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Culturally Responsive Teaching to Support Meaningful Learning in Mathematics Primary School: A Content Analysis in Student's Textbook

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Abstract: This study aims to analyse and measure the mathematics textbooks used by elementary school students. The analysis examines how the aspects of Culturally Responsive Teaching (CRT) in the textbook support meaningful learning and the aspects of Pancasila student profiles, specifically the global diversity in the Independent Curriculum. This research adopted a descriptive qualitative approach with a content analysis technique. The data source consists of mathematics teaching materials from fourth-grade student textbooks published by the Ministry of Education and Culture. Data collection was conducted through observation and documentation. The analysis included the presentation of the material, consistency of the theme, consistency of learning outcomes, mathematics representation, and the three aspects of culturally responsive teaching. The results indicate that the contextual aspect of CRT is the most dominant in presenting meaningful learning. The CRT aspects in the textbooks, including explanations of concepts and examples of pictures presented, show that 8% are related to educational values, 11% to artefacts, and 81% to contextual meaning. The mathematics representation is appropriate for the theme and the learning outcomes. Therefore, the teachers must provide additional learning on CRT aspects still lacking in textbooks.

Keywords: culturally responsive teaching, meaningful learning, student's mathematics textbook

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Introduction

Society Era 5.0 represents a period of development that prioritizes the well-being of society with the support of technology. Its main objective is to find solutions to social problems that focus on human beings and simplify various aspects of people's lives (Hendarsyah, 2019). It must be supported by Quality Education, one of the United Nations' Sustainable Development Goals (SDGs). Improving educational quality entails ensuring that by 2030, all students have acquired knowledge and skills that promote sustainable development and cultural contributions (Riekmann, 2018; Mulà, 2009). It calls for meaningful learning to support the quality of education.

In meaningful learning, the learning environment is created around interesting and relevant things that students need and are familiar with in their surroundings (Polman et al., 2020). One crucial aspect of meaningful learning is to connect new concepts with students' prior knowledge (Vallori, 2014; Chambers, 2008). Therefore, the socio-cultural background of students becomes important to consider in education to achieve meaningful learning. As Saifer (2011) stated, culture not only reflects the way of life of a certain community but also influences how people learn, teach, and solve problems.

The importance of cultural aspects in supporting meaningful learning has received attention in Indonesia, leading to the emergence of the Independent Curriculum. Indarta et al. (2022) argue that curriculum development will be effective when it aligns with the needs and demands of the community. Addressing the cultural crisis in Indonesia requires immediate action, and one of the government's steps is the implementation of the Independent Curriculum. The Pancasila student profile is one of the characteristics distinguishing this curriculum from the previous one, emphasizing the strengthening of students' character. There are six aspects of the Pancasila student profile, namely, (1) faithful, God-

fearing, and having noble character, (2) cooperative, (3) embracing global diversity, (4) independent (5) having critical thinking, and (6) creative.

Realizing the importance of the Pancasila student profile in Indonesian children's education, the government has issued a policy to include the CRT approach as one of the topics in pre-service teacher education starting in 2022. However, only 20% of the students could implement their learning practices effectively. Most students only associate artefacts in implementing teaching practices with the CRT approach. Educational values and context are not given much attention in their learning process. Then, how can the textbooks use by student's support integrating the three cultural aspects in the CRT approach? For that, content analysis related to the textbooks must be conducted to determine whether they integrate one of the three cultural aspects in CRT.

Cultural-based mathematics learning is crucial in supporting the achievement of SDGs and the Pancasila student profile. Culture represents a specific society's behavioural patterns, becoming the distinct characteristic of that community, which means culture is an inherent aspect of human existence (Kohls in Wintergerst, 2011). Thus, CRT is one approach to education that aligns with meaningful learning. CRT emphasizes local cultures surrounding students, not just ancestral heritage (Nicol, Archibald, & Baker, 2013).

Culture and meaningful mathematics learning are two intertwined aspects because, fundamentally, mathematics is a notation of real life and human activity, both individually and socially (Cimen, 2014; Heuvel-Panhuizen, 2003). CRT seeks to make learning more relevant and effective for students by bridging their cultures and prior experiences, incorporating various ethnic activities (Bonner & Adams, 2012). CRT has three main dimensions: 1) the relevance of learning to students' cultural backgrounds, 2) student communities in building knowledge, and 3) reflection on perspectives in social justice and challenging assumptions (Ebersole et al., 2016). Mathematics learning should also consider the educational values behind the concepts, not just focus on arithmetic skills and problem-solving (Seah et al., 2016). CRT adopts the concept of integrated culture, including values, context, and artefacts.

Because mathematics is closely related to students' social and cultural environment, mathematics learning will become meaningful if presented with a CRT approach. Facing the cultural crisis in Indonesian children, educators must pay attention to all aspects that support their learning, including the students' textbooks. The alignment between mathematics learning competencies and themes or sub-themes regarding how student textbooks support CRT to achieve meaningful learning must be considered.

Methods

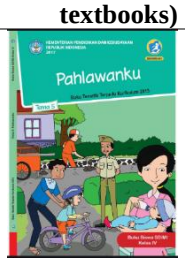
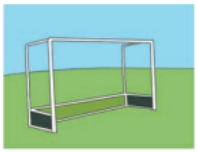
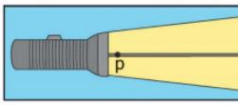
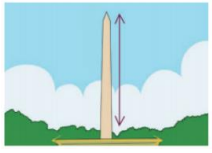
This research adopted a descriptive qualitative approach with a content analysis technique. The data source consisted of mathematics teaching materials from the 4th-grade student textbooks, focusing on theme 5, "My Heroes," published by the Ministry of Education and Culture. Data collection was conducted through observation and documentation. The analysis includes the presentation of the material, consistency of the theme, consistency of learning outcomes, mathematics representation, and the three aspects of culturally responsive teaching.

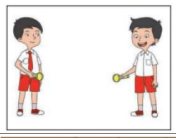
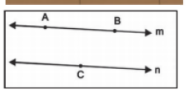
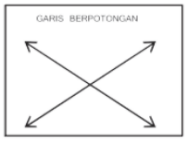
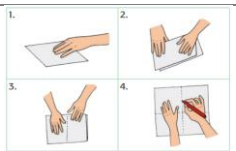
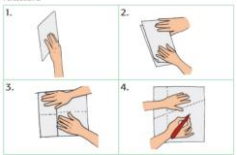
Results and Discussion

Learning mathematics will be meaningful and remain in students' memory if it is associated with the student culture and social justice experience (Aronson & Laughter, 2016). In this study, the culture based RME learning approach provides meaningful learning and improves student CRT skills. Learning depends on contexts, cultures, and social factors. CRT in mathematics education enables students to comprehend why mathematics is essential to their lives (Thomas & Berry III, 2019). Learning mathematics by adapting to students' culture will enhance their knowledge of culture and help them understand mathematics concepts easily (Averill et al., 2009). Applying these CRT aspects makes meaningful learning possible because students feel engaged and connected to the material, and the relevance of the learning increases. It can result in deeper and more meaningful learning experiences for students, helping them develop a more comprehensive understanding of the world and enhancing their social and cultural skills.

Table 1 below is the result of content analysis from grade 4 elementary school students' books in terms of the presentation of mathematical concepts from the textbook, consistency of the theme, consistency of learning outcomes, mathematics representation, and the three aspects of culturally responsive teaching, namely educational value, contextual, and artefact.

Table 1. Content Analysis of Theme 5 in Fourth-Grade Student Textbooks in Contextual Aspect

No	Presentation (Page in the textbooks)	Consistency of the Theme	Mathematics Representation	Contextual
1	 cover	The cover fits the theme: "My Heroes". Here, heroes mean the war heroes, mothers, fathers, and even the cleaning service. They all are heroes with their responsibilities.	Some images that appear are examples of lines and line segments, such as roads, windows, carts, and even bicycle wheel spokes.	Images with the context of the heroes around us
2	 page 16	This traffic sign is a hero for us to ride on the road safely.	This image is an example of a line.	Traffic signs are in the form of two lines.
3	 page 16	Goals were scored by a hero from his team.	This image is not an example of a line but a segment.	A soccer goal is very close to the student's life, especially for boys.
4	 page 16	Directions are heroes when we get lost.	This image is not an example of a line but a segment.	The direction sign is around the students.
5	 page 16	The hand is our hero. It helps us do anything, like writing, holding, or even saying “hi.”	This image is not an example of a line but a segment.	Our fingers can relate to the term finger joints.
6	 page 16	Hero for plants in photosynthesis.	This image is not an example of a line but a segment.	The leaf bone describes the segment well.
7	 page 17	Hero in the dark.	A flashlight is a good example of a ray. There is a starting point. The other point keeps on going.	A flashlight is a good example of a ray.
8	 page 19	Hero in characterizing a place.	The line symbol next to the image should be a segment symbol, not a line with arrows in both directions.	A monument is an example of a line segment around the students.

9	 	Playing the flashlight is a hero in giving examples of intersecting and parallel lines.	A flashlight is a good example of a ray. It explains parallel and intersection rays.	Students also like this activity, learning by playing with a flashlight.
10	  page 34	A wall as an example of a line. Walls of a dwelling as a hero in providing security and warmth.	Line symbols are written correctly, but a wall is not right as an example of a line. This example is more appropriate for line segments.	Wall of the house with parallel segment around the students.
11	  page 34	This traffic sign is a hero for us to ride on the road safely.	The symbol for two intersecting lines is correct, even though the example image is intersecting and perpendicular.	Traffic signs as a form of intersection lines.
12	 page 34	Heroes for air ventilation and sunlight into the house.	The image is an example of intersection and perpendicular lines.	Students often find windows with this model.
13	 page 34	Heroes for railway transportation.	The image is an example of intersection and perpendicular lines.	Railroads are a good example of intersecting lines and are close to student life.
14	 page 43	Heroes in sports.	The image is an example of intersection and perpendicular lines.	The strings on a racket are good examples and easy to understand for students as examples of intersecting lines.
15	 page 66	Heroes help students understand perpendicular lines.	Practice finding the perpendicular line.	Discovering the nature of the lines by students' selves through paper folding is joyful learning.
16	 page 68	Heroes to help students understand intersecting lines	Practice finding the intersecting line.	Discovering the nature of the lines by students' selves through paper folding is joyful learning.
17		A safe road intersection has traffic lights and heroes in avoiding accidents.	The image is an example of an intersection and perpendicular lines. It is a correct example. A road is a line that can be extended in both directions.	The students easily understand perpendicular and intersecting lines using this contextual image.

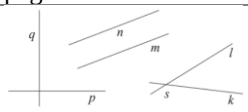
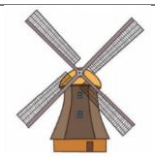
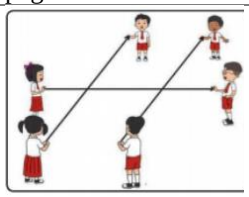
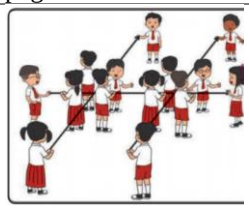
	page 69			
18	 Give an example in everyday life of how the line is formed. page 81	Open-ended questions heroes in making students engaged in meaningful learning	Practice to find parallels, intersecting lines and perpendicular lines in student life. But The symbol of the line should have arrows in both directions.	Practice to find parallels, intersecting lines and perpendicular lines in student life. It is meaningful learning.
19	 page 86	Heroes in the utility of the windmill.	The image is an example of intersection and perpendicular lines. To be precise, it is a segment.	The windmill is a familiar object to the students.
20	 page 104	Heroes in enlivening students' social spirit.	The image is an example of intersection and perpendicular lines. To be precise, it is a segment.	The students like this activity, learning angle by playing with a rope.
21	 page 105	Heroes in building students' social spirit.	Students learn about corresponding angles and vertical angles.	The students like this activity, learning angle by playing with a rope.

Table 2. Content Analysis of Theme 5 in Fourth-Grade Student Textbooks in Artefact Aspects

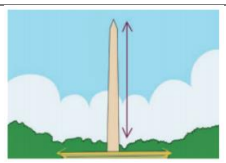
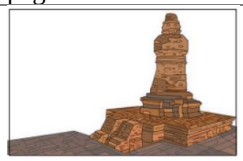
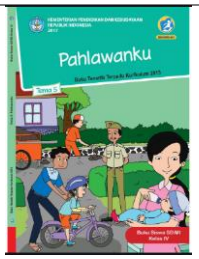
No	Presentation	Consistency of the Theme	Mathematics Representation	Artefact
1	 page 19	The monuments are a symbol to commemorate the struggles of the heroes.	The line symbol next to the image should be a segment symbol, not a line with arrows in both directions.	A monument is an artefact that can exemplify a line segment.
2	 page 31	Sriwijaya, the largest maritime kingdom in the Nusantara during its time (8th to 11th century), was a hero in unifying several regions of Indonesia.	The students are asked to write down two sample lines from this image. It should be two samples of line segments, not lines.	Muara Takus temple is an artefact from the Sriwijaya kingdom.
3	 page 86	Windmills are heroes in generating wind power electricity.	The image is an example of intersection and perpendicular lines. To be precise, it is a segment.	These artefacts were well known in the Netherlands.

Table 3. Content Analysis of Theme 5 in Fourth-Grade Student Textbooks in Moral Value Aspects

No	Presentation	Consistency of the Theme	Mathematics Representation	Value
1	 cover	The cover fits the theme: "My Heroes". Here, hero means war heroes, mothers, fathers, and even the cleaning service. They all are heroes with their responsibilities.	Some images that appear are examples of lines and line segments, such as highways, windows, carts, and even bicycle wheel spokes**.**	The educational value is implied from the image. We should appreciate and respect every hero in our surroundings, and their kindness should be repaid with even greater kindness
2	Text: *Have you had a good spirit for learning?* page 21	Matching the theme, King Purnawarman is a hero from the Tarumanegara kingdom who always fought tirelessly for the welfare of his people, such as by improving the flow of the Ganges River for the benefit of all the people.	In learning mathematics, a strong learning spirit is needed. A disciplined attitude in studying and practising extensively will lead to success in understanding various mathematical concepts.	Following the character of King Purnawarman, namely the spirit of spirit and love of its people.

Based on Tables 1, 2, and 3 on content analysis of the three cultural aspects (contextual, artefacts, and values), all mathematical concepts represented in the student book "My Heroes" align with the desired competencies. The alignment with the theme is also evident, although some are implicit (not directly stated). The recurring error in mathematical concepts is in providing examples of a line and a segment. Some picture examples accurately represent a line, such as the traffic sign at a road intersection and its symbol on page 34, the train track image, and the road intersection image on page 69. However, some images mentioned as lines are examples of line segments, such as a picture of a wall, a racket string, folded paper, windmills, and strings played by children. Inconsistency also arises when depicting symbols for lines and line segments. On page 44, the symbol for a line is correct, with arrows pointing in both directions. However, on page 81, the line symbol is depicted without arrows. Another error is the example of a child holding a string, which is a line segment, but the symbol written on its left side is the symbol for a ray, which is more appropriate for a picture of a child holding a flashlight, as shown in Figure 1 below.

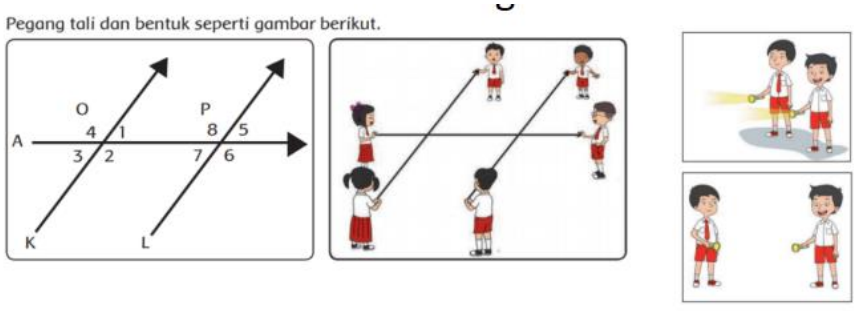
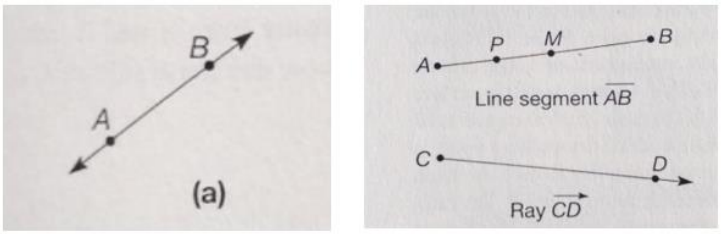


Figure 1. The Misconception in The Student Textbook About "Ray and Line Segment."

In mathematics learning in this student textbook, theme 5 discusses lines, line segments, and rays. It is important to make students understand the concepts, symbols, and examples of their correct usage in everyday life and differentiate these three terms correctly.



(a) (b)

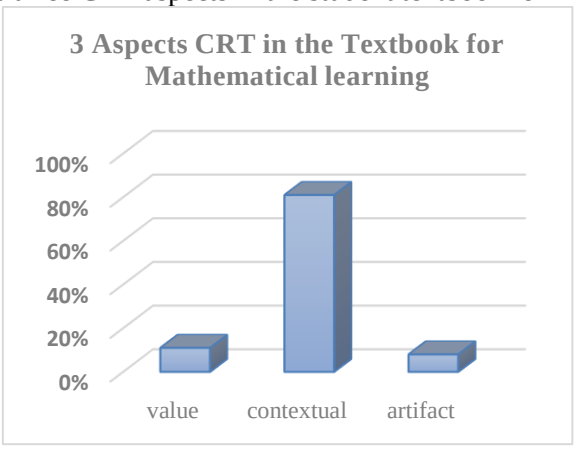
Figure 2. The Symbols for A Line (a), A Line Segment, and A Ray (b)

In a line, arrows in both directions indicate that it can be extended infinitely in both directions. For a line segment, there is only one arrow at one end, while the other end does not have an arrow, meaning the line segment cannot be extended (Musser et al., 2008). So, the example used in Figure 1, where some children hold strings, is an example of a line segment, as the length of the string is definite. The symbol of the string written on the left side of the picture is the symbol for a ray, whereas it should be the symbol for a line segment.

The student book has provided various examples of diverse mathematical concepts that are suitable for elementary school students' characteristics, such as pictures of children playing with strings or flashlights and other objects found in the students' surroundings. Mathematics learning that is connected with students' culture and social experiences will be meaningful and will be retained in students' memory for a longer time (Aronson & Laughter, 2016).

Indeed, it can be said that this book supports meaningful learning as demonstrated in CRT with its three aspects: values, context, and artefacts. CRT in mathematics learning empowers learners to appreciate why mathematics is important in their lives. By incorporating examples and concepts relevant to the student's culture and experiences, the book enhances the meaningfulness of the learning process and fosters a deeper understanding of the subject. Moreover, the book's focus on the student's context and cultural background helps create a more inclusive and engaging learning environment, making mathematics more relevant and relatable to their everyday lives (Thomas & Robert Q. Berry III, 2019). Table 4 below shows that the contextual aspect is the most dominant CRT aspect in mathematics learning in the student textbook theme 5 for grade 4 elementary school, accounting for 81%. Next is the artefact aspect, which is 11%, although this number is much lower than the contextual aspect. Lastly, the value aspect accounts for 8%. However, in other subjects, several lessons are related to educational values.

Table 4. The scores of the three CRT aspects in the student textbook for mathematics learning



Unfortunately, the value aspect occupies the lowest position among the three cultural aspects, considering that the core of education is the transmission of values. It serves as a message to primary school teachers to incorporate educational values behind their mathematics materials. By doing so, they can help instil important life values and ethics in their students while teaching mathematics. Integrating values in the learning process can lead to a more holistic and meaningful education for the students.

Conclusion

The conclusion that can be drawn from the findings and discussions is that textbooks greatly support meaningful learning. The contextual aspect of CRT is the most dominant in presenting meaningful learning in student textbooks. However, educational values and artefacts are still lacking in enriching mathematics learning in the textbook. Educational values become crucial in developing the Pancasila Student Profile in students' character. The most important aspect of the content analysis results is that there are still some errors in providing examples of concepts of lines, rays, and line segments in everyday life, as well as incorrect representation of symbols for those three mathematical concepts. Therefore, teachers should have multiple sources to provide examples of mathematical concepts to avoid misconceptions.

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