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A praxeological analysis of linear equations in Indonesian mathematics textbooks: Focusing on systemic and epistemic aspect

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Abstract

Educational research has consistently highlighted that learning obstacles stem not only from the design of learning situations but also from curriculum structures and textbooks, which are pivotal learning resources. Despite the growing body of literature, limited studies focus on the specific challenges posed by the design of learning materials, particularly in early algebra within the Indonesian context. This study addresses the gap by analyzing the grade VII mathematics textbook in the *Merdeka Curriculum*, with a focus on linear equations with one variable, to uncover learning obstacles in early algebra. Utilizing Didactical Design Research (DDR), a qualitative approach, the research examines the praxeological components of the textbook— tasks (T), techniques (τ), technology (θ), and theory (Θ). The findings indicate three primary categories of learning obstacles: ontogenic, epistemological, and didactic. Notably, the analysis reveals that the design of linear equation content in the textbook is non-systemic and lacks epistemic coherence, posing significant challenges for learners. This study contributes to the understanding of curriculum design by identifying specific obstacles in the *Merdeka Curriculum*'s grade VII mathematics textbook and underscores the need for more systemic and epistemically aligned textbook development. Future research should extend this analysis to other textbooks across various grade levels to determine if these findings are consistent within the broader curriculum framework.

Keywords: Didactical Design Research, Learning Obstacles, Linear Equations, Praxeology, Textbooks

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The curriculum serves as a fundamental component in the pursuit of improving educational quality (Laevers, 2005). It comprises all systematically designed learning processes implemented by educational institutions, either in group settings or individually, within or beyond the formal school environment (Kelly, 1983). As outlined in Law Number 20 of 2003 on the National Education System, the curriculum consists of a structured framework of objectives, content, subject matter, and instructional methodologies that serve as a reference for conducting learning activities to achieve specific educational outcomes. In Indonesia, the national curriculum has undergone several revisions over time (Yasin et al., 2023). Consequently, these changes require educators to demonstrate innovation in designing instructional materials, particularly due to the limited availability of resources that align with the *Merdeka Curriculum* (Putri et al., 2024).

Since gaining independence in 1945, Indonesia's national curriculum has undergone multiple revisions, including those implemented in 1947, 1952, 1964, 1968, 1975, 1984, 1994, 2004, 2006, 2013, and 2021 (Insani & Akbar, 2019). Figure 1 provides a visual representation of the evolution of the Indonesian curriculum over time.

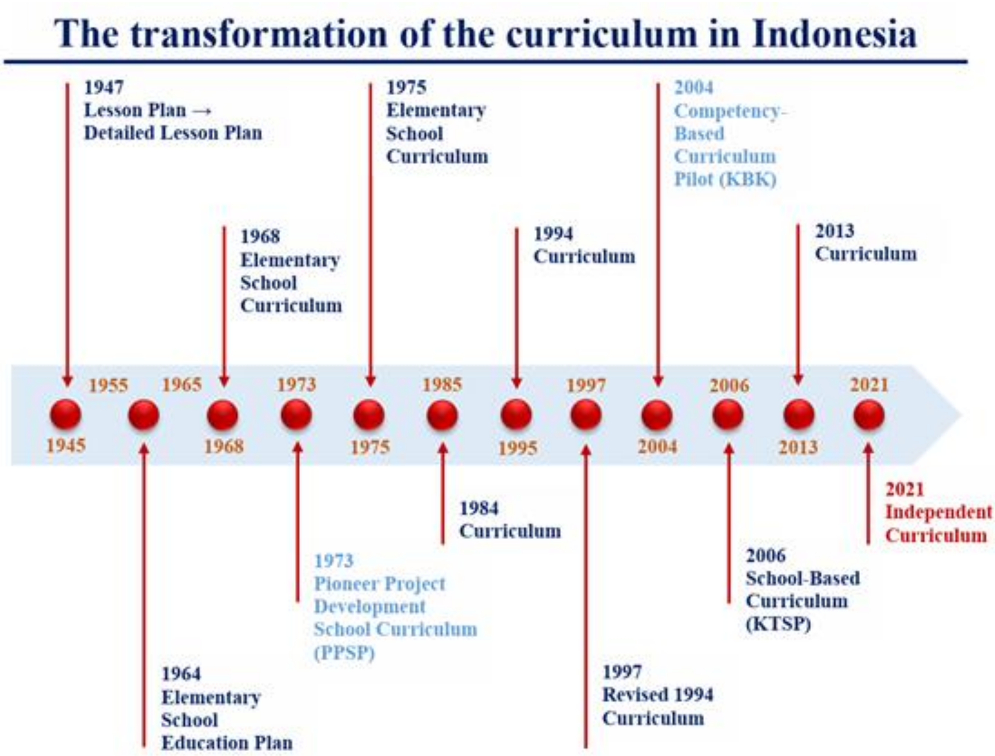


Figure 1. The transformation of Indonesian curriculum

The transformation of the curriculum has been driven by the need to address inefficiencies in previous systems. However, despite various reforms and updates, these changes have not yet resulted in significant improvements in the quality of education (Al-Daami & Wallace, 2007). As a result, the overall standard of Indonesian education remains unsatisfactory. Frequent modifications or replacements of curriculum policies often lead to declines in student achievement, primarily due to challenges in adapting to new learning structures and the difficulties educators face in effectively implementing curriculum policies as intended by the government (Grigg, 2012).

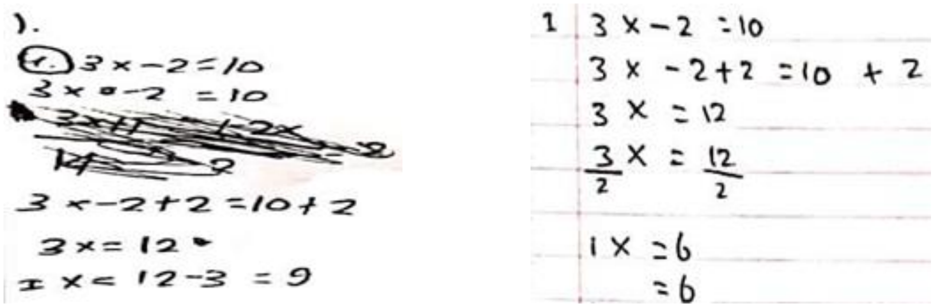
An initial analysis of curriculum developments from the earliest version to the current *Merdeka Curriculum* suggests that many of the observed changes are predominantly administrative in nature. Meanwhile, substantive aspects related to educational approaches have not received sufficient attention. The curriculum has largely emphasized the implementation of teaching models or pedagogical approaches, whereas didactic components, such as the design of instructional materials and their impact on student learning, have not been equally prioritized (Ligozat et al., 2015). Thus, greater emphasis should be placed on didactic aspects, particularly in the development of instructional materials (Suryadi, 2019). A deeper understanding of didactic principles will ensure that curriculum reforms go beyond administrative adjustments or teaching model applications, instead focusing on the effective design of instructional materials to enhance learning outcomes. Notably, curriculum changes in Indonesia have significantly influenced the modification of various learning resources, particularly textbooks.

Textbooks serve as essential tools in supporting the achievement of educational objectives within a curriculum (Hussain et al., 2022). As stipulated in Minister of Education and Culture Regulation Number

25 of 2022, textbooks are designed in accordance with the National Education Standards and are aligned with the prevailing curriculum to facilitate the learning process. Educators predominantly rely on textbooks as the primary reference in instructional activities, as they provide structured frameworks and comprehensive resources for lesson planning and implementation (Li et al., 2009).

However, the involvement of expert teams in the development of textbooks does not necessarily ensure the accuracy or quality of their content and structure. This issue aligns with the findings of Hendriyanto et al. (2023), who highlighted that mathematics textbooks under the 2013 Curriculum primarily foster knowledge acquisition through perceptual and memorial learning processes. Furthermore, the absence of sufficient justification for the conclusions drawn from task designs indicates shortcomings in the development of introspective and a priori reasoning skills.

To further explore this issue, a preliminary study was conducted in five Indonesian junior high schools, involving 46 students from four different provinces. The study focused on students' understanding of algebraic concepts, as assessed through a diagnostic test. Figure 2 presents examples of students' responses during the assessment.



(a) (b)

Figure 2. Students’ answer in preliminary study

The findings indicate that 80.43% of students exhibit limited mathematical proficiency, particularly in fundamental arithmetic operations and the application of mathematical concepts to contextual problems, which tend to be approached in a procedural manner. This challenge appears to stem from a cognitive transition from arithmetic-based thinking to an algebraic framework, which is hindered by students limited contextual understanding. Furthermore, the preliminary analysis suggests that conceptual errors observed among students are not solely attributable to instructional delivery by teachers but may also be influenced by the structure and presentation of learning materials, specifically the mathematics textbook used in the *Merdeka Curriculum*. Inadequately designed textbooks can contribute to student misconceptions (Kajander & Lovric, 2009). Therefore, the development of textbooks should integrate alternative learning approaches as a proactive measure to mitigate potential learning challenges and facilitate students' learning trajectories. Given their central role in classroom instruction, textbooks must be carefully structured to support effective learning (Hadar, 2017).

A study analyzing linear equations in Dominican textbooks revealed an emphasis on practical applications rather than theoretical foundations, highlighting the need for more complex praxeologies to foster critical thinking (López et al., 2024). Additionally, comparative research on textbooks and teacher practices indicates a degree of alignment between the praxeologies presented in textbooks and those implemented in classrooms (Barbosa & Lima, 2020). The praxeological analysis of single-variable linear equations across various textbooks and academic literature underscores the value of this approach in improving instructional quality. Textbooks offer significant advantages, including the ability to present a structured sequence of ideas (Palló, 2006), facilitate the learning process, and enhance students' comprehension and critical thinking (Fan, 2013). Furthermore, research suggests that well-designed textbooks can positively impact students' learning outcomes (Robinson et al., 2014; Törnroos, 2005). Consequently, greater emphasis should be placed on the didactic design of textbooks to ensure that they not only provide accurate information but also promote a deeper conceptual understanding among students.

Learning Obstacles

Inaccuracies in the presentation of content within textbooks can lead to learning obstacles that hinder students' cognitive development (Hendriyanto et al., 2023). Learning obstacles refer to barriers in the learning process caused by external factors, particularly deficiencies in didactic design. These obstacles slow down or restrict students' ability to acquire new knowledge, often manifesting as learning difficulties and recurring errors (Brousseau, 2002; Suryadi, 2019).

Learning obstacles can be categorized into three types based on their origins: ontogenic obstacles, epistemological obstacles, and didactical obstacles (Brousseau, 2002). Identifying these obstacles requires structured tasks or problem-solving activities that enable teachers to assess students' knowledge construction processes (Hendricson & Kleffner, 2002). Importantly, learning obstacles do not arise spontaneously but are shaped by specific influencing factors. Kansanen and Meri (1999) emphasize that these barriers can be understood through the dynamic interplay between the teacher, students, and subject matter. If any of these elements face challenges, learning obstacles are more likely to emerge.

Furthermore, learning obstacles are not confined to instructional practices alone but can also stem from curriculum design or textbooks, which serve as primary learning resources (Suryadi, 2019). A key concern is the uncritical adoption of existing textbook designs, which may inadvertently perpetuate conceptual misunderstandings if not thoroughly examined. Thus, to evaluate the impact of didactic design on students' cognitive processes in acquiring new knowledge, a systematic analysis of mathematics textbooks is necessary (Nurlaily et al., 2019).

Previous studies have employed various theoretical frameworks to analyze the sequencing and structure of tasks in mathematics textbooks, with the Theory of Didactical Situations being one of the most prominent (Arslan et al., 2011; Daher et al., 2022). Furthermore, Arslan et al. (2011) provides a structured approach to adidactical situations, offering insights into students' engagement across different phases of these situations. On the other hand, Daher et al. (2022) extend this framework within a mathematical context by examining situation types, inherent paradoxes in the didactical contract, and key components necessary for evaluating task design for prospective teachers.

Beyond the Theory of Didactical Situations, other frameworks have been applied in textbook analysis, such as Hermeneutic Phenomenology (Sulastri et al., 2022; Isnawan et al., 2022). Furthermore, Sulastri et al. (2022) explore epistemological challenges faced by students in understanding limits and functions in an online learning environment, whereas Isnawan et al. (2022) investigates parental perspectives on their children's mathematics education during distance learning.

Additionally, Praxeology has been widely utilized (Suryadi et al., 2023; Utami et al., 2024; Wijayanti & Winslow, 2017). Suryadi et al. (2023) employs Praxeology to analyze mathematical task design, focusing on applied techniques, theoretical justifications, and underlying principles shaping instructional methods. On the other hand, Utami et al. (2024) apply this framework to examine how Indonesian textbooks introduce the concept of functions at the lower secondary level, while Wijayanti and Winslow (2017) use Praxeology to systematically classify textbook components, emphasizing explicit and implicit tasks and techniques.

Furthermore, the Theory of Didactic Transposition has been instrumental in comparative analyses (Huang et al., 2021; Bosch et al., 2021). Huang et al. (2021) investigates didactic processes through diverse data sources, including lesson plans, classroom observations, and post-lesson discussions, while Bosch et al. (2021) analyze external didactic transposition in a comparative study, exploring its integration into undergraduate mathematics curricula across European and Canadian institutions. Figure 3 presents a visual summary of these theoretical frameworks and their applications in textbook analysis (Suryadi, 2019).

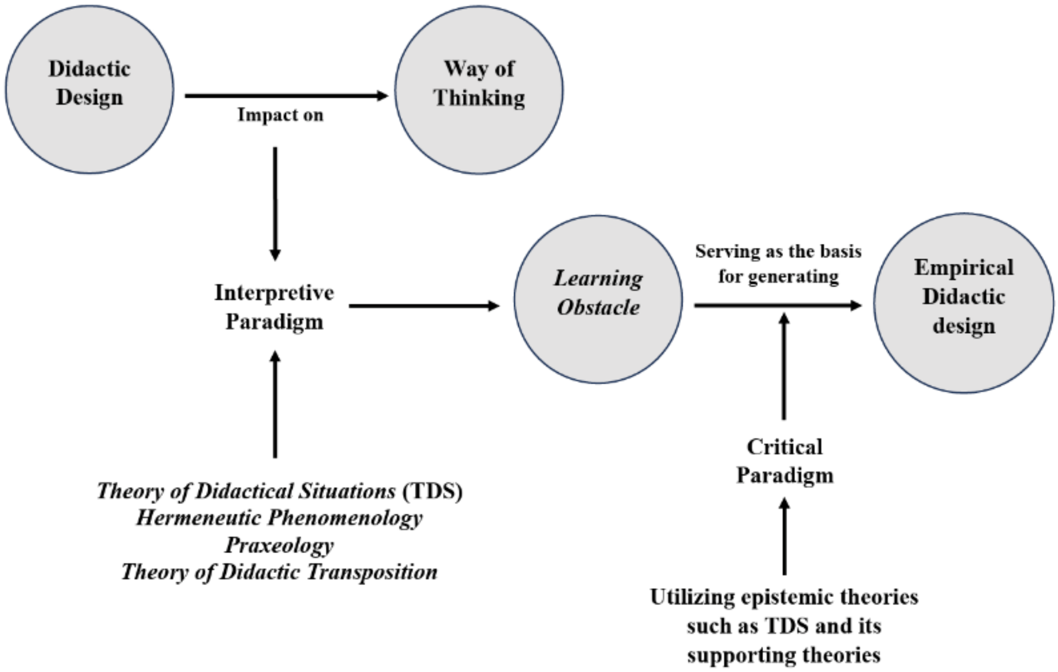


Figure 3. Theory and framework for generating new didactic designs

From the perspective of diffusion, knowledge that is disseminated can be observed in multiple forms, including its representation within curricula and textbooks (knowledge to be taught) and its adaptation in instructional materials, such as Lesson Plans, which constitute the taught knowledge developed by educators. The perceptual data embedded in both knowledge to be taught and taught knowledge play a critical role in identifying learning obstacles. By examining these perceptual elements, researchers can gain insights into potential barriers that hinder students' comprehension. This perceptual data is subsequently analyzed through the lens of praxeology, allowing for a systematic investigation of the relationships between tasks, techniques, and theoretical justifications that shape the learning process.

Mathematical Praxeology Analysis

Praxeology is a theoretical framework used to analyze human actions to determine whether they can be classified as knowledge. It serves as a tool for examining didactic design, thereby facilitating the identification of potential learning obstacles (Utami et al., 2024; Wickman, 2012). Within the Anthropological Theory of the Didactic (ATD), praxeology has emerged as a fundamental concept. Chevallard (2019) asserts that praxeology represents the basic unit through which human actions and behaviors can be comprehensively analyzed. A core principle of praxeology in ATD is that no human action or behavior occurs without a reason or justification by the individual performing it.

Praxeology consists of two components, namely praxis and logos. Praxis, or the practical block (know-how), can be defined as human activities, while logos or the knowledge block (know-why), refers to human thinking and reasoning. The praxis block is formed by the type of task (T), which refers to the problems or situations given, and the technique (τ), which refers to the way of solving these problems. Praxis always requires logos, which consists of technology (θ) to provide reasons for the techniques used and theory (Θ) to provide reasons related to technology. These four elements (T, τ, θ, Θ) are used comprehensively to study human knowledge. Table 1 illustrates the four elements of praxis block and the logos block in praxeology.

Table 1. Four elements in praxeology

***Praxis* Blocks**		***Logos* Blocks**	
Type of Task	**Technique**	**Technology**	**Theory**
The type of problem provided	An approach to addressing the problems	A way of justifying the technique	A way of justifying the technology

Research Gap and Novelty in Early Algebra Learning

This study focuses on early algebra, particularly the topic of linear equations in one variable. Blanton (2008) categorizes early algebra into three main focus areas: (1) Generalized arithmetic, (2) Equivalences, expressions, equations, and inequalities, and (3) Functional thinking. Research on these early algebra topics remains a relatively recent development in mathematics education. However, as illustrated in Figure 4, studies on early algebra have shown significant growth over the past five years, indicating increasing scholarly interest and exploration in this domain.

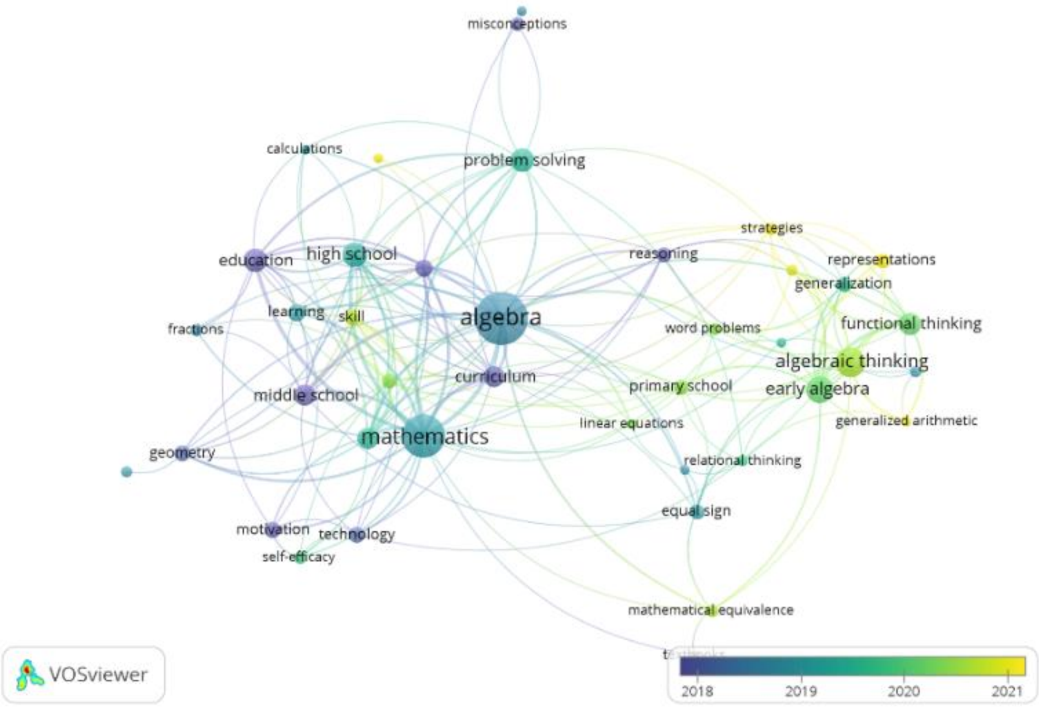


Figure 4. Overlay visualization of research trends on early algebra

Research in early algebra over the past five years has primarily focused on linear equations, functional thinking, and generalized arithmetic. However, studies on linear equations demonstrate greater potential for further exploration compared to functional thinking and generalized arithmetic (Fardian et al., 2024). An overlay visualization reveals that the symbol representing linear equations is the smallest and positioned farthest from the symbol of early algebra, indicating a research gap that necessitates further investigation into this topic. Additionally, there is currently no direct connection established between the study of linear equations and textbook content. This gap highlights an opportunity for an in-depth analysis of mathematics textbooks in relation to linear equation material. Figure 5 presents a fishbone diagram outlining the state of the art of this research.

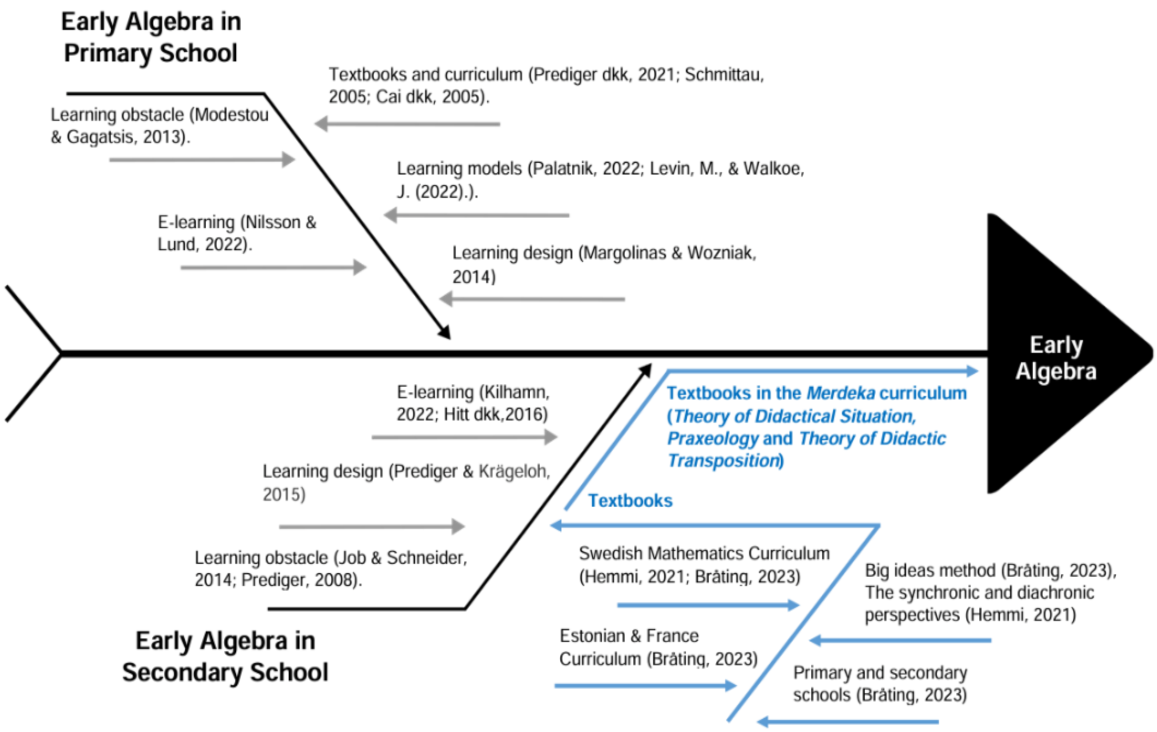


Figure 5. Fishbone diagram on early algebra

In Figure 4, the blue color highlights the primary issues explored in this research. The first focus pertains to the scarcity of studies analyzing early algebra textbooks at the junior high school level. This gap exists because early algebra is primarily designed to introduce algebraic concepts to elementary school students and has already been incorporated into the curricula of several countries, including the United States, Spain, and Japan (Pinto & Cañadas, 2021; Watanabe, 2011). However, in Indonesia, early algebra instruction is not included in the elementary school curriculum (Utami et al., 2023). As a result, students often encounter significant challenges in comprehending algebraic concepts upon entering junior high school. These misunderstandings create barriers to learning, hindering their ability to progress to more advanced mathematical topics (Johar et al., 2023).

The second focus highlights the tendency of existing research to analyze textbooks from countries with high Programme for International Student Assessment (PISA) scores, such as Estonia (Overall score = 516), Sweden (Overall score = 488), and France (Overall score = 478). Consequently, education systems in countries with lower PISA scores, such as Indonesia, receive limited research attention (Fardian & Dasari, 2023). Given this disparity, PISA scores provide a compelling rationale for investigating the teaching materials available in Indonesia's *Merdeka Curriculum*. Analyzing these materials is crucial for understanding their didactic design and its impact on students' cognitive processes in acquiring new mathematical knowledge.

In contemporary mathematics education research, analyzing students' learning obstacles has become increasingly urgent. First, a comprehensive understanding of these obstacles can significantly contribute to the advancement of teaching methodologies. Identifying common misconceptions, cognitive barriers, and difficulties in the learning process enables the development of innovative pedagogical approaches tailored to students' needs. Second, recognizing learning obstacles serves as a crucial foundation for educators and policymakers in designing curricula and instructional materials (Adelman et al., 1999). By addressing these barriers, curricula can be refined to better support student learning, ultimately leading to improved educational outcomes. Third, investigating learning obstacles facilitates the development of didactic designs that enhance students' retention and conceptual understanding (Astriani et al., 2022). By proactively identifying and mitigating these challenges, students can establish a solid foundation in mathematics, enabling them to engage with more advanced mathematical concepts effectively. Figure 6 presents the research roadmap outlining the implementation of this study.

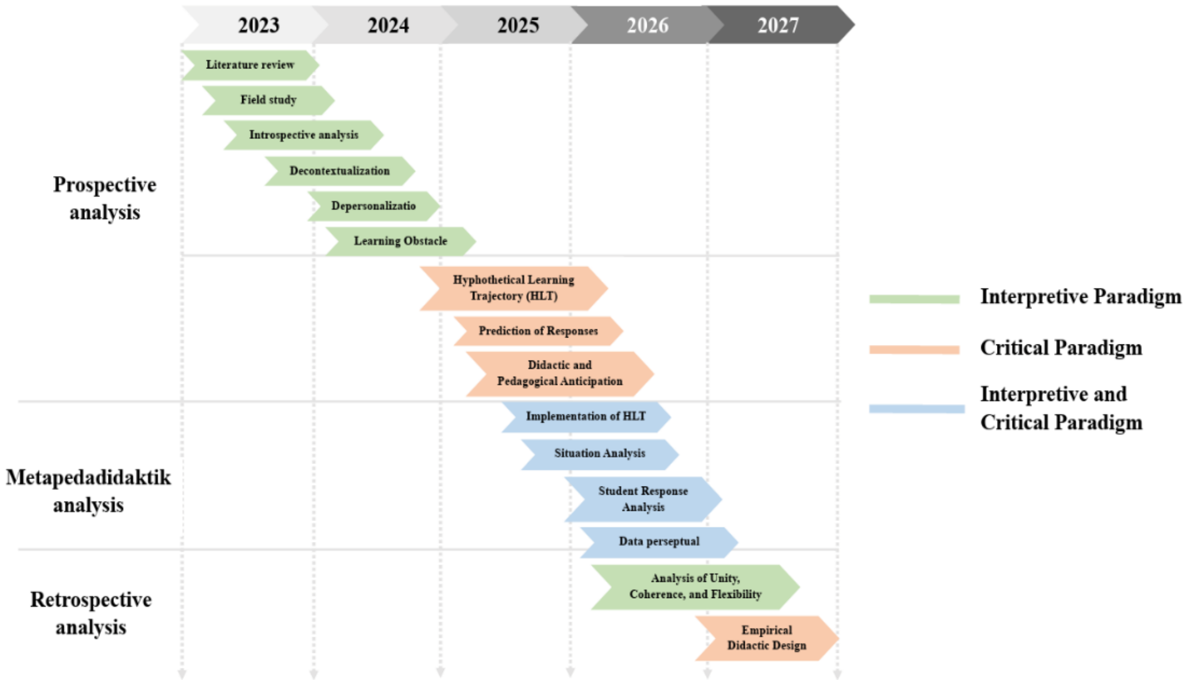


Figure 6. Research roadmap

Based on an analysis of the research gap and the study's novelty, the research questions guiding this investigation are as follows: (1) Is the content of linear equations with one variable in the Grade VII mathematics textbooks of the *Merdeka Curriculum* systemic or epistemic? (2) What potential learning obstacles arise in the presentation of linear equations with one variable in the Grade VII mathematics textbooks of the *Merdeka Curriculum*? This research serves as an initial step in developing knowledge that is justified, true, and believed, specifically in relation to the teaching and learning of linear equations.

METHODS

Research Design

This study aimed to provide a comprehensive analysis of the learning obstacles encountered in a junior high school mathematics textbook, specifically in understanding the topic of linear equations in one variable. These obstacles served as the foundation for examining the systemic and epistemic aspects of the Grade VII mathematics textbook within the *Merdeka Curriculum*. The research employed a qualitative approach based on Didactical Design Research (DDR). Qualitative research follows an interpretive paradigm, which seeks to explore and deeply understand the essence of reality as experienced by learners (Creswell, 2016; Suryadi, 2019). Within the context of DDR, this interpretive paradigm was applied to investigate how the existing didactic design influences students' cognitive processes in acquiring new mathematical knowledge, thereby identifying potential learning obstacles.

Sample and Data Collection

In this investigation, initial data was gathered from grade VII mathematics textbook. The textbook served as the primary source for identifying the four components of praxeology: tasks (T), techniques (τ), technology (θ), and theory (Θ). As discussed earlier, this research did not solely focus on textbook analysis. The textbook utilized in this study was "*Matematika untuk Sekolah Menengah Pertama Kelas VII*" in the second edition in 2021, written by the Gakko Tosho team. "*Matematika untuk Sekolah Menengah Pertama Kelas VII*" is a translation and adaptation of the original book titled "Mathematics for Junior High School", which was compiled and published by Gakko Tosho Co., Ltd. This book was published by the Indonesian Curriculum and Book Development Center, has been approved by the Ministry of Education, and distributed for use as the official learning resource in schools. This book can be accessed through the website of the National Library of the Republic of Indonesia (ISBN 978-602-244-514-2). The series of tasks studied in this research is the Linear Equation material in Chapter 3 (pp. 90-112). In allowing the research to utilize the textbook, the authors stated a disclaimer in the preface: "*Feedback from educators, students, parents, and the community, especially in pilot schools, is highly expected for the improvement and refinement of this curriculum and learning textbook*..."

A didactic design K is constructed based on n type of tasks T_i such that $K = \sum_{i=1}^{n} T_i$. Furthermore, each type of task T_i is composed of m_i tasks $t_{i,j}$, so that $T_i = \sum_{j=1}^{m_i} t_{i,j}$. In this study, t is defined as a "task". Overall, there are 50 tasks, which are divided into two categories: examples and exercises, distributed across 5 types of tasks. The concept of "task" in the Anthropological Theory of the Didactic (ATD) relates to the concept of "a piece of work". Chevallard (2019) explains that "*The boundary between work and nonwork is fragile: if you go to the kitchen to fetch a new glass of water, you will not count it as work, unless you are a salaried maid and have this task imposed on you*." (p. 84). Based on Chevallard (2019)'s explanation regarding tasks, not all tasks in the student book will be analyzed using mathematical praxeology. The tasks further analyzed in this study are those aimed at building students' understanding of the concept of linear equations and do not include tasks intended for assessment, such as example problems.

To justify the findings of the praxeological analysis of the textbook, this study employed hermeneutic phenomenology. A preliminary study was conducted at a junior high school in Indonesia, involving 63 seventh-grade students as participants. These students were selected based on their engagement with the topic of linear equations in one variable as part of their current curriculum. The sampling process followed a purposive approach to ensure the selection of participants most relevant to the research objectives. Additionally, 10 representative students were further selected through purposive sampling as representatives of groups employing similar problem-solving strategies. These students participated in in-depth interviews to gain deeper insights into their learning obstacles. To assess their understanding, students were required to complete five test items designed to evaluate three key indicators: (1) comprehension of the definition of a linear equation in one variable, (2) the ability to translate mathematical problems into algebraic equations, and (3) problem-solving proficiency in contextual scenarios using equation properties.

Data Analysis

The data analysis process involved two distinct phases. In the initial phase, the focus was directed towards examining the practical elements of the textbooks. The initial phases involved a thorough examination of the practical components embedded within the text, encompassing the types of tasks (T) and techniques (τ) utilized. Subsequently, the analysis transitioned to the second phase, which involved a deeper exploration of the theoretical or logical aspects of the textbooks, including technology (θ) and theory (Θ). Both components of praxeology investigated from the textbooks were elaborated upon with an initial analysis of the concept of linear equations with one variable. This elaboration was expected to provide suggestions for enhancing the quality of praxeology organization within the textbooks in accordance with the didactic perspective of linear equations with one variable (how students should construct early algebra as mathematical knowledge).

The information gathered from various documents, such as textbooks and additional learning resources created by educators, is analyzed using praxeology. The researcher follows the analysis techniques as outlined below (Suryadi, 2019): Firstly, a didactic design K is constructed based on n types of tasks T_i so that $K = \sum_{i=1}^{n} T_i$. Each T_i certainly has its characteristics, as seen from the possible responses of learners. However, these possible responses can be interpreted as perceptual and memorial actions that learners may undertake. These perceptual and memorial actions lead to the formation of certain mathematical objects that can be formed through *Merdeka* processes as a result of facilitating T_i. In that case, T_i can be said to be epistemic. Secondly, from a didactic perspective as a science, $K = \sum_{i=1}^{n} T_i$ is a subsystem of the discipline D. As a result, the sequence of T_i also forms a system because each T and its subsequent T are interrelated both structurally and functionally. Based on this principle, the results of praxeological analysis for each T_i are further examined to ascertain whether $K = \sum_{i=1}^{n} T_i$ forms a system in which each component is interconnected or not.

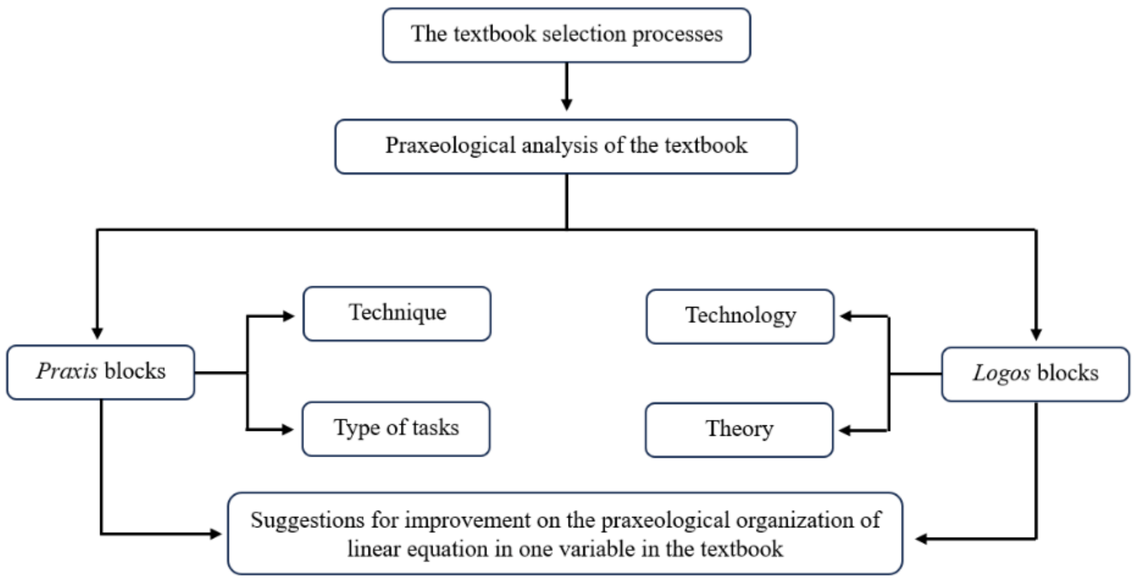


Figure 7. Research procedures in praxeological analysis

Praxeology is a fundamental discipline that examines human actions and behaviors (Suryadi, 2019). Within the framework of the Anthropological Theory of the Didactic (ATD), praxeology has emerged as a central concept, as Chevallard (2019) posits that it serves as the fundamental unit for comprehensively analyzing human actions and behaviors. Praxeology provides a theoretical foundation for evaluating human activities to determine whether they constitute knowledge. Given that didactic design is inherently a form of human action, praxeology can be utilized to assess whether a design exhibits systemic and epistemic qualities (Bosch & Gascón, 2014).

To ensure confirmability in qualitative research, a focus group discussion (FGD) was conducted with three distinguished experts: a specialist in algebra, an expert in mathematics education, and a curriculum design authority. This FGD aimed to critically examine and validate the findings derived from the task analysis, ensuring the didactic design's systemic and epistemic robustness. This validation process enhances the verifiability and objective interpretability of the research findings, enabling other scholars to assess their reliability. A comprehensive overview of all research stages in this study is illustrated in Figure 7.

RESULTS AND DISCUSSION

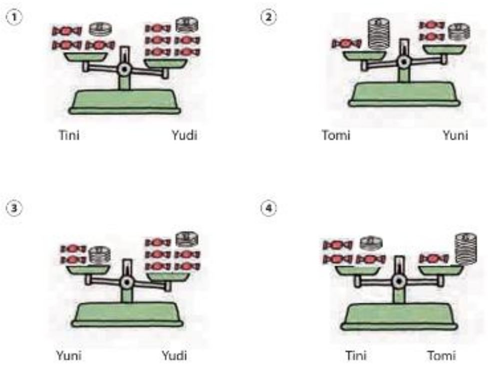
Praxis Blocks

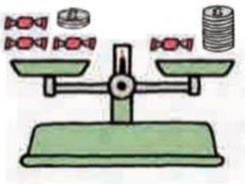
The analysis of task sequences in textbooks was conducted to examine how information is structured and presented to facilitate student engagement in comprehending mathematical learning materials. This study specifically focused on the first five types of tasks (T_1, T_2, T_3, T_4, T_5) to assess their role in supporting students' understanding. Table 2 provides an overview of these five task types along with their corresponding examples from the selected textbook.

Table 2. Types of tasks and tasks in praxis blocks

<table>
<tr><th>Type of Task (T)</th><th>Task (t)</th></tr>
<tr><td rowspan="2">T_1
Understanding the truth of mathematical statements in equations when letters are substituted with numbers.</td><td>$t_{1,1}$
Candies and Rp. 100 coins are placed in a box. Tini, Yudi, Yuni, and Tomi each randomly take a handful of candies and Rp. 100 coins from the box. The number of candies and coins they get is as follows:

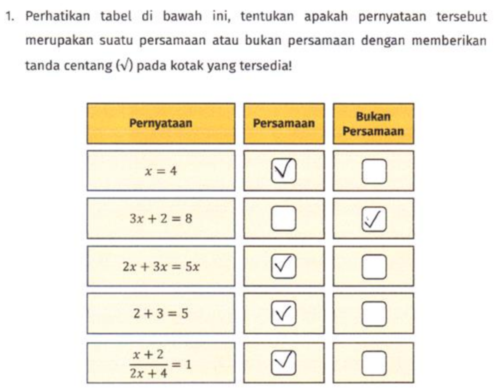
Tini: Candies 3, Coins 2
Yudi: Candies 5, Coins 3
Yuni: Candies 2, Coins 4
Tomi: Candies 1, Coins 10

A scale is used to compare the weight of candies, and each child gets Rp.100 coins. The results are shown as follows:

If the weight of one candy is x grams, and the weight of a coin worth Rp. 100 is 1 gram which mathematical statement can be used to determine the weight of one candy? How do we determine its weight?</td></tr>
<tr><td>$t_{1,2}$
Which among 1, 2, and 3 is a solution to the equation
$$2x + 5 = 11 \quad (1)$$</td></tr>
</table>

	$t_{1,3}$ Dewi argues that $$2x + 3x = 5x \quad (2)$$ is not an equation. Discuss whether Dewi's opinion is correct.
T_2 Understanding the solution of an equation without substituting numbers into letters.	$t_{2,1}$ The weight on the left side is $(3x + 2)$ grams, and the weight on the right side is $(x + 10)$ grams. What operation should be done so that we can reduce one side to just one candy while still maintaining a balanced scale (equal weight)? 
T_3 Solving the equation using the properties of equations	$t_{3,1}$ Which properties of equations are used in the following two equations? (a) $x-9=3$ (1); $x-9+9=3+9$; $x=3+9$ (2); $x=12$ (b) $2x=6+x$ (1); $2x-x=6+x-x$; $2x-x=6$ (2); $x=6$
	$t_{3,2}$ (a) $x-9=3$ (1); $x-9+9=3+9$; $x=3+9$ (2); $x=12$ (b) $2x=6+x$ (1); $2x-x=6+x-x$; $2x-x=6$ (2); $x=6$ When comparing (1) and (2) in (a), Wida observes the following: In (1), the left side has a term -9. When 9 is added to both sides, the -9 on the left side will disappear whereas in (2), 9 appears on the right side. For (b), what do you observe when comparing (1) and (2)?
	$t_{3,3}$ In (a) and (b), how do we directly derive (2) from (1)? Explain using your understanding. (a) $x-9=3$ (1); $x=3+9$ (2) (b) $2x=6+x$ (1); $2x-x=6$ (2)
T_4 Solving equations using algebraic manipulation	$t_{4,1}$ Solve the equation $$8x - 3 = 5 + 6x \quad (3)$$
	$t_{4,2}$ Solve the equation $$5x - 2(x - 3) = 3 \quad (4)$$
	$t_{4,3}$ Solve the equation $$2{,}3x = 0{,}5x + 9 \quad (5)$$
	$t_{4,4}$ Solve the equation $$\frac{5}{6}x - 2 = \frac{1}{3}x \quad (6)$$
T_5 Understanding a situation using linear equations	$t_{5,1}$ The price of 2 pens and 3 notebooks is Rp.7,100. The price of each pen is Rp. 1,300. What is the price of 1 notebook?

	$t_{5,2}$ A rabbit hutch is made from a rectangular fence. Using wire fencing of 24 meters in length, what is the length of the side fence so that the length of the front fence is 3 meters longer than the side fence?
	$t_{5,3}$ A younger sister walks from home to the station, which is 1 km away. After 9 minutes of walking, her older sister realizes that her younger sister forgot something and intends to catch up with her by riding a bike. If the younger sister walks at a speed of 60 m per minute and the older sister rides a bike at a speed of 240 m per minute, how long will it take for the older sister to catch up and meet her younger sister?

The task sequence T_1, T_2, T_3, T_4, T_5 presented in the textbook presented in Table 2 follows a hierarchical arrangement designed to support students in understanding the concept of linear equations in one variable. However, none of these tasks explicitly develop students' comprehension of the formal definition of linear equations in one variable. Ideally, textbook learning materials should begin with a clear definition to help students grasp the meaning and purpose of the topic. Instead, the tasks in the textbook guide students toward transforming equations into the standard form $ax + b = 0, (a \neq 0)$ without first clarifying the significance of a, b and x. To further explore this issue, a preliminary study was conducted in an Indonesian junior high school. Figure 8 presents students' responses during the diagnostic assessment test.



1. Perhatikan tabel di bawah ini, tentukan apakah pernyataan tersebut merupakan suatu persamaan atau bukan persamaan dengan memberikan tanda centang (√) pada kotak yang tersedia!

Pernyataan	Persamaan	Bukan Persamaan
$x = 4$	√	
$3x + 2 = 8$		√
$2x + 3x = 5x$	√	
$2 + 3 = 5$	√	
$\frac{x+2}{2x+4} = 1$	√	

Look at the table below, determine whether the statement is an equation or not an equation by putting a check mark (√) in the box provided!

Statement	Equation	Not Equation

Figure 8. S4's answer

The preliminary observations revealed that students struggled to differentiate between the concepts of equations and equality. Specifically, 31 out of 63 students exhibited conceptual errors in interpreting equations, while 32 and 23 students, respectively, demonstrated misunderstandings related to the concept of equality in problems 1C and 1D. These findings underscore a significant challenge in students' comprehension of fundamental mathematical concepts, particularly in distinguishing between equations and equality. Further analysis suggests that the conceptual errors identified among students were not solely attributable to instructional methods but were also potentially influenced by the presentation of materials in the *Merdeka Curriculum* mathematics textbook. This hypothesis is supported by student interview responses, with one student stating, "*In Chapter 3, there was no definition of the concept of a linear equation, so we were confused when answering question number 1*." The absence of a clear definition of linear equations in the textbook contributed to students' confusion and difficulty in solving related problems.

The sequence of tasks T_1, T_2, T_3, T_4, T_5 on linear equations in one variable, as presented in the Grade VII mathematics textbook in the *Merdeka Curriculum*, primarily emphasizes algebraic manipulation. While this structured approach aids in procedural fluency, it does not provide students with opportunities to develop a deeper conceptual understanding through multiple problem-solving strategies. By focusing solely on algebraic transformations, students may struggle to connect linear equations to real-life applications or to interpret the concept graphically.

To validate these findings, an assessment test was conducted using a contextual problem: Nadya purchased 6 kg of oranges from Mr. Ikhwan's store, paid Rp50,000, and received Rp8,000 in change. The students were asked to determine the price per kilogram of oranges. Figure 9 presents a student's solution to this problem, illustrating their approach to solving the given task.

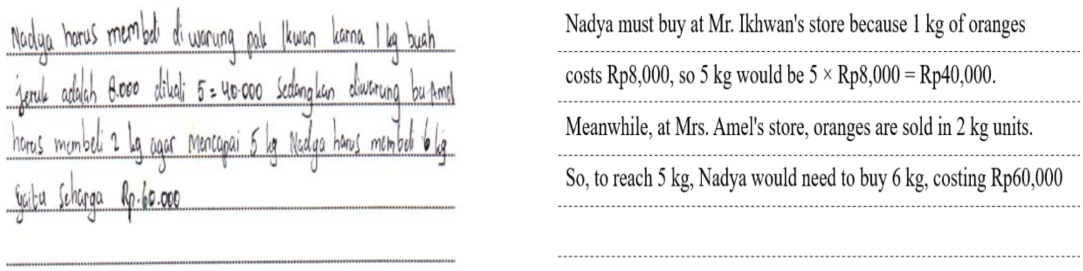


Figure 9. S1's answer

The interview findings indicate that S1 believes it is not possible for Nadya to purchase exactly 5 kg of oranges at Mrs. Amel's store. This reasoning is reflected in S1's statement, "*I thought it couldn't be divided like that*," which suggests an assumption that purchases must be made in fixed increments rather than variable quantities. In the diagnostic assessment, the problem explicitly stated that 2 kg of oranges cost Rp15,000. Based on this assumption, S1 reasoned that oranges could only be purchased in multiples of 2 kg, failing to recognize that the price per kilogram could be determined by dividing the total cost. As a result, S1 concluded that Nadya would need to buy at least 6 kg of oranges at Mrs. Amel's store, amounting to Rp60,000, making it more expensive than purchasing 5 kg at Mr. Ikhwan's store.

The interview with S1 further revealed that the observed conceptual errors primarily stemmed from a lack of problem-solving skills. When approaching the problem, S1 relied on an arithmetic method rather than considering algebraic or geometric approaches. The distinction between these approaches significantly impacts students' ability to process and interpret mathematical information. In S1's case, problem-solving was based on direct calculations using multiples, such as the given price for 2 kg of oranges, instead of employing algebraic reasoning. A more structured algebraic approach would involve expressing the relationship mathematically, such as setting up the equation $2x$ = 15,000 (Equation 1) and solving for x = 7,500 (Equation 2), where x represents the price per kilogram of oranges. By utilizing algebraic methods, students can better understand the relationships between variables and develop a deeper conceptual grasp of mathematical structures. Additionally, a geometric approach could also be applied to visualize the problem. Figure 10 illustrates the problem-solving process using a graphical representation.

The cost per kilogram of oranges at Mrs. Amel's store is Rp7,500, whereas at Mr. Ikhwan's store, it is Rp8,000. As depicted in the graph, purchasing 5 kg of oranges at Mrs. Amel's store results in a total cost of Rp37,500, which is lower than the Rp40,000 required at Mr. Ikhwan's store. This comparison demonstrates that Mrs. Amel's store is the more economical choice for Nadya. The graphical representation effectively illustrates the cost differences, aiding in decision-making by visually highlighting the impact of price variations. Consequently, incorporating a new task (T) that focuses on solving linear equations in one variable through graphical methods is essential. Such an addition would enable students to develop a geometric perspective on how linear equations interact with the x- and y-axes, as well as enhance their ability to interpret graphical solutions within real-world contexts.

Textbooks designed for classroom learning must establish a coherent progression between topics to ensure conceptual continuity. Introducing graphical methods for solving linear equations in one variable represents a valuable enhancement to instructional strategies. This approach helps students visualize variable relationships and comprehend equation solutions in a geometric framework. Mastering this method in grade VII would provide students with a solid foundation for understanding linear functions in grade VIII. Prior exposure to graphical representations of linear equations would better equip students to grasp more advanced concepts, such as slope, intercepts, and variations in linear function graphs. The integration of graphical methods strengthens prerequisite knowledge, thereby reducing potential learning difficulties and facilitating smoother transitions to more complex mathematical topics in subsequent grades.

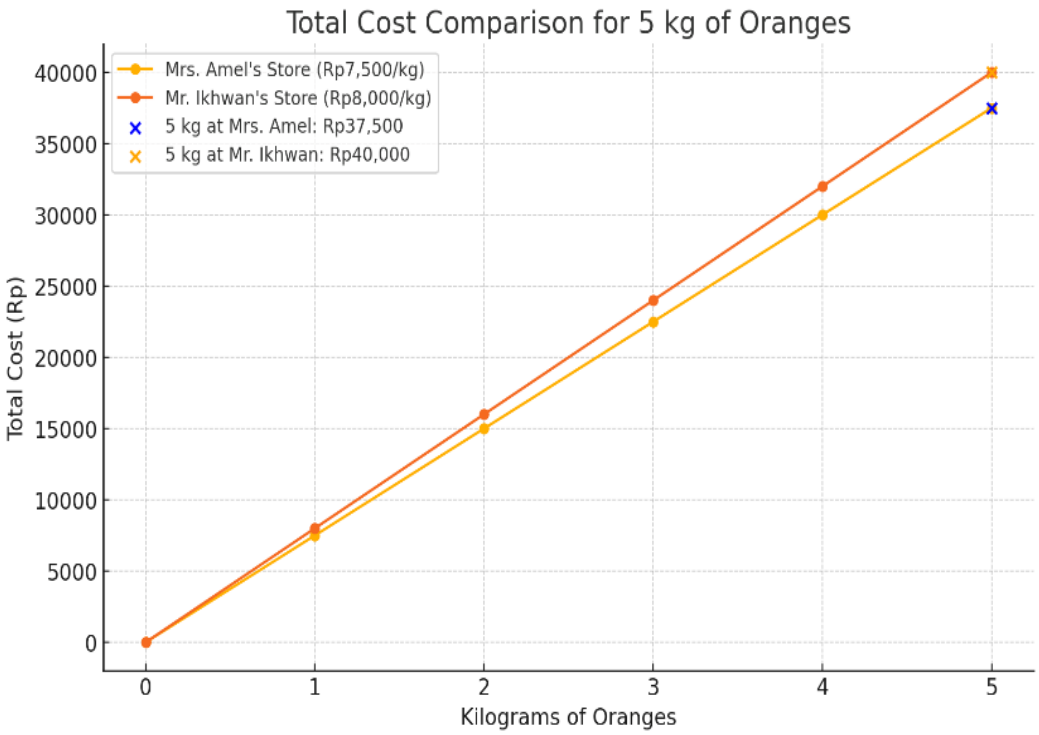


Figure 10. Total cost comparison for 5 kg of oranges

Furthermore, the integration of graphical methods enhances students' problem-solving skills and broadens their understanding of mathematical applications in real-world contexts. The inclusion of specific T focused on solving linear equations in one variable through graphical methods not only facilitates comprehension of the current material but also establishes a robust conceptual foundation for future learning. Within T_1, three tasks (t) are designed to assist students in understanding the validity of mathematical statements in the context of linear equations in one variable. $t_{1,1}$ and $t_{1,2}$ require students to verify the truth of mathematical statements by substituting values into an equation until it holds true. Meanwhile, $t_{1,3}$ presents problems that encourage students to explore the distinction between equations and non-equations. However, the absence of a specific T that explicitly introduces the definition of a linear equation in one variable may hinder students' ability to fully grasp the tasks within T_1.

In this context, establishing a clear understanding of the definition of linear equations in one variable is an essential prerequisite before engaging with t in T. A well-defined conceptual foundation enables students to comprehend the nature and properties of linear equations, their operational mechanics, and their distinction from other types of equations. By mastering this definition, students will be better equipped to approach tasks in T_1, particularly $t_{1,1}$ and $t_{1,2}$, which require an understanding of the truth of mathematical statements through numerical substitution.

In T_2, there is one t aimed at helping students understand how to solve equations without substituting numbers into variables. To solve this problem, students must first master the prerequisite material, which involves understanding the properties of equations, specifically subtraction within equations. However, this prerequisite material is actually located in T_3, which deals with solving equations using equation properties. At this stage, there is a mismatch in the presentation sequence of linear equations in one variable material. It is important to recognize that combining T_2, with T_1 to create a unified T is viable, as both tasks focus on verifying the correctness of mathematical statements. There is no immediate necessity to categorize them as distinct types of tasks, as they share the same underlying principle. This consolidation would streamline the task structure and simplify the learning process for students.

In T_3, there are three t aimed at helping students understand equations using equation properties. However, these t only focus on constructing students' understanding of addition and subtraction within equations. There are no specific t designed to help students understand the properties of multiplication or division within the context of linear equations. The absence of t focusing on multiplication and division operations can hinder students' overall understanding of equation properties because the material provided is only theoretical without relevant contextual example.

In T_4, there are four t aimed at helping students solve equations through algebraic manipulation. $t_{4,1}$ requires students to understand equation properties, especially in terms of addition and subtraction, as a prerequisite for completing the problem. Meanwhile, $t_{4,2}, t_{4,3}$ and $t_{4,4}$ require students to understand the properties of multiplication and division within the context of linear equations as their prerequisite material. However, like a domino effect, the absence of t specifically addressing multiplication and division of fractions in the previous T_3 can lead to a learning obstacle in answering T_4.

In T_5, there are three t aimed at helping students understand situations using linear equations. Task $t_{5,1}$ is an example of a "problem solving using linear equations" type of question. At the same time, $t_{5,2}$ is categorized as "geometric problem solving using linear equations" and $t_{5,3}$ falls under "problem solving using linear equations involving speed." However, in $t_{5,1}$, there is a discrepancy with the material being taught, which is linear equations in one variable. This occurs because $t_{5,1}$ involves two variables, namely pens and notebooks. This error can cause difficulties for students in constructing their understanding, especially since the topic of systems of linear equations with two variables is only taught in grade VIII according to the *Merdeka* Curriculum. Therefore, adjustments need to be made to ensure that the questions given align with the material being taught to avoid unnecessary confusion or difficulties for students.

In $t_{5,2}$ and $t_{5,3}$, the given problems are too complex for students who are transitioning from elementary school to junior high school as they combine both algebra and geometry. To solve $t_{5,2}$, students must master prerequisite material related to plane figures in space. However, the material on plane figures in space is typically taught in the second semester of grade VII. Similarly, to solve $t_{5,3}$, students must understand the relationship between distance, speed and time. Therefore, students are forced to solve equations in $t_{5,2}$ and $t_{5,3}$ with limited scientific knowledge acquired from elementary school. If the problems are too complex or require several complicated solution steps, it can also pose an obstacle for students who are not yet proficient in mathematics.

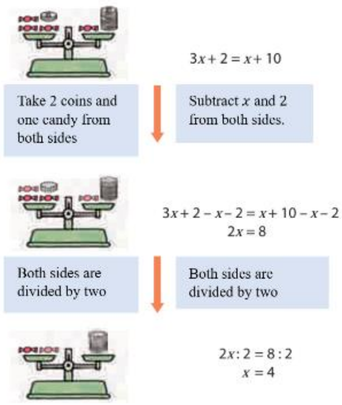
In the context of praxeology, identifying τ within the praxis block enhances our understanding of how individuals or groups utilize specific tools, strategies, or approaches to accomplish t within a given context. The textbook explicitly outlines strategies for each T, considering that the analyzed t are examples designed to help students develop a conceptual understanding of equations, particularly their definitions and related properties. Furthermore, this research extends its analysis by assessing the effectiveness of these strategies when implemented by students.

The categorization of τ in this study follows the perspective of Takeuchi and Shinno (2020), who systematically classify τ into four distinct types: perceptual (τ_1), physical (τ_2), operational (τ_3) and algebraic (τ_4). This classification provides a structured framework for analyzing the different ways students engage with mathematical concepts in their learning process. The findings of this study, including detailed descriptions of the strategies associated with each T, are presented in Table 3.

Table 3. Technique in Praxis Blocks

<table>
<tr><th>Type of task (T)</th><th>Technique (τ)</th><th>Description of Technique</th></tr>
<tr><td>T_1</td><td>τ_1, τ_3, τ_4</td><td>$t_{1,1}$
We can express the relationship between the left side and the right side of the balance with the equation
$$3x + 2 = x + 10 \ (\tau_1) \quad (7)$$
Substitute integers from 1 to 5 for both sides to see if the equation holds (τ_4). The next step is to calculate the weight of one candy (τ_3).
<table>
<tr><th>x</th><th>$3x + 2$</th><th>conjunction</th><th>$x + 10$</th></tr>
<tr><td>1</td><td>$3(1) + 2 = 5$</td><td><</td><td>$(1) + 10 = 11$</td></tr>
<tr><td>2</td><td>$3(2) + 2 = 8$</td><td><</td><td>$(2) + 10 = 12$</td></tr>
<tr><td>3</td><td>$3(3) + 2 = 11$</td><td><</td><td>$(3) + 10 = 13$</td></tr>
<tr><td>4</td><td>$3(4) + 2 = 14$</td><td>=</td><td>$(4) + 10 = 14$</td></tr>
<tr><td>5</td><td>$3(5) + 2 = 17$</td><td>></td><td>$(5) + 10 = 15$</td></tr>
</table>
In the equation (7), if the value of x is 4, then the value on the left-hand side is equal to the value on the right-hand side. Hence, both sides are equal, and the equation holds (is true). The equation does not hold for values other than 4. Therefore, the solution to the equation $(3x + 2) = (x + 10)$ is 4. This implies that the weight of one candy is 4 g.</td></tr>
<tr><td></td><td></td><td>$t_{1,2}$
By substituting 1, 2, and 3 successively for x in the equation (τ_3), the left-hand side of the equation is as follows:
When $x = 1$, then $2(1) + 5 = 7$
When $x = 2$, then $2(2) + 5 = 9$
When $x = 3$, then $2(3) + 5 = 11$
From the above calculations, when $x = 3$, the equation holds.</td></tr>
<tr><td></td><td></td><td>$t_{1,3}$
In the equation
$$2x + 3x = 5x \quad (8)$$
the equation holds regardless of the number substituted for x (τ_1). Therefore, there is no equation.</td></tr>
<tr><td>T_2</td><td>τ_3, τ_4</td><td>$t_{2,1}$</td></tr>
</table>

<table>
<tr><td></td><td></td><td>
On the balance scale, equilibrium can be maintained by removing an equal amount of weight from both sides and so forth (τ_3, τ_4). This process is illustrated in the diagram below

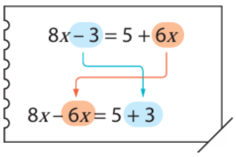


</td></tr>
<tr><td>T_3</td><td>τ_1, τ_4</td><td>
$t_{3,1}$

a. Utilizing property 1 (τ_4) of equations (add 9 to both sides).
b. Utilizing property 2 (τ_4) of equations (subtract x from both sides).
</td></tr>
<tr><td></td><td></td><td>
$t_{3,2}$

With reference to Wilda's explanation, it would be better if we could clarify that in step 2, instead of explaining the disappearance of the term x on the right side, it is preferable to explain that the term $-x$ appears on the left side (τ_1).
</td></tr>
<tr><td></td><td></td><td>
$t_{3,3}$

1. Transfer the term (τ_4) from the left side to the right side in (a).
2. Transfer the term (τ_4) from the right side to the left side in (b).
3. Change the sign when transferring terms (τ_4).
</td></tr>
<tr><td>T_4</td><td>τ_3, τ_4</td><td>
$t_{4,1}$



$8x - 3 = 5 + 6x$
Move -3 and $6x$ to the right side (τ_3, τ_4):
$8x - 6x = 5 + 3$
$2x = 8$

$x = 4$ (9)
</td></tr>
<tr><td></td><td></td><td>
$t_{4,2}$

Remove the parentheses by applying the distributive property (τ_3).
$5x - 2(x - 3) = 3$
$5x - 2x + 6 = 3$
Move 6 to the right side (τ_4).
$5x - 2x = 3 - 6$
$3x = -3$

$x = -1$ (10)
</td></tr>
<tr><td></td><td></td><td>
$t_{4,3}$

Convert the coefficients of the equation into integers by multiplying both sides by 10 (τ_3).
$2{,}3x = 0{,}5x + 9$
Multiply both sides by 10 (τ_4), resulting in:
</td></tr>
</table>

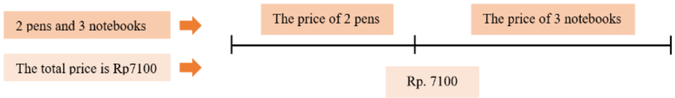
$2{,}3x.10 = (0{,}5x + 9)10$ (convert the coefficients to integers)
$23x = 5x + 90$ (swap the left-hand side and the right-hand side)
$23x - 5x = 90$ (write it in the form of $ax = b$)
$18x = 90$ (divide both sides by the coefficient of x)
$x = \frac{90}{18}$
$x = 5$ (11)

$t_{4,4}$
Convert the coefficients to integers by multiplying both sides by 6 (τ_3).
$\frac{5}{6}x - 2 = \frac{1}{3}x$
Multiply both sides by 6 (τ_4).
$[\frac{5}{6}x - 2]6 = [\frac{1}{3}x]6$ (convert the coefficients to integers)
$5x - 12 = 2x$ (swap the left-hand side and the right-hand side)
$5x - 2x = 12$ (write it in the form of $ax = b$)
$3x = 12$ (divide both sides by the coefficient of x)

$x = 4$ (12)

T_5 | τ_3, τ_4 | $t_{5,1}$

1. Find the relationship between the quantities in the problem and express them using diagrams, pictures, or tables, as well as equations in words.



2. Based on the above picture, the price of 2 pens plus the price of 3 notebooks equals Rp. 7100.
3. Clarify the known and unknown quantities. Use letters to represent the unknown quantity.

Known quantity: Rp. 1,300 for 1 pen, 2 pens cost Rp. 2,600.
Unknown quantity: the price of one notebook.
If the price of one notebook is x rupiah, then it is obtained

$$2(1{,}300) + 3x = 7{,}100 \quad (13)$$

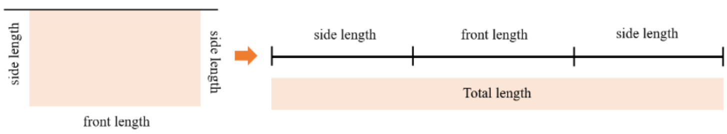
4. Solving the equation above yields $x = 1{,}500$ (τ_3).
5. Recheck the solution to the equation, which is the solution to the given problem

If the price of one notebook is Rp. 1,500, then

$$2{,}600 + 3\,(1{,}500) = 7{,}100 \quad (14)$$

Thus, the solution is $x = 1{,}500$.
Therefore, the price of one notebook is Rp. 1,500.

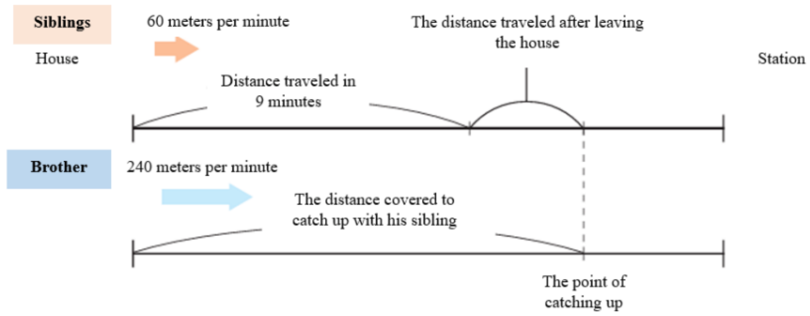
$t_{5,2}$
We can express the relationship between the total length and the length of the three sides of the fence with the diagram below.



The above diagram is expressed in the sentence "two times the length of the side plus the length of the front equals the total length". If we assume the length of the side fence is x meters, then the length of the front is $(x + 3)$ meters. We can form an equation and solve it using the relationship between the quantities (τ_4).

Let x be the length of the side fence.
$2x + (x + 3) = 24$
$3x = 21$
$x = 7$ (15)
Therefore, the length of the side fence is 7 meters, which is the answer to the problem.

$t_{5,3}$
The relationship between the quantities is presented in the diagram below



When the elder sibling arranges and meets the younger sibling, the equation 'the distance traveled by the younger sibling is equal to the distance traveled by the elder sibling' applies.
If the elder sibling catches up and meets the younger sibling x minutes after leaving the house, then we can express the relationship between distance, speed, and travel time in the table below (τ_4)

	Sibling	Brothers
Speed (meters/minute)	60	240
Travel time (minutes)	$X + 9$	X
Distance (meters)	$60(x + 9)$	$240x$

If the elder sibling catches up and meets the younger sibling x minutes after leaving home, then
$60(x + 9) = 240x$
$60x + 540 = 240x$
$60x - 240x = -540$
$-180x = -540$
$x = 3$ (16)

If we substitute $x = 3$ into the equation and both of them cover 720 meters, which is less than 1 km. Therefore, the elder sibling catching up to the younger sibling 3 minutes after leaving home is a solution to the given problem

Based on the analysis of t within the praxis block, the Grade VII mathematics textbook in the *Merdeka Curriculum* predominantly employs algebraic techniques to explain various T. However, the findings of this research reveal that almost all t for each T are exclusively presented in the textbook. This limitation results in a learning approach that encourages students to imitate rather than actively develop their own problem-solving strategies. Furthermore, the implementation of t in the textbook does not fully align with the conceptualization proposed by Chevallard (2019), wherein t should involve actions that reflect active engagement by the learners. Consequently, this textbook-centered approach increases the risk of students relying on rote memorization of problem-solving procedures rather than developing a deep conceptual understanding of the material. As a result, newly acquired knowledge becomes susceptible to forgetting, ultimately hindering students' long-term retention and application of mathematical concepts.

Logos Blocks

The logos block components include technology (θ) and theory (Θ). θ represents tools or methods to justify τ. At the same time, Θ is a conclusion in the form of theoretical knowledge that serves to generalize the entire process T, θ and Θ. In the textbook, this research identified three discourses θ related to linear equations with one variable and then organized the praxis block into three local praxologies. T_1 and its τ (τ_1, τ_3, τ_4) are coherently aligned within θ_1, which is organized into the first local praxology. T_1 is used to provide an understanding of the truth of mathematical statements in equations governed by θ_1 (the process of replacing one expression or variable with an equivalent or appropriate value in an equation). τ associated with T_1 (τ_1, τ_3, τ_4) aligns with θ_1 as they are involved in the substitution process used to solve or understand linear equations with one variable (perceptual, operational, and algebraic). Therefore, θ_1 justifies these τ (τ_1, τ_3, τ_4) in the first local praxeology.

Furthermore, the rationale behind T_2 and the associated τ (τ_3, τ_4) is found in a different technology discourse related to elimination (θ_2), labeled as the second local praxeology. T_2 is used to provide an understanding of solving equations without substituting numbers into the letters governed by θ_2 (techniques used to eliminate or remove variables in a system of linear equations with the aim of finding solutions to the system). τ_3 and τ_4 are justified by θ_2 because they involve the identification and use of mathematical expressions as the basis for solving T_2.

Finally, τ related to linear equations as algebraic operations (θ_3) emerges as the justification basis for validating for T_3, T_4, T_5, along with their sets of τ (τ_1, τ_3, τ_4) forming the last local praxology. T_3, T_4 and T_5 serve as validations to conclude T_1 and T_2 through τ_1, τ_3, and τ_4 and are justified by θ_3 (procedures or actions used to manipulate algebraic expressions). Overall, T_1 and T_2 result in a Θ_1 (an open mathematical sentence using the equal sign to express the relationship between two quantities called an equation). Meanwhile, T_3, T_4 and T_5 are interrelated and result in a Θ_2 (if m is added, subtracted, multiplied, or divided on both sides, then the equation remains valid). The results of the analysis of θ and Θ are described in Table 4. This comparative framework aims to highlight nuances and differences between the portrayal of these technologies in textbooks and the formal definitions established, which can be seen from the scientific literature.

Table 4. Praxis blocks and logos blocks in praxeological analysis of indonesian mathematical textbooks

Type of Task (T)	Technique (τ)	Technology (θ)	Theory (Θ)
T_1	τ_1, τ_3, τ_4	θ_1	Θ_1
T_2	τ_3, τ_4	θ_2	Θ_1
T_3	τ_1, τ_4	θ_3	Θ_2
T_4	τ_3, τ_4	θ_3	Θ_2
T_5	τ_3, τ_4	θ_3	Θ_2

Discussion with Experts Regarding the Textbook's Praxeological Organization

Through discussions with mathematics experts regarding the textbook's praxeological analysis, this study identified how to understand the material of linear equations with one variable. The textbook indicates that linear equations with one variable consist of a combination of three local praxeologies. These praxeologies are referred to as "local" because T and t share discourses from three different θ (Bosch

& Gascón, 2014). These three θ are reinforced by two Θ, particularly algebraic theory.

A didactic design K is constructed based on n types of tasks T_i so that $K = \sum_{i=1}^{n} T_i$. Each T_i certainly has its characteristics, as seen from the possible responses of learners. However, these possible responses can be interpreted as perceptual and memorial actions that learners may undertake. These perceptual and memorial actions lead to the formation of certain mathematical objects that can be formed through *Merdeka* processes as a result of facilitating T_i. In that case, T_i can be said to be epistemic.

Based on the analysis of didactic design using praxeology, the absence of T specifically addressing the definition of linear equations with one variable may lead learners to struggle in understanding t in the textbook, particularly in $t_{1,1}, t_{1,2}$ and $t_{1,3}$. In T_3, there are three t $(t_{3,1}, t_{3,2}, t_{3,3})$ aimed at helping learners understand equations by utilizing their properties. However, these t only focus on the concept of addition and subtraction within equations, without any tasks specifically aimed at reinforcing learners' understanding of the properties of multiplication or division in the context of linear equations. Like a domino effect, the absence of t specifically addressing multiplication and division in equations in the previous T_3 may cause barriers in learning when answering T_4 because $t_{4,1}, t_{4,2}, t_{4,3}$ and $t_{4,4}$ require prior knowledge of the properties of multiplication and division in the context of linear equations as their prerequisites. According to Brousseau (2002), inconsistencies in the presentation of material in textbooks can lead to learning obstacles. The lack of discussion on multiplication and division operations within the context of linear equations in previous stages can hinder students' understanding of the material in subsequent stages, thus potentially becoming a didactic obstacle in their learning process. Elkjær and Jankvist (2021) highlighted the importance of a strong foundation in multiplication and division for understanding linear equations. Elkjær's task design for equation solving includes a range of arithmetical equations but does not specifically address multiplication and division. This gap can hinder students' ability to grasp the properties of these operations in the context of linear equations.

Moreover, the questions presented in $t_{5,2}$ and $t_{5,3}$ are too complex for students who are in the transitional phase between elementary and junior high school. This forces learners to solve equations in $t_{5,2}$ and $t_{5,3}$ with limited scientific knowledge, which is typically taught in elementary school. According to Suryadi (2019), obstacles arising from the mismatch between the conceptual demands in instructional design and students' prior learning experiences can lead to ontogenic conceptual obstacles.

The collection of t_i constructed from the grade VII mathematics textbook in the *Merdeka* Curriculum appears to be insufficient in facilitating the *Merdeka Curriculum* formation of mathematical objects in students. Consequently, the grade VII mathematics textbook, particularly on the subject of linear equations with one variable in Indonesia, is non-epistemic, potentially giving rise to epistemological learning obstacles. From a didactic perspective as a science, $K = \sum_{i=1}^{n} T_i$ is a subsystem of the discipline D. As a result, the sequence of T_i also forms a system because each T and its subsequent T are interrelated both structurally and functionally. Based on this principle, the results of praxeological analysis for each T_i are further examined to ascertain whether $K = \sum_{i=1}^{n} T_i$ forms a system in which each component is interconnected or not.

None of T were specifically designed to build students' understanding of the concept of linear equations with one variable. This constitutes a deficiency as the material in the textbook should ideally commence with a clear definition to aid students in grasping the meaning and purpose of the content. The importance of starting textbook material with a definition was underscored by Hansson (2006), who emphasized the need for a clear and well-structured definition to aid in understanding. This is particularly crucial for concepts that are difficult to define, such as vague, value-laden, controversial, and inconsistent concepts. Eldridge (1935) further supported this by highlighting the need for students to grasp the subject matter in its entirety, which can be facilitated by a clear definition. The type of tasks implies that upon entering the topic of linear equations in one variable in grade VII, students are presumed to understand already the definitions of coefficients, constants, and variables.

According to Suryadi (2019), the absence of T addressing the definition of linear equations in one variable may lead to ontogenic conceptual obstacles, namely the mismatch between conceptual demands in instructional design and students' prior learning experiences. Students are required to comprehend the definitions of coefficients, constants, and variables. However, algebraic instructions at the elementary school level are not included in Indonesia's curriculum. Consequently, when students enter junior high school, they often encounter difficulties in learning the concept definitions in algebra, such as coefficients, constants, and variables. The excessively high demands on conceptual thinking may result in frustration among students, thereby hindering the learning process.

T_1, T_2, T_3, T_4, T_5 in the textbook direct students to transform the final equations in the tasks into the form $ax + b = 0\ (a \neq 0)$ without providing an initial explanation of the meanings of a, b and x. Consequently, when students begin studying the topic of linear equations with one variable in the grade VII, they are expected to already have a sufficient understanding of coefficients, constants, and variables without a clear and in-depth introduction to these concepts. In other words, in terms of structure, the concepts and thought processes developed in each task lack coherence. According to Brousseau (2002), the mismatch between the actual learning process, such as the inconsistency in the sequence and presentation stages of the material and what should be theoretically executed, can lead to the possibility of didactical obstacles.

The approach adopted in the series of tasks related to linear equations with one variable in the Grade VII mathematics textbook primarily emphasizes algebraic procedures. Consequently, students are not adequately exposed to diverse problem-solving strategies that could enhance their conceptual understanding. The predominant focus on algebraic steps limits students' ability to contextualize linear equations with one variable in real-world applications or interpret their graphical representations. Therefore, it is essential to incorporate additional tasks that emphasize solving linear equations with one variable using graphical methods. This integration would facilitate students' geometric comprehension of linear equations, particularly their intersections with the x- and y-axes, while also enabling them to interpret graphical solutions in relation to real-world scenarios.

The introduction of graphical methods for solving linear equations with one variable represents a significant advancement in the pedagogical approach to mathematics instruction. This method allows students to visualize variable relationships and comprehend solutions geometrically. Mastery of graphical methods at the Grade VII level provides a strong foundation for understanding linear functions in Grade VIII. By familiarizing students with the graphical representation of linear equations, they will be better prepared to engage with more complex mathematical concepts, including slopes, intercepts, and transformations of linear functions. Strengthening these prerequisite skills at the lower grade level minimizes learning difficulties in subsequent grades, thereby fostering a more coherent progression in mathematical understanding. Consequently, the incorporation of graphical methods not only enriches students' comprehension at the Grade VII level but also enhances their preparedness for advanced topics in the following academic year.

This finding aligns with the study by Mengistie (2020), which demonstrated that the use of graphical methods significantly improves students' comprehension and mathematical performance. By enabling students to visualize the interplay between variables and interpret solutions geometrically, this approach establishes a robust foundation for learning linear functions in Grade VIII. Additionally, the integration of multiple representations—algebraic, numerical, and graphical—into the curriculum fosters critical thinking and facilitates the connections between these different mathematical representations (Smith, 1997). Visualization techniques, particularly those involving vector geometry, have proven to be effective in the instruction of linear algebra concepts. Moreover, the introduction of graphical models and fundamental graph algorithms to lower-secondary students has been shown to enhance their familiarity with abstract modeling tools and cultivate problem-solving skills (Németh, 2017).

The arrangement of tasks in the linear equation section of the Grade VII mathematics textbook within the *Merdeka Curriculum* lacks both structural and functional coherence. As a result, the didactic design of the textbook, specifically in relation to linear equations with one variable in Indonesia, appears to be non-systemic, potentially impeding the learning process from a didactic perspective. Empirical classroom observations, qualitative analyses employing praxeological methods, and expert feedback gathered through FGD have yielded a critical insight: the non-systemic and non-epistemic structure of the mathematics textbook under the *Merdeka Curriculum* constitutes a significant factor contributing to students' learning difficulties.

Collaborative discussions with experts have led to the development of an alternative praxeological reference model for linear equations in the textbook, visually depicted in Figure 11. In this representation, the unshaded diagram illustrates the existing praxeological components present in the current textbook, while the yellow-shaded diagram highlight types of tasks that could be incorporated into the model. Additionally, the green-shaded diagram identifies components that could be introduced to enhance the model's comprehensiveness. Frequent curriculum revisions in Indonesia are often driven by political considerations rather than pedagogical imperatives. This phenomenon underscores how changes in national leadership often lead to corresponding shifts in curriculum policies (Bondi, 2008). As a result, the saying "*Change the minister, change the curriculum*" has become prevalent in Indonesia (Putri & Suhardi, 2023). Consequently, Indonesians have come to anticipate significant curriculum reforms following political transitions (Istanti, 2014). The upcoming transition in 2024 from President Joko Widodo to Prabowo Subianto is expected to influence educational policies, including the direction of mathematics education.

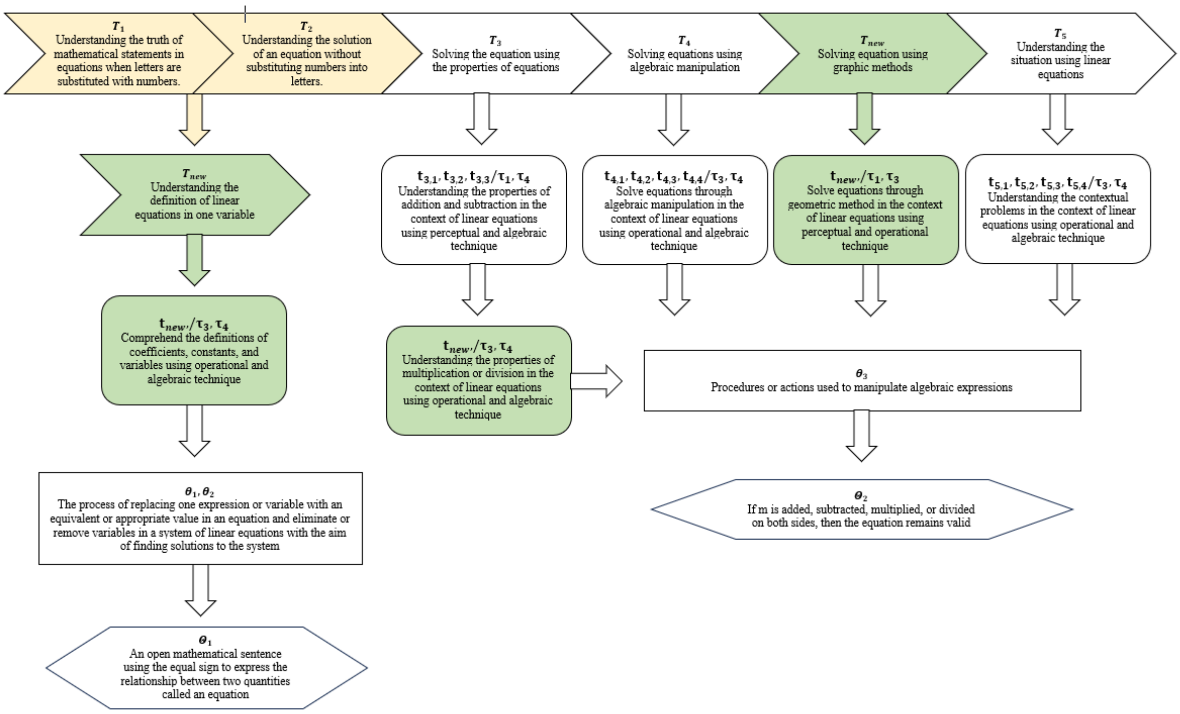


Figure 11. Alternative praxeological reference model of linear equation

This study has broader implications for the Indonesian education system. The proposed praxeological reference model provides an alternative framework for policymakers seeking to enhance the structuring and presentation of instructional materials on linear equations with one variable. By offering a well-structured approach, this model aims to bridge the gap between theoretical knowledge and practical applications in mathematics education. Moreover, the praxeological reference model, designed based on students' learning difficulties, aligns with their prior knowledge and cognitive development, thereby fostering a more effective comprehension of linear equations with one variable.

CONCLUSION

The praxeological analysis of the grade VII mathematics textbook in the *Merdeka Curriculum* reveals three primary categories of learning obstacles in the linear equation material: ontogenic, epistemological, and didactic obstacles. The collection of t_i within the praxeological organization T constructed in the textbook is insufficient in supporting students' formation of mathematical objects in accordance with the principles of the *Merdeka Curriculum*. As a result, the textbook, particularly in the section on linear equations with one variable, is classified as non-epistemic, meaning that it does not adequately facilitate the development of mathematical understanding. Furthermore, the structure and function of the collection of T in the linear equation material lack coherence, leading to a didactic design that is non-systemic. These findings highlight significant limitations in the instructional approach of the textbook, which may hinder students' conceptual development and problem-solving abilities in learning linear equations. Therefore, understanding these learning obstacles serves as a foundation for future research aimed at designing didactic frameworks that align with the principles of justified, true, and belief-based knowledge construction in mathematics education.

Despite its contributions, this study is subject to certain limitations. The scope of the research is confined to the analysis of the linear equation material in the grade VII mathematics textbook of the *Merdeka Curriculum*, which restricts the generalizability of the findings to other mathematical topics and grade levels. Additionally, this study does not extend its examination to the pedagogical strategies employed by teachers or the actual learning experiences of students, which could provide further insights into the effectiveness of the textbook. Moreover, while the research identifies structural and functional deficiencies in the textbook, it does not propose an alternative didactic design to address these challenges. Future studies should consider these aspects to provide a more comprehensive evaluation of mathematics textbooks in the *Merdeka Curriculum* and their impact on student learning.

To further enhance the understanding of textbook design and its implications for mathematics education, future researchers are encouraged to conduct comparative studies between the mathematics textbook entitled "*Matematika untuk Sekolah Menengah Pertama Kelas VII*" and its original source, "Mathematics for Junior High School," published by Gakko Tosho Co., Ltd in Japan. Such a comparison would allow for an in-depth analysis of contextual alignment, content accuracy, and cultural adaptation in the translation from Japanese to Indonesian. Additionally, similar praxeological analyses should be extended to other mathematical topics across different grade levels within the *Merdeka Curriculum* to determine whether the identified obstacles persist throughout the curriculum. A broader investigation would provide valuable insights for refining textbook development and ensuring that instructional materials are better aligned with the objectives of the *Merdeka Curriculum*, ultimately supporting students in achieving a more meaningful and coherent mathematical learning experience.

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