PRAXEOLOGICAL ORGANIZATION OF SIMILARITY TASKS IN JUNIOR HIGH SCHOOL TEXTBOOKS ACROSS FOUR CURRICULA

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Abstrak

Penelitian ini bertujuan untuk menganalisis soal kesebangunan dalam buku teks matematika SMP dari empat kurikulum berbeda: KTSP, Kurikulum 2013, Kurikulum 2013 Revisi, dan Kurikulum Merdeka, menggunakan pendekatan prakseologi organisasi dalam kerangka Teori Antropologi Didaktik (ATD). Metode penelitian yang digunakan adalah kualitatif dengan metode studi dokumen. Subjek penelitian berupa soal-soal kesebangunan pada buku teks matematika SMP yang diterbitkan oleh Pemerintah Indonesia dari empat kurikulum berbeda. Instrumen penelitian berupa teknik pengkodean digunakan untuk mengumpulkan data empiris tentang struktur organisasi praksiologi dalam buku teks, sedangkan instrumen analisis berfungsi untuk menafsirkan organisasi dialektis antara komponen praxis yang terdiri dari jenis soal (T) dan teknik penyelesaian (τ). Hasil penelitian menunjukan bahwa terdapat sembilan jenis soal (T_1-T_9) dan sembilan teknik penyelesaian (τ_1 - τ_9), yang bervariasi antar-kurikulum. Penurunan jumlah soal secara signifikan ditemukan dalam buku Kurikulum Merdeka menunjukkan pergeseran fokus kurikulum dalam hal numerasi. Temuan ini menunjukkan bahwa variasi soal dan pendekatan penyajian dalam buku teks berkaitan erat dengan perubahan kurikulum. Hal ini sesuai dengan peran buku sebagai cetak biru kurikulum. Sehingga penelitian ini membawa manfaat terhadap pengembangan pedagogi matematika, serta memberikan kontribusi bagi guru, penulis buku, dan pengambil kebijakan dalam merancang sumber pembelajaran yang lebih efektif.
Kata Kunci: prakseologi organisasi, kesebangunan, buku teks, kurikulum, ATD

Abstract

This study aims to analyze similarity task in Indonesian junior high school mathematics textbooks from four different curricula: KTSP, the 2013 Curriculum, the Revised 2013 Curriculum, and the Merdeka Curriculum, using the praxeological organization approach within the framework of the Anthropological Theory of the Didactic (ATD). The research employed a qualitative approach using a document analysis method. The subjects of the study were similarity related problems found in junior high school mathematics textbooks published by the Indonesian government, across four different curricula. Coding techniques were used as the research instrument to gather empirical data about textbook praxeology organization structures, while the analysis instrument interpreted the didactic organization between praxis elements: types of task (T) and technique (τ). The study identified nine types of task (T_1-T_9) and nine corresponding techniques (τ_1 - τ_9), which vary across curricula. A significant reduction in the number of type odf tasks was found in the Merdeka Curriculum textbook, indicating a shift in curricular focus concerning numeracy. These findings reveal that the variation in problem types and presentation approaches in textbooks is closely related to curriculum changes. This aligns with the role of textbooks as blueprints of the curriculum. Therefore, this research contributes to the development of mathematics pedagogy and provides valuable insights for teachers, textbook authors, and policymakers in designing more effective learning experiences.
***Keywords**: organizational praxeology, similarity, textbook, curriculum, ATD*

INTRODUCTION

Textbooks are an essential and frequently utilized resource by both teachers and students in the learning process (Rizqi et al., 2021). According to the Regulation of the Minister of National Education Permendiknas (2016) textbooks serve as the primary resource in the learning process to achieve core competencies and basic competencies. In mathematics education, textbooks function as a main reference for both teachers and students. This is line with Shabrina et al. (2022) state that mathematics textbooks play a crucial role in supporting mathematics learning activities, which ultimately influence learning success and the achievement of competencies. Based on this explanation, it is evident that textbooks are a vital primary resource in the learning process, particularly in mathematics education. Textbooks not only serve as a reference for teachers and students, but also play a strategic role in facilitating the achievement of core and basic competencies and in supporting overall success in learning mathematics.

Textbooks contain content that must be carefully considered to ensure optimal use. This content includes instructional material, examples, and practice exercises. Examples and practice tasks play a crucial role for students, as they can serve as indicators of their understanding of the material. This is in line with Fan et al. (2013), who state that most teachers rely on textbooks as their primary resource in the teaching process, particularly in presenting examples and exercises. The textbooks used in schools are published by both government and private publishers. According to Permendiknas (2016) both government and private publishers are authorized to publish textbooks. However, schools tend to choose Electronic School Books (BSE) because they are government-subsidized and are used as the main textbooks in the learning process.

The educational curriculum in Indonesia continues to undergo changes in response to evolving needs and developments over time (Sapitri, 2022; Herman & Aisiah, 2022; Prianti, 2022). One of the main focuses in each of these changes is the revision of content in mathematics subjects, particularly the topic of similarity, which consistently appears in every curriculum. This highlights the importance of learning about similarity for students. This topic has practical applications in daily life, such as estimating the height of objects like buildings, trees, or poles without directly measuring them. Therefore, it is evident that similarity is a topic closely related to students' everyday experiences. Although the concept of similarity is a key component in mathematics education, its presentation and scope vary across curricula, adapting to the specific learning objectives being targeted. As textbooks serve as the "potentially implemented curriculum" (Valverde, 2002), the topic of similarity is consistently included in mathematics textbooks and thus becomes a mandatory part of students' learning.

On the other hand, students still experience difficulties in understanding the concept of similarity. This is consistent with the findings of Islami et al. (2019), which revealed that 40% of students struggled with calculations when solving similarity tasks. Additionally, 60% of students faced difficulties both in performing calculations and in comprehending the concepts of similarity and congruence. These difficulties are evident at the stage of understanding the task, where students are unable to determine the goal of the question and fail to identify the relevant information needed to answer it. According to Rohmah and Rosyidi (2022), this occurs because students understanding does not align with the intended meaning of the tasks. As explained by Setiawan (2020) that in the process of proving the similarity of two triangles, students often struggle due to a lack of understanding of fundamental concepts such as the properties of similar triangles, side ratios, and similarity criteria. These conceptual errors are compounded by difficulties in making appropriate connections between related concepts-for example, confusing similarity with congruence or incorrectly identifying corresponding sides. This weakness in both conceptual understanding and conceptual linkage leads students to construct invalid and illogical mathematical arguments.

The importance of the topic of similarity and the difficulties students face in understanding it represent a critical issue that deserves serious attention. Considering the crucial role of textbooks in mathematics education, this study focuses on analyzing the exercises in mathematics textbooks using the organizational praxeology framework within the Anthropological Theory of the Didactic (ATD). This theory is relevant for analyzing textbook exercises as it aids in understanding the relationships among learning, knowledge, and the broader cultural and social context. ATD is an approach used to examine human mathematical activity through an epistemological model of mathematical knowledge (Chevallard, 1989). However, due to time constraints, this study is limited to analyzing the types of tasks and their associated techniques .

Analyses of textbooks based on organizational praxeology have been widely conducted in various previous studies. Research by Hendriyanto et al. (2023) employed the ATD approach to examine mathematics textbooks on the topic of sets from Indonesia and Singapore, with the aim of identifying the characteristics of the knowledge presented in both books. Meanwhile, the study by Rizqi et al. (2021) utilized the organizational praxeology model to compare two mathematics textbooks- namely the Electronic School Book (BSE) and the Erlangga-published textbook- focusing specifically on the topic of sets. Several studies have also employed the ATD approach to analyze geometry content. The research by Utami et al. (2024) applied the organizational praxeology analysis approach to examine how the concept of functions is presented in Indonesian mathematics textbooks. However, studies focusing on similarity are still relatively scarce. Some of the research that discusses similarity includes the following Wijayanti (2019), for instance, evaluated the presentation of similarity and congruence concepts in Indonesian mathematics textbooks by comparing the types of tasks found in textbooks and national examinations, aiming to understand the connection between theory and practice. The study by Kuncoro et al. (2024) observed variations in the presentation of similarity tasks in geometry topics between textbooks from Indonesia and Singapore. This study found that differences in task design and instructional methods have the potential to affect students' conceptual and procedural understanding of similarity. Similarly, the study by Islahia et al. (2020) aimed to analyze changes in the presentation of theory and techniques related to exponential functions in high school mathematics textbooks, from the 2004 Curriculum to the 2013 Revised Curriculum at 2017, using the organizational praxeology framework.

In short, the problem arises in this study because textbooks significantly shape learning outcomes, yet the evolution of similarity tasks across curricula remains unexplored. Students continue to struggle with conceptual linkages such as confusing similarity with congruence and problem-solving techniques, indicating potential shortcomings in textbook task design. While curriculum reforms aim to enhance education, no study has systematically examined whether textbook exercises on similarity have pedagogically evolved to address these persistent student difficulties. This gap leaves unanswered whether curricular changes have translated into improved task design that better supports conceptual understanding and problem-solving skills.

Thus, this study is expected to highlight both the similarities and differences in the presentation of similarity content across curricula. Furthermore, it aims to examine the evolution of these approaches in light of changes in educational policy (and the development of textbooks in the future), as well as to evaluate the pedagogical implications of these design choices for the advancement of mathematics education.

METHOD

This study is qualitative research employing a document analysis method on mathematics textbooks, specifically the Electronic School Books (BSE), focusing on the analysis of similarity tasks across four curriculum periods. This study adopts the organizational praxeology approach. Praxeology is an analytical tool introduced by Chevallard, based on the principle that every human action can be questioned in terms of its rationale (Chevallard, 2019). Mathematical praxeology concerns how mathematical content is structured and presented in both student and teacher textbooks (Takeuchi & Shinno, 2020). In organizational praxeology, there are two main components: praxis and logos. Praxis includes the types of tasks and techniques, representing the practical aspects of mathematics learning, while logos comprises the theory and technology that provide the rational basis and justification for actions within the praxis. However, due to time constraints, this study focuses solely on the praxis component-namely, the types of tasks and their associated techniques-without an in-depth discussion of the logos aspect.

The data sources consist of analyses of similarity tasks found in textbooks from four curriculum periods: the School-Based Curriculum (KTSP), the 2013 Curriculum, the Revised 2013 Curriculum, and the Merdeka Curriculum. The researcher conducted a survey and review of several available Electronic School Books (BSE). There are four KTSP textbooks: those by Marsigit et al. (2011), Dris & Tasari (2011), Wagiyo et al. (2008), and Kusumawardani & Budhi (2011). For the 2013 Curriculum, there is only one textbook by Subchan et al. (2015). The Revised 2013 Curriculum includes two textbooks by As'ari et al. (2018) and Subchan et al. (2018). The Merdeka Curriculum has two textbooks: the first edition compiled by the Gakko Tosho Team (2021) and a later edition by Susanto et al. (2022). The researcher analyzed the textbooks with the highest amount of contextual tasks for each curriculum. As a result, four textbooks were selected as data sources for this study. The KTSP textbook analyzed is Matematika 3 untuk SMP/MTs Kelas IX by Wagiyo et al. (2008). For the 2013 Curriculum, the textbook Matematika SMP/MTs Kelas IX Semester 1 by Subchan et al. (2015) was used. The Revised 2013 Curriculum textbook analyzed is Matematika SMP/MTs Kelas IX by Subchan et al. (2018). Meanwhile, the Merdeka Curriculum textbook analyzed is Matematika SMP/MTs Kelas VII by Susanto et al. (2022).

The data collection in this study was carried out through a detailed examination of exercises related to the topic of similarity in mathematics textbooks. The initial step involved identifying sections within the textbooks that specifically address similarity concepts. Subsequently, the researcher reviewed the explanatory sections and example problems to gather a variety of tasks associated with the concept. This process included conducting an epistemological study to determine the types of tasks and the techniques applied in solving them. All available tasks, both from the examples and exercises sections, were comprehensively compiled for analysis.The data analysis technique employed the organizational praxeology framework. The collected tasks were categorized based on their types, under the assumption that the techniques demonstrated in the examples would be applicable to the exercises, provided they were contextually appropriate. The classification model was designed to be dynamic and was expanded progressively in response to the discovery of new task types, following the model developed by Wijayanti (2019). Further, the tasks were categorized to enable a quantitative analysis of the forms of mathematical praxis presented in each textbook. To ensure the confirmability of the findings, the analysis results were validated through triangulation involving academic supervisors, junior high school mathematics teachers, undergraduate Mathematics Education students, and Professional Teacher Education (PPG) participants. This validation process aimed to ensure that the conclusions drawn were based on the data itself rather than on researcher bias or subjectivity.

RESULTS AND DISCUSSION

The topic of similarity in junior high school mathematics textbooks is presented with varying numbers of pages across different curricula. In the KTSP, 2013 Curriculum, and Revised 2013 Curriculum, similarity is discussed together with congruence within the same chapter. The number of pages devoted to this topic are 34 pages (KTSP), 65 pages (2013 Curriculum), and 69 pages (Revised 2013 Curriculum), respectively. Meanwhile, in the Merdeka Curriculum, similarity and congruence are treated separately, with similarity taught in grade VII and congruence in grade IX. The similarity material in the Merdeka

Curriculum spans 24 pages. The analysis of similarity tasks in textbooks from the four curriculum periods will be discussed and classified according to categories of plane figure similarity, namely similarity related to polygons and similarity related to triangles.

Types of tasks related to polygon similarity

The tasks analyzed relate to the topic of similarity in plane figures (polygons) in junior high school mathematics textbooks. In the KTSP curriculum, these tasks are divided into several sections such as example tasks, exercises 1 and 2, practice questions, and task-solving tasks. In the 2013 Curriculum, the tasks include example tasks, exercises 4.3 and 4.4, activity 4.12, ayo kita tinjau ulang, and competency test 4. Meanwhile, in the Revised 2013 Curriculum, the tasks consist of example tasks, exercises 4.3 and 4.4, activity 3, ayo kita tinjau ulang, and competency test 4. In the Merdeka Curriculum, tasks related to polygon similarity are found only in exercise 5.2. Each type of task is accompanied by techniques, where each example provided includes detailed explanations. Within the topic of polygon similarity, four different types of tasks were identified. One task may consist of several sub-questions, allowing a single task to contain more than one type. A more detailed explanation of each type of task analyzed is as follows.

a. Type and technique of task 1 (T_1 and τ_1)

Type task T_1 ask students to determine whether two given polygonal figures are similar. Based on the analysis, T_1 tasks have two variations, namely $T_{1.1}$ and $T_{1.2}$. Variation $T_{1.1}$ requires students to select the pair of similar polygons from three given figures, where the lengths of the sides and/or the measures of the angles are provided. Meanwhile, variation $T_{1.2}$ asks students to determine whether two polygonal figures are similar, even though information about side lengths and/or angle measures is not explicitly given. This task presents two trapezoids with given side lengths, and students are asked to determine whether the two figures are similar polygons. To solve this task, students can identify pairs of corresponding sides using the symbols shown, then compare the lengths of these sides by calculating the ratio between the smaller and the larger sides. Additionally, to determine the correspondence of angles, students can observe the symbols indicating equal angles in each figure. Based on the information provided in the task and the type of question asked, the researcher classifies the task into a specific task type and technique as described below:

T_1: Given two polygonal figures P and Q, with certain side lengths and/or angle measures, determine whether the two polygons are similar.

τ_1: Arrange the angles in P and Q from smallest to largest (by inspection or visual observation), and check whether the angles are equal. If so, verify the proportionality of the corresponding sides of the polygons, paying attention to the "sides between the corresponding angles as the corresponding sides.

$T_{1.1}$ tasks appear only in the 2013 Curriculum and the 2013 Revised Curriculum. The example of the task presents three rectangles with specified side lengths, and students are asked to determine which pairs among the three rectangles are similar. The solution applies technique T_1 repeatedly, starting by comparing first and second of rectangles through the comparison of corresponding side lengths. The equality of angles is guaranteed by the property of rectangles, namely that all four angles are right angles. A similar procedure is then applied to rectangle iii. The researcher classifies this task and technique as follows.

$T_{1.1}$: Given three polygonal figures i, ii, and iii, with specific side lengths and/or angle measures, determine which pairs of polygons are similar.

$\tau_{1.1}$: Apply τ_1 (arrange the angles in i and ii from smallest to largest-by inspection or visual observation -and check whether the angles are equal. If so, verify the proportionality of the corresponding sides of the polygons, paying attention to the "sides between the corresponding angles" as the corresponding sides). Then repeat the same process for polygon iii.

For $T_{1.2}$ and $\tau_{1.2}$, the researcher categorized the task according to the following task type and technique.

$T_{1.2}$: Two polygonal figures are given (without known side lengths and/or angle measures). Determine whether the two figures are similar or not.

$\tau_{1.2}$: Observe the overall shape of the figures and use measuring tools to measure the sides. Apply 11 to compare the shapes, angle measures, and side ratios. Determine whether the shapes are similar (even if sizes or orientations differ).

b. Type and technique for task 2 (T_2 and τ_2)

Task type T_2 aims to identify corresponding angles and sides in a given polygonal figure.

The example of the task presents two similar trapezoids with certain side lengths provided and asks students to identify the pairs of angles that have equal measures. Since the two figures are stated to be similar, there exists a correspondence between their angles and sides. The technique involves visual observation by matching corresponding angles and aligning the positions of corresponding sides in the smaller and larger trapezoids.

The textbook does not explicitly describe a technique for solving T_2 tasks. Most authors only provide the answer without any explanation. The researcher categorized the task according to the following task type and technique.

T_2 : Two similar polygons P and Q are given withsome angles and/or sides known. Identify which angles and/or sides correspond to each other.

τ_2: Identify corresponding angles by aligning them based on their relative positions. Identify corresponding sides as those lying between corresponding angles.

c. Type and technique for task 3 (T_3 and τ_3)

Task type T_3 requires students to determine the unknown side length of one of two polygonal figures that are known to be similar. An example of a task in this category is provided below. Figure 4 illustrates an example of task T_3.

In this task, students are presented with two similar trapezoids, along with information about the lengths of two sides and the measure of the angle between corresponding sides. Students are asked to determine the unknown side lengths and angle measures. Using technique t_2, students identify pairs of corresponding sides and then apply the proportionality formula $\frac{p_1}{q_1} = \frac{p_2}{q_2}$. To calculate unknown side lengths using cross multiplication. A similar method is applied to determine unknown angle measures, using the proportion $\frac{s_1}{s'_1} = \frac{s_2}{s'_2}$ followed by cross multiplication. The researcher categorized this task using the following task type and technique.

T_3 : Two similar polygons P and Q are given, along with the length p_1 of one side in P, and lengths q_1 and q_2 of two sides in Q. Given that p_1 and q_1 correspond, find the length p_2 of the side in P.

τ_3: Calculate the unknown side length using $P_2 = \frac{P_1}{q_1} q_2$ d and/or determine an unknown angle measure using $S_2 = \frac{S_1}{S'_1} S'_2$.

d. Type and technique for task 4 (T_4 andτ_4)

Task type T_4 requires students to determine proportional relationships between corresponding sides and/or angles in similar polygonal figures. Based on the analysis T_4 includes a single variation, namely $T_{4.1}$, which asks students to determine the ratio of areas and/or perimeters of the polygons.

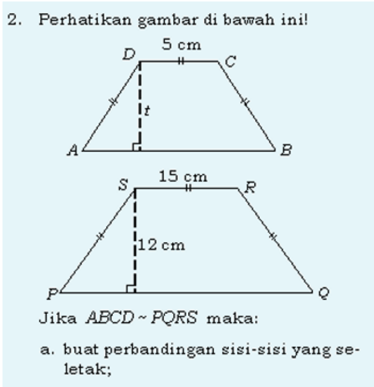

Figure 1. Example T_4 (in Indonesian language)

The task 2a in figure 1 appears in a textbook, found in the practice tasks section on page 11, based on the KTSP. Students are presented with two similar trapezoids and are asked to determine the ratio of corresponding side lengths. The solution begins with technique τ_2, identifying corresponding sides based on the positions of corresponding angles. Next, students express the proportional relationships in the form $\frac{AB}{DE} = \frac{AC}{DF} = \frac{BC}{EF}$. This technique relies on visual observation, similar to the approach used in T_2 tasks. The researcher categorized this task according to the following task type and technique.

T_4 : Two similar polygons are given with known side lengths and/or angle measures. Determine the proportional relationships between corresponding sides and/or angles.

τ_4 : Identify corresponding sides of the two similar polygons. Write the side length ratios in the form $\frac{AB}{DE} = \frac{AC}{DF} = \frac{BC}{EF}$.

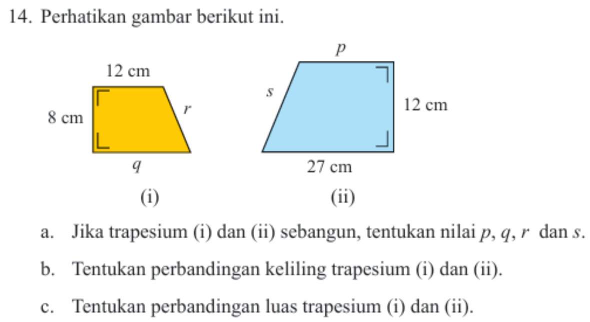

Figure 2. Example $T_{4.1}$ (in Indonesian language)

The tasks 14b and 14c in figure 2 are taken from the Revised 2013 Curriculum textbook, found in competency test 4 on page 265. In these tasks, students are asked to determine the ratio of areas and/or perimeters of two figures. The technique involves calculating the area and/or perimeter of each figure, then expressing the ratio in the form $\frac{l_1}{l_1}$ and/ or $\frac{k_2}{k_2}$. To accomplish this, students must first understand the formulas for the area and perimeter of each polygon. The researcher categorized the task using the following type of task and technique.

$T_{4.1}$: two similar polygons are given with certain side lengths and/or angle measures. Determine the ratio of the areas and/or perimeters of the polygons.

$\tau_{4.1}$: first, use τ_3 to find any unknown side lengths. Then, calculate the area and/or perimeter of each polygon, and express the result in the form $\frac{l_1}{l_1}$ and/ or $\frac{k_2}{k_2}$.

Types of tasks related to triangle similarity

Tasks involving triangle similarity often require specific techniques. In this study, five types of tasks related to triangle similarity were identified. Moreover, triangle similarity tasks were found to be the most dominant compared to other types of similarity task across all curriculum periods. Triangle similarity tasks appear in both worked examples and practice exercises. Several task in triangle similarity share characteristics with those found in the polygon similarity topic. Each type of task is described below, followed by its corresponding technique and an example with discussion. The detailed analysis for each type is presented as follows.

a. Type and technique of task 5 (T_5 and τ_5).

The example of the task presents two triangles with different side lengths and asks students to determine whether the triangles are similar. The technique involves ordering the side lengths of each triangle from shortest to longest, and then comparing the ratios of the corresponding sides to verify if they are proportional. The researcher categorized the task using the following type of task and technique.

T_5 : two triangles are given with certain side lengths and/or angle measures. Determine whether ΔACB and ΔFCE are similar.

τ_5 : Order the side lengths in each triangle as $t_1 \leq t_2 \leq t_3$ etc and examine whether $\frac{t_1}{s_1} = \frac{t_2}{s_2} = \frac{t_3}{s_2}$ Alternatively, order the angles in each triangle from smallest to largest and check whether $\angle 1 = \angle 1, \angle 2 = \angle 2$ and $\angle 3 = \angle 3$.

Based on the analysis, type of task T_5 was found to have two additional variations. The first variation $T_{5.1}$ involves determining whether two triangles are similar, even though the side lengths and/or angle measures of the triangles are not provided. In this case, students must rely on visual observation and reasoning about shape correspondence to assess similarity. The second variation, $T_{5.2}$, presents students with two triangles in corresponding orientation (i.e., matching direction or relative position), where certain side lengths and/or angle measures are known. Students are then asked to determine whether the two triangles are similar by comparing the proportional relationships of corresponding sides and/or angles.

To solve this task, students are expected to use visual observation to compare the shape, angle measures, and side proportions of the given triangles. They then determine whether the shapes are congruent in form (despite differences in size or orientation). Based on these observations, students are asked to decide whether the two triangles are similar. The researcher categorized this task using the following type of task and technique.

$T_{5.1}$: two or more triangles are given, but their side lengths and/or angle measures are not provided. Determine whether ΔACB and ΔFCE are similar.

$\tau_{5.1}$: observe the overall shape of the triangles and measure the sides using measuring tools. Apply τ_1 to compare the form, angle measures, and side proportions. Determine whether the shapes are identical in form, even if they differ in size or orientation).

For $T_{5.2}$ and $\tau_{5.2}$, the researcher categorized the task according to the following task type and technique.

$T_{5.2}$: two or more triangles are given with certain known side lengths and/or angle measures. Additional information is provided, such as the notation that (ΔACB is parallel to ΔFCE). Determine whether ΔACB dan ΔFCE are similar.

$\tau_{5.2}$: begin by calculating the unknown side lengths and/or angle measures. Then, compare the corresponding sides and/or angles using technique (τ_5).

b. Type and technique of task 6 (T_6 dan τ_6)

Type task 6 is a special case involving right triangles. In these tasks, students are asked to investigate whether the given right triangles are similar figures or not (ilustrate in figure 3). Figure 3 presents an example of task T_6.

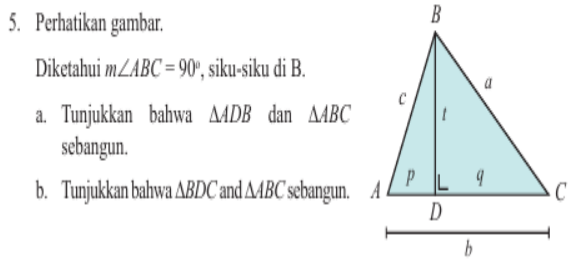

Figure 3. example T_6 (in Indonesian language)

Type of task 6 is a special case involving a right triangle. Question number 5 in figure 9 is taken from the mathematics textbook based on the 2013 curriculum, Exercise 4.4 on page 169. In this question, students are asked to identify the triangle that is similar to triangle ABC. This task can be solved by letting $\angle A = x$ and $\angle B = y$ which gives the relationship $x + y = 90^0$. Consider triangle ADC which is a right triangle with a right angle at point D. Then, $\angle ACD + \angle A = 90^0$. Since $\angle A = x$, it follows that $\angle ACD = y$. Similarly, in triangle DBC, which is also a right triangle with a right angle at point D, the equation $\angle B + \angle BCD = 90°$. since $\angle B = y$, then $\angle BCD = x$. Therefore, the three triangles ΔABC, ΔADC, and ΔDBC have the same angle measures, namely 90°, x, and y. The researcher categorized this task using the following task type and technique.

T_6 : given a right triangle ABC with $\angle m = 90^o$, right-angled at B. Show that ΔADB and ΔABC are similar.

τ_6 : let $\angle A = x$ and $\angle B = y$ so that $x + y = 90^0$.

c. Type and technique of task 7 (T_7 and τ_7)

Type of the task 7 ask students to determine the length of a side and/or the measure of an unknown angle in two similar triangles.

In this case, students apply technique τ_3 by using the ratio $\frac{AE}{EC} = \frac{AD}{BD}$ supported by additional algebraic steps to determine the unknown side lengths in the two similar triangles. The researcher categorized this task using the following type of task and technique.

T_7: given two triangles $\Delta ADE \sim \Delta ABC, DE//BC$, and the lengths of three out of four sides AE, AC, AD, AB are known. Find the remaining length.

τ_7 : Use the proportion $\frac{AE}{EC} = \frac{AD}{BD}$ and eliminate the unknown side.

d. Type and technique of task 8 (T_8 and τ_8)

Type task 8 are special cases involving right triangles. Figure 5 presents an example of task T_8.

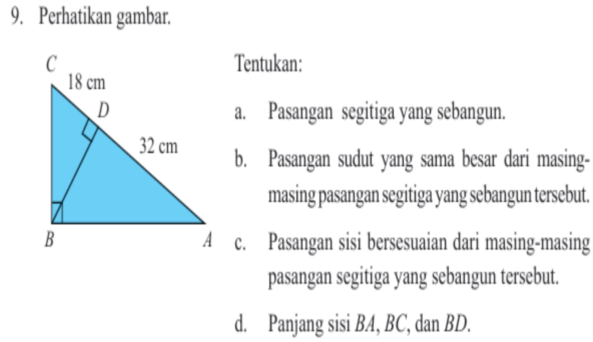

Figure 5. example T_8 (in Indonesian language)

Question 9d in figure 5 is taken from the revised 2013 curriculum mathematics textbook, Exercise 4.4 on page 256. Students are asked to find the length of a side and/or the measure of another unknown angle. To solve a T8 question, students can isolate the unknown side length using the proportion $\frac{AB}{AC} = \frac{AC}{AD} = \frac{CB}{CD}$ and support their solution with the Pythagorean Theorem (to find the hypotenuse) to identify the unknown side length in a right triangle. Based on the information presented and the question posed. The researcher categorized this task using the following type of task and technique.

T_8 : Given a right triangle ABC with $\angle m = 90^{o}$, , right-angled at B. The lengths of two sides and/or an angle are known. Determine the length of the remaining side and/or the measure of the unknown angle.

τ_8 : Use the proportion $\frac{AB}{AC} = \frac{AC}{AD} = \frac{CB}{CD}$ to eliminate the unknown side.

e. Type and technique of task 9 (T_9 and τ_9)

Type task 9 refers to a question that asks students to determine the proportional relationships between corresponding sides and/or angles of two similar triangles. Typically, this type of question presents two triangles along with specific information regarding side lengths and/or angle measures. Figure 6 presents an example of task T_9.

Figure 6. Example of T_9 (in Indonesian language)

Question number 2b in figure 12 is taken from the revised 2013 curriculum mathematics textbook, Exercise 4.4 on page 255. A T_9 question requires students to determine the proportional relationships between corresponding sides and/or angles of two similar triangles. To solve a T_9 task, students may begin by identifying the corresponding sides of the similar triangles. Then, they write the proportional relationships of the side lengths in the form

$\frac{AB}{DE} = \frac{AC}{DF} = \frac{BC}{EF}$. This technique also applies when determining the proportional relationships between corresponding angles. The researcher categorizes this question by type and technique as follows.

T_9 : given two similar triangles with certain known side lengths and/or angle measures. Determine the proportional relationships between corresponding sides and/or corresponding angles.

τ_9 : identify the corresponding sides of the two similar triangles. Express the side length ratios in the form $\frac{AB}{DE} = \frac{AC}{DF} = \frac{BC}{EF}$. For identifying corresponding angles, match the sequence of vertex letters in the triangle names to reflect angle correspondence (e.g $\triangle ABC \sim \triangle DEF$ implies that $\angle A = \angle D, \angle B = \angle E, \angle C = \angle F$).

Quantitative Survey of Similarity Question Types in Textbooks Across Four Curriculum Periods

Table 1 presents the results of a quantitative survey on the types of similarity questions found in junior high school mathematics textbooks from four different curriculum periods.

Tabel 1. Quantitative survey of textbook analysis

Types of task	**KTSP** Wagiyo et al. (2008)	**2013 Curriculum** Subchan et al. (2015)	**2013 Revised Curriculum** Subchan et al. (2018)	**Merdeka Curriculum** Susanto et al. (2022)
Polygon				
T_1	8	6	6	3
T_2	1	2	2	0
T_3	11	10	10	0
T_4	6	5	5	0
Triangle				
T_5	7	6	6	4
T_6	2	3	3	1
T_7	19	5	5	3
T_8	4	2	2	1
T_9	10	5	5	5
Total	**68**	**44**	**44**	**17**

Methodological remark

In the analysis of similarity-related questions across four curricula-namely KTSP, the 2013 Curriculum, the 2013 Revised Curriculum, and the Merdeka Curriculum-based on the praxeological framework of the Anthropological Theory of the Didactic (ATD), several questions were identified that could not be clearly classified within the praxeological blocks. These questions are open-ended, involve assumptions, or lack clearly defined solution techniques due to insufficient supporting information. In the KTSP curriculum, three questions were found to be unclassifiable using the praxeological framework. These include two questions that asked students to sketch polygons and one that asked them to draw a triangle with specific dimensions. In the 2013 Curriculum and its revised version, eight such questions were identified: two questions required drawing polygons and triangles, three involved visual exploration, two focused on error analysis, and one was related to three-dimensional objects. Meanwhile, in the Merdeka Curriculum, only one question was identified, which required students to draw a triangle. The question presents a task requiring a sketch. This question asks students to draw a polygon or triangle, but it does not require an understanding of similarity concepts. Therefore, it is not included in the classification of question types and techniques in this study. Figure 7 presents an Visual exploration task.

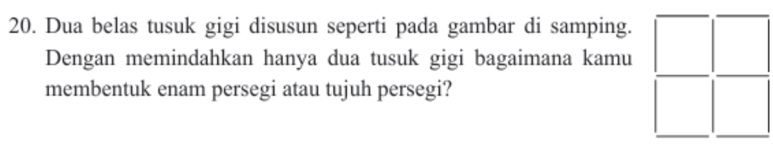
20. Dua belas tusuk gigi disusun seperti pada gambar di samping. Dengan memindahkan hanya dua tusuk gigi bagaimana kamu membentuk enam persegi atau tujuh persegi?

Figure 7. Visual exploration task (in Indonesian language)

Question number 20 in figure 7, which appears in the 2013 Revised Curriculum textbook, on page 267, is found only in the 2013 Curriculum and its revised version. This question asks students to move toothpicks to form a specific number of squares, emphasizing visual skills and creativity rather than formal mathematical techniques. As it is intuitive in nature, it is not included in the classification of mathematical solution techniques in this study. Figure 8 presents an Error analysis task.

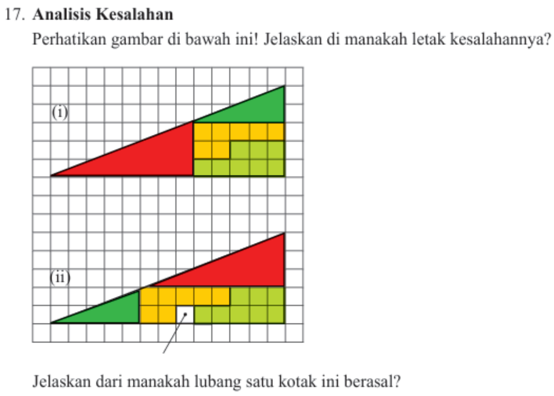

Figure 8. an Error analysis task (in Indonesian language)

Problem number 15 in figure 9, taken from Exercise 4.4 on page 259 of the Kurikulum 2013 Revisi textbook by Subchan et al. (2018). Is an exploratory question that appears exclusively in the 2013 Curriculum and its revised version. The next task is an error analysis task. An exploratory question that appears exclusively in the 2013 Curriculum and its revised version. This problem encourages students to analyze logical or visual errors in the representation of plane figures, aiming to develop critical and analytical thinking skills. Figure 9 presents a task related to three-dimensional objects.

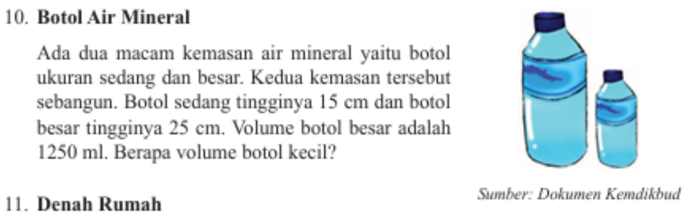

Figure 9. Task related to three-dimensional objects (in Indonesian language)

Problem number 10 in figure 9 is found in the Kurikulum 2013 textbook by Subchan et al. (2015), Exercise 4.3 on page 156. This question presents two mineral water bottles of different sizes described as similar, and students are asked to calculate the volume of the smaller bottle. Although the term "similar" is used, solving the problem requires an understanding of volume comparison-not just length or area. This is noteworthy since the concept of similarity is typically introduced prior to volume (solid geometry) in the curriculum sequence.

DISCUSSION

This analysis reveals a development in the types and variations of problems compared to the findings of Wijayanti (2019), although the techniques remain largely similar. For instance, in problem type T_1, a new variation ($T_{1.2}$) is identified in the Merdeka Curicculum textbook, which requires students to analyze the similarity of two figures through visual comparison, angle congruence, and ratio of corresponding sides. This variation aligns with type T_8 in the praxeological model proposed by Kuncoro et al. (2024), reflecting the diversity of problem forms without altering their underlying mathematical principles. Variations in problem presentation are also found in types T_1, T_3, T_4, and T_5.

One notable finding is the emergence of problems that combine information about side lengths and angle measures, in contrast to Wijayanti (2019) classification, which separates these into distinct types. In the previous study, type T_5 involved triangles with given angle measures, while type T_6 involved triangles with given side lengths, both requiring students to determine whether the triangles are similar. In this study, such problems are unified under type T_5, since several questions present triangles with both side lengths and angle measures provided simultaneously. Furthermore, the technique remains the same-ordering the sides and/or angles from the smallest to the largest before comparing. This suggests that variations in the type of information provided do not necessarily create a new problem type but rather expand the forms of representation within an existing type.

Another notable finding in the topic of triangle similarity involves specific problems related to right triangles (T_6 and T_8), which consistently appear across the four curriculum-based textbooks analyzed. In mathematics textbooks, right triangles are typically treated separately from other triangle types due to their distinct geometric properties. The presence of a 90^0 angle allows the application of specialized concepts such as the Pythagorean theorem and trigonometric ratios, which are not applicable to general triangles. This separation aims to provide deeper conceptual emphasis and facilitate students' understanding of the relationships between sides and angles in right triangles, particularly in the context of similarity proofs and practical applications in everyday situations.

Another new finding pertains to problems that require students to compare corresponding sides and/or angles of two similar figures (T_4 and T_9). Such problems were consistently found in all four curriculum textbooks, indicating a shared emphasis on the importance of understanding corresponding parts in similar shapes. However, students still face significant challenges in identifying the correct measures of corresponding sides or angles. This difficulty is supported by the findings of Puryanti (2021), who reported that students struggle to compare the lengths of sides in similar figures, especially when the given side lengths and angles differ. This suggests a limited student understanding of the concept of proportionality in similar shapes. The issue is further reinforced by Mawaddah et al. (2021), who found that some students mistakenly believe that equal side lengths imply equal angles or vice versa. Such misconceptions reflect a fundamental misunderstanding of the core concepts of similarity and congruence.

In addition to requiring procedural steps, similarity problems also demand a deeper conceptual understanding of various mathematical domains. The topic of similarity often intersects with concepts such as ratios, proportions, scale, properties of triangles and polygons, coordinate systems, and in some cases, basic trigonometry. Furthermore, comprehension of parallel lines within triangles, angle relationships, and arithmetic operations-including ratios and proportional reasoning is essential. These complexities highlight that solving similarity problems necessitates the integration of multiple interconnected mathematical concepts. This aligns with the findings of Setiawan (2020), who emphasized that reasoning and proof in similarity not only require geometric understanding but also involve algebraic operations, comparisons, and equivalence demonstrating the interdisciplinary nature of mathematical thinking.

In general, the number of similarity problems in the Merdeka Curriculum textbooks is notably lower compared to previous curricula. This change indicates a shift in emphasis regarding similarity content across curricula, with Merdeka Curriculum adopting a more selective approach in presenting similarity problems. This may reflect an adaptation to a more focused learning approach or a deliberate reduction of certain content loads within the structure of the new curriculum.

The number of similarity problems in the 2013 Curriculum and its revision remains consistent, with a total of 44 problems. This aligns with the policy of the Ministry of Education and Culture Kemendikbud (2016), which stated that the revision of the 2013 Curriculum was intended to refine the formulation and emphasis of competencies without altering the number of Core Competencies (KI) and Basic Competencies (KD).

In the most recent curriculum, the problems tend to emphasize conceptual understanding through contextual situations relevant to everyday life. This is evident in the inclusion of real-world problem-based tasks, such as using a camera's zoom function, measuring heights using shadows, and performing map-based calculations that apply principles of similarity.

CONCLUSION

The praxeological organitation analysis of similarity tasks across four curricula KTSP, the 2013 Curriculum, the Revised 2013 Curriculum, and the Merdeka Curriculum-identified nine task types (T_1-T_9)) and corresponding techniques (τ_1- τ_9). exceeding the eight found in previous studies. Key differences lie in task classification, including the separation of side length and angle information, and the inclusion of tasks focused on right triangles and comparisons of corresponding elements. The topic of similarity also requires integration with other mathematical concepts such as arithmetic, ratios, proportions, trigonometry, and the Pythagorean theorem.

The decrease in task variety from KTSP to the Merdeka Curriculum indicates a shift toward a more focused and streamlined curriculum, likely aimed at reducing content load. This study contributes to mathematics education theory, particularly in teaching similarity, and offers practical insights for teachers, textbook authors, and policymakers in improving instructional materials and curriculum design.

This study is limited to a theoretical analysis of government-published junior high school mathematics textbooks covering similarity material across four curriculum periods. To gain a more comprehensive perspective, future research is recommended to include comparisons with textbooks from private/external publishers.

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