
The Structure of Senior High School Mathematics Curriculum in Indonesia: A Focus on the Statistical Investigation and Reasoning

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Abstract. *This study examines the structure of the intended curriculum in data analysis and probability within Indonesia's secondary mathematics curriculum. Through content analysis, the study breaks down the curriculum structure into three tiers: large, medium, and small. The analysis of the large structure indicates that the curriculum aligns with the goals of mathematics education, focusing on reasoning and problem-solving to enhance student numeracy at each stage. In the medium structure, the curriculum consistently employs a spiral model that aids student advancement from Level B to Level C, following the GAISE II framework. However, the small structure analysis uncovers a disproportion in the PPDAC investigation cycle, where the data, analysis, and conclusion stages overshadow the problem and plan stages. The study concludes that there is a need to reinforce the independent investigation planning stage in each phase to ensure that the shift from empirical to theoretical data is perceived as a coherent unit of statistical reasoning. Further research is suggested to assess the implemented and attained curricula.*

Keywords: *intended curriculum, PPDAC, GAISE II, concept progression, statistical investigation, statistical reasoning*

INTRODUCTION

The Education 2030 Agenda, as articulated through Sustainable Development Goal 4 (SDG 4), represents a global commitment to ensuring inclusive and equitable quality education and fostering lifelong learning opportunities for all individuals. Consistent with UNESCO's vision (UNESCO, 2015), educational curricula must undergo periodic review to maintain their relevance in fostering the skills, competencies, values, and knowledge necessary for students to become proactive contributors to sustainable development. Enhancing curriculum quality is a pivotal component in advancing the national education system.

The curriculum, in theoretical terms, is not strictly delineated but rather encompasses a wide range of elements, from specific learning objectives to comprehensive educational experience programs (Ornstein & Hunkins, 2016; Su,

2012). In mathematics education, the curriculum is envisioned as a vector that includes goals, content, resources, instructional strategies, and evaluation methods (Howson et al., 1982; Niss, 2016). According to the TIMSS framework, the curriculum is categorized into three levels: intended (written documents and textbooks), implemented (classroom practices), and attained (student learning outcomes) (Mullis et al., 2016). This study concentrates on the intended curriculum level, recognizing its role as a crucial foundation for enhancing the quality of mathematics education (Lloyd et al., 2017).

Indonesia has implemented a series of curriculum reforms over the past few decades to achieve the objectives of Sustainable Development Goal 4 (Mukminin et al., 2019; Ningrum et al., 2023). Furthermore, curriculum policy emphasizes the enhancement of students' literacy and numeracy skills (Kartini et al., 2025). However, every individual needs a more specialized form of literacy: statistical literacy. This is crucial for comprehending variability and making informed, data-driven decisions in the modern world (Moreno, 2002; Sharma, 2017). Upon entering the workforce, students will need to possess statistical skills, such as the ability to analyze and interpret data, which are crucial for making informed and critical decisions (Moreno, 2002). Thus, integrating statistical concepts into the high school mathematics curriculum is vital to effectively preparing students.

In high school, the study of statistics has evolved into a more comprehensive investigative process and a deeper form of reasoning. Students are required not only to illustrate data but also to conduct their own investigations, encompassing the entire process from problem formulation to conclusion drawing. This approach facilitates deeper understanding through a structured thinking cycle, such as the Problem, Plan, Data, Analysis, Conclusion (PPDAC) framework (Wild & Pfannkuch, 1999).

Furthermore, the statistics education community has identified statistical reasoning and thinking as crucial learning objectives in introductory statistics courses. Students are expected to develop the ability to apply statistical concepts and ideas to comprehend, analyze, and interpret data, thereby enabling them to draw meaningful conclusions from statistical information. Consequently, to meet

international quality standards, the high school curriculum should align with the GAISE II Framework, which evaluates the level of statistical proficiency (Bargagliotti et al., 2020).

While previous research has predominantly focused on the future of statistical education (Tiro, 2018), the presentation of statistical topics within the intended curriculum (Tiro, 2017), and comparisons of the curriculum with those of other countries (Anuniwat & Ningtyas, 2024), there is a notable lack of studies investigating the structure of the Indonesian mathematics curriculum, particularly concerning the inclusion of statistical investigation and reasoning in senior high school. Consequently, this study analyzes the structure of the senior high school mathematics curriculum, as delineated in the intended curriculum.

METHODS

This study employed a qualitative research methodology, emphasizing content analysis (Mayring, 2014). The data were examined using a framework adapted from previous studies (Baba, 2010; Kusaka, 2020) to provide an in-depth analysis of the curriculum structure. This framework divides the intended curriculum into three categories: large, medium, and small structures (Table 1). It serves as an instrument for assessing the comprehensiveness and organization of content, irrespective of subject matter.

Table 1. Structure of the Intended Curriculum

Structure	Descriptions
Large	level of school, subject and aims of Mathematics
Medium	time allocation, domain, relation among units
Small	relation within a unit

This study employed the most recent Indonesian curriculum (Kemendikdasmen, 2025) and examples of learning outcomes delineated by governmental authorities on official websites (Kemdikbudristek, 2024), and electronic Merdeka curriculum textbooks provided on government official websites: textbooks for grades 10 (Susanto et al., 2023), 11 (Dwi et al., 2024;

Susanto et al., 2021), and 12 (Tohir et al., 2022; Utami et al., 2022). Following the compilation of materials for analysis, the data analysis was executed through the following steps (Mayring, 2014): (1) gathering all pertinent details about the curriculum structure from official curriculum documents, government-issued papers, and students' mathematics textbooks; (2) arranging the gathered information into illustrative diagrams and tables; (3) assessing the learning goals and how well the statistical content is organized to aid students' comprehension of statistical investigation; and (4) examining and interpreting the findings.

The study was conducted by applying two primary lenses: the PPDAC cycle (Wild & Pfannkuch, 1999), which detects investigative components such as problem, plan, data, analysis, and conclusion (Figure 1) within curriculum content and textbooks, and the GAISE II Framework (Bargagliotti et al., 2020), which serves as a benchmark to assess the statistical proficiency level (levels A, B, or C) anticipated for high school students.

The framework outlined in the GAISE II Report by the American Statistical Association details the progression of students' statistical reasoning abilities through three distinct learning stages. At Level A, students begin by understanding basic data concepts and learn to interpret, display, and describe data using graphs or tables in contexts they are familiar with. Level B serves as a transitional phase in which students begin to compare data distributions, explore relationships between two variables, and apply probability concepts and simple models to elucidate data patterns. In contrast, Level C represents a more advanced stage of statistical reasoning in which students can conduct more thorough statistical investigations, employ statistical models and probability, and interpret data variability and uncertainty to reach more formal conclusions.

The analysis process was divided into three separate stages, as outlined in the framework (Table 1). The first stage, large-structure analysis, involves examining the overarching objectives of the high school mathematics curriculum as specified in the documents. The second stage, medium-structure analysis, entails mapping the time allocation and sequence of statistical topics from grades 10 to 12, with a focus on how these topics are distributed across grade levels. The final stage, small-

structure analysis, involves coding the learning activities and practice questions in textbooks. Researchers classify each activity according to the PPDAC stages to determine which stages are highlighted and which are neglected.

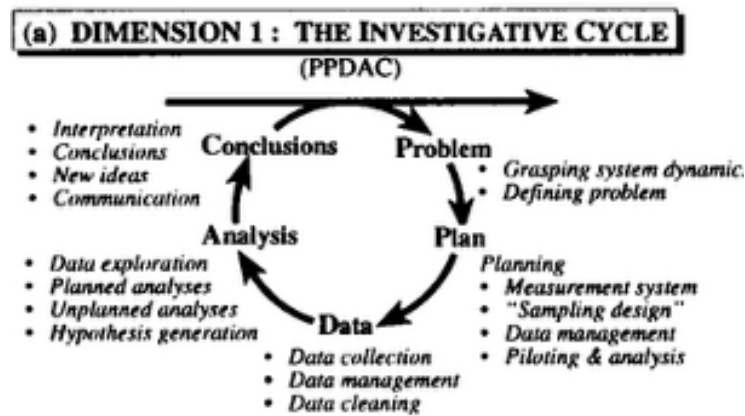


Figure 1. The PPDAC Cycle (Wild & Pfannkuch, 1999)

RESULT AND DISCUSSION

Large Structure Analysis

Level of School

The structure of Indonesia's national education system is outlined in the Act of the Republic of Indonesia on the National Education System Law No. 20 of 2003. The education system follows a 6-3-3-4 structure: six years of elementary schooling, three years of junior high school, three years of either general or vocational high school, and four years of university education. Since 2013, the entire 12-year primary and secondary education system has become compulsory in Indonesia (Sukmayadi & Yahya, 2020).

The structure of the Merdeka curriculum is divided into two components: (1) intracurricular and (2) co-curricular. The intracurricular component lists the skills and knowledge that students should acquire within a specific timeframe. The co-curricular component helps students achieve goals aligned with early childhood education standards. These competencies are articulated as dimensions of the learner profile (Wahyudin et al., 2024). Intracurricular activities are the primary educational tasks conducted according to the planned program schedule.

In contrast, co-curricular activities involve learning different subjects and often include themes and projects to facilitate the application of knowledge in real life. These activities require a specific time allocation. Projects can be undertaken flexibly, either at specific times or as part of the regular weekly schedule. In contrast, the regular subject schedule typically incorporates intracurricular activities. This study focuses exclusively on the **intracurricular structure**.

The curriculum organizes the educational framework into distinct phases that align with students' developmental stages. In elementary schools, the curriculum is divided into three phases: Phase A covers grades 1 and 2, Phase B covers grades 3 and 4, and Phase C covers grades 5 and 6. In junior high school, students enter Phase D, which spans grades 7-9. At the senior high school level, the structure is further divided into Phase E for the 10th grade and Phase F for grades 11 and 12. This phased approach was established by the Ministry of Primary and Secondary Education to tailor educational outcomes to students' developmental stages and learning requirements.

Breaking the curriculum into phases is based on the idea of learning progressions. This means students' knowledge and skills grow step by step from basic to advanced levels (Shepard, 2018). Research shows that learning should follow the path of concept development. This helps students build on their knowledge from simple to complex stages. This method ensures that the curriculum, teaching, and tests align, helping teachers monitor students' progress and plan effective teaching methods (Harris et al., 2022; Shepard, 2018). In this way, the curriculum focuses on developing students' skills over time, rather than specific class content (Adams, 2019; Kim & Care, 2018).

Subjects

During Phase E, students are required to study a set of mandatory subjects, including religious education, Pancasila education, Indonesian language, mathematics, English, sports, physical education and health, history, informatics, arts, culture, and crafts. Additionally, tenth-grade students receive a broad introduction to the natural sciences, covering physics, chemistry, and biology, as well as the social sciences, which encompass sociology, economics, history, and

geography. As they progress to Phase F, the curriculum shifts to a more adaptable elective system. Here, students still engage with mandatory subjects but can select four to five elective courses, such as advanced mathematics, based on their interests and the resources available at their school (Wahyudin et al., 2024). This approach mirrors a global trend towards a more adaptable curriculum that seeks to lessen the emphasis on technical content (Wahyudin et al., 2024; Yuberta & Firmanti, 2025) to enhance higher-order thinking skills.

From a policy perspective, distinguishing mathematics as a mandatory subject from advanced mathematics as an optional subject in phase F reflects an attempt to create distinct educational pathways. Mathematics is included at every grade level to support the ongoing development of numeracy skills. In phase E, mathematics subjects involving statistics are included in the curriculum, while science and social studies are still taught in a general manner. This provides a great opportunity to apply interdisciplinary statistical investigations, in which data from natural or social phenomena can be processed using mathematical tools learned in the same class. This strategy aligns with previous research, which highlights the importance of civic statistics in modern education, focusing on students' ability to comprehend complex social data to engage in democratic processes (Engel, 2019). The integration of different subjects in phase E facilitates cross-curricular statistical analysis, which aligns with GAISE II's vision of using statistics to foster a comprehensive understanding of variability across various societal dimensions (Burrill, 2025).

Aims of the Subject

In the curriculum, mathematics aims to equip students with the following knowledge and skills:

1. understand mathematical content by understanding facts, concepts, principles, operations, and relationships, and apply them with flexibility, precision, efficiency, and appropriateness to solve mathematical problems (mathematical understanding and procedural skills),

2. use reasoning about patterns and properties, perform mathematical manipulations to make generalizations, gather evidence, or explain mathematical ideas and statements (mathematical reasoning and proof),
3. solve problems by comprehending the problem, designing a mathematical model, solving the model, or interpreting the solution obtained (mathematical problem solving),
4. communicate ideas using symbols, tables, graphs, or other media to clarify situations or problems, and represent a situation in mathematical symbols or models (mathematical communication and representation),
5. connect mathematical content in terms of facts, concepts, principles, operations, and mathematical relationships within a discipline, across disciplines, across science, and to life (mathematical connections),
6. cultivate an attitude that values the usefulness of mathematics in life, characterized by curiosity, attention, and interest in learning mathematics, as well as being creative, patient, independent, diligent, open-minded, tough, resilient, and confident in problem-solving (mathematical disposition).

The objectives of mathematics education within this curriculum emphasize two primary aspects. First, students are expected to attain a comprehensive understanding of the material. Second, they should employ reasoning to formulate generalizations and gather evidence. This indicates that the Indonesian curriculum prioritizes mathematical reasoning and proofs. In the context of statistics, this objective aligns with a previous study that argued that the ability to reason and use data to construct arguments is fundamental to understanding statistics (Wild & Pfannkuch, 1999). By emphasizing the gathering of evidence, the curriculum enables educators to transcend formulaic instruction and encourages students to engage in more profound inquiry.

Emphasizing the resolution of problems through mathematical models (Point 3) and enhancing communication via tables and graphs (Point 4) facilitates the application of the PPDAC investigation cycle. The transformation of real-world scenarios into mathematical models is crucial during the Analysis and Conclusion phases of statistical inquiry. According to the GAISE II framework (Bargagliotti et

al., 2020), this communication skill extends beyond technical aspects, helping elucidate complex situations or problems.

The integration of mathematical concepts from various disciplines and the cultivation of positive attitudes towards mathematics (points 5 and 6) underscore the significance of statistics in comprehending societal dynamics. These interconnections align with the concept of civic statistics (Engel, 2019), in which statistical analysis facilitates the examination of social and scientific issues. Furthermore, developing open-mindedness, resilience, and problem-solving confidence is crucial for navigating the uncertainties inherent in real-world data. Consequently, the objectives of mathematics education have contributed to a robust understanding of statistics, thereby establishing mathematics as an essential skill for all individuals.

Medium Structure Analysis

The medium structure analysis focuses on the domain of statistics, mapping the time allocation and sequence (progression) of statistics topics within the mathematics subject from grades 10 to 12. At this stage, the researcher examines how the Statistics domain is distributed vertically across grade levels.

Time Allocation

Table 2 presents an overview of the proportion of mathematics learning load in high school.

Between Phases E and F, there is a notable change in cognitive load. In Grade 10 (Phase E), the mathematics allocation remains nominally unchanged at 108 LH, but it constitutes only 9.1% of the total mandatory load. This is because students are required to take a wide array of compulsory subjects, including integrated science and social studies, at the start of high school. This low percentage suggests that in Phase E, mathematics must share the spotlight with other subjects, which presents significant opportunities to explore cross-disciplinary mathematical connections (aligned with objective number 5) by analyzing data from science or social projects. This allows for the application of interdisciplinary data science,

which is crucial for achieving the objectives of mathematical connection and civic literacy among students (Burrill, 2025; Engel, 2019).

Table 2. Time allocation for high school subjects (assuming 1 year = 36 weeks and 1 lesson hours = 45 minutes)

Components	Lesson Hours		
	Phase E - Grade 10	Phase F - Grade 11	Phase F - Grade 12
Mathematics (as a compulsory subject)	108	108	96
Advanced Mathematics (as an elective subject)	-	180	160
Total of lesson hours for compulsory subjects	1,188	684	608
Total of lesson hours for elective subjects	-	720-900	640-800
Ratio of Math to the total compulsory subjects	9.1%	15.8%	15.8%
Ratio of Advanced Math to the total elective subjects	-	20%-25%	20%-25%

As students transition into Phase F (Grades 11 and 12), an intriguing situation arises: the proportion of mandatory mathematics hours increases to 15.8% of the total required hours. This shift is not due to an increase in mathematics hours but rather a significant reduction in other mandatory subjects, which have been moved to the elective category (Wahyudin et al., 2024). From a policy perspective, this arrangement grants mathematics teachers greater flexibility in time (Anggraena et al., 2025) to focus on objectives such as reasoning, problem-solving, and communication (objectives 2, 3, and 4). With a larger share of time allocated to compulsory subjects, there is a greater opportunity for in-depth statistical investigation compared to when students are in Grade 10.

Nevertheless, the structure becomes increasingly intricate for students enrolled in Advanced Mathematics. This optional course demands a substantial time commitment, with 180 LH in Grade 11 and 160 LH in Grade 12, accounting for 20% to 25% of students' total elective workload. This significant time allocation indicates that the curriculum offers an intensive route for honing procedural skills and gaining a more technical grasp of concepts (Objective 1).

Domain

Mathematics is generally categorized into various subjects that students are required to study during Phases E, F, and F+ (Advanced Mathematics). In Phase E, which marks the beginning of high school, students focus on four primary domains: Numbers, Algebra and Functions, Geometry, and Data Analysis and Probability. In Phase F, which covers grades 11 and 12 and is compulsory, the subjects remain the same as in Phase E. Phase F+ is designed for students specializing in mathematics and covers a wide range of topics. This includes Algebra and Functions, Geometry, Data Analysis, Probability and an additional specialized domain: calculus. It is important to note that, within the Indonesian curriculum, the domain of statistics is referred to as data analysis and probability.

The data indicate that the curriculum is structured in a spiral format, in which nearly all domains, except calculus, are explored continuously from Phases E to F (grades 10–12), each with varying levels of complexity. This approach is similarly applied to the domains of data analysis and probability, which are included at every stage.

Relation among units

This structure analysis examines the development of skills and knowledge in the domains of data analysis and probability across learning phases, referencing the unit objectives outlined in the curriculum document, specifically the learning outcomes (CP) document (Table 3).

Table 3. Time allocation for high school subjects (assuming 1 year = 36 weeks and 1 lesson hours = 45 minutes)

Phase	Learning Outcomes
Compulsory Mathematics	
Phase E – grade 10	Students can represent and interpret data by determining the quartiles and interquartile range. They can create and interpret box plots (also known as box-and-whisker plots) and use them to compare different datasets. Depending on the characteristics of the data and their specific requirements, students can determine and utilize box plots, histograms, and dot plots. They can use scatter plots to investigate and describe the relationship between two quantitative variables, including one independent variable such as time. Students can evaluate

	statistical reports found in the media based on their presentation, statistical data, and representation. They can describe the concept of probability and determine the expected frequency of compound events. Students can investigate the ideas of independent and mutually exclusive events and determine their probabilities.
Phase F – grade 11 and 12	Students can conduct statistical investigations on bivariate data. They can identify and describe the association between two categorical (qualitative) variables and between two numerical (quantitative) variables. Students can estimate the most suitable linear model for numerical (quantitative) data. They can differentiate between associations and cause-and-effect relationships. Students understand the concepts of conditional probability and independent events by utilizing the principles of permutations and combinations.
Advanced Mathematics	
Fase F+	Students understand the concept of discrete random variables and probability functions and apply them to data modeling. They can interpret the parameters of statistical distributions, such as uniform, binomial, and normal distributions, calculate expected values for binomial and normal distributions, and use them to solve problems.

This curriculum shows a step-by-step statistical learning level based on the GAISE II framework. In Phase E, students learn to show and understand data using box plots, histograms, dot plots, and scatter diagrams. They also begin learning about probability, including independent and mutually exclusive events and expected frequency. This phase focuses on comparing data, understanding data displays, and examining how variables relate, which aligns with Level B. In Phase F, students move to more complex tasks, such as analyzing two-variable data, identifying relationships between variables, selecting the best linear model, and learning about conditional probabilities. In the advanced phase (F+), students explore random variables, probability functions, and probability distributions, such as the binomial and normal distributions, to model data. This shows the shift from simple data analysis to more formal statistical modeling and probability, reflecting students' growth in statistical reasoning from Level B to Level C in the GAISE II framework.

Although the connection between units appears logical, there are crucial aspects that warrant discussion concerning the jump in complexity from Phase E to Phase F. Moving from single-variable to bivariate analysis imposes a considerable cognitive burden on students, particularly when grasping the concept of a regression or best-fit model. Without a thorough understanding of the variability in Phase E, students may rely on formulas without truly understanding the core relationship between the variables. Consequently, the linkage between these units should be reinforced by a learning strategy that ensures the statistical investigation cycle within each phase. This approach will facilitate a smooth transition to stochastic modeling in Phase F+ with a well-developed conceptual foundation.

These findings align with those of previous research. Interpreting data representations, such as tables and graphs, is vital for enhancing statistical literacy and reasoning among secondary school students (Pallauta et al., 2021). To effectively enhance students' statistical reasoning, the learning approach should be more contextual and promote a deeper conceptual understanding (Saidi & Siew, 2022). Investigation-based learning trajectories facilitate a more conceptual understanding of the inference process from samples to populations (van Dijke-Droogers et al., 2025). In addition, using digital storytelling to present data can enhance students' ability to discern patterns and relationships within data (Batur & Çakıroğlu, 2023). Collectively, these studies demonstrate that a statistics learning approach focused on data exploration, statistical investigation, and meaningful contexts is more effective in cultivating students' statistical reasoning skills or even statistical inferences.

Small Structure Analysis

Small-structure analysis emphasizes how statistical concepts are organized to develop students' reasoning skills, rather than focusing on progression through different phases. It examines the interconnections between concepts, the architecture of statistical thinking processes, and the approaches students take during their investigations. This is done by analyzing the learning outcomes document (Table 3) and cross-checking them against practice questions found in textbooks for phase E (grade 10 (Susanto et al., 2023)), and phase F (grade 11

(Susanto et al., 2021) and 12 (Tohir et al., 2022)), phase F+ of advanced mathematics (grade 11 (Dwi et al., 2024) and 12 (Utami et al., 2022))

Small Structure Analysis for Phase E

In Phase E, the learning outcomes reveal a relationship with the PPDAC cycle, with a notable emphasis on particular stages. The Data and Analysis stage stands out prominently, as demonstrated by students' skills in representing and interpreting data through quartiles, interquartile range, and various graphical methods, such as box plots, histograms, dot plots, and scatter plots. Additionally, students begin to delve into the relationships between variables, marking their initial foray into bivariate data analysis. The Conclusion stage begins to emerge as students are tasked with evaluating statistical reports found in the media and interpreting the results and data representations. However, the Problem and Plan stages are not yet clearly defined, resulting in partial engagement with the PPDAC cycle at this phase, with a primary focus on data processing and interpretation.

In the textbook, the PPDAC cycle is subtly integrated, even though its steps are not explicitly listed. This is particularly noticeable in the exercises on pages 184–186, where tasks start with a problem context (Problem), such as a phenomenon to be explored. Students are then indirectly guided to plan data collection (Plan); for instance, they are instructed to identify the data source. Subsequently, students either receive or are tasked with gathering data (Data). They are then required to analyze this data using frequency tables, diagrams, or graphs (Analysis), and finally, they conclude from their analysis (Conclusion). Therefore, while the term PPDAC is not directly mentioned, its structure is embedded in the form of guiding questions within the practice problems, leading students through each stage.

The cross-check results reveal that the PPDAC cycle is not directly mentioned in the learning outcomes or the textbook. However, it is subtly incorporated into the learning activities, especially during the Data and Analysis phases. Additionally, not every exercise in the textbook thoroughly addresses the entire PPDAC cycle; however, some questions guide students through the stages incrementally, using scaffolding questions.

Small Structure Analysis for Phase F

Phase F's learning outcomes align well with the PPDAC cycle, even though each stage does not explicitly break them down. The phrase "conduct statistical investigations on bivariate data" suggests engagement in the Problem and Plan stages, as students are tasked with formulating questions and deciding on methods to explore relationships between variables. The Data and Analysis stages seem to be emphasized through the ability to identify and describe associations between variables. This stage involves recognizing and explaining connections between both categorical and numerical variables and estimating the optimal linear model. The Conclusion stage is evident in the ability to differentiate between associative and causal relationships, which necessitates a critical interpretation of the analysis results.

When examining the 11th-grade mathematics textbook broadly (given that the 12th-grade textbook lacks a data analysis section), the teaching framework remains consistent with the PPDAC cycle, even though it is not explicitly outlined. The primary focus is on the Data stage, especially the Analysis phase, where students work with bivariate data using scatter plots, linear regression, and correlation and determination coefficients to explore relationships among variables. The Conclusion stage is also well-developed, as students are required to interpret their analytical results and assess their contextual significance. In contrast, the Problem and Plan stages receive less attention because the context and data are typically provided in advance.

The practice problems on pages 105–106 also demonstrate this, where the PPDAC framework is subtly present, concentrating on the analysis of bivariate data. The Problem phase is introduced through the context of variable relationships, even if students do not explicitly define it. In contrast, the Plan phase is scarcely visible because the methods and data are pre-established. The Data phase is clearly shown by the presentation of paired data ready for examination, and the Analysis phase is most prominent through tasks like creating scatter plots, finding regression equations, and computing correlation coefficients. The Conclusion phase occurs when students interpret their calculation results in relation to the problem's context.

Although not every problem fully encompasses all stages of the PPDAC model, it often focuses more on analytical skills and data interpretation.

The comparison reveals that both phase F learning outcomes and the textbook generally correspond with the PPDAC cycle, even though neither explicitly outlines it as a structured framework. In both instances, the data and, particularly, the analysis stages are the most prominent, while the conclusion stage is adequately developed through result interpretation. However, the problem and, especially, the plan stages receive less focus, as tasks are typically pre-structured with predetermined contexts and data. Overall, the application of PPDAC is implicit and leans more towards analytical processing than a comprehensive, student-led statistical investigation cycle.

Small Structure Analysis for Phase F+

In Phase F+, the learning outcomes do not significantly align with the PPDAC cycle as a framework for statistical investigation. Although the phrase "data modeling" is mentioned, it pertains more to theoretical probabilistic modeling, including concepts like binomial and normal distributions and expected values. The activities do not involve gathering or analyzing empirical data, unlike the Data and Analysis stage of PPDAC. This observation is supported by a review of the grade 12 Advanced Mathematics textbook, which reveals an absence of data analysis content and a greater emphasis on probability-based mathematical modeling. Consequently, the focus of learning in this phase shifts from statistical investigation to theoretical probability modeling, leading to minimal connection to PPDAC.

The results from the small structure suggest that, in general, from Phase E to Phase F, the connection to the statistical investigation process becomes increasingly evident, particularly in the Data, Analysis, and Conclusion stages. This sequence aligns with the PPDAC model in Statistical Thinking in Empirical Inquiry (Wild & Pfannkuch, 1999). It supports advancing statistical reasoning skills from Level B to Level C, as outlined in the GAISE II Report framework. Nonetheless, the analysis reveals that some initial stages of the statistical investigation cycle, particularly the Problem and Plan phases, are not clearly articulated in the learning outcomes and in textbooks. This indicates that, while the curriculum's conceptual structure

supports the development of statistical reasoning, there is still a need to incorporate activities that encourage students to formulate investigative questions and design data-collection strategies. Therefore, a more explicit inclusion of all stages of statistical investigation could enhance the comprehensive development of students' statistical thinking skills.

CONCLUSION

The intended mathematics curriculum in the domain of Data Analysis and Probability has established a consistent spiral curriculum flow across all levels. At the Large Structure level, this curriculum aligns with the overarching goals of mathematics education, which focus on problem-solving, reasoning, and proof, making mathematics a mandatory subject to enhance numeracy development at every stage of student growth. In the Medium Structure, although mathematics is allocated only 9.1% of the total compulsory time in Phase E, the curriculum effectively illustrates logical connections between units through a continuous division of domains from Phase E to Phase F+, aiding students' transition from intermediate literacy (Level B) to advanced literacy (Level C) as per the GAISE II framework. However, an analysis of the Small Structure reveals an imbalance in the PPDAC investigation cycle, with the Data, Analysis, and Conclusion stages being more prominent than the Problem and Plan stages. Consequently, further research is warranted to broaden the study's scope from the intended to the implemented curriculum to observe how teachers incorporate the Problem and Plan stages in the classroom, and to the attained curriculum level to assess the degree to which students achieve independence in conducting comprehensive statistical investigations.

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