Jurnal Gantang X (1) (2025): 105-118

JURNAL GANTANG

e-ISSN: 2548-5547
p-ISSN: 2503-0671

http://ojs.umrah.ac.id/index.php/gantang/index

A comparative analysis of Indonesian and Indian mathematics textbooks on circles for secondary schools

Trisna Wulandari, Cecil Hiltrimartin*, Ely Susanti

Universitas Sriwijaya, Palembang, South Sumatra, 30662, Indonesia
*Corresponding Author : cecilhitrimartin@fkip.unsri.ac.id

Submission: May 1st 2025; Accepted: May 24th 2025; Published: May 31st 2025
DOI: https://doi.org/10.31629/jg.v10i1.7170

Abstract

Students' understanding of the concept of circles is still low, which can be influenced by differences in presentation in textbooks between countries and curriculum. Therefore, this study aimed to analyze by comparing the material and questions on the topic of circles in Indonesian and Indian mathematics textbooks in terms of facts, concepts, principles, cognitive levels, PISA framework, and problem-solving questions. This study was conducted using a descriptive-comparative method with a qualitative approach. The objects of this study were Indonesian mathematics textbooks Merdeka Curriculum for grade XI and Curriculum 2013 for grade VIII, as well as Indian mathematics textbooks for grade X. The results showed that the three books had different focuses in delivering the material. Indian books emphasized formal proofs and geometric visualizations and included exploratory activities based on practice. Indonesian books, Curriculum 2013, focused more on contextual activities and gradual discovery of concepts, while Merdeka Curriculum books emphasized conceptual understanding through an exploratory and reflective approach. The questions in the Merdeka Curriculum book are more cognitively diverse, in line with the PISA framework and Polya's problem-solving stages. This finding is essential for developing adaptive textbooks that support higher-order thinking and 21st-century mathematical literacy.

Keywords: comparative analysis; mathematics textbook; circle; PISA; problem solving

How to cite: Wulandari T., Hiltrimartin, C. & Susanti, E. (2025). A comparative analysis of indonesian and indian mathematics textbooks on circles for secondary schools. *Jurnal Gantang, 10(1),* 105 – 118. https://doi.org/10.31629/jg.v10i1.7170

I. Introduction

Mathematics is a basic science that significantly contributes to forming logical, critical, and systematic thinking skills in students (Firsta & Susanti, 2024; Ristiyana, Botutihe & Kurniawan, 2024). One of the important topics in the branch of geometry taught at the secondary level is the circle (Jannah & Budiman, 2022). This material covers radius, diameter, central angle, circumference angle, tangent, and various relevant geometric theorems (Weniarni, 2022). Understanding the concept of a circle is important in supporting the learning of advanced topics such as trigonometry, geometric transformations, and calculus. Therefore, the

concept of the circle must be understood comprehensively.

To achieve a comprehensive understanding, quality learning resources are needed, including textbooks (Nufus & Fitraini, 2024; Ramadhona, Siregar & Alpindo, 2023; Triansyah et al., 2023). Textbooks act as the main media in learning mathematics in schools, not only as a source of teaching materials but also as a means of conveying the philosophy and curriculum approach (Ramadhona et al., 2023; Vinnervik, 2023). In Indonesia, the change in curriculum from the 2013 Curriculum to the Merdeka Curriculum reflects a change in educational orientation from content-centered to contextual learning and oriented toward understanding concepts and developing 21st-century student competencies (Rahmadani, Lestari, Syafira, Inayah & Pratiwi, 2025). On the other hand, India, through the National Curriculum Framework (NCF), has also developed national textbooks that emphasize exploratory and activity-based learning.

However, empirical data shows students' understanding of circles is still relatively low (Elyana, Astutiningtyas & Susanto, 2023; Muharrom & Kadarisma, 2022). Many students struggle to solve problems related to tangents or angles in a circle. This is often caused by weak conceptual understanding and limited geometric visualization (Sitorus, Hutape & Anggraini, 2021; Umami & Asdarina, 2024). In addition, these difficulties are often also influenced by inaccuracies and limitations in textbooks, such as conceptual errors, unclear explanations of principles, and non-representative examples of questions (Anggriana, Karim & Rahmawati, 2024).

Several previous studies have examined the evaluation of mathematics textbooks from various aspects, such as the suitability of the content to the national curriculum, the level of mathematical literacy based on the PISA framework, and the cognitive level of questions according to Bloom's Taxonomy (Anifarka & Rosnawati, 2023; Wahyuni, Nurisma, Mardiya, 2023). However, studies that specifically compare the presentation of circle material between textbooks from two countries with different curriculum systems and educational cultures are still minimal, such as between Indonesia and India. This gap is important because cross-country comparisons can provide broader insights into how different approaches to delivering mathematics material can affect students' understanding. In addition, not many studies deeply analyze how the structure of the presentation of facts, concepts, principles, and types of questions in textbooks contributes to developing students' high-level thinking skills and mathematical literacy.

This study aims to analyze and compare the presentation on the topic of circles in three secondary mathematics textbooks, namely the Mathematics Textbook Curriculum 2013 for grade VIII and the Mathematics Textbook Merdeka Curriculum for grade XI from Indonesia, as well as the Mathematics Textbook for grade X from India. The analysis covers facts, concepts, principles, cognitive levels of questions, the PISA framework, and problem-solving questions. This analysis is expected to provide input for curriculum developers and textbook writers in improving the quality of the presentation of circle material that is contextual and conceptual and encourages students' high-level thinking skills.

II. Research Method

This study employed a qualitative approach using a descriptive-comparative method, which was considered appropriate for examining similarities and differences in the presentation of mathematical content across textbooks from different educational systems. The qualitative design allowed for an in-depth analysis of how circle-related content is structured, delivered, and assessed without relying on numerical or statistical generalizations.

The analysis focused on six key aspects: facts, concepts, principles, cognitive levels of questions, alignment with the PISA framework,

and problem-solving components. Each aspect was operationalized through document analysis. Facts, concepts, and principles were identified based on how definitions, examples, and theorems were presented and explained in the text. Coding was conducted using a deductive content analysis approach, referencing predefined categories informed by curriculum standards.

To categorize cognitive levels of questions, Bloom's Revised Taxonomy (Anderson & Krathwohl, 2001) was applied, encompassing six domains: remembering (C1), understanding (C2), applying (C3), analyzing (C4), evaluating (C5), and creating (C6). For the PISA framework alignment, the analysis followed OECD's PISA 2021 Mathematics Framework, assessing each textbook in terms of content (e.g., space and shape), context (personal, societal, occupational, scientific), and mathematical process competencies (formulating, employing, interpreting).

Problem-solving components were analyzed using Polya's four-step model: understanding the problem, devising a plan, carrying out the plan, and reviewing the solution.

These indicators guided the classification of problem types and the depth of reasoning required in student tasks.

This study's objects are Indonesian mathematics textbooks, the Merdeka curriculum, and the 2013 curriculum, as well as Indian mathematics textbooks. Table 1 below presents information related to the research objects used in this study.

Table1. Research object

No	Country	Book	Curriculum
1	Indonesia	Susanto, D., et al. 2021. *Matematika untuk SMA/SMK Kelas XI.* Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi.	Merdeka Curriculum
2	Indonesia	As'ari, A. R., et al. 2017. *Matematika untuk SMP/MTs Kelas VIII Semester 2.* Pusat Kurikulum dan Perbukuan Kementrian Pendidikan dan Kebudayaan.	2013 Curriculum
3	India	NCERT. (2022). *Mathematics Textbook for Class X.* National Council of Educational Research and Training.	*National Curriculum Framework* (NCF)

This research procedure uses a descriptive-comparative method with a qualitative approach to the Merdeka Curriculum mathematics textbooks, the 2013 Curriculum mathematics textbooks, and Indian mathematics textbooks, as shown in Figure 1 below.

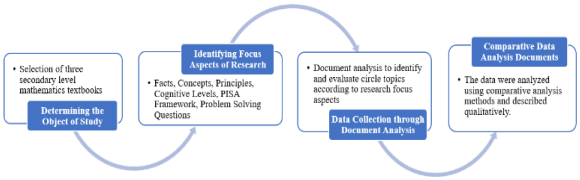


Figure 1. Research procedure

Figure 1 presents the research procedure consisting of four main stages: (1) selecting textbooks as research objects, (2) combining aspects of analysis including facts, concepts, principles, cognitive levels of questions, suitability to the PISA framework, and problem-solving, (3) data coding process based on predetermined categories, and (4) compiling thematic comparison results.

This study began with selecting three secondary-level mathematics textbooks

containing topics on circles, namely two from Indonesia (the 2013 Curriculum and the Merdeka Curriculum) and one from India (NCF). Document analysis was then conducted on these textbooks to identify and evaluate how circle content was presented in line with the focus of the study. Data were collected through a comparative document analysis method and examined qualitatively using a content analysis approach. This method enabled the researchers to explore similarities and differences in the formulation of concepts, instructional approaches, content structure, and application contexts related to circles in each textbook.

The analytical components in this study included chapters or subchapters discussing circle topics, explanations of concepts and principles, and related practice questions. The analysis was conducted manually without software, guided by a predefined framework. The categories referenced Bloom's Revised Taxonomy to classify the cognitive levels of questions and the OECD's 2021 PISA Mathematics Framework to assess content alignment, contextual relevance, and process competencies in mathematical literacy.

III. Results and Discussion

Facts, Concepts, and Principles Aspects

The first aspect analyzed is the comparison of facts, concepts, and principles from the Independent Curriculum, 2013 Curriculum, and Indian Book mathematics textbooks presented in Table 2 below.

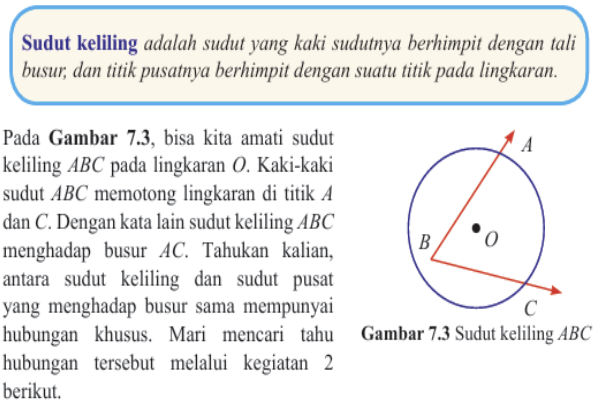
Table 2. Comparison of facts, concepts, and principles

Aspect	Merdeka Curriculum Book	2013 Curriculum Book	Indian Book
Fact	Facts are presented through real contexts such as bicycle wheels, sewer covers, and lighthouses. Using narrative and exploratory approaches. Terms such as central angle, circumference, tangent, and chord quadrilateral are associated with real situations.	Facts present the definition of a circle, radius (r), diameter (d), arc, central angle, and circumference angle directly. Visualization of facts is limited to text-dominant and procedural.	Facts are introduced through practical experiments, such as using wire to make a circle. It emphasizes visualization and experiential understanding, such as the definition of the center point, radius (r), and tangent, which is proven through experiments.
Concept	Concepts are developed through exploration and reflection activities. Students are guided to find relationships between concepts using tools such as GeoGebra.	Concepts are explained through definitions and applications in problems. Relationships between concepts (central and circumference angles) are not explicitly demonstrated.	Concepts are explained step-by-step and in-depth. A deductive approach is used to develop understanding through proof and illustration.
Principle	Principles are discovered through exploration, but not all are formally derived. Some proofs are visual.	Principles such as "circumferential angle = ½ central angle" and "radius perpendicular to tangent" are stated without proof. Not all principles are concluded with conclusions.	Principles are presented with deductive mathematical proofs, such as the theorem of two tangents from an external point and the relationship between central angles and circumference.

Based on the comparative analysis of the three books, it can be seen that the presentation of facts, concepts, and principles from the Merdeka curriculum book, the 2013 curriculum book, and the Indian book have different characteristics in their presentation related to the material on circles. The Merdeka Curriculum book offers a more contextual and exploratory

approach, introducing concepts through trigger questions and reflective activities. Facts and concepts are reinforced with everyday narratives and visual aids such as GeoGebra. However, several important mathematical principles have not been explicitly drawn as conclusions, and mathematical symbolization is not always consistent, such as in writing angles, arcs, and tangents. The 2013 Curriculum book displays procedural material focusing on formulas and direct application. Facts are written directly in the text without much real-life context. Few activities lead students to discover concepts independently, and principles are presented descriptively without formal proof. Meanwhile, the Indian book strengthens the deductive and exploratory approach with theorem proofs and practice-based activities. Facts, concepts, and principles are presented in stages, supported by straightforward illustrations. However, some parts still require teacher guidance to avoid misconceptions due to dense narratives or complex diagrams.

The Indonesian Mathematics textbook for the 2013 Curriculum contains factual errors in its presentation, as shown in Figure 2 below.



Sudut keliling *adalah sudut yang kaki sudutnya berhimpit dengan tali busur, dan titik pusatnya berhimpit dengan suatu titik pada lingkaran.*

Pada **Gambar 7.3**, bisa kita amati sudut keliling *ABC* pada lingkaran *O*. Kaki-kaki sudut *ABC* memotong lingkaran di titik *A* dan *C*. Dengan kata lain sudut keliling *ABC* menghadap busur *AC*. Tahukan kalian, antara sudut keliling dan sudut pusat yang menghadap busur sama mempunyai hubungan khusus. Mari mencari tahu hubungan tersebut melalui kegiatan 2 berikut.

Gambar 7.3 Sudut keliling *ABC*

Figure 2. Factual errors in the 2013 curriculum textbook

The image above is on page 72 in activity 7.2; fact errors in the 2013 curriculum mathematics textbook, such as Figure 2, lie in errors in the presentation of geometric facts, which are still visually incorrect and do not match the definition. Based on the definition explained directly in the book above, the picture states, "A circumferential angle is an angle whose legs coincide with a chord, and whose center point coincides with a point on the circle." Meanwhile, in the picture, point B, as the center point of the circumferential angle ABC, does not coincide with a point on the circle or is not on the circumference of the circle. So, as a geometric fact, if you look at the picture, angle ABC $(\angle ABC)$ is not a circumferential angle if point B is not on the circle.

This can give rise to the misconception that circumferential angles can be formed from points outside the circle. As a result, students have the potential to fail to distinguish between the central angle and the angle of the circumference, experience confusion in solving visual problems, and are more likely to memorize formulas without fully understanding the geometric concept. This can also hinder their ability to understand the relationship between angles in a circle and construct logical arguments. This error can be corrected by changing the image according to the definition of the circumferential angle with point B on the circle, as in Figure 3 below.

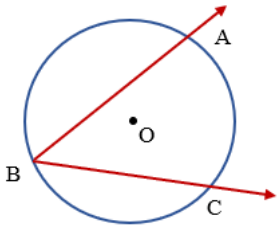


Figure 3. Improvement of factual images of 2013 curriculum textbooks

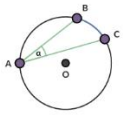
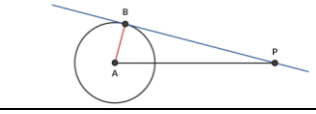
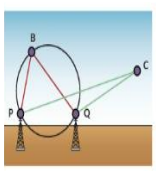
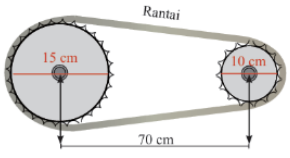
As a correction to the error, Figure 3 presents a geometrically correct illustration, where the vertex of the circumference angle lies precisely on the arc of the circle. This illustration clearly shows two chords forming an angle with the meeting point on the circumference of the circle, according to the definition of the circumference angle. This image is not only corrective but also an effective visual aid in strengthening students' conceptual understanding. By seeing an accurate visual

representation, students can more easily build connections between verbal definitions and actual geometric shapes. In addition, this kind of illustration is also important in visual-based learning, especially for students with a spatial learning style, so that understanding of geometric concepts is not merely symbolic or procedural but also intuitive and applicable.

Cognitive Level Aspects of Questions

The second aspect analyzed is comparing the questions presented in terms of cognitive level from the Independent Curriculum, 2013 Curriculum, and Indian Book mathematics textbooks in Table 3 below.

Table 3. Cognitive level comparison

Level	Independent Curriculum Book	2013 Curriculum Book	Indian Books
C1 Remember	Appears at the beginning of the chapter in a narrative or reflective question format, such as naming the parts of a circle in the "Let's Remember" activity. 2. Titik O disebut apa untuk bangun datar tersebut? 3. Jarak 2 cm itu disebut apa bagi bangun datar tersebut?	Questions ask students to name elements of a circle, such as radius, diameter, and angle names. They are direct and definitional. Sudut yang terbentuk antara diameter dengan garis singgung lingkaran adalah .... A. lancip C. tumpul B. siku-siku D. tidak pasti	Dominant in early practice. Asking for definitions, names of circle parts, and basic properties explicitly. How many tangents can a circle have? Fill in the blanks : (i) A tangent to a circle intersects it in _____ point (s). (ii) A line intersecting a circle in two points is called a _____. (iii) A circle can have _____ parallel tangents at the most. (iv) The common point of a tangent to a circle and the circle is called ...
C2 Understand	In exploration activities, students are asked to describe the results of visual observations to demonstrate an understanding of central angles and their relationship to circumference angles. Ini adalah Kasus 3 dari bukti Eksplorasi 2.1.  a. Gambarkan sudut pusat yang menghadap ke busur yang sama dengan sudut keliling $\angle BAC$. b. Apakah pada lingkaran berikut juga berlaku bahwa sudut pusat besarnya dua kali lipat sudut keliling? Buktikan.	The questions ask students to respond to their understanding of the definition of circle elements such as diameter and center point. "Is the intersection of two diameters always at the center point?" (Question No.4 Essay 7.1).	The questions ask students to conclude or explain the results of experiments on circles and tangents. Activity 3 : Draw a circle on a paper. Take a point P inside it. Can you draw a tangent to the circle through this point? You will find that all the lines through this point intersect the circle in two points. So, it is not possible to draw any tangent to a circle through a point inside it [see Fig. 10.6 (i)].
C3 Applying	There are applications in real-world contexts, such as calculating the length of a tangent line by directly applying the Pythagorean theorem. Jika jari-jari lingkaran A adalah 7 cm dan titik P berjarak 25 cm dari titik A, berapakah panjang garis singgung $\overline{PB}$? 	The question asks whether to apply the formula for the tangent line of the external common of two circles. Diketahui dua lingkaran berbeda. Jari-jari lingkaran pertama adalah 15 cm, sedangkan jari-jari lingkaran kedua adalah 8 cm. Jika jarak pusat kedua lingkaran tersebut adalah 25 cm, maka panjang garis singgung persekutuan luar kedua lingkaran tersebut adalah ... cm A. 23 cm C. 25 cm B. 24 cm D. 26 cm	Used in student experiments, such as drawing two tangents from an external point and calculating their lengths. Example 3 : PQ is a chord of length 8 cm of a circle of radius 5 cm. The tangents at P and Q intersect at a point T (see Fig. 10.10). Find the length TP.
C4 Analyze	It appears in the "Let's Think Critically" section, which asks students to analyze by comparing two geometric situations.  Pelajari sudut yang dibentuk antara cahaya dari kedua mercusuar ($\angle PCQ$) jika kapal berada di luar lingkaran/pada lingkaran/di dalam lingkaran. Menurutmu, informasi apa yang perlu diketahui kapten kapal tentang lokasi ini untuk memastikan kapalnya tidak kandas?	Some questions ask you to analyze the given information to determine the elements of a circle. Diketahui jarak pusat sumbu gir pada sepeda X adalah 70 cm. Jika diameter gir belakang 15 cm, dan gir depan 10 cm, maka taksiran terdekat panjang rantai penghubung kedua gir tersebut adalah .... A. 48 cm C. 140 cm B. 69 cm D. 220 cm 	Some questions challenge students to analyze experimental images' geometric conditions and conclude the line length. A triangle ABC is drawn to circumscribe a circle of radius 4 cm such that the segments BD and DC into which BC is divided by the point of contact D are of lengths 8 cm and 6 cm respectively (see Fig. 10.14). Find the sides AB and AC.

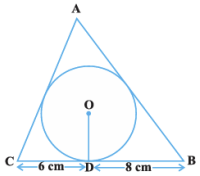
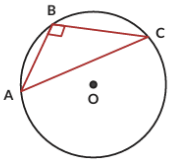
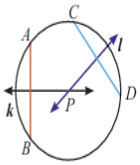


Fig. 10.14

C5 Evaluate	It is in a reflective form, such as evaluating the results of exploration, explaining why an angle forms a right triangle, and determining whether there are any visual errors based on understanding. Apa yang salah pada gambar berikut? 	It only appears in openreflections at the end of the chapter, such as evaluating the truth of the situation and its reasons. Perhatikan gambar di samping. Garis k adalah garis sumbu tali busur AB. Garis l adalah garis sumbu tali busur CD. Titik P adalah perpotongan garis sumbu k dan l. Benarkah perpotongan kedua garis sumbu tersebut tepat di titik pusat? Jelaskan. 	Rarely appears explicitly. Evaluation is usually implied such as assessing the relationship between lines and angles. To be questioned more to evaluate whether the given statement is valid from the proof. "Prove that the perpendicular at the point of contact to the tangent to a circle passes through the center" (No.5 Exercise 10.2).
C6 Create	Several open-ended tasks exist, such as creating variations of circle construction or creating contextual problems, such as asking students to design their procedures or methods based on previous geometric principles and aids. 	A question asks you to make a circle and a sector that passes through 3 specified points. Diketahui 3 titik berbeda A, B, dan C tidak segaris. Buatlah lingkaran yang melalui 3 titik tersebut.  Diketahui 3 titik berbeda A, B, dan C tidak segaris. Buatlah juring setengah lingkaran yang melalui 3 titik tersebut. 	There are no explicit questions at the creating level. The primary focus is on proof and observation. There are questions that ask you to draw circles from several understood concepts. "Draw a circle and two lines parallel to a given line such that one is a tangent and the other a secant to the circle."

Analysis of the questions in the three textbooks based on the division of cognitive domains: remembering (C1), understanding (C2), applying (C3), analyzing (C4), evaluating (C5), and creating (C6). (Araiku, Sidabutar & Mairing, 2019) show that most of the questions on the circle material are still dominated by low cognitive levels, especially in category C3 (Applying). These questions focus on identifying the elements of a circle, using the circumference and area formulas and tangents, and solving procedural questions. The analysis results of questions in the Merdeka curriculum book show 7%: C1, 12%: C2, 35%: C3, 26%: C4, 9%: C5, and 11%: C6. The Merdeka Curriculum book is more varied. In addition to presenting questions at levels C1–C3, this book begins to present exploratory and reflective questions in activities such as Let's Explore, Let's Think Critically, and Let's Be Technological, which lead to levels C4 (Analyze) to C6 (Create). Although not yet dominant, efforts to encourage high-level thinking skills are already visible. The 2013 Curriculum book is dominant in C3–C4 questions with an instructional approach, namely 44,7%: C3 and 28,3%: C4. Questions C5–C6 are almost non-existent, so they do not support the development of high-level thinking skills such as evaluation and creation. Meanwhile, the Indian book has a relatively even distribution of questions at levels C1–C4, dominated by

questions at level C3 by 35%. The questions are primarily based on experimental activities and geometric proofs, encouraging in-depth understanding and analysis of concepts. However, like the other two books, levels C5 (Evaluating) and C6 (Creating) have not appeared explicitly in the form of open-ended questions or projects, but some questions already show the levels of C5 and C6, such as questions that ask to assess the truth of statements and prove them.

Overall, these results indicate that despite the variation in approaches between textbooks, there is still a need to increase the number and quality of questions that encourage higher-order thinking skills (HOTS), especially at analysis, evaluation, and creation levels. This is important to prepare students to face the challenges of the 21st century that emphasize contextual problem-solving, critical thinking, and innovation, which are important notes for textbook compilers.

PISA Framework Aspects

The third aspect analyzed compares the PISA framework in the Merdeka Curriculum mathematics textbook, the 2013 Curriculum, and the Indian Book. PISA is an international assessment organized by the OECD (Organization for Economic Co-operation and Development) since 1997, which is carried out every 3 years (Bybee, Mccrae & Laurie, 2009; Özaydin & Arslan, 2022). PISA aims to measure how far students are prepared to face the challenges they will go through in the future by solving real-life problems (Almarashdi & Jarrah, 2023). PISA focuses on three core topics: reading, mathematics, and science (Rusmana, 2019). There are three components of PISA, namely content, context, and process competencies (Fitria, Ubaidah & Basir, 2025). A comparison of the three books in terms of PISA aspects is shown in Table 4 below.

Table 4. PISA framework comparison

PISA Components	Independent Curriculum Book	2013 Curriculum Book	Indian Books
Content (Space and Shape, Quantity, Change and Relationship, and Uncertainty and Data)	There is quite a lot of contextual content in this book: geometry, angle relationships, quadrilaterals, and bowstrings that tend to space and shape. Quantity, uncertainty data, and change and relationship are only supporting content.	This book's main focus is on geometry (circles), tending towards space and shape. It covers elements, angles, sectors, and tangents but is not much related to data/statistics or functions.	In this book, the content of Space & Shape is very dominant, in-depth on tangents and proofs. However, there is no content on quantity, uncertainty data, change, or relationship.
Context (Personal, Occupational, Societal, Scientific)	**The many contexts include personal (wheel), occupational (navigator, garden lights), societal (gutter cover), and scientific (horizon, viewpoint).**	**Personal(plates, music), Occupational (carpenter, archaeologist), and Societal (Borobudur Temple). Meanwhile, Scientific is less explored.**	**Dominant abstract and academic presentation. Focus on pure concept exploration, so minimal real-world context.**
Process Competence (Formulating, Employing, Interpreting)	Very complete: - **Formulation**, formulating real situations such as lighting angle and viewing distance. - **Employing** and using theorems and visualizations.	**The formulation** is quite good and is employed routinely. Meanwhile, interpreting is still minimal, and the question is rarely asked, "What does it mean?"	Tends to employ and formulate proofs. Interpreting is rarely associated with real-world meaning.

	Interpreting, interpreting results, critical reflection, and arguments.	

Based on the analysis of three mathematics books on the topic of circles, namely the 2013 Curriculum Book, the Indian NCF Book, and the Merdeka Curriculum Book, it can be concluded that each book's suitability level to the PISA Framework shows significant differences. The Merdeka Curriculum Mathematics Book shows the highest suitability with the PISA approach. This book presents circle material contextually and interactively, with real-life examples such as bicycle wheels, gutter covers, and ship navigation. Students are invited to formulate problems from everyday situations, use geometric concepts to solve problems and reflect and interpret the results. The 2013 Curriculum Mathematics Book is at an intermediate level. Some questions have led to real-world contexts, such as carpenters and historical relics, but there is still much procedural material. The mathematical process that is trained focuses more on the use of formulas (employing), while the aspects of problem formulation (formulating) and interpretation of results (interpreting) have not been optimally developed. Meanwhile, the Indian mathematics book (NCF) is more prominent in geometric concepts and proofs but is almost entirely free from the real-world context. This approach does strengthen students' formal understanding, but does not support the development of competencies relevant to mathematical literacy in everyday life as emphasized in the PISA Framework.

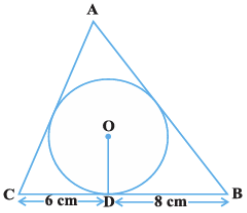
Thus, the Independent Curriculum Mathematics Book is closest to the principles of global mathematical literacy (PISA Framework) because it integrates strong content, authentic contexts, and a comprehensive process approach.

Problem-Solving Aspects

The fourth aspect analyzed compares the problem-solving questions in the Merdeka Curriculum mathematics textbook, the 2013 Curriculum, and the Indian Book. Problem-solving ability is one of the important competencies in mathematics learning that emphasizes critical, creative, collaborative, and communicative thinking skills as demand for 21st-century development (Fitri, Yuanita & Maimunah, 2020; Rahman & Setyaningsih, 2022), so questions are needed that can support these abilities. The indicators of problem-solving abilities that are expected to be supported by the questions given according to Polya (Arumbifa & Dewi, 2025), among others: (1) Understanding the Problem: Students can identify known and asked information, (2) Planning a Solution: Students can choose the right strategy or method to solve the problem, (3) Implementing the Plan: Students can apply the chosen strategy systematically, and (4) Evaluating Results: Students review the solutions obtained and check their accuracy. A comparative analysis of the problem-solving aspects of the three books can be shown in Table 5 below.

Table 5.
Comparison of problem-solving questions

Textbook	Question	Indicator	Information
Independent Curriculum Book	**Exploration 2.1** Garden lights with a 30° beam angle want to be placed so that they illuminate a circular arc	- Understand the problem: Identify the angle and the arc to be illuminated. - Make a plan: Determine the position of the lamp installation	The questions are presented realistically and emphasize exploration and critical thinking. Polya's stages are met:

Textbook	Question	Indicator	Information
	(slide). Where can the lights be installed to continue illuminating the same part?	point that produces the same circumference angle (30°). - Carry out the plan: Draw several lamp positions with similar circumference angles. - Recheck: Ensure that all lamp positions continue to illuminate the desired arc.	understanding the problem, planning, implementing, and reflecting/evaluating the solution.
	Exploration 2.2 A navigator sees a harbor on the horizon. The line of sight is a tangent to the earth's circle. Find the angle between the tangent and the radius at the point of tangency.	- Understand the problem: Determine the relationship between tangent and radius. - Make a plan: Use the tangent theorem (perpendicular to the radius). - Carry out the plan: Draw the radius to the tangent point and determine the angle size. - Recheck: Ensure the angle obtained is 90°.	
2013 Curriculum Book	**Issue 7.1** A carpenter who makes household appliances must cut square or rectangular boards into circles. The carpenter has a problem finding the centre point of the circle to be made. Can you help the carpenter get the largest possible circle from the boards?	- Understand the problem: Identify the shape of the board and the purpose of making the circle. - Make a plan: Determine the method (drawing diagonals). - Carry out the plan: Draw diagonals to find the centre point. - Recheck: Make sure the centre point is precisely at the intersection of the diagonals.	Real-world context-based questions that encourage understanding the problem include exploratory steps but do not include an explicit final evaluation or re-examination.
Indian Books	**Exercise 10.2** A triangle ABC is drawn to circumscribe a circle of radius 4 cm such that the segments BD and DC into which BC is divided by the point of contact D are of lengths 8 cm and 6 cm, respectively (see Fig. 10.14). Find the sides AB and AC.  Fig. 10.14	- Understand the problem: Identify the elements of tangents in the triangle image, including the inner circle. - Make a plan: A system of equations or modeling will be formed using tangents' properties. - Carry out the plan: Arrange equations and perform simple arithmetic calculations. - Recheck: Re-evaluate the calculated side lengths and the basic properties of triangles and inner circles.	The questions are presented with triangle and inner circle visualizations, supporting understanding and implementation of the solutions (Stages 1–3). The recheck stage is not explicitly stated in the instructions.

Based on the analysis of the three books, it was found that all three had integrated problem-solving elements according to the stages proposed by Polya, namely, understanding the problem, designing a plan, implementing the plan, and re-examining the solution (Pandiangan & Sihombing, 2025). All books have fulfilled the first three stages quite well. The books present problems in real contexts, such as the work of a carpenter, the

position of a ship navigator, and the use of bicycle wheels to help students understand the problems and design strategies for solving them.

However, only the Merdeka Curriculum Book explicitly and systematically presents all four Polya stages in their entirety. This book presents questions in a strong contextual context and encourages students to reflect on and re-evaluate the solutions they create. Meanwhile, the Old Indonesian Book and the Indian Book have not provided explicit space for the stage of reflection or re-examination of solutions, although the three initial stages have been implemented well through the instructions, activities, and proofs designed. In addition, the Indian Book is also significantly lacking in presenting questions in the contextual form of everyday life. Therefore, to develop problem-solving skills comprehensively, it is recommended that teachers complement both books with reflective or evaluative questions to fulfil Polya's thinking cycle comprehensively.

IV. Conclusion

Based on a comparative analysis of the three books, significant differences in focus were found in the delivery of circle material. The Merdeka Curriculum Book emphasizes conceptual understanding through exploratory and reflective activities. The material is presented with a contextual approach that encourages students to discover concepts independently. However, not all principles are concluded explicitly. This book also balances content, context, and process competencies according to the PISA framework. In addition, the stages of problem-solving based on the Polya model are presented systematically and explicitly.

Meanwhile, the 2013 Curriculum Book focuses on presenting material procedurally. Although some activities are contextual, facts are presented directly, and principles are only explained descriptively. Independent exploration and discovery of concepts are still limited. Regarding mathematical literacy, this book is not optimal for developing interpreting skills. Problem-solving questions are presented but do not explicitly direct students to the stage of reflection and final evaluation of the solution.

On the other hand, the Indian Book highlights formal proof and geometric visualization with a deductive approach. The material is arranged in stages and is equipped with strong illustrations to strengthen students' mathematical logic. However, this book is minimal in presenting real contexts and has not developed much of the interpreting aspect of the PISA framework. The questions are dominant at the application and proof levels but do not explicitly display creative or reflective exploration. In terms of the cognitive level of the questions, the three books cover levels C1–C6. The Indonesian book, both the 2013 Curriculum and the Independent Curriculum, is more dominant at levels C3 (applying) and C4 (analyzing). Meanwhile, the Indian book stands out on questions at levels C3 and C6 (creating). However, only the Independent Curriculum Book explicitly covers the four stages of problem-solving: understanding the problem, planning, implementing, and re-examining the solution.

Overall, the three books have their characteristics and advantages. This finding is important to consider in developing textbooks that are more adaptive to students' needs. The ideal book presents material contextually, strengthens conceptual understanding, and encourages high-level thinking skills relevant to the demands of 21st-century learning.

References

Almarashdi, H. S., & Jarrah, A. M. (2023). Assessing tenth-grade students' mathematical literacy skills in solving pisa problems. *social sciences*, *12*(1). https://doi.org/10.3390/socsci12010033

Anggriana, E., Karim, A., & Rahmawati, E. Y. (2024). Analisis soal cerita pada buku matematika siswa kelas vii jenjang smp

kurikulum 2013 berdasarkan taksonomi bloom. *algoritma : jurnal matematika, ilmu pengetahuan alam, kebumian dan angkasa*, *2*(6), 154–163. https://doi.org/10.62383/algoritma.v2i6.298

Anifarka, A., & Rosnawati, R. (2023). Analisis buku teks matematika smp berdasarkan tingkat kognitif pada taksonomi bloom revisi dan numerasi pada akm. *jurnal cendekia : jurnal pendidikan matematika*, *7*(3), 2151–2166. https://doi.org/10.31004/cendekia.v7i3.1701

Araiku, J., Sidabutar, R., & Mairing, J. P. (2019). Gender differences in mathematics ability of junior high school students based on bloom's taxonomy. *jurnal gantang*, *4*(1), 15–25. https://doi.org/10.31629/jg.v4i1.969

Arumbifa, F. Y., & Dewi, N. R. (2025). Kajian teori : pengembangan bahan ajar bernuansa alat musik tradisional gamelan jawa pada materi lingkaran untuk meningkatkan kemampuan pemecahan masalah matematis dengan model problem based learning. *prisma, prosiding seminar nasional matematika*, *8*, 105–113.

Bybee, R., Mccrae, B., & Laurie, R. (2009). PISA 2006: an assessment of scientific literacy. *journal of research in science teaching*, *46*(8), 865–883. https://doi.org/10.1002/tea.20333

Elyana, D., Astutiningtyas, E. L., & Susanto, H. A. (2023). Kesalahan siswa dalam menyelesaikan soal garis singgung lingkaran. *plusminus: jurnal pendidikan matematika*, *3*(1), 93–106. https://doi.org/10.31980/plusminus.v3i1.1226

Firsta, R. R., & Susanti, E. (2024). Indonesian realistic mathematics education learning design for least common multiple material using calendar context for grade vii students. *jurnal gantang*, *9*(2), 205–214. https://doi.org/10.31629/jg.v9i2.6951

Fitri, M., Yuanita, P., & Maimunah, M. (2020). Pengembangan perangkat pembelajaran matematika terintegrasi keterampilan abad 21 melalui penerapan model problem based learning (pbl). *jurnal gantang*, *5*(1), 77–85. https://doi.org/10.31629/jg.v5i1.1609

Fitria, M., Ubaidah, N., & Basir, M. A. (2025). Profil literasi matematika siswa berdasarkan self-efficacy pada penyelesaian soal pisa konten quantity. *cartesian: jurnal pendidikan matematika*, *04*(02), 82–93. https://doi.org/10.33752/cartesian.v4i2.6373

Jannah, M., & Budiman, I. (2022). Analisis kemampuan berpikir kritis matematis siswa dalam menyelesaikan soal cerita pada materi lingkaran. *jpmi*, *5*(1), 237–246. https://doi.org/10.22460/jpmi.v5i1.p%25p

Muharrom, A., & Kadarisma, G. (2022). Analisis kesulitan siswa madrasah tsanawiyah dalam menyelesaikan soal lingkaran. *jpmi (jurnal pembelajaran matematika inovatif)*, *5*(2), 463. https://doi.org/10.22460/jpmi.v5i2.8286

Nufus, H., & Fitraini, D. (2024). Statistics education research integrated with islamic studies (a study of validity and practicality of textbook development). *jurnal gantang*, *9*(2), 265–276. https://doi.org/10.31629/jg.v9i2.6959

Özaydin, Z., & Arslan, Ç. (2022). Assessment of mathematical reasoning competence by pisa 2021 mathematics framework. *kuramsal eğitimbilim*, *15*(3), 453–474. https://doi.org/10.30831/akukeg.1027601

Pandiangan, R., & Sihombing, I. (2025). Penerapan PBL dalam upaya meningkatkan kemampuan pemecahan masalah matematis siswa smp kelas vii. *jurnal pengabdian masyarakat dan riset pendidikan*, *03*(04), 826–831. https://doi.org/https://doi.org/10.31004/jerkin.v3i4.538

Rahmadani, N. S., Lestari, E. M., Syafira, N., Inayah, N., & Pratiwi, D. A. (2025).

Analisis Hambatan implementasi kurikulum merdeka pada aspek pemahaman guru dan orientasi siswa terhadap hasil belajar di sdn berangas barat 2. *maras: jurnal penelitian multidisplin*, 530–541.

Rahman, Z. H., & Setyaningsih, R. (2022). Meningkatkan kemampuan pemecahan masalah siswa melalui pendekatan realistic mathematics education. *aksioma: jurnal program studi pendidikan matematika*, *11*(2), 1620–1629. https://doi.org/10.24127/ajpm.v11i2.5139

Ramadhona, R., Siregar, N. A. R., & Alpindo, O. (2023). The practicality of plane and space geometry textbook as teaching materials in mathematics education department of umrah. *jurnal gantang*, *8*(1), 65–73. https://doi.org/10.31629/jg.v8i1.5658

Ristiyana, T., Botutihe, G., & Kurniawan, M. S. (2024). Analisis kemampuan berpikir kritis siswa dalam menyelesaikan soal cerita matematika smk al basyariah. *jurnal pemikiran dan kajian pendidikan*, *8*(6), 191–198.

Rusmana, I. M. (2019). Literasi matematika sebagai solusi pemecahan masalah dalam kehidupan. *diskusi panel nasional pendidikan matematika*, *5*(1), 1.

Sitorus, P. S., Hutapea, N. M., & Anggraini, R. D. (2021). Pengembangan perangkat pembelajaran menggunakan model discovery learning berbasis pembelajaran matematika realistik pada materi garis singgung lingkaran kelas VIII SMP/MTs. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *5*(3), 3069–3081. https://doi.org/10.31004/cendekia.v5i3.921

Triansyah, F. A., Arif, H. M., Munirah, M. P., Romadhianti, R., Prastawa, S., Fajriana, K., … & Iman, M. N. (2023). *Pemahaman kurikulum dan buku teks*. cendikia mulia mandiri.

Umami, I. N., & Asdarina, O. (2024). Analisis level berpikir geometris siswa smp dalam menyelesaikan soal lingkaran berdasarkan teori van hiele. *Kognitif: Jurnal Riset HOTS Pendidikan Matematika*, *4*(1), 460–471. https://doi.org/10.51574/kognitif.v4i1.1554

Vinnervik, P. (2023). An in-depth analysis of programming in the Swedish school curriculum—rationale, knowledge content and teacher guidance. In *Journal of Computers in Education* (Vol. 10, Issue 2). Springer Berlin Heidelberg. https://doi.org/10.1007/s40692-022-00230-2

Wahyuni, I., Nurisma, A., & Mardiya, R. (2023). Analisis soal penalaran proposional pada buku teks matematika siswa kelas vii berdasarkan taksonomi bloom. *Jurnal Pembelajaran Dan Matematika Sigma (JPMS)*, *9*(2), 233–238.

Weniarni, L. (2022). *Etnomatematika 1*. Penerbit NEM.

JURNAL GANTANG. May 2025; X (1): 105 - 118
p-ISSN. 2503-0671
e-ISSN. 2548-5547