research instruments. This approach provides insights that statistical methods may not capture, as Sidiq and Choiri (2019) noted. The research focused on exploring students' understanding of profit and loss concepts through the lens of Bruner's theory and considering their learning interests.

Data collection tools include learning interest questionnaires to assess student engagement in math learning. The questionnaire has been validated before the collecting the data (Gembong, 2010) to ensure the level of reliability and accuracy in measuring student interest were high enough. After filling out the Questionnaire, subjects will be selected which are categorized into three levels (Anggraini et al., 2022), namely high (score ≥ mean + standard deviation), medium ((mean – standard deviation) < score < (mean + standard deviation) and low (score ≤ mean – standard deviation). Next, students will be given a concept understanding test. Concept understanding test and interview guidelines were validated by mathematics education experts with results of 0.814 and 0.814 in the high category. Concept understanding test is aimed at finding out students' understanding of concepts. Interview guidelines were data collection techniques carried out by researchers to obtain information from respondents in detail. The code for interview data collection using code: *Wi = Interview to i, i=1, 2, ...etc.; Li= Level to i, i=1,2,3; Si= Subject to i, i=1,2,3; PiLi= Question i for Level i; i=1, 2, ...etc.;Si,jLi=*

Subject to i for question to j for Level i, i=1,2,3. The concept understanding test used in this study is the profit and loss problem as follows.

Profit and Loss Problem

1. Rossi bought a Civic car rearview mirror for Rp. 2,100,000.00. After that, Rossi sold it for Rp. 1,800,000.00. After selling it, Rossi bought another Civic car rearview mirror for Rp.2,250,000.00. Then resell it for Rp. 2,050,000.00. How much did Rossi suffer with the sale of his Civic rearview mirror?

2. Mr. Ahmad bought a diesel engine for Rp. 1,000,000.00. Then, Mr. Ahmad sold it for Rp. 1,500,000.00. After selling the diesel engine, Mr. Ahmad bought another diesel engine for Rp. 800,000.00. Then it was re-sold for Rp. 1,600,000.00. How much profit did Mr. Ahmad receive from the sale of his diesel engine?

The interview guide that has been developed and used in this research refers to indicators of understanding based on Bruner's theory. Bruner's theory consists of three stages, namely, enactive, iconic, and symbolic (Kurniasih et al., 2015). Indicators of conceptual understanding based on Bruner's theory used in this study are presented in Table 1.

Table 1. Understanding indicators based on Bruner's theory and interview guidelines

Stages of Bruner's Theory	Indicators	Descriptors	Interview Guidelines
Level 1 (Enactive)	Students illustrate a problem that is presented with direct experience in the field.	Highlight: Students could illustrate the problems-presented, because the problems are following the practice in the field.	a. What happened to the problem? b. Do you have experience in buying and selling on scattered issues?
Level 2 (Iconic)	Students build a reception of an aspect by getting to know the concept of addition or subtraction to the profit or loss of the problems presented.	Interpret and compare: Students could receive information and build a perception of an aspect to understand a concept in a problem and students can compare the problem is in the category of profit or loss.	How could you say that there is a profit or loss in this problem?
Level 3 (Symbolic)	Students begin to have an idea, start to design formulas, explain how to solve problems, and then draw conclusions from the results of their works.	a. Explain: Students could explain the stages in solving problems with formulas that have been designed. b. Conclude: Students could apply appropriate formulas to solve problems and students could conclude or determine the amount of profit or loss in the problem presented.	a. How do you determine the amount of profit or loss from the problem? b. Do you have any difficulties in solving these problems?

Data was analyzed through a reduction process, data presentation, and conclusions/verification drawings (Miles et al., 2014; Saldaña, 2013). In this study, the technique of checking the validity of data is used triangulation method. Triangulation of methods for data validation tests is carried out by checking data with different methods but to the same source (Widyahening, 2018). The research procedure can be seen in Figure 1.
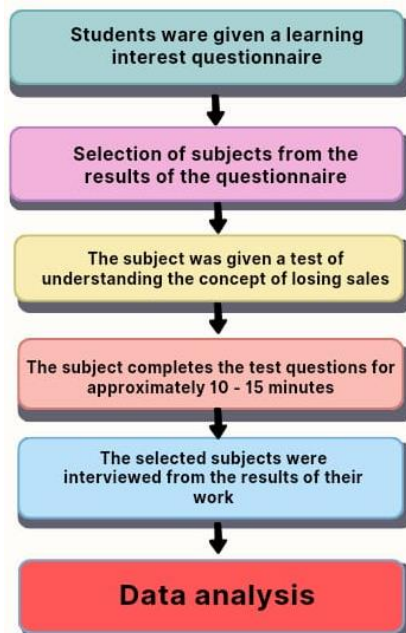
Figure 1. Research procedure

Results

This study produces data on understanding profit and loss concepts based on Brunner's theory by considering students' learning interests. Students were asked to complete a questionnaire to measure their interest in learning mathematics. The student learning interest questionnaire results showed that this study's subjects were three students. The subjects were taken from the results of the learning interests of all tenth-grader students in a Vocational School, which consists of 26 students.

The researchers used the test results to determine the research subjects consisting of 3 students, namely BO for student 1, KI for student 2, and AA for student 3. The learning interest questionnaire results showed that BO was in the high learning interest category. At the same time, KI was included in the medium learning interest category, and AA was included in the low learning interest category. In addition, based on the results of the learning interest questionnaire, the selection of the three subjects was also based on information from the mathematics teacher's considerations, as shown in Table 2.

Table 2. Research subject

Learning Interest Category	Score	Score Range	Subject
High	51	≥ 50.32	BO
Medium	47	$45.45 - 50.32$	KI
Low	41	≤ 45.45	AA

The selected subjects were given a profit and loss problem test and an interview. The test and interview results for each subject were selected in this study and presented as follows:

Subject with high learning interest

Level 1 (Enactive)

The test results of subject 1 (BO) at level 1 (enactive) can be seen in Figure 2.
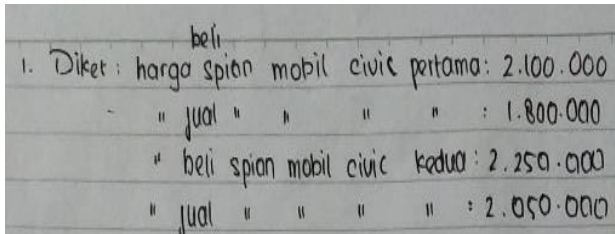
Translation

Informasion:

The purchase price of the first Civic`s rearview mirror = Rp. 2,100,000

The selling price of the first Civic`s rearview mirror = Rp. 1,800,000

The purchase price of the second Civic`s rearview mirror = Rp. 2,250,000

The selling price of the second Civic`s rearview mirror = Rp. 2,050,000

Figure 2. Subject 1 test result in level 1 (Enactive)

Based on the test result in Figure 2, subject 1 (BO) could describe a problem and also experience something similar to the problem presented which is also supported by the results of the interview (S1.1 L1). Subject 1 (BO) experienced it directly, namely helping his mother sell at home (*S1.2L1*).

P1L1 : Previously you have given a question. Try to tell us what happened to the problem?

S1.1 L1 : Well, ma'am, what I took from question number 1 was to have a loss.

P2L1 : Do you have an experience similar to the incident in the question?

S1.2 L1 : Once, ma'am, I used to sell on helping my mother and I also had losses just like in the question.

Subject 1 (BO) understands the problem, creates a solution plan, illustrates and records information well. Personal experience in buying and selling helps subject 1 (BO) solve the problem well.

Level 2 (Iconic)

The test results of subject 1 (BO) at level 2 (Iconic) can be seen in Figure 3.
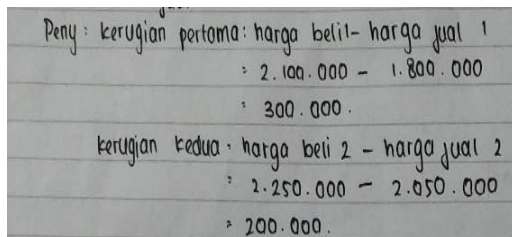
Translation

Solution : 1st loss = 1st buying price – 1st selling price

= Rp. 2,100,00 – Rp. 1,800,00

= Rp. 300,000

2nd loss = 2nd buying price – 2nd selling price

= Rp. 2,250,000 – Rp. 2,050,000

= Rp. 200,000

Figure 3. Subject 1 (BO) test result in level 2 (iconic)

Based on the test result in Figure 3, subject 1 (BO) could interpret and distinguish between profit and loss and solve them with the appropriate formula, where students represent problems in mathematical models. This can be seen from the results of the interview (*S1.1 L2*) which shows that subject 1 (BO) could present problems and choose the appropriate formula.

P1L2   : How could you mention that question number 1 has a loss?

S1.1 L2   : When I calculated number 1, there was a dispute over the buying and selling price, ma'am. The purchase price was greater than the selling price.

Subject 1 BO could represent the problem in a mathematical model and compare the profit or loss, demonstrating good understanding through direct experience.

Level 3 (Symbolic)

The results of the subject 1 (BO) test at level 3 (Symbolic) can be seen in Figure 4.

Translation

Solution : 1st loss = 1st buying price – 1st selling price

= Rp. 2,100,000 – Rp. 1,800,000

= Rp. 300,000

2nd loss   = 2nd buying price – 2nd selling price

           = Rp. 2,250,000 – Rp. 2,050,000

           = Rp. 200,000

Overall losses = 1st loss + 2nd loss

              = Rp. 300,000 + Rp. 200,000

              = Rp. 500,000

Figure 4. Subject 1 test result in level 3 (Symbolic)

Based on the test result in Figure 4, subject 1 (BO) could classify and solve a problem. It can be seen from the results of the interview (*S1.1 L3*) which able to solve problems according to the formula and re-check to ensure that the conclusions produced are correct (*S1.2 L3*).

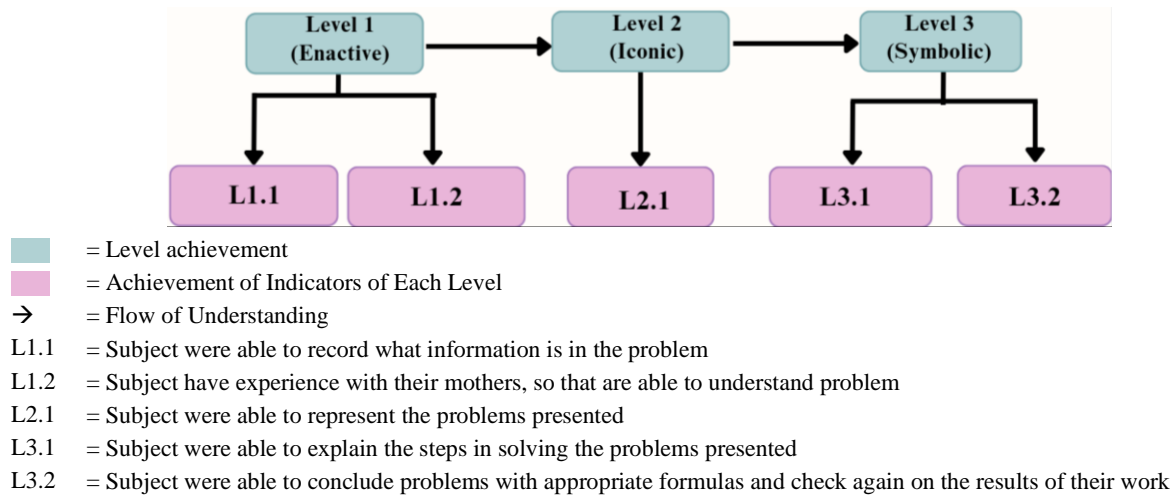P1L3   : How can you determine the amount of loss from the problem?

S1.1 L3   : Okay, ma'am, by the way, I looked for the initial or first loss, continue to looked for the second loss, then added up all the losses that have been found. Where it has been determined that if the purchase price was greater than the selling price, it will have a loss.

P2L3   : Do you have any difficulties in solving these problems?

S1.2 L3   : No ma'am, because I already understood the problem and wrote down everything I knew on the question. Therefore, I already known the steps in completing it. I also checked the results of my work again to make sure there was nothing wrong.

Subject 1 (BO) evaluates the results of the solution, determines the amount of profit or loss, follows the procedures clearly, and demonstrates excellent ability in solving problems. The diagram in Figure 5, shows the achievement of a level of understanding of concepts based on Bruner's theory in students with a high interest in learning.

= Level achievement

= Achievement of Indicators of Each Level

→ = Flow of Understanding

L1.1 = Subject were able to record what information is in the problem

L1.2 = Subject have experience with their mothers, so that are able to understand problem

L2.1 = Subject were able to represent the problems presented

L3.1 = Subject were able to explain the steps in solving the problems presented

L3.2 = Subject were able to conclude problems with appropriate formulas and check again on the results of their work

Figure 5. Understanding the concept of high learning interest categories

Subject with medium learning interest

Level 1 (Enactive)

The results of the subject 2 (KI) test at level 1 (Enactive) can be seen in Figure 6
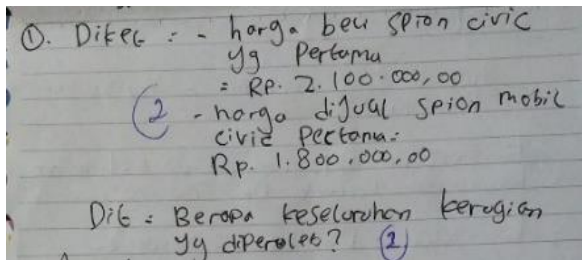
Translation

Information:

The purchase price of the first Civic`s rearview mirror = Rp. 2,100,000

The selling price of the first Civic`s rearview mirror = Rp. 1,800,000

Asked: How much is the total loss obtained?

Figure 6. Subject 2 test result in level 1 (Enactive)

Based on the test result in Figure 6, Subject 2 (KI) could illustrate a problem, but unable to write down the information completely and subject 2 (KI) has experienced something similar to the problem presented (S2.1 L1), namely subject 2 (KI) accompanied his brother in selling. It can be seen from the following interview test (S2.2L1).

P1L1 : Previously you had given a question. Try to tell us what happened to the problem?

S2.1 L1 : What I took from question number 2 was to experience profits.

P2L1 : Do you have a similar experience to the incident in the question?

S2.2 L1 : I have felt that I have made a profit, because I used to sell.... with my brother.

Subject 2 (KI) understands the problem, creates a detailed solution plan in the second interview test, and demonstrate sufficient ability to distinguish between profit and loss.

Level 2 (Iconic)

The results of the subject 2 (KI) test at level 2 (Iconic) can be seen in Figure 7.

Translation

Answer :

1st loss = 1st buying price – 1st selling price

= Rp. 2,100,000 – Rp. 1,800,000

1st loss = Rp. 300,000

2nd loss = Rp. 2,250,000 – Rp. 2,050,000

2nd loss = Rp. 200,000

Figure 7. Subject 2 test result in level 2 (Iconic)

Based on the test result in Figure 7, Subject 2 (KI) could interpret and distinguish an advantage or disadvantage and solve it with the appropriate formula by representing the problem in a mathematical model. It can be seen from the results of the interview test (S2.1 L2) which shows that subject 2 (KI) could present problems and choose the appropriate formula.

P1L2   : Hoe could you explain that question number 2 has a problem?

S1.1 L2   : Because in number 2, there is a price dispute, the value of the selling price is greater than the purchase price.

Subject 2 (KI) could represent and compare the profit or loss of the problem presented, and then demonstrate a good ability to use formulas.

Level 3 (Symbolic)

The results of the subject 2 (KI) test at level 3 (Symbolic) can be seen in Figure 8.

Translation

Answer :

1st loss = 1st buying price – 1st selling price

= Rp. 2,100,000 – Rp. 1,800,000

1st loss = Rp. 300,000

2nd loss = Rp. 2,250,000 – Rp. 2,050,000

2nd loss = Rp. 200,000

Overall losses

= Rp. 300,000 + Rp. 200,000

= Rp. 500,000

Figure 8. Subject 2 (KI) test result in level 3 (symbolic)

Based on the test result in Figure 8, Subject 2 (KI) could classify and explain a problem. It can be seen from the results of the interview test (S2.1 L3) able to solve problems according to the formula and subject 2 (KI) re-checks to ensure the conclusions produced are correct (S2.2 L3).
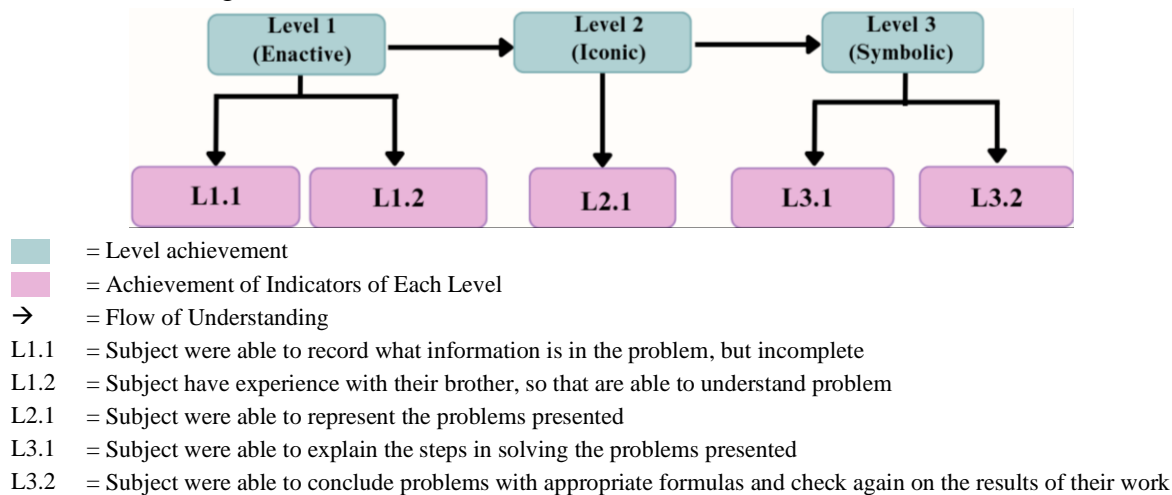
P1L3   : How do you determine the amount of loss from the problem?

S2.1 L3   :By calculating the initial profit, continued to look for the second profit, then I added everything up, ma'am. Where it has been determined that the selling price was greater than the purchase price, then it was said to be profitable.

P2L3   : Do you have any difficulties in solving these problems?

S2.2 L3   : No ma'am, I have already known the steps in completing it. At number 2, I did a re-check to make sure my answer was correct.

Subject 2 (KI) explains the steps to solve, re-checks the results of his work, and demonstrate good ability to solve problems. The diagram in Figure 9, shows the achievement of an understanding level of concepts based on Bruner's theory in students with moderate interest in learning.

■ (teal)	= Level achievement
■ (pink)	= Achievement of Indicators of Each Level
→	= Flow of Understanding
L1.1	= Subject were able to record what information is in the problem, but incomplete
L1.2	= Subject have experience with their brother, so that are able to understand problem
L2.1	= Subject were able to represent the problems presented
L3.1	= Subject were able to explain the steps in solving the problems presented
L3.2	= Subject were able to conclude problems with appropriate formulas and check again on the results of their work

Figure 9. Understanding the concept of medium learning interest category

Subject with low learning interest

The results of the subject 3 (AA) test can be seen in Figure 10.
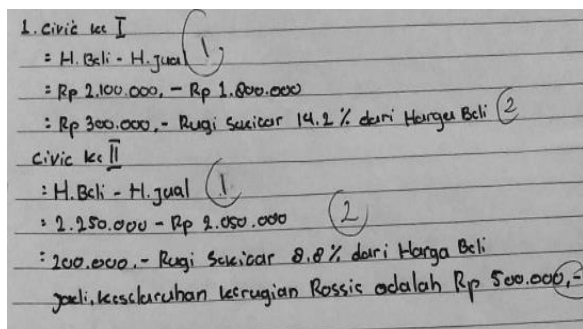
Translation
1. 1st Civic
= 1st buying price – 1st selling price
= Rp. 2,100,000 – Rp. 1,800,000
= Rp. 300,000, a loss of around 14,2% from the buying price
2nd Civic
= 2nd buying price – 2nd selling price
= Rp. 2,250,00 – Rp. 2,050,000
= Rp. 200,000, a loss of around 8,8% of the purchase price
So, Rossi`s overall losses are Rp. 500,000

Figure 10. Subject 3 (AA) test results

Level 1 (Enactive)

Based on the test result in Figure 10, Subject 3 (AA) is unable to meet the indicators in stage 1, as can be seen in the interview below. Subject 3 (AA) could describe the problem (S3.1 L1) but Subject 3 (AA) never experienced anything similar to the problem presented. It can be seen from the following interview test (S3.2L1).

P1L1   : Previously you had given a question. Could you tell us what happened to the problem?
S3.1 L1   : At number 1, it has a loss.

P2L1 : Do you have a similar experience to the question?
S3.2 L1 : No., I don't ma'am.

Subject 3 (AA) cannot write down the knowledge and understanding related to the problem and cannot meet the level 1 (Enative) criteria.

Level 2 (Iconic)

Based on the test result in Figure 10, Subject 3 (AA) could interpret, could distinguish between the profit and loss and could solve it with the appropriate formula by representing the problem in a mathematical model. It could be seen from the results of the interview test (S1.1 L2) which showed that subject 3 (AA) could present problems and chose the appropriate formula.

P1L2 : How can you explain that question number 1 has a loss?
S3.1 L2 : Because in number 1 there is a price dispute, the price of expenses is greater than the income.
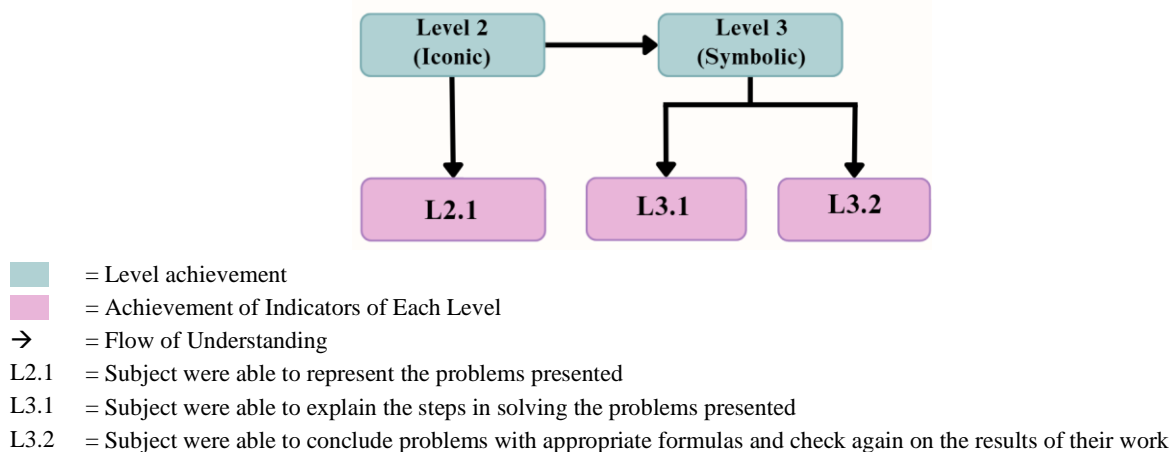
Subject 3 (AA) could represent the problem in a mathematical model, could compare the profit or loss, and met the level 2 criteria.

Level 3 (Symbolic)

Based on the test result in Figure 10, Subject 3 (AA) could classify and explain a problem. It could be seen from the results of the interview test (S3.1 L3) being able to solve the problem according to the formula and subject 3 (AA) did not feel any difficulties which could be seen from the interview (S3.2 L3), but subject 3 (AA) was not able to solve the problem correctly.

P1L3 : How do you determine the amount of loss from the problem?
S3.1 L3 : I looked for the first loss, followed by the second loss, then I added it all, with the formula that had been given by the teacher.
P2L3 : Do you have any difficulties in solving these problems?
S3.2 L3 : No ma'am, I have already known the steps in completing it.

Subject 3 (AA) did not recheck to ensure that the conclusions produced were correct, so subject 3 (AA) had a low score. The diagram in Figure 11, shows the achievement of a level of understanding of concepts based on Bruner's theory in students with low interest in learning.

- = Level achievement
- = Achievement of Indicators of Each Level
→ = Flow of Understanding
L2.1 = Subject were able to represent the problems presented
L3.1 = Subject were able to explain the steps in solving the problems presented
L3.2 = Subject were able to conclude problems with appropriate formulas and check again on the results of their work

Figure 11. Understand the concept of low learning interest categories

Discussion

Students with a high learning interest category have a complete understanding of concepts from level 1 (enactive) and level 2 (iconic) until level 3 (symbolic). It is relevant to Bruner's theory that the student learning process will go through three stages: enactive, iconic, and symbolic (Zuliana et al., 2019; Budiman & Purwati, 2023). This theory is used as an analytical tool to describe developments related to solving these problems. According to Eci and Sinaga (2021), students with a high level of interest in learning could model and illustrate at the active stage, where students have direct experience of buying and selling when helping their mothers at home so that students could record everything that is known in the problems presented. In the iconic stage, students could interpret and compare the advantages or disadvantages of the problem. Then, students can also classify and explain the steps to complete it. Students can also deduce from their work's results that they fulfill Bruner's theory at the symbolic stage. In Bruner's theory, Sundari and Fauziati (2021)stated that conceptual understanding and learning interests are interrelated and influence each other. In the context of a high level of understanding of concepts with a high interest in learning, Bruner's theory emphasizes the importance of providing students with real and relevant experiences. In addition, Bruner noted the critical role of learning structure in improving students' understanding of concepts and learning interests (Amalia & Yunianta, 2019). Thus, a high level of understanding of concepts and a high interest in learning in the context of Bruner's theory can be the key to improving quality education and learning. By providing relevant learning experiences, suitable learning structures, and active and collaborative learning approaches, we can help students better understand the concepts being taught and stay motivated to learn. All of this will positively impact the formation of a young generation who are intelligent, creative, and have a high interest in learning.

Students with a medium learning interest category can reach the stages of Bruner's theory entirely. In Bruner's theory, the student learning process will go through three stages: enactive, iconic, and symbolic (Zuliana et al., 2019; Febrianti & Purwaningrum, 2021). This theory is used as an analytical tool to describe developments related to solving these problems. For students with a moderate level of interest in learning, according to Yusuf (2023), the application of Bruner's theory of teacher learning in the teaching and learning process in the classroom is by exemplifying and illustrating concrete objects in daily life so that students understand better. Students have direct buying and selling experience when they join their brother at home, so they can record what is known. However, students do not record everything related to the problem because of a lack of understanding of the concepts of the problem. In the iconic stage, students could interpret or compare an existing advantage or disadvantage in the problem. Then, students can also classify and explain the steps to complete it. Students can conclude from the results of their work that they fulfill Bruner's theory of the symbolic stage. A good learning structure is vital to increasing conceptual understanding with moderate learning interest (Nisa & Nursuprianah, 2013). A good learning structure involves careful learning planning, delivering well-structured subject matter, and providing constructive feedback to students. With a good learning structure, students will find it easier to understand the concepts taught and stay motivated to learn. Thus, the level of understanding of concepts with moderate interest in

learning in the context of Bruner's theory requires a proper approach to learning and a variety of varied teaching strategies. By creating a supportive and engaging learning environment, students can develop a strong understanding of the concepts and remain motivated to learn (Maghfiroh et al., 2016). All of this will positively impact the quality of education and form a young generation that is capable, creative, and highly interested in learning.

Students with low learning interest categories are only able to reach iconic and symbolic stages in Bruner's theory.In enactive students cannot fulfill the enactive stage is when students gain knowledge by making direct observations of facts or realities that occur in the surrounding environment (Hawa, S. 2009; Angraini et al., 2023)because students do not have direct experience in buying and selling, so students are not able to record what is known in the problems presented. In the iconic stage, students can interpret and compare an advantage or disadvantage that exists in the problem. Then, students are also able to explain the steps in solving the problem, but they cannot conclude correctly and do not recheck the results of the answers, so they do not meet Bruner's theory of the symbolic stage. Concepts and learning interests are two important factors in the learning process. The level of understanding of concepts possessed by an individual will greatly affect his or her interest in learning (Yunuka, 2016). If a person has a low understanding of concepts, then their interest in learning also tends to be low. This can negatively impact their learning ability and academic achievement. Low interest in learning can also lead to individuals being less motivated to develop a better understanding of concepts (Mulyono & Hapizah, 2018). In this context, students must strengthen their understanding of the concepts that can underlie the subject matter, as well as increase their interest in learning the subject matter. Because with a strong interest in learning, it will help students in learning (Apriyanto & Herlina, 2020). Concept-centered learning can also help individuals overcome obstacles that arise in the learning process, as well as encourage them to develop critical and analytical thinking (Rahmad, 2020). Thus, to improve the understanding of concepts and low learning interest of individuals, educators, and supervisors need to provide support, apply a constructivist learning approach, provide challenges and opportunities for participation, and create a supportive learning environment. By implementing these strategies, it is hoped that individuals who have a low understanding of concepts and interest in learning can improve their learning abilities (Wen, 2018) as well as achieve better academic achievements.

Conclusion

The students with high, medium, and low interest in learning have different understandings of concepts based on Bruner's theory. Students with a high learning interest category can meet the stages of Bruner's theory, where students can exemplify or illustrate a problem. Students can represent problems in mathematical models and compare profit or loss. Students can classify and explain the steps in solving problems, then conclude reasonably and recheck to ensure the results of their work. Students with a medium learning interest category can interpret and compare profit or loss in problems, but students need help understanding in detail what happens in the problem. Students can classify and explain the steps to solve it and conclude quite well,

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but students are not careful in understanding a problem, so the results are less precise. Students with a low learning interest category can compare and explain the steps to solve it, but there needs to be an in-depth student understanding of the problem. Students can only write formulas and the results of their works without writing down the knowledge of the problem, so the students' results are not precise.

This research is limited to exploring the concept of profit and loss based on Bruner's theory, which was reviewed from the learning interest of tenth-grader students of vocational schools. The results of this study cannot be used to predict the understanding of mathematical concepts in other materials. It is because each mathematical concept can be applied to different problems in everyday life. The results of this study cannot be generalized and may only apply to subjects with the same characteristics. The results of this study can be used to design differentiated learning according to needs based on students' learning interests. Students with a high interest in learning should do more problems to practice their numeracy skills or understand a problem presented and deepen their understanding of mathematical concepts. Students with medium and low interest in learning should have many practice questions to understand mathematical concepts better and be more thorough to avoid making mistakes. Thus, teachers should design more appropriate learning strategies and media for students with medium and low learning interests so that they have a good conceptual understanding.

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Conflicts of Interest

The authors declare no conflict of interest regarding the publication of this manuscript. In addition, authors have completed the ethical issues, including plagiarism, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies.

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Author Contributions

Wasilatul Murtafiah: Review & editing, formal analysis, methodology, and supervision; **Maya Puji Lestari Rahayu:** Conceptualization, writing the original draft, analysis and interpretation data, editing, and visualization; **Sardulo Gembong:** Review & editing, formal analysis, methodology, and supervision; **Dwi Rosita Sari:** Review & editing; **Faridah Hanim Yahya:** Review & supervision.

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