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Intended Statistics Curriculum at the Elementary Level: Thailand vs. Indonesia

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Abstract

Mathematics occupies a central role in school education, with the mathematics curriculum serving as a critical tool for guiding curriculum reform. To identify the need for reform in specific contexts, it is necessary to examine curricula from a comparative perspective. Such an approach can yield valuable insights into the directions and priorities for curriculum reform. Accordingly, this study examined the current status of the intended statistics curriculum in Thailand and Indonesia. A qualitative content analysis was employed as the research design, with one mathematics curriculum document from Thailand and one from Indonesia purposively selected for analysis. The findings reveal that, in the domain of statistics, Indonesia introduces probability alongside statistics at the elementary level, whereas Thailand does not include probability at this stage. Furthermore, both countries place limited emphasis on incorporating a comprehensive statistical problem solving process within their curricula. It is important to note that this study focuses exclusively on the intended curriculum; further research is required to provide a more nuanced understanding.

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INTRODUCTION

The mathematics curriculum has long served as a cornerstone of school education and is recognized as a vital tool for reforming mathematics teaching and learning (Baba, 2010). Over the years, reform efforts have sought to broaden and deepen school mathematics, aiming to prepare students for further academic pursuits while enhancing national competitiveness in an increasingly globalized world (Lloyd et al., 2017). Achieving these dual objectives requires a mathematics curriculum design that aligns with both national priorities and global perspectives. However, curriculum designs vary extensively across countries, reflecting diverse educational philosophies, goals, and challenges. Cross-national curriculum studies in mathematics education enable educators and researchers to understand these variations, offering insight into how different education systems address similar challenges, understand the intended learning content in various countries, and share effective teaching and learning strategies for mathematics across borders (Schmidt et al., 2017; Schmidt et al., 2005).

To conduct such cross-curricular studies, several foundational inquiries must be addressed (Elbehary, 2020). These include determining which countries or jurisdictions should be selected for study, identifying which mathematical content areas should be prioritized and why, deciding which aspects of the mathematics curriculum should be the focus of examination, and exploring how insights can be derived from the study.

To address the first inquiry, this study selected Thailand and Indonesia as the focus for examination. The rationale for selecting these countries is outlined below. First, both Thailand and Indonesia share a commitment to sustainable development, as evidenced by their active participation in the United Nations' 2030 Agenda for Sustainable Development. Additionally, both countries aim to enhance education quality, with a particular emphasis on achieving Sustainable Development Goal (SDG) 4 (Sachs et al., 2024). Beyond these shared objectives, the educational systems in both countries exhibit similar foundational characteristics. For instance, each country's education system is governed by a national curriculum: Thailand's Basic Education Core Curriculum is administered by the Ministry of Education (Ministry of Education Thailand [MoET], 2008, 2017), while Indonesia's Merdeka Curriculum is managed by the Ministry of Education, Culture, Research, and Technology and the Ministry of Religious Affairs (Ministry of Education Culture Research and Technology of the Republic of Indonesia [MoECRT], 2024). Elementary education in both countries spans grades 1 to 6, although the grade-level organization differs slightly. In Thailand, education is organized by individual grades (1 through 6), whereas in Indonesia, the curriculum is divided into phases: Phase A (grades 1–2), Phase B (grades 3–4), and Phase C (grades 5–6). Despite these terminological differences, the overall structure of elementary education is comparable in both countries. Furthermore, mathematics is a compulsory subject in both systems.

Thailand and Indonesia also share similar economic development contexts (Asian Development Bank, 2024), and students in both countries demonstrate comparable performance in international assessments, such as the Programme for International Student Assessment (PISA) and the Trends in International Mathematics and Science Study (TIMSS). However, research on statistics education in Thailand remains relatively limited (e.g., González et al., 2020; González, 2023), as evidenced by the lower number of papers presented at international conferences and fewer publications in leading statistics education journals, such as the Statistics Education Research Journal and the Journal of Statistics Education. In contrast, Indonesia boasts a more active community of scholars conducting research in this field (e.g., Kurnia et al., 2024), as highlighted in the research chapter on mathematics education by Langrall et al. (2017). This disparity suggests that Thailand, currently in the early stages of developing its statistics education research, could benefit from leveraging the experiences and insights gained by Indonesia in this domain.

Addressing the second inquiry, it is essential to consider the international assessment performance of students in both countries (i.e., PISA and TIMSS), as these results help identify priority content areas for study and provide a shared context for research. In Thailand, a closer examination of student performance across mathematics content domains in PISA reveals that students performed poorly in the domain of “Uncertainty and Data” (OECD, 2023). Similarly, in the most recent TIMSS study in which Thailand participated, in 2015, student performance in the “Data and Chance” domain was the lowest among all mathematics content areas for grade 8 (Mullis et al., 2016). Moreover, a significant decline in achievement was noted between the TIMSS 2007 and 2015 cycles (Mullis et al., 2012; Mullis et al., 2016). A similar trend was observed in Indonesia. In the most recent PISA assessments, the “Uncertainty and Data” domain was also the weakest area for Indonesian students among the mathematics content domains (OECD, 2023). Additionally, statistics-related content poses significant challenges for Indonesian students, as evidenced by the TIMSS study for Grade 4 students in 2015 (Mullis et al., 2016). These challenges highlight the critical need to focus on statistics as a key area for improvement in both countries.

Mathematics, as part of the curriculum, represents the educational opportunities provided to students and shapes their potential learning experiences in the subject (Baba, 2002, 2010; Cai, 2014). Barquero et al. (2023) observed that research on mathematics curricula has been framed using multiple theoretical perspectives, including the three-level model, didactic processes, and sociocultural approaches. Among these, the three-level curriculum model has been the most widely adopted globally. The first level, the intended curriculum, is outlined in documents typically created by national education authorities, specifying expectations for mathematics learning content, including textbooks and standards. The second level, the implemented curriculum, focuses on the teaching and learning activities associated with curricular materials and tasks in schools and classrooms. Finally, the attained curriculum evaluates students’ achievements and attitudes, as evidenced by their performance on tasks and assessments (Barquero et al., 2023; Cai, 2014; Hirsch & Reys, 2009; Lloyd et al., 2017). Given the curriculum’s influence on educational activities at all stages, studies on the intended curriculum have long been prioritized as it serves as the foundation of the curriculum (Baba, 2002, 2010; Lloyd et al., 2017). The effectiveness of the intended curriculum is closely linked to the attained learning outcomes, as observed in student performance in assessments (Hirsch & Reys, 2009).

For the final inquiry, and in light of the aforementioned foundational questions, it is valuable to consider the Statistical Problem Solving (SPS) process as a framework for gaining deeper insights (Bajaria & Copp, 1987; Bargagliotti et al., 2020). The SPS process has been examined under various terminologies, such as the investigative cycle (Wild & Pfannkuch, 1999) and statistical investigation (Watson, 2006). Despite differences in terminology, these frameworks share the common goal of addressing statistical problem solving comprehensively. The SPS process consists of four fundamental processes: formulating statistical investigative questions, collecting and considering data, analyzing the data, and interpreting the results. Formulating statistical investigative questions that anticipate variability is the foundation for productive inquiries. During the Collecting/Considering Data phase, methods such as random sampling are employed to reduce and detect variability, while experiments with different treatments may introduce variability. After data collection, it is critical to assess the differences among variables, outcomes, and collection methods to assess whether the data can effectively address the investigative question. Data analysis involves understanding variability through distributions, using graphical displays and numerical summaries to explore and compare the data. Finally, Interpreting the Results entails incorporating variability into statistical interpretations (Bargagliotti et al., 2020). By adopting this perspective, curriculum designers and educators can derive valuable insights to enhance curriculum development and instructional strategies.

Building on the above discussion, this study focuses on the intended statistics curriculum at the elementary level. The intended statistics curriculum refers to the statistical content that students are expected to learn, encompassing the essential knowledge specified in the curricula. By examining this, a clearer understanding of the statistical learning content intended for students can be developed.

Therefore, this study examines the current status of the intended statistics curriculum at the elementary level in Thailand and Indonesia. To achieve this objective, this study poses the following Research Question (RQ): What is the current status of intended statistics curricula at the elementary level in Thailand and Indonesia?

RESEARCH METHODS

Research Design

This study employed qualitative content analysis as the research design. This method was selected because it facilitates the examination of textual data, emphasizing language as a means of communication (Hsieh & Shannon, 2005; Mayring, 2015). Content analysis seeks to provide a deeper understanding and nuanced insights into the phenomenon under examination (Mayring, 2015). In this context, the phenomenon refers to the intended statistics curriculum at the elementary level in Thailand and Indonesia.

Research Procedures

The qualitative content analysis for this study followed the procedures outlined below (Hsieh & Shannon, 2005; Mayring, 2015).

Formulating the Research Question

The research question guiding this study has been outlined earlier.

Gathering the Data

Data for this study were selected using purposive sampling. The primary data sources included two key curriculum documents: Thailand's Basic Education Core Curriculum (MoET, 2017) and Indonesia's Merdeka Curriculum (MoECRT, 2024), both of which focus on the elementary education level. These documents outline the learning content expected of students and were analyzed as primary sources. Since the original documents were written in Thai and Bahasa Indonesia, they were translated into English to facilitate analysis.

Categorizing Data

The learning content from the selected curriculum documents was categorized into constructs, subconstructs, and knowledge and skills, as detailed in Tables 1 and 2. Constructs represent overarching concepts or "big ideas" incorporated within each grade level. Subconstructs delineate specific concepts under these big ideas (e.g., Fukuda, 2020; Watson et al., 2018) Knowledge and Skills refer to the specific competencies and knowledge that students are expected to acquire.

Analyzing the Categorizing Data

Once the data categorization process was completed, the categorized content was analyzed. The findings of this analysis are presented and discussed in the Results and Discussion section.

RESEARCH RESULTS

In the intended mathematics curriculum, content domains at the elementary level are divided into specific categories that differ across countries. In Thailand, the curriculum divides mathematics content into three domains: numbers and algebra, measurement and geometry, and statistics and probability. In contrast, Indonesia's curriculum comprises five domains: numbers, algebra, measurement, geometry, and data analysis and probability. Notably, both countries explicitly integrate statistics into their mathematics curricula. However, the naming conventions differ: Thailand labels the domain as "Statistics and Probability," while Indonesia uses the term "Data Analysis and Probability," which conveys an equivalent meaning. For consistency, the term "Statistics and Probability" will be used hereafter to denote both labels.

Learning Content in the Intended Statistics Curriculum

The learning content of the intended statistics curriculum is summarized in Tables 1 and 2, which display the current state of the intended statistics curriculum in Thailand and Indonesia.

In Thailand's elementary curriculum, the statistics and probability domain focuses exclusively on data representation. In contrast, Indonesia's curriculum incorporates broader constructs, including data representation, uncertainty, and probability.

In Thailand, the progression from the first to sixth grade reflects a mixed approach, with different statistical concepts introduced and revisited at various stages. While the knowledge and skill levels vary slightly across grades, the intended processes are similar. In the first grade, students are introduced to data representation through reading pictographs. They use data from charts and graphs to answer questions, focusing on single-unit representation in pictographs. In the second grade, the emphasis on reading pictographs continues, but with increased depth. Students work with data represented in multiple units, such as 2, 5, and 10, using charts and graphs to answer questions. In the third grade, the curriculum expands to include data collection and representation. Students collect, classify, and represent data by reading and writing pictographs and creating one-way tables. In the fourth grade, students progress to reading and writing bar graphs and working with two-way tables. They use data from these representations to solve problems. By the fifth grade, line graphs are introduced alongside the continued use of bar graphs. Students read line graphs, solve problems using data from these graphs, and draw bar graphs, thus broadening their graphical representation skills. Finally, in the sixth grade, students are introduced to pie charts. They read and interpret data from pie charts to solve problems. By the end of elementary school, students have developed a comprehensive understanding of various methods of data representation.

Table 1. Learning Content in the Intended Statistics Curriculum in Thailand

Grade	Thailand		
	Construct	Subconstruct	Knowledge and Skill
1	Data Representation	Reading pictographs	Use data from a pictograph to solve problems when given a one-unit pictograph.
2	Data Representation	Reading pictographs	Use data from a pictograph to solve problems when given a one-unit, 5-unit, or 10-unit pictograph.
3	Data Representation	Data collection, classification, reading/writing pictographs, one-way table	Draw a pictograph and use data from the pictograph to solve problems. Draw a one-way table from numeral data and use its data to solve the problem.
4	Data Representation	Reading/writing bar graphs, two-way table	Use data from bar charts/two-way tables to solve problems
5	Data Representation	Reading line graphs, reading/writing bar graphs	Use data from line graphs to solve problems. Draw bar graphs from numeral data
6	Data Representation	Reading pie charts	Use data from pie charts to solve problems

Note: The authors developed and underlined the text in Table 1, based on data from the MoET (2017).

In contrast, the Indonesian curriculum for the domains of statistics and probability is more systematically divided into distinct phases, with specific subconstructs defining the boundaries of each phase. Table 2 illustrates that the first and second grades share the same subconstruct because they belong to Phase A, while the third and fourth grades are grouped in Phase B. Notably, in Phase C, the fifth and sixth grades have different subconstructs due to the variations in the constructs addressed. This systemic division of subconstructs ensures a clear developmental trajectory for students, focusing on specific aspects of data representation at each phase. In the first grade, Indonesian students begin by classifying objects based on attributes such as fruits and colors. They learn to classify objects, count them using tally marks or numbers, and compare the objects. In the second grade, students continue to develop their data management skills by collecting data through peer and teacher interactions and presenting them using tally marks or pictographs. By the third grade, the focus shifts to more structured data collection methods, such as observations, surveys, and experiments. Students present the data they collect in tables and learn to explain and compare the data in these tables.

Table 2. Learning Content in the Intended Statistics Curriculum in Indonesia

Grade	Indonesia		
	Construct	Subconstruct	Knowledge and Skill
1	Data Representation	Sort, categorize, compare and present data of many objects using tally charts and pictographs up to four categories.	Classify objects, count objects using tally/numbers, compare objects based on attributes Collect data, sort/compare data using tally and pictographs
2	Data Representation		
3	Data Representation	Sort, compare, present, analyze and interpret data in the form of tables, pictographs, and bar charts (with single-unit scale).	Collect, and present data in tables, explain and compare data on tables
4	Data Representation		Present data into pictographs, and bar charts (with single-unit scale) and interpret data from these charts
5	Data Representation	Sort, compare, present, and analyze data of numbers of objects and data of measurements in the form of diagrams, pictographs, bar charts, and frequency tables to obtain information.	Collect, sort, compare measurement data, present data in frequency tables, pictographs, bar charts (with single-unit or multi-unit scale)
6	Data Representation		
	Uncertainty and Probability	Determine the likelihood of events in a randomized trial	Determine the likelihood of events in a randomized experiment and Predict what will happen in a randomized experiment

Note: The authors developed and underlined the text in Table 2, based on data from the MoECRT (2024).

By the fourth grade, Indonesian students are proficient in presenting data in bar graphs (with a single unit scale) and interpreting the data. In the fifth grade, the curriculum emphasizes collecting, sorting, comparing, and presenting measurement data in pictographs, tables, and bar graphs (with single- or multiple-unit scales). In the sixth grade, Indonesian students continue to explore the concepts of uncertainty and probability, which remain integral to the study of statistics. They learn basic probabilities through randomized experiments and predict the probability of events in these experiments.

DISCUSSION

Based on the results, several observations regarding the intended statistics curriculum in Thailand and Indonesia can be made. Initially, a key difference between the two countries is that Thailand does not introduce probability at the elementary level, instead beginning this topic at the secondary school level (see MoET, 2017), even though the curriculum is labeled as "Statistics and Probability." In contrast, Indonesia introduces probability in the sixth grade, at the end of elementary education. Both countries robustly introduced the foundational concepts of statistics at the elementary level, while probability was inadequately introduced from the beginning of the elementary year. This situation aligns with Steinbring's (1988, 1991) observation that probability and statistics are often taught sequentially, with probability introduced after statistics, which can downplay the crucial relationship between the theoretical aspects of probability and the empirical applications of statistics in real-world situations. Innabi et al. (2022) argue that this approach contradicts the inherent nature of statistics teaching, which typically involves two intertwined lines of statistical and probabilistic reasoning. Elbehary (2020) describes this as a conventional method of teaching both statistics and probability under analogous conditions (cf. Australian Curriculum Assessment Reporting Authority [ACARA], 2015; Ministry of Education New Zealand [MoENZ], 2007). Similarly, Kazak and Confrey (2007) explain that in traditional approaches, the connection between probability and statistics is often addressed only in the context of advanced statistical inference, where the concept of probability is applied. This is evident in the curricula of both countries.

Furthermore, the separation of statistics and probability in early education can lead to student difficulties with the abstract nature of probability (Cobb & Moore, 1997; Moore, 1997; Moore & Cobb, 2000). Taylor (2011) highlights the relationship between understanding randomness—central to probability—and applying this understanding to real-world situations in statistics. Probability theory provides a framework for modeling uncertainty, while statistics deals with analyzing data to make sense of that uncertainty. This tension stems from the distinction between the two fields: probability focuses on theoretical models of chance, whereas statistics emphasizes empirical data and practical applications. When probability concepts are introduced later in education without adequate early exposure, students are more likely to develop misconceptions and face challenges in applying probability theory to statistical reasoning. This situation is not unique to Thailand and Indonesia but has also been observed in other countries (Burrill & Pfannkuch, 2024). The conventional approach of teaching statistics and probability sequentially further reinforces this challenge. The asynchronous introduction of these topics is evident not only within the structure of curricula but also in educational practices (Milinkovic & Radovanovic, 2021) and research (Langrall et al., 2017), which highlights the global nature of this educational challenge.

When examining the subconstructs of knowledge and skills, both Thailand and Indonesia place significant emphasis on the SPS process. In Thailand, the curriculum more directly focuses on the interpretation of results. The intended subconstructs emphasize the statistical activities of "reading pictographs or […]" and "the use data from pictographs or [...] to solve the problem […]" across all grades. This implies that students are expected to employ statistical evidence from data displays to answer statistical questions. Bargagliotti et al. (2020) note that interpreting results involves using statistical facts from data collection to answer investigative questions. Indonesia, while similar to Thailand, makes broader progress in data collection, analysis, and interpretation. Students in Indonesia begin with sorting, comparing, and organizing data, then progress to presenting and analyzing data in various formats (tables, pictographs, and bar charts) across all grade levels. These activities align with Bargagliotti et al's. (2020) categorization of the data analysis process, where students are expected to analyze data by identifying key features of data collection. The skills of "presenting data" imply that students will learn to visualize variables using appropriate displays, and when the curriculum asks them to "analyze data of a number of objects," it indicates that students are expected to identify and observe key features of data collection, as described by Bargagliotti et al. (2020) in their framework for analyzing data. The emphasis on "interpreting data from these charts" aligns with the goal of helping students recognize statistical evidence and make conclusions based on data, an essential aspect of the SPS process. However, this process is primarily emphasized for third- and fourth-grade students (as seen in Table 2), and is not explicitly mentioned for the upper grades in Indonesia's curriculum.

Upon a careful review of the curricula in both countries, it is evident that while Thailand and Indonesia both address the SPS process, neither fully incorporates the entire process. For example, in Thailand, the critical stages of Formulating Statistical Investigative Questions and Collecting/Considering Data receive less emphasis, while in Indonesia, Formulating Statistical Investigative Questions and Interpreting the Results are underrepresented in the upper-grade curriculum. This gap in the curriculum may limit students' understanding of the full cycle of statistical inquiry. Practical data analysis involves summarizing datasets through methods such as collecting and sorting data, yet this process seems to dominate the Indonesian curriculum. However, the omission of the initial and final stages of the SPS process—namely, Formulating Statistical Investigative Questions and Interpreting the Results—could hinder students' abilities to engage in and comprehend statistical literacy (cf. Gal, 2002; Watson, 2006). This lack of emphasis may limit students' ability to connect their analyses to real-world contexts, where data-driven decision-making is increasingly important. Students will need a solid understanding of statistics to critically evaluate conclusions drawn from data (e.g., graphs, tables, and inferential statistical data) (Bargagliotti et al., 2020; Fukuda, 2020).

To address these challenges, we propose that curricula in Thailand and Indonesia should be restructured to include a more comprehensive approach to the SPS process. Such a curriculum would not only strengthen students' statistical literacy and problem solving abilities but would also enable them to experience the full range of activities within the SPS process. This would provide students with a more well-rounded understanding of data analysis, setting the foundation for an earlier introduction to probability alongside statistics.

Countries such as Australia and New Zealand have developed curricula that begin with fundamental concepts and progress toward inferential statistics, fostering essential skills in reasoning, argumentation, and critical thinking in statistics education (ACARA, 2015; MoENZ, 2007). New Zealand's curriculum, in particular, is often cited as a global model for statistical curriculum reform and provides a valuable reference for curriculum developers aiming to implement similar improvements (Elbehary, 2020; Forbes, 2014). Contextualizing these approaches in Thailand and Indonesia could significantly enhance the quality of statistics education in both countries, ensuring a more comprehensive and cohesive development of statistical literacy over the long term.

CONCLUSION

This study explored the current status of the intended statistics curricula in Thailand and Indonesia, classifying students' expected learning content into three categories: constructs, subconstructs, and knowledge and skills. In terms of constructs, Thailand's curriculum emphasizes data representation as the primary focus for elementary students, while Indonesia introduces data representation alongside uncertainty and probability in the final grade. Examining the subconstructs of knowledge and skills through the lens of the SPS process, Thailand prioritizes Interpreting the Results, emphasizing the use of data displays to answer statistical questions. In contrast, Indonesia presents a more progressive approach, beginning with data collection and consideration, moving through data analysis, and concluding with Interpreting the Results. However, less emphasis is placed on this final stage. Both countries' curricula would benefit from encompassing the entire SPS process. Incorporating all stages of the SPS process could significantly enhance students' statistical problem solving competencies, strengthen their understanding of real-world statistical contexts, and equip them to critically evaluate conclusions derived from data investigation.

A key limitation of this study is its focus solely on the learning content in the intended curriculum. It does not delve into other crucial aspects, such as teaching methodologies, evaluation and assessment practices, curriculum resources (i.e., textbooks, teaching materials, etc.), and classroom-level practices. Future research should address these areas to provide a more comprehensive understanding of statistical education in Thailand and Indonesia.

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