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Enhancing mathematical literacy: A comparative study of mathematics learning curricula in Thailand and Indonesia

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Abstract

PISA studies from 2000 to 2022 revealed that the achievements of Thailand's students in mathematics were always better than those of Indonesian students. Thailand still uses the 2008 curriculum until now. Meanwhile, Indonesia already changed its curriculum three times during these periods, namely Curriculum 2006, Curriculum 2013, and Curriculum 2020. Based on this data, it is important to investigate the impact of the curriculum and its implementation on students' mathematical literacy. This study aimed to investigate how students in Thailand performed better in mathematical literacy compared to their Indonesian counterparts within the context of mathematics curricula. We compared the mathematics curricula of the two countries and analyzed the implementation of the curricula in mathematics learning. Document analysis, observations, and interviews were conducted. The results show that the curricula and how they are implemented in the two countries are not strikingly different. Three notable differences are students' focus in the learning process, the preparation of learning admissions by teachers, and changes in the curriculum.

Keywords:
Comparative study, Curriculum, Mathematics literacy, PISA, Policy

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1. INTRODUCTION

One of the most important objectives in mathematics learning is to develop students' mathematical literacy. Mathematical literacy refers to how students' can solve daily life problems, especially in the modern society (Bolstad, 2023). Mathematical literacy encompasses not only the ability to solve problems but also the capacity of students to translate these problems and effectively present their solutions (OECD, 2013, 2017, 2019a, 2023a). Furthermore, mathematical literacy is also related to other mathematical skills and

even digital literacy, which are crucial in this high-technology era (Busnawir et al., 2023). More importantly, mathematical literacy represents the success of a country education.

The importance of mathematical literacy can be seen from the number of studies focusing on this topic. The fact that there are 39,000 results for "review articles" on mathematical literacy in Google Scholar is remarkable. One of the emerging issues is the recovery of students' mathematical literacy abilities following the COVID-19 pandemic, during which there was a global decline in students' mathematical literacy skills (OECD, 2019b, 2023b). To enhance mathematical literacy, numerous studies have been conducted, including the development of interactive e-modules to assist students in their learning (Efendi et al., 2024; Khair et al., 2023) addressing problems to make students get used to mathematical literacy (Rusdiana et al., 2023; Susanta et al., 2022) and even problems in the COVID-19 pandemic context (Purbaningrum & Manoy, 2022).

In the area of curriculum development, the Ministry of Education of Indonesia continually strives to create an appropriate curriculum to enhance students' mathematical literacy. In this context, Indonesia has transitioned from the 2006 curriculum to the 2013 curriculum, and subsequently to the 2020 curriculum, known as the Merdeka curriculum. Recently, in 2023, the OECD published the results of the PISA 2022 assessment. However, the outcomes of this assessment remain unsatisfactory for Indonesia (OECD, 2023b). Indonesia ranked 69th out of 81 participating countries. Although Indonesia's rank has improved by approximately 5 positions, the OECD (2023b) states that this is largely due to the impact of COVID-19 on global achievement in mathematical literacy, and Indonesian students' scores have also decreased by 13 points.

There are numerous potential causes that can influence students' mathematical literacy. In the PISA assessment, one of the indicators is the socio-economic background of the countries. The OECD (2023b) states that socio-economically advantaged students scored, on average, 93 points more in mathematics than their disadvantaged counterparts across OECD countries. Cohen (2022) states that sociological factors affect the quality of educational systems in the world, comprising factors related to students' homes and factors related to students' schools. Studies also indicate that socio-economic background factors, such as parents' education, economic status, and students' cultural capital, influence academic achievement, including mathematical literacy (Broer et al., 2019; Muelle, 2020). Furthermore, mathematical anxiety (Ashcraft & Kirk, 2001), self-efficacy (Pajares & Miller, 1994), motivation (Ryan & Deci, 2000), instructional method (Hattie, 2008), teacher knowledge (Hill et al., 2005), access to learning materials (Cheung & Slavin, 2013), parental involvement (Fan & Chen, 2001), language proficiency (Abedi & Lord, 2001), and cultural attitude towards math (Leung, 2002) also influence students' performance. Also, course curriculum is one of the biggest factors in students' mathematical literacy (Hidayah et al., 2025; Levine, 2002; Lidinillah et al., 2022).

This result raises the question, given that Thailand is still using the 2008 curriculum: "How is this possible?" Moreover, since the launch of the 2008 curriculum in Thailand, students' results have consistently outperformed those of Indonesia (OECD, 2010, 2014, 2016, 2019b, 2023b). The results of the PISA assessments from 2009 to 2022 for Indonesia and Thailand are illustrated in Figure 1.

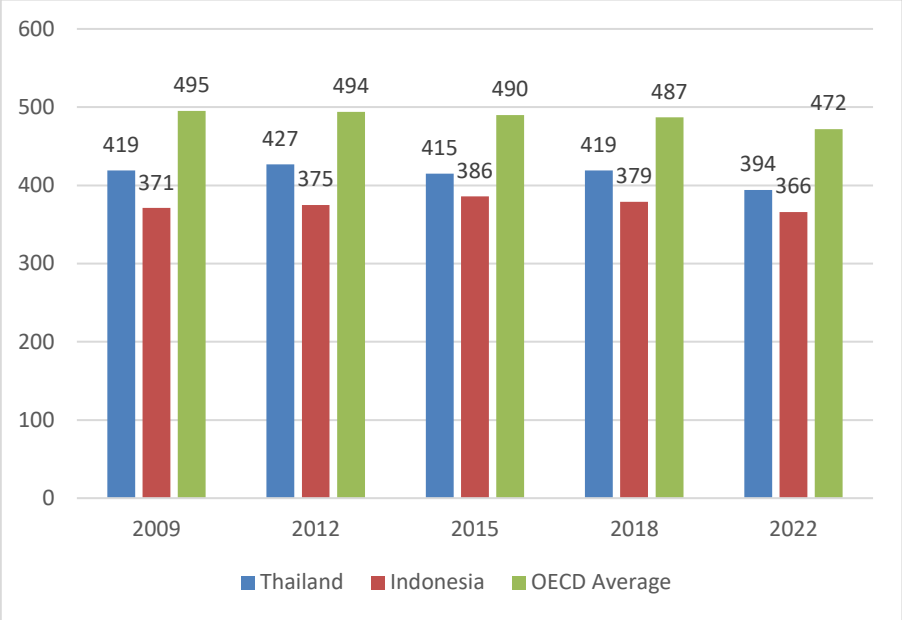


Figure 1. Thailand and Indonesia students' performance in mathematics literacy

Reseasrch on curriculum is one of the solutions researchers can conduct to improve students' mathematical literacy. Some studies aim to incorporate new methods into the current curriculum; for example, Pujiastuti and Haryadi (2022) recommend including guided inquiry learning with augmented reality in the mathematics curricula. Other studies focus on developing new mathematics curricula. Amir et al. (2019) developed a learning design to be integrated into primary school curriculum. Some studies have compared mathematics curricula from different countries, e.g. Mehrjoo et al. (2022) compared Iran and Singapore mathematics curricula.

Comparing mathematics curricula is an effort by researchers to prepare a more effective curriculum. Although the curriculum is a national matter, Lingard (2021) argues that national curriculum development is, to some extent, an expression of and response to globalization. Lloyd et al. (2017) stated that comparing curricula from other countries can provide new perspectives and insights. These findings can enhance a country's curriculum in achieving its educational goals.

Research on curriculum comparison is not new; numerous studies have examined the comparison of curricula. Therefore, in this study, in addition to comparing the curricula of the two countries, the researchers also investigated how the curriculum was implemented and its impact on mathematics, particularly in relation to mathematical literacy skills. Research by Serçe and Acar (2021) demonstrated that the countries studied (Singapore, Estonia, Canada, and Turkey) have their own focus on mathematics learning. According to Serçe and Acar (2021), the mathematics curriculum in Singapore emphasizes the development of in-depth and complex mathematical skills. In contrast, Estonia places greater emphasis on fostering critical thinking skills and mathematical problem-solving abilities (Serçe & Acar, 2021). The mathematics curriculum in Canada is more flexible, allowing students to choose topics that align with their interests (Serçe & Acar, 2021). Lastly, the mathematics curriculum in Turkey emphasizes the development of basic and fundamental

mathematical skills (Serçe & Acar, 2021). Additionally, Batur et al. (2021) conducted cross-national comparative research on statistics curricula. They found that the statistics curriculum in Turkey requires significant improvements and recommended the design and development of new standards for teaching statistics. Chi (2022) also compared the probability and statistics curriculum in secondary school mathematics textbooks in Vietnam and Germany. The findings revealed differences between the Vietnamese and German curricula, particularly in the outcomes of student skills. The Vietnamese curriculum emphasizes the development of numeracy skills and the use of formulas, while the German curriculum focuses on fostering critical thinking skills and data analysis (Chi, 2022). Furthermore, Vicente et al. (2020) stated that the Singapore curriculum features more diverse and challenging mathematical story problems, emphasizing reasoning and problem-solving, whereas Spain presents simpler and less challenging problems, focusing on problem-solving steps related to strategies and verification. Thus, according to Vicente et al. (2020), the Singapore curriculum is considered to provide better support for high-quality mathematics learning, as it enhances reasoning and helps students understand the mathematical structure of story problems compared to the curriculum in Spain. While there are differences in the mathematics curricula of each country, they all share the common goal of developing strong foundational mathematics skills (Chi, 2022; Serçe & Acar, 2021). Additionally, the mathematics curriculum in each country emphasizes the importance of incorporating technology into mathematics instruction (Chi, 2022; Serçe & Acar, 2021). From the previous discussion, it is evident that there has been no research comparing the mathematics curricula of Indonesia and Thailand in relation to the mathematical literacy skills examined in this study.

To achieve mathematical literacy skills, it is essential not only to focus on the differences in curricula but also to consider the implementation of the curriculum (Chávez et al., 2015; Walsh, 2016). This can be observed in how teachers conduct learning activities to foster mathematical literacy skills (Erixon, 2016; Sampaio & Coutinho, 2015). Has the learning process thus far supported the achievement of mathematical literacy skills? Several studies indicate that learning approaches that stimulate students' reasoning, problem-solving, and higher-order thinking skills have a positive impact on students' mathematical literacy skills (Bahtiar et al., 2020; Rohman et al., 2019; Rozhenko et al., 2022). Additionally, research by Sunarti et al. (2022) indicates that the curriculum in Indonesia places greater emphasis on mastering subject matter.

Based on the literature review, there is currently no study that compares the mathematics curricula of Indonesia and Thailand and their implementation in relation to achieving mathematical literacy abilities. Furthermore, most curriculum comparative studies focus on countries with significant differences. Ultimately, this study aims to examine how Thai students' mathematical literacy performance surpasses that of Indonesian students within the context of their mathematics curricula.

2. METHOD

The curriculum comprises several components, including rationale or vision, aims and objectives, content, learning activities, teacher roles, materials/resources, grouping,

location, time, and assessment (Van den Akker, 2010). In this study, the components are limited to the specific aspects of the mathematics curriculum, including content, learning activities, teacher roles, materials/resources, grouping, location, time, and assessment. This limitation is based on the premise that vision, aims, and objectives do not directly affect students' achievement. The details of the components and indicators are presented in Table 1.

Table 1. Components of curriculum and indicators

Components of Curriculum	Description	Indicator
Content	What are they learning?	Levels and structure of instruction
Learning activities	How are they learning?	(More) Open-ended or (more) closed-ended, learning styles, amount of guidance.
Teacher role	How is the teacher facilitating learning?	Student- & teachercenteredness, solo or coteaching.
Material and resources	What materials or resources are used for learning?	Choice in topics/courses product and task options in assignments, high and low (or no) tech materials.
Grouping	With whom are they learning?	Fixed or flexible individual/small group/whole-class, individually/collaboratively.
Location	Where are they learning?	Inside/outside classroom/ school, traditional/blended/digital.
Time	When are they learning?	Pace, duration, time span, sequence, synchronous/asynchronous communication, fixed or loose deadlines.
Assessment	How to measure how far learning has progressed?	Forms of assessment.

Sources: (Akker et al., 2007; Jonker et al., 2020; Plomp, 2013; Van den Akker, 2010)

To address these questions and collect data, document analysis and observations were conducted. The researchers first performed document analysis, followed by observations in the schools to examine the implementation of the curriculum as well as the teaching and learning processes. The instruments used included a notebook and an observation sheet. Details regarding the instruments and data sources are presented in Table 2.

Table 2. Instruments and data sources

Components of Curriculum	Notebook	Observation sheet	Data Sources
Content	How are the level and structure of instruction(topics)?	-	Thailand: pubhtml5.com /ticd/gctv/basic/ Indonesia: https://bit.ly/IndonesiaCurriculum
Learning activities	Is the learning (More) open-ended or (more) closed-ended?	Is the learning (More) Open-ended or (more) closed-ended? What is the learning style of the mathematics learning?	Thailand: pubhtml5.com /ticd/gctv/basic/ Indonesia:

Components of Curriculum	Notebook	Observation sheet	Data Sources
	What is the learning style of the mathematics learning? What is the amount of guidance by the teacher?	What is the amount of guidance by the teacher?	https://bit.ly/IndonesiaCurriculum
Teacher role	How is the learning process? Student or teacher center? Is the teacher solo or coteaching?	How is the learning process? Student or teacher center? Is the teacher solo or coteaching?	Thailand: pubhtml5.com/ticd/gctv/basic/ Indonesia: https://kurikulum.kemdikbud.go.id/file/1711507788_manage_file.pdf
Material and resources	How is the choice in topics/courses product and task options in assignments? Is the material high and low (or no) tech?	How is the choice in topics/courses product and task options in assignments? Is the material high and low (or no) tech?	Thailand: pubhtml5.com/ticd/gctv/basic/ Indonesia: https://bit.ly/IndonesiaCurriculum
Grouping	Is the learning process have fixed or flexible individual/small group/whole-class? Is the students individually/ collaboratively	Is the learning process have fixed or flexible individual/small group/whole-class? Is the students individually/ collaboratively	Thailand: pubhtml5.com/ticd/gctv/basic/ Indonesia: https://bit.ly/IndonesiaCurriculum
Location	-	Is the learning process inside/outside classroom/ school? Is the learning process traditional/blended/digital?	Thailand: pubhtml5.com/ticd/gctv/basic/ Indonesia: https://kurikulum.kemdikbud.go.id/file/1720050633_manage_file.pdf
Time	What is the duration of the mathematics learning process?	What is the duration of the mathematics learning process? How is the pace of the mathematics learning process? What is the sequence and time span of the mathematics learning process? Is the communication synchronous/asynchronous? Is the exercise or homework fixed/loose?	Thailand: pubhtml5.com/ticd/gctv/basic/ Indonesia: https://kurikulum.kemdikbud.go.id/file/1711507788_manage_file.pdf
Assessment	What is the assessment used in the mathematics learning?	What is the assessment used in the mathematics learning?	Thailand: pubhtml5.com/ticd/gctv/basic/ Indonesia: https://kurikulum.kemdikbud.go.id/file/1720050633_manage_file.pdf

Participants of this study were selected using purposive sampling technique. With the limited time of the study in Thailand, 4 secondary schools were selected (2 schools in each country) with the criteria of 1 government school and 1 private school in Indonesia and Thailand. The selected government schools have almost the same characteristics. Private schools were also selected based on the criteria where both schools are managed by the University, namely SMP Pembangunan Laboratorium UNP and Prasarnmit Demonstration School (Secondary) of Srinakharinwirot University.

The observation are done in one teaching and learning meeting, where the observations did not affect the learning process. To get more data, the teachers also got interviewed using informal interview. Interviews were conducted by researchers to further explore how the curriculum is implemented in the learning process to achieve mathematical literacy skills. The collected data were analyzed using a qualitative approach (Edmonds & Kennedy, 2016; Weyant, 2022). The data were reduced and categorized based on the indicators. Once the data were clarified, they were presented in this paper.

3. RESULTS AND DISCUSSION

3.1. Results

3.1.1. Curriculum

Content

The content of mathematics learning in the schools of Thailand and Indonesia is presented in Table 3.

Table 3. The content in mathematics learning in school of Thailand and Indonesia

Content	
Thailand	**Indonesia**
Document analysis: There are 6 strands/areas which are presented every year. The 6 strands are, 1. Numbers and Operations: the numerical concepts and sense of perception; real number system; the properties of real numbers; the operation of numbers; ratio; percentage; problem-solving involving numbers; and the application of numbers for real life. 2. Measurement: length; distance; weight; area; volume and capacity; money and time; measuring units; estimation for measurement; trigonometric ratio; problem-solving regarding measurement; and application of measurement for various situations. 3. Geometry: the geometric figures and the properties of one-dimensional geometric figures; visualisation of geometric models; geometric theories; and geometric	**Document analysis:** There are 5 content elements in mathematics learning: 1. Number: The field of study of Number discusses numbers as numeral symbols, concepts of number, operations of number arithmetic, and the relationship between various number arithmetic operations in the sub-elements of visual representation, sequence properties, and operations. 2. Algebra: The field of study of Algebra discusses non-formal algebra in the form of image symbols up to formal algebra in the form of letter symbols that represent certain numbers in the sub-elements of equations and inequalities, number relations and patterns, and ratios and proportions. 3. Measurement: The field of study of Measurement discusses measurement quantities, how to measure certain quantities, and proves principles or

Content	
Thailand	**Indonesia**
transformation through translation, reflection and rotation. 4. Algebra: pattern; relationship; function; sets and their operations; reasoning; expression; equation; equation system; inequality; graph; arithmetic order; geometric order; arithmetic series; and geometric series. 5. Data Analysis and Probability: determining an issue; writing questions; determining methods of study; data collection; systematization and presentation; central tendency and data distribution; data analysis and interpretation; opinion polling; probability; application of statistical knowledge and probability; application of probability for explaining various situations as well as for facilitating decision-making for real life. 6. Mathematical Skills and Processes: problem-solving through diverse methods; reasoning; communication; presentation of mathematical concepts; linking mathematics with other disciplines; and attaining ability for creative thinking.	theorems related to certain quantities in the sub-elements of geometric and non-geometric measurement quantities. 4. Geometry: The field of study of Geometry discusses various forms of flat and spatial shapes and their characteristics in the sub-elements of flat geometry and spatial geometry. 5. Data and opportunity analysis: The field of study of Data and Opportunity Analysis discusses the definition of data, types of data, data processing in various forms of representation, and quantitative data analysis related to the centralization and distribution of data and the opportunities for the emergence of certain data or events in data sub-elements and their representations, as well as uncertainty and opportunities.

Learning activities

The mathematics learning activities in school of Thailand and Indonesia can be seen in Table 4.

Table 4. The mathematics learning in school of Thailand and Indonesia

Open-ended or Close-ended	
Thailand	**Indonesia**
Document analysis: The learning process depends on the teachers. The teachers can choose among the essential learning processes for learners: integrated learning process; knowledge-creating process; thinking process; social process; heuristic learning process; learning process from actual experience; process of actual practice; management process; research process; self-learning process; and process of developing characteristics. **Observation:** Totally closed ended. There is no time for students to ask questions, only answering teachers' question.	**Document analysis:** Teachers are flexible to combine open-ended questions or closed-ended based on the context and needs of the learners. For example, an teacher might start with closed-ended questions to ensure students understand the basics of a concept, then move to open-ended tasks to test students' creativity and problem solving. **Observation:** More closed-ended because there is no opportunity for students to ask questions, only answering direct questions given by the teacher during the lesson.

Learning styles	
Document analysis: Depends on the teachers. **Observation:** Only visual and audio. There is no support for khinestetic learning style students.	**Document analysis:** Students with different learning styles are given the opportunity to learn in a way that suits them best. For example, geometry concepts can be taught through visualization, while algebra concepts can be explained verbally or numerically. **Observation:** Only visual and audio. No learning for students with kinesthetic learning styles.
Guidance	
Document analysis: Depends on the teachers. **Observation:** 2 of 3 teachers do 100%. The teachers totally control the class.	**Document analysis:** Guidance provided by teachers is tailored to the needs of each student. Teachers act as facilitators who help students find and develop their potential independently, but still provide guidance as needed. **Observation:** Teachers do not fully control the class, because teachers collaborate learning with small group discussions even though they are still under the supervision of teachers.

Teacher roles

The teacher roles in mathematics learning in school of Thailand and Indonesia can be seen in Table 5.

Table 5. The teacher roles in mathematics learning in school of Thailand and Indonesia

Student center or teacher center	
Thailand	**Indonesia**
Document analysis: Student centered. **Observation:** Teacher centered. The teacher took full control over the learning process.	**Document analysis:** Student centered. **Observation:** Student centered. Teachers as facilitators in learning. Teachers design learning that is relevant to students, provide feedback to improve student understanding, and direct students to learn independently and collaboratively.
Solo or co-teaching	
Document analysis: Depends on the teachers. **Observation:** Solo.	**Document analysis:** Teachers are given the freedom to choose teaching methods that suit the needs of students. **Observation**: Solo

Material/resources

The material/ resources for mathematics learning used by Thailand and Indonesia schools can be seen in Table 6.

Table 6. The material/ resources in mathematics learning in school of Thailand and Indonesia

The choice in topics/courses product and task options in assignments	
Thailand	**Indonesia**
Document analysis: Depends on the teachers to prepare for it. **Observation:** Based on students' textbooks. The teachers present the context, practice, etc.	**Document analysis:** Flexible for teachers to determine according to the needs of students. **Observation:** Teachers create their own student worksheet which is designed based on textbooks provided by the government or books by publishers in Indonesia that are commonly used by schools.
The material high and low (or no) tech	
Document analysis: Depends on the teachers. **Observation:** Low. Teachers only use PowerPoint to present their resources on TV or smartboard.	**Document analysis:** Flexible for teachers to determine according to the needs of students. **Observation:** Low. Teachers use whiteboards and PowerPoint displayed through a projector.

Grouping

The grouping in mathematics learning in the Thailand and Indonesia schools can be seen in Table 7.

Table 7. The grouping of mathematics learning in Thailand and Indonesia schools

Learning process have fixed or flexible individual/small group/whole-class	
Thailand	**Indonesia**
Document analysis: Depends on the teachers. **Observation:** Fixed individual. The teacher manages the classroom while students engage in listening and completing their practice exercises. Occasionally, discussions occur among students, although these are not initiated by the teacher.	**Document analysis:** Flexible teachers to determine the learning process. **Observation:** Teachers manage the classroom at the beginning of the lesson, after which students are instructed to engage in small group discussions to address problems presented by the teachers.
Students individually/ collaboratively	
Document analysis: Depends on the teachers. **Observation:** Students work individually with the teacher while also collaborating with their peers. Although the teachers do not formally arrange them into groups, students actively seek assistance from one another regarding how to approach or solve the problems assigned by the teacher.	**Document analysis:** Flexible teachers to determine the learning process. **Observation:** Some students study independently, while others seek assistance from their peers and teachers to address the problems presented.

Location

The location of mathematics learning of Thailand and Indonesia schools can be seen in Table 8.

Table 8. The location of mathematics learning in Thailand and Indonesia schools

Inside/outside classroom/ school	
Thailand	**Indonesia**
Observation: Inside of the class and only in the class. The teachers indicated that they only conduct the learning process within the classroom, with no outdoor learning activities or laboratory sessions. The rationale for this approach is that the duration of the learning process is limited to 50 minutes, and engaging in activities outside the classroom or in the laboratory would consume time that could impact the overall learning experience.	**Observation:** Instruction occurs exclusively within the classroom. A notable difference between Indonesia and Thailand is that the learning process in Indonesia allows for more instructional time at the secondary school level, with durations ranging from a minimum of 80 minutes to a maximum of 120 minutes, divided into 40-minute segments for each learning hour. Teachers indicated that additional time is necessary to manage students effectively during outdoor learning activities. Furthermore, the teachers have not yet integrated laboratory-based learning into their instructional preparations.
Traditional/blended/digital	
Observation: Vary. The advanced-level school is equipped with a smartboard, which teachers can use for presentations, writing, and other instructional activities. The classroom also features a microphone and speaker system. In contrast, the regular-level school has a television that can be utilized to present the learning resources prepared by the teacher, along with a whiteboard for writing.	**Observation:** Blended. Both schools are equipped with similar learning resources in the classroom, including a projector that teachers can use to present educational materials and a whiteboard for engaging activities with students.

Time

The duration of mathematics instruction in the schools of Thailand and Indonesia is presented in Table 9.

Table 9. The duration of mathematics learning in the Thailand and Indonesian schools

Duration	
Thailand	**Indonesia**
Document analysis: Based on the level of education, the time allocation for mathematics instruction is as follows: 200 hours for Grades 1-3, 160 hours for Grades 4-6, 120 hours for Grades 7-9, and 240 hours for Grades 10-12. Furthermore, educational institutions have the flexibility to divide the time allocation for each session and may adjust the total hours based on their readiness and priorities.	**Document analysis:** The allocation of learning time is governed by the Decree of the Minister of Education and Culture Number 56/M/2022. At the elementary school level, one learning period (JP) is defined as 35 minutes; at the junior high school level, it is 40 minutes; and at the high school level, it is 45 minutes. For first-grade elementary students, there

Duration	
Thailand	**Indonesia**
However, institutions must not exceed five hours of instruction per day for primary school and six hours per day for lower secondary school. **Observation:** The school adheres to the curriculum recommendations, allocating 50 minutes for each session of a single course.	are 4 JPs allocated for mathematics each week, totaling 180 JPs per year. For grades II to V, there are 5 JPs each week, resulting in a total of 216 JPs per year. In sixth grade, there are also 5 JPs each week, amounting to 192 JPs per year. In junior high school, mathematics subjects are allocated 5 JPs each week, with a total of 180 JPs per year for grades VII and VIII, and 160 JPs per year for grade IX. At the high school level, grade X has 3 JPs each week, totaling 144 JPs per year. For grades XI and XII, there are two types of mathematics courses: general mathematics, which has 3 JPs each week and totals 144 JPs per year, and advanced mathematics, which has 4 to 5 JPs per week, resulting in a total of 720 to 900 JPs per year. **Observation:** Schools follow the curriculum rules to implement learning with a study time of 80 minutes to 120 minutes per week.
Pace	
Observation: Fast. Teachers tend to speak fast and focus on completing the learning process within the 50-minute timeframe.	**Observation:** Teachers tend to prioritize students' engagement during lessons, with the expectation that this focus will enhance their understanding of mathematical concepts.
Sequence and Time Span	
Observation: The sequence of instruction begins with the teacher providing context from the students' textbook. Next, the teacher explains the concept of the topic. Following this, students are given practice exercises and homework. The time allocation for this sequence is approximately 20 minutes for context and explanation, 20 minutes for practice, and 10 minutes for exercises.	**Observation:** The instructional sequence begins with preparing the classroom and ensuring students are ready for learning. The teacher then introduces mathematical concepts related to the topic. Following this, students are asked to solve problems on worksheets in groups. Afterward, students present their answers to the class and engage in a discussion about the responses. The teacher then provides a conclusion and administers a quiz before closing the lesson. The time allocation for this sequence is approximately 15 minutes for class preparation, 20 minutes for the teacher's explanation of the mathematical concept, 60 minutes for group discussions, 15 minutes for presentations, and 10 minutes for closing.
Synchronous and asynchronous communication.	
Observation: Synchronous. The teachers tend to ask the students to continue their sentences.	**Observation:** Students tend to answer teachers' questions with yes/no answers.

Duration	
Thailand	**Indonesia**
Exercise or homework fixed/loose	
Observation: Fixed. Students are required to submit the homework assigned by the teachers at the next meeting.	**Observation:** Fixed. Homework is assigned by the teacher prior to the commencement of the lesson and is to be submitted at the next meeting.

Assessment

The assessment of mathematics learning in the Thailand and Indonesia schools is presented in Table 10.

Table 10. The assessment for learning mathematics in school of Thailand and Indonesia

Assessment	
Thailand	**Indonesia**
Document analysis: There are four types of assessment: classroom assessment, school assessment, local assessment, and national assessment. **Observation:** In the classroom, assessment is conducted through homework and tests for each completed topic.	**Document analysis:** Assessment in the Independent Curriculum comprises three types: diagnostic assessment, formative assessment, and summative assessment. Diagnostic assessment is further divided into cognitive diagnostic assessment and non-cognitive diagnostic assessment. The Independent Curriculum does not differentiate between the three assessment domains—knowledge, skills, and attitudes and behavior. The emphasis is placed on the assessment criteria for the Pancasila student profile. **Observation:** Assessment is conducted through in-class assignments and exercises, homework, and quizzes administered at the end of the learning period.

3.1.2. Teacher and Learning Process

Anwarul Islam School (Thailand)

At Anwarul Islam School, there is only one mathematics teacher; however, this teacher does not possess an educational background in mathematics. During the learning observation, the activities were predominantly teacher-centered, with the teacher explaining more than the students engaged in their own activities. The topic covered during the observation was exponentiation. The lesson commenced with the teacher explaining the concept of exponents, as illustrated in Figure 2.

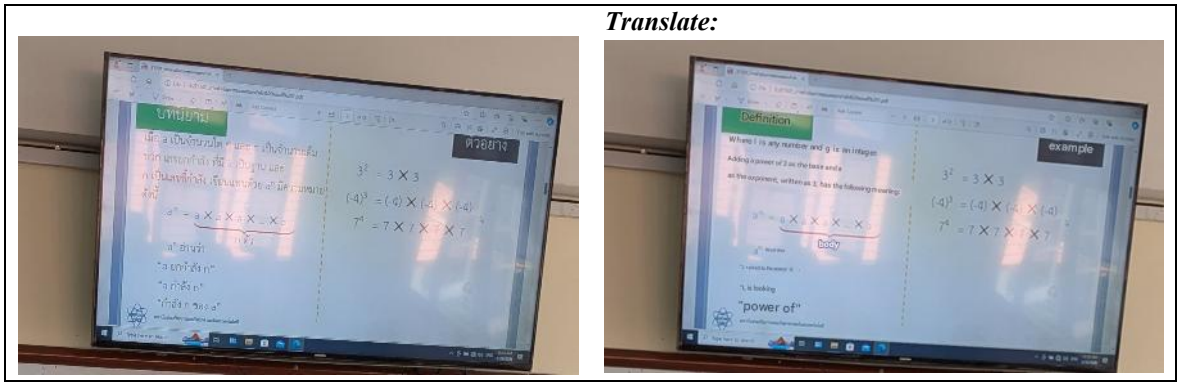


Figure 2. Concept of exponential

In his explanation, the teacher emphasized that exponentiation is repeated multiplication, rather than repeated addition. He also clarified that exponentiation does not involve the multiplication of a base number by its exponent. The teacher provided an example by writing it on the board, as illustrated in Figure 3.

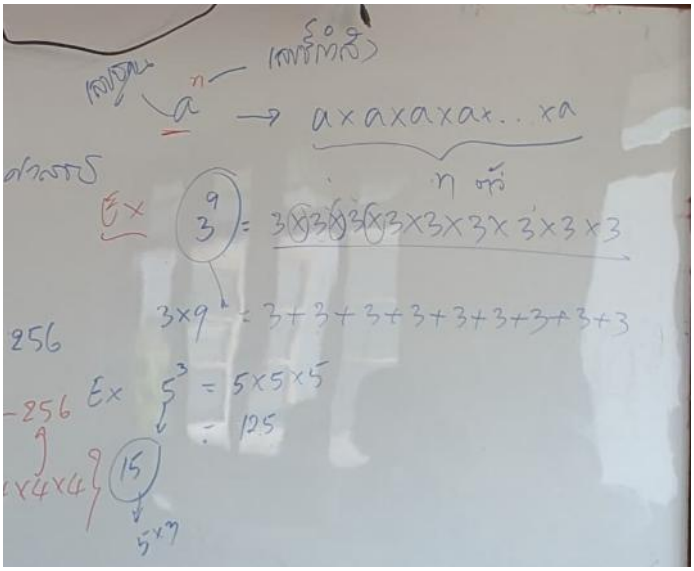


Figure 3. Example

The teacher then proceeded to explain the concept of multiplication in exponents. He again illustrated this concept on the board, as shown in Figure 4.

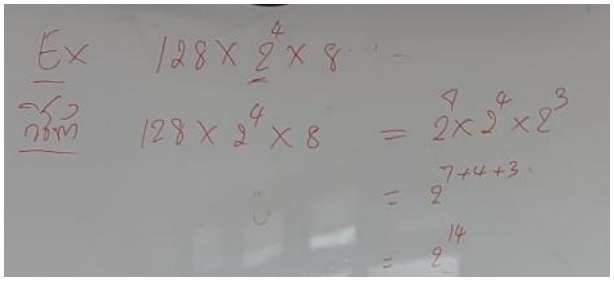
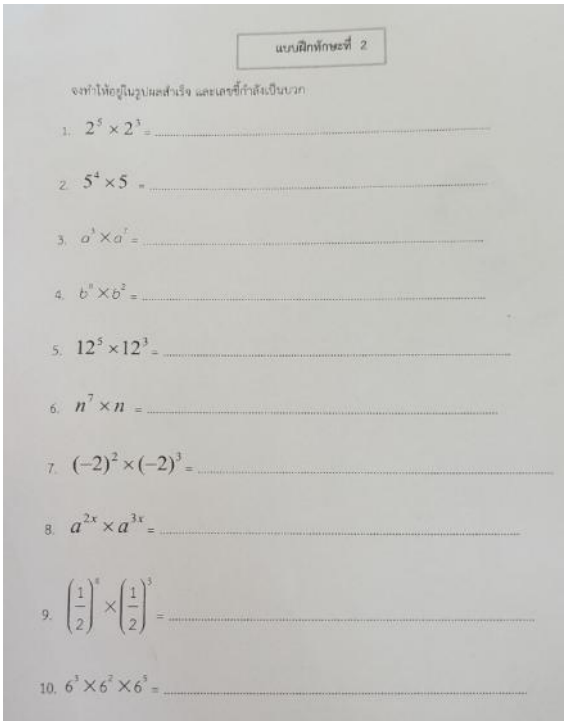


Figure 4. Exponential multiplication

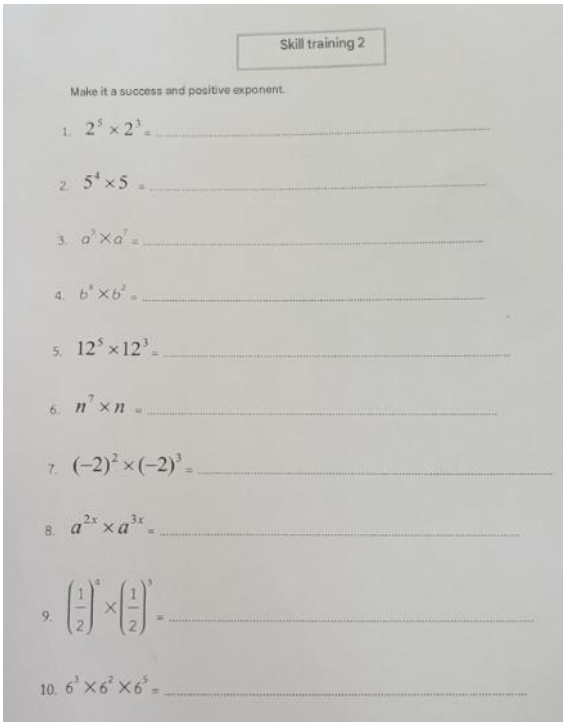
Based on Figure 4, the teacher instructed students to simplify numbers into exponents. He explained how to convert numbers that were not yet in exponent form into exponents with the same base as those already known, ensuring that all expressions were in exponent form with a common base. The teacher further clarified that when the base numbers were the same, the exponents could be added together. Following the example questions in Figure 3, the teacher wrote additional exponent questions on the board, and students took turns answering the questions presented. Finally, students were asked to complete a worksheet containing exercises, as illustrated in Figure 5.

Translate:



แบบฝึกทักษะที่ 2

1. $2^5 \times 2^3 =$ .....
2. $5^4 \times 5 =$ .....
3. $a^3 \times a^7 =$ .....
4. $b^n \times b^2 =$ .....
5. $12^5 \times 12^3 =$ .....
6. $n^7 \times n =$ .....
7. $(-2)^2 \times (-2)^3 =$ .....
8. $a^{2x} \times a^{3x} =$ .....
9. $\left(\frac{1}{2}\right)^4 \times \left(\frac{1}{2}\right)^3 =$ .....
10. $6^3 \times 6^2 \times 6^5 =$ .....



Skill training 2

Make it a success and positive exponent.

1. $2^5 \times 2^3 =$ .....
2. $5^4 \times 5 =$ .....
3. $a^3 \times a^7 =$ .....
4. $b^n \times b^2 =$ .....
5. $12^5 \times 12^3 =$ .....
6. $n^7 \times n =$ .....
7. $(-2)^2 \times (-2)^3 =$ .....
8. $a^{2x} \times a^{3x} =$ .....
9. $\left(\frac{1}{2}\right)^4 \times \left(\frac{1}{2}\right)^3 =$ .....
10. $6^3 \times 6^2 \times 6^5 =$ .....

Figure 5. Students' worksheet

One concern during the lesson was that students were very focused and attentive to the teacher's explanations. In this class, there were students who could not speak Thai; therefore, when the teacher explained, these students remained quiet and did not disturb their peers. Due to this limitation, they could only pay attention to the teacher through what was written on the board and what was displayed on the TV connection. Additionally, students received informal lessons outside of school that assisted them in their learning. The learning period lasted for 50 minutes; however, the teacher did not spend too much time checking readiness or disciplining students to refocus after the change of class hours.

Prasarnmit Demonstration School (Thailand)

Prasarnmit Demonstration School is a laboratory school affiliated with Srinakharinwirot University. This school has its own curriculum, which differs from that of other schools while still adhering to the Thai curriculum. The researcher observed the learning activities of one of its mathematics teachers, who was teaching the topic of drawing quadratic equation graphs. The observed teacher was pursuing a doctoral program and

developing a curriculum related to mathematical literacy. Unlike the previous school, the teacher's role in this setting was to guide students in their learning activities to help them discover mathematical concepts. Initially, students engaged in group discussions to determine the quadratic equation graph based on an experiment involving the pouring of water into different containers, during which they recorded the time and height. The learning activities are illustrated in Figure 6.

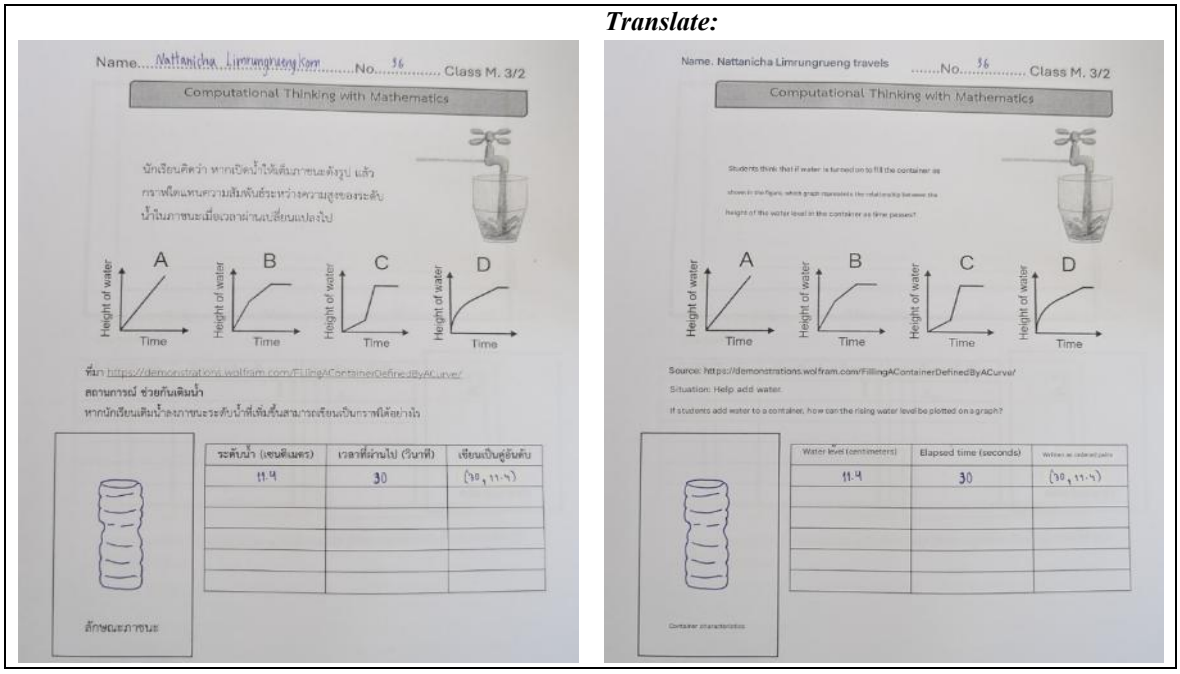


Figure 6. Group activity

After conducting the experiment, the teacher continued to explain the mathematical concept of quadratic equations. He immediately demonstrated how to use the formula to determine the quadratic equation related to the problem presented in front of the class. Figure 7 illustrates the mathematical concept taught by the teacher.

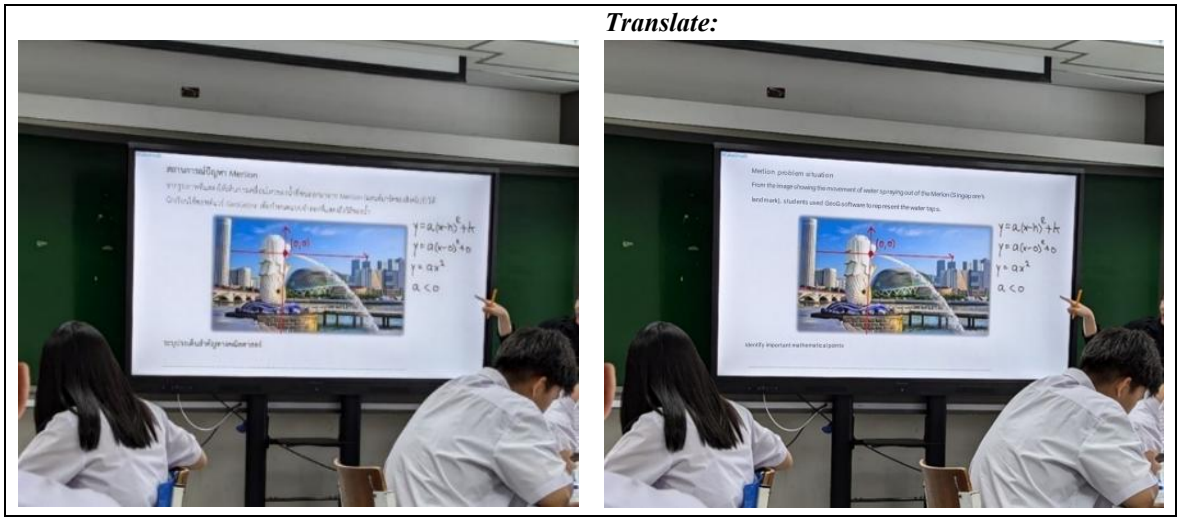
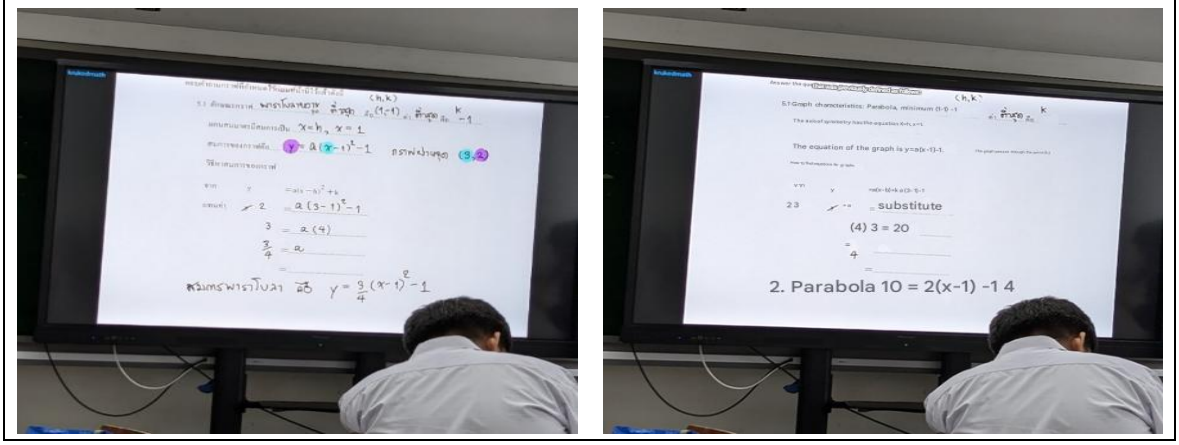


Figure 7. Mathematics concept for students

After that, the teacher provided an example of a question to determine a quadratic equation from a given quadratic equation graph. In this instance, he also explained how to solve it. The teacher wrote out the solution in detail, as illustrated in Figure 8.



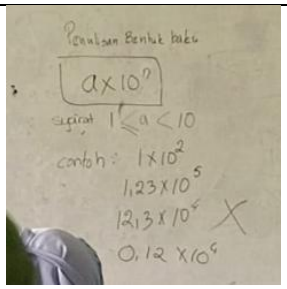
Translate:

Figure 8. Solutions for the problem by the teacher

One concern during the lesson was that students were very focused and attentive to the teacher's explanations. In group activities, students contributed to one another in completing their assignments. Similar to the previous school, learning at this institution also lasted for 50 minutes. Teachers did not spend excessive time preparing for lessons or disciplining students to refocus after the change of class hours.

SMPN Laboratorium School (Indonesia)

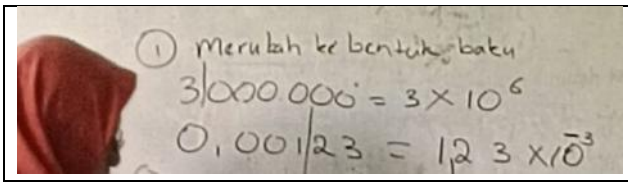
SMPN Laboratorium School is a laboratory school affiliated with Padang State University. The curriculum implemented is consistent with government recommendations. The researcher observed the learning activities of one of the mathematics teachers at the school, who was teaching the topic of scientific notation. The observed teacher had been teaching for over 10 years. During the learning activities, students were provided with a worksheet to complete in small groups. Before they began working on the worksheet, the teacher first wrote on the board and explained the standard form of scientific notation. Similar to schools in Thailand, Indonesia also employs a teacher-centered approach to learning. Figure 9 illustrates the teacher's explanation of the standard form of scientific notation.



Translate:
Writing in standard form
$a \times 10^n$
Condition $1 \leq a < 10$
example: 1×10^2
1.23×10^5
12.3×10^4 X
0.12×10^4

Figure 9. Standard form of scientific notation

After that, the teacher provided an example of a question to determine the standard form of a decimal number. In this instance, he also explained how to solve it. The teacher wrote out the solution in detail, as illustrated in Figure 9.

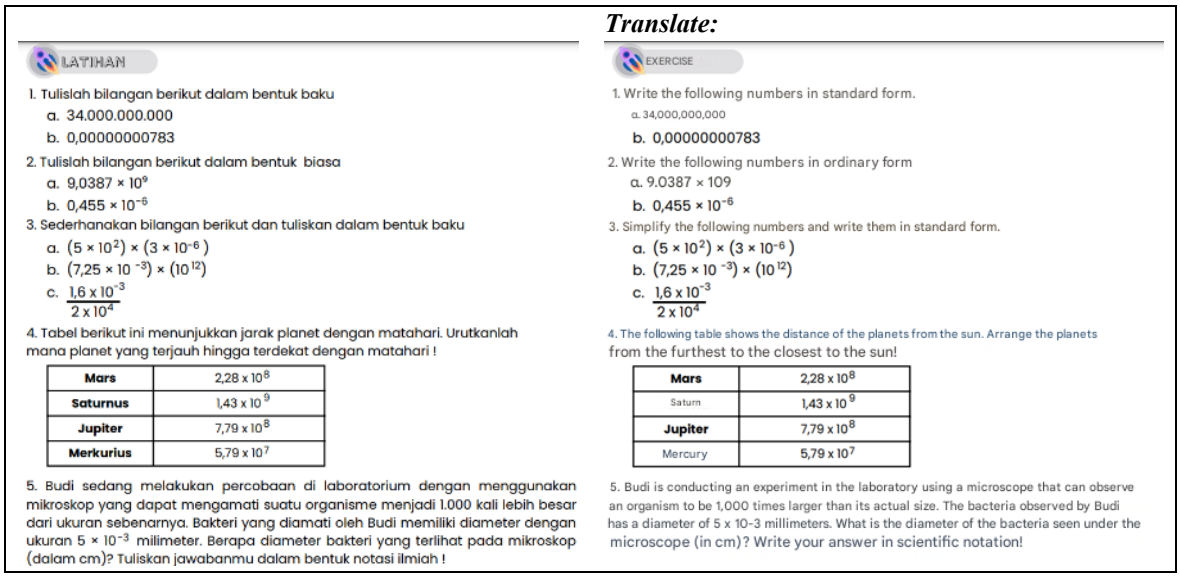


Translate:
Change to standard form

$3.000.000 = 3 \times 10^6$
$0{,}00123 = 1{,}23 \times 10^{-3}$

Figure 10. Solutions for the problem by the teacher

Based on Figure 10, the teacher guided students in converting known numbers into standard scientific notation according to the previously explained requirements. After completing the explanation, the teacher directed students to work on the worksheet containing the exercises, as illustrated in Figure 11. While students worked on the worksheet, the teacher provided guidance and support to help them complete the exercises.



LATIHAN

1. Tulislah bilangan berikut dalam bentuk baku
   a. 34.000.000.000
   b. 0,00000000783
2. Tulislah bilangan berikut dalam bentuk biasa
   a. $9{,}0387 \times 10^9$
   b. $0{,}455 \times 10^{-6}$
3. Sederhanakan bilangan berikut dan tuliskan dalam bentuk baku
   a. $(5 \times 10^2) \times (3 \times 10^{-6})$
   b. $(7{,}25 \times 10^{-3}) \times (10^{12})$
   c. $\frac{1{,}6 \times 10^{-3}}{2 \times 10^4}$
4. Tabel berikut ini menunjukkan jarak planet dengan matahari. Urutkanlah mana planet yang terjauh hingga terdekat dengan matahari !

Mars	$2{,}28 \times 10^8$
Saturnus	$1{,}43 \times 10^9$
Jupiter	$7{,}79 \times 10^8$
Merkurius	$5{,}79 \times 10^7$

5. Budi sedang melakukan percobaan di laboratorium dengan menggunakan mikroskop yang dapat mengamati suatu organisme menjadi 1.000 kali lebih besar dari ukuran sebenarnya. Bakteri yang diamati oleh Budi memiliki diameter dengan ukuran 5×10^{-3} milimeter. Berapa diameter bakteri yang terlihat pada mikroskop (dalam cm)? Tuliskan jawabanmu dalam bentuk notasi ilmiah !

Translate:

EXERCISE

1. Write the following numbers in standard form.
   a. 34,000,000,000
   b. 0,00000000783
2. Write the following numbers in ordinary form
   a. 9.0387 × 109
   b. $0{,}455 \times 10^{-6}$
3. Simplify the following numbers and write them in standard form.
   a. $(5 \times 10^2) \times (3 \times 10^{-6})$
   b. $(7{,}25 \times 10^{-3}) \times (10^{12})$
   c. $\frac{1{,}6 \times 10^{-3}}{2 \times 10^4}$
4. The following table shows the distance of the planets from the sun. Arrange the planets from the furthest to the closest to the sun!

Mars	$2{,}28 \times 10^8$
Saturn	$1{,}43 \times 10^9$
Jupiter	$7{,}79 \times 10^8$
Mercury	$5{,}79 \times 10^7$

5. Budi is conducting an experiment in the laboratory using a microscope that can observe an organism to be 1,000 times larger than its actual size. The bacteria observed by Budi has a diameter of 5 x 10-3 millimeters. What is the diameter of the bacteria seen under the microscope (in cm)? Write your answer in scientific notation!

Figure 11. Students' worksheet

Based on Figure 11, it can be observed that the types of questions in the practice exercises include conceptual questions and story problems. Thus, during the learning process, teachers encourage students to think mathematically and develop their mathematical literacy. A concern during the lesson was that some students appeared less focused and attentive. This lack of engagement may have been influenced by the time allocation for mathematics lessons, which ranged from 80 to 120 minutes. At the beginning of the lesson, teachers spent a considerable amount of time preparing the classroom and disciplining students before commencing the instruction.

SMPN 8 Padang (Indonesia)

Similar to other schools, the curriculum implemented at SMPN 8 Padang aligns with government standards. The researcher observed the learning activities of one of the

mathematics teachers at the school, who had been teaching for over 10 years. The topic covered was geometric transformation. During the learning process, the teacher utilized PowerPoint as a learning medium, displaying it in front of the class using a projector. After initiating the lesson, the teacher communicated the learning objectives to be achieved. Subsequently, the teacher explained the concept related to rotation, instructing students to memorize all the formulas associated with this topic. The teacher then asked questions about the formulas at random. Following this, the learning activity progressed to working on practice questions from the worksheet. Students were provided with millimeter paper to illustrate the rotation of lines and planes, ensuring the accuracy of their representations. To facilitate the exercises, the teacher divided the students into several groups, allowing them to discuss and collaborate on completing the practice questions.

One concern during the lesson was the level of student focus and attention while the teacher explained in front of the class. The time allocation for mathematics lessons was the same as that of the Laboratory School junior high school, which ranged from 80 to 120 minutes. However, at the beginning of the lesson, the teacher spent a considerable amount of time preparing the classroom and disciplining students before commencing the instruction.

3.2. Discussion

In terms of content, Thailand has a specific area that provides a deeper review of mathematical skills and processes, allowing students to become more familiar with solving problems, particularly those encountered in everyday life. However, although there is no specific area designated for this purpose, the curriculum in Indonesia strongly emphasizes the use of contextual problems in each topic to be taught and in problem-solving activities. Research conducted by Junianto and Wijaya (2019), Rachmaningtyas et al. (2022), and Suharta and Suarjan (2018) indicated that the use of contextual problems in learning positively impacts students' mathematical literacy. This serves as evidence that the curricula in both Indonesia and Thailand have indeed promoted the development of literacy skills. Nevertheless, the results of the mathematical literacy tests based on the PISA assessments for these two countries remain in the low category.

In learning theory, skills are classified as direct objects, while problem-solving in mathematical literacy is considered an indirect object (Gagne, 1970). Both are recommended to be taught using demonstration and drill methods (Bell, 1978). Theoretically, the mathematics curricula in both countries are not significantly different; the effectiveness largely depends on how Indonesian teachers implement the learning process. However, in practice, Indonesian teachers encounter numerous challenges in executing this mathematics curriculum. These challenges include teachers' readiness to utilize the curriculum, a lack of resources, and other related issues (Nurcahyono & Putra, 2022; Nurhidayah & Yahya, 2023; Putri et al., 2023). Consequently, one of the factors influencing the results of the mathematical literacy test is the teachers' preparedness in the learning process.

In terms of learning activities, each curriculum allows flexibility for teachers, granting them the autonomy to choose the learning processes they implement. The difference lies in the Thai curriculum, which provides more detailed expectations for the learning

process, whereas the Indonesian curriculum does not. During observations, it was found that most teachers in Indonesia provided 100% of the direction for their lessons. However, learning activities in Indonesia are not entirely teacher-directed; teachers assign group work for discussion.

The roles of teachers, materials/resources, grouping, and assessment in the mathematics curricula of Indonesia and Thailand are similar. The primary difference occurs in the actual learning process, where Thai teachers tend to adopt a teacher-centered approach, while Indonesian teachers often employ a student-centered approach. The student-centered approach is generally more effective than the teacher-centered approach, as it actively involves students in the learning process (Groves & Robinson, 2024; Marpaung & Azzajjad, 2020). Nevertheless, many teachers in Indonesia still utilize a teacher-centered approach (Firmansyah & Jiwandono, 2022). This aligns with research findings (Jannah & Habiby, 2022; Setyawardani & Edy, 2024; Umbara & Nuraeni, 2019), which indicate that learning methods that promote student engagement through discussions, as outlined in the curriculum, positively impact students' mathematical literacy. When students are given the opportunity to explore their problem-solving abilities, they are better prepared to tackle similar mathematical literacy questions in the future.

In learning activities, the Indonesian mathematics curriculum is more conducive to developing mathematical literacy skills. This is attributed to the effectiveness of small group learning compared to a teacher-centered approach (Abdu et al., 2021; Jazuli et al., 2019; Widodo et al., 2023). However, observations indicated that a teacher-centered approach was employed 100% of the time in classes where the primary learning objective was to understand mathematical concepts, specifically the concept of exponents. This concept serves as a direct object in mathematics learning (Gagne, 1970), and utilizing an expository method is not an inappropriate choice (Bell, 1978). This has been regulated in the curriculum in Indonesia.

In terms of location, both countries utilize the same technique, which is confined to the classroom. However, Indonesia allocates more time for each meeting. Regarding facilities, Thailand is superior in both blended and modern technologies. In blended learning, television is more efficient than a projector, particularly when educators bring their own projectors, as is often the case in Indonesia. In Thailand, classes can be prepared quickly, minimizing wasted time, whereas in Indonesia, setting up a projector can take up to 10 minutes. The availability of facilities also depends on the school's resources; using smartboards is the optimal choice, as they offer multiple functions, including the ability to write directly on the teaching materials displayed. This facility significantly influences effectiveness, especially the smartboard (Broslavskaya, 2018; Omuralieva et al., 2020). When preparation for learning takes a long time, it provides students with opportunities to socialize, which can detract from their attention and focus on learning.

Based on the previous discussion, it can be concluded that the curricula in Indonesia and Thailand have made efforts to promote mathematical literacy. However, several factors hinder this achievement, one of which is students' attention during the learning process. Learning is not meaningful if it does not begin with students' awareness and engagement in the educational experience.

4. CONCLUSION

The comparison of curricula and their implementation, when reviewed across all components, reveals minimal differences. The most notable distinction lies in student focus during the learning process, as well as in the preparation of learning materials by teachers and the frequency of curriculum changes. Thai students tend to exhibit greater focus compared to their Indonesian counterparts. In Indonesia, curriculum changes occur more frequently, whereas the curriculum in Thailand has remained unchanged since 2008, although it allows flexibility for teachers to be creative.

Given the lack of significant differences between these two mathematics curricula, further research is warranted. Future studies should analyze each aspect of the mathematics curricula in greater depth. Additionally, students' behaviors in solving mathematical problems and their attitudes toward learning could serve as valuable focal points for future research.

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Declarations

Author Contribution : AF: Conceptualization, Supervision, and Writing – original draft; YH: Formal analysis, and Methodology, Writing – review and editing; GB: Investigation, and Resources. HS: Data curation, Formal analysis, Visualization, and Writing – review and editing; H: Formal analysis, Project administration, and Resources.

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Conflict of Interest : The authors declare no conflict of interest.

Additional Information : Additional information is available for this paper.

REFERENCES

Abdu, R., van Helden, G., Alberto, R., & Bakker, A. (2021). Multimodal dialogue in small-group mathematics learning. *Learning, Culture and Social Interaction*, *29*, 100491. https://doi.org/10.1016/j.lcsi.2021.100491

Abedi, J., & Lord, C. (2001). The language factor in mathematics tests. *Applied Measurement in Education*, *14*(3), 219–234. https://doi.org/10.1207/S15324818AME1403_2

Akker, J. v. d., Bannan, B., Kelly, A. E., Nieveen, N., & Plomp, T. (2007). Curriculum design research. In *An introduction to educational design research* (Vol. 37, pp. 37–50).

Amir, M. F., Mufarikhah, I. A., Wahyuni, A., Nasrun, N., & Rudyanto, H. E. (2019). Developing 'fort defending'game as a learning design for mathematical literacy

integrated to primary school curriculum in Indonesia. *Elementary Education Online*, *18*(3), 1081–1092. https://doi.org/10.17051/ilkonline.2019.610145

Ashcraft, M. H., & Kirk, E. P. (2001). The relationships among working memory, math anxiety, and performance. *Journal of Experimental Psychology: General*, *130*(2), 224–237. https://doi.org/10.1037/0096-3445.130.2.224

Bahtiar, A., Syamsuddin, A., & Akib, I. (2020). Description of mathematical communication skills, logical thinking and its influence on the ability of mathematical literacy for students of grade v elementary school. *International Journal of Scientific and Technology Research*, *9*(4), 1075–1078. https://www.ijstr.org/final-print/apr2020/Description-Of-Mathematical-Communication-Skills-Logical-Thinking-And-Its-Influence-On-The-Ability-Of-Mathematical-Literacy-For-Students-Of-Grade-V-Elementary-School.pdf

Batur, A., Özmen, Z. M., Topan, B., Akoğlu, K., & Güven, B. (2021). A cross-national comparison of statistics curricula [Farklı Ülkelerin Matematik Öğretim Programlarının İstatistik Öğrenme Alanı Açısından Karşılaştırılması]. *Turkish Journal of Computer and Mathematics Education (TURCOMAT)*, *12*(1), 290–319. https://doi.org/10.16949/turkbilmat.793285

Bell, F. H. (1978). *Teaching and learning mathematics (in secondary schools)*. W. C. Brown Company. https://books.google.co.id/books?id=kTHfAAAACAAJ

Bolstad, O. H. (2023). Lower secondary students' encounters with mathematical literacy. *Mathematics Education Research Journal*, *35*(1), 237–253. https://doi.org/10.1007/s13394-021-00386-7

Broer, M., Bai, Y., & Fonseca, F. (2019). A review of the literature on socioeconomic status and educational achievement. In M. Broer, Y. Bai, & F. Fonseca (Eds.), *Socioeconomic Inequality and Educational Outcomes: Evidence from Twenty Years of TIMSS* (pp. 7–17). Springer International Publishing. https://doi.org/10.1007/978-3-030-11991-1_2

Broslavskaya, G. (2018). The impact of multimedia technology on the effective study of mathematics. *Bulletin of Lviv State University of Life Safety*(18), 145–150.

Busnawir, B., Kodirun, K., Sumarna, N., & Alfari, Z. (2023). Analysis of the effect of social skills and disposition of digital literacy on mathematical literacy ability. *European Journal of Educational Research*, *12*(1), 59–69. https://doi.org/10.12973/eu-jer.12.1.59

Chávez, Ó., Tarr, J. E., Grouws, D. A., & Soria, V. M. (2015). Third-year high school mathematics curriculum: Effects of content organization and curriculum implementation. *International Journal of Science and Mathematics Education*, *13*(1), 97–120. https://doi.org/10.1007/s10763-013-9443-7

Cheung, A. C. K., & Slavin, R. E. (2013). The effectiveness of educational technology applications for enhancing mathematics achievement in K-12 classrooms: A meta-analysis. *Educational Research Review*, *9*, 88–113. https://doi.org/10.1016/j.edurev.2013.01.001

Chi, N. (2022). A comparative study of the probability and statistics curricula in the high school mathematics textbooks of vietnam and germany. *International journal of education and practice*, *10*(2), 69–83. https://doi.org/10.18488/61.v10i2.2942

Cohen, S. E. (2022). Factors and parameters influencing student achievement in mathematics: A comparative study between israel and finland. *European Journal of Educational Research*, *11*(3), 1813–1824. https://doi.org/10.12973/eu-jer.11.3.1813

Edmonds, W. A., & Kennedy, T. D. (2016). *An applied guide to research designs: Quantitative, qualitative, and mixed methods*. Sage Publications. https://doi.org/10.4135/9781071802779

Efendi, S. A., Haryono, Y., & Cesaria, A. (2024). Development of e-module based on mathematical literacy skill in statistical materials. *Vygotsky: Jurnal Pendidikan Matematika Dan Matematika*, *6*(1), 39–50. https://doi.org/10.30736/voj.v6i1.951

Erixon, E.-L. (2016). Learning activities and discourses in mathematics teachers' synchronous oral communication online. *Research in Mathematics Education*, *18*(3), 267–282. https://doi.org/10.1080/14794802.2016.1190667

Fan, X., & Chen, M. (2001). Parental involvement and students' academic achievement: A meta-analysis. *Educational Psychology Review*, *13*(1), 1–22. https://doi.org/10.1023/A:1009048817385

Firmansyah, A., & Jiwandono, N. R. (2022). Kecenderungan guru dalam menerapkan pendekatan student centre learning dan teacher centre learning dalam pembelajaran [Teachers' tendency to apply student centered learning and teacher centered learning approaches in learning]. *Jurnal Guru Indonesia*, *2*(1), 33–39. https://doi.org/10.51817/jgi.v2i1.229

Gagne, R. M. (1970). *The conditions of learning*. Department of Educational Research.

Groves, T., & Robinson, W. (2024). Distilling the comparative essence of teachers' centres in England and Spain 1960-1990: past perspectives and current potential for teacher professional development? *Research Papers in Education*, *39*(1), 93–112. https://doi.org/10.1080/02671522.2022.2089215

Hattie, J. (2008). *Visible learning: A synthesis of over 800 meta-analyses relating to achievement*. Routledge. https://doi.org/10.4324/9780203887332

Hidayah, I. R., Sa'dijah, C., Anwar, L., Yerizon, Y., & Arnawa, I. M. (2025). Empowering students' numeracy skills: Mathematics teachers' perceptions regarding the effectiveness and challenges of Indonesian national curriculum and the programs–A mixed method study. *Infinity Journal*, *14*(1), 163–188. https://doi.org/10.22460/infinity.v14i1.p163-188

Hill, H. C., Rowan, B., & Ball, D. L. (2005). Effects of teachers' mathematical knowledge for teaching on student achievement. *American Educational Research Journal*, *42*(2), 371–406. https://doi.org/10.3102/00028312042002371

Jannah, M., & Habiby, W. N. (2022). Effectiveness of the PBL model on mathematics learning to cultivate mathematical literacy of elementary school students. *Al-Jabar: Jurnal Pendidikan Matematika*, *13*(2), 455–463. https://doi.org/10.24042/ajpm.v13i2.13116

Jazuli, L. O. A., Solihatin, E., & Syahrial, Z. (2019). The effects of Brain-based learning and Project-based learning strategies on student group mathematics learning outcomes student visual learning styles. *Pedagogical Research*, *4*(4), em0047. https://doi.org/10.29333/pr/5949

Jonker, H., März, V., & Voogt, J. (2020). Curriculum flexibility in a blended curriculum. *Australasian Journal of Educational Technology*, *36*(1), 68–84. https://doi.org/10.14742/ajet.4926

Junianto, J., & Wijaya, A. (2019). Developing students' mathematical literacy through problem based learning. *Journal of Physics: Conference Series*, *1320*(1), 012035. https://doi.org/10.1088/1742-6596/1320/1/012035

Khair, S., Kartono, K., & Susilaningsih, E. (2023). Developmentof Lombok culture-based ethnomathematics module to improve mathematical literacy of class iv elementary school students. *International Journal of Research and Review*, *10*(3), 249–257. https://doi.org/10.52403/ijrr.20230327

Leung, F. K. S. (2002). Behind the high achievement of east asian students. *Educational Research and Evaluation*, *8*(1), 87–108. https://doi.org/10.1076/edre.8.1.87.6920

Levine, T. (2002). Stability and change in curriculum evaluation. *Studies in Educational Evaluation*, *28*(1), 1–33. https://doi.org/10.1016/S0191-491X(02)00010-X

Lidinillah, D. A. M., Rahman, R., Wahyudin, W., & Aryanto, S. (2022). Integrating sundanese ethnomathematics into mathematics curriculum and teaching: A systematic review from 2013 to 2020. *Infinity Journal*, *11*(1), 33–54. https://doi.org/10.22460/infinity.v11i1.p33-54

Lingard, B. (2021). National curriculum making as more or less expressions of and responses to globalization. In M. Priestley, D. Alvunger, S. Philippou, & T. Soini (Eds.), *Curriculum making in Europe: Policy and practice within and across diverse contexts* (pp. 29–52). Emerald Publishing Limited. https://doi.org/10.1108/978-1-83867-735-020211003

Lloyd, G. M., Cai, J., & Tarr, J. E. (2017). Issues in curriculum studies: Evidence-based insights and future directions. *Compendium for research in mathematics education*, 824–852.

Marpaung, D., & Azzajjad, M. (2020). The effectiveness of student centre learning in experiment method on acid and base solution to increase student achievement. *Journal of Applied Science, Engineering, Technology, and Education*, *2*(1), 32–36. https://doi.org/10.35877/454RI.asci2156

Mehrjoo, N., Nourian, M., & Abai Kopai, M. (2022). A comparative study of mathematics curriculum in primary schools of Iran and Singapore. *Iranian Journal of Comparative Education*, *5*(2), 1871–1897. https://doi.org/10.22034/ijce.2022.273973.1288

Muelle, L. (2020). Socioeconomic and contextual factors associated with low academic performance of peruvian students in PISA 2015. *Apuntes: Revista de Ciencias Sociales*, *47*(86), 117–154. https://doi.org/10.21678/apuntes.86.943

Nurcahyono, N. A., & Putra, J. D. (2022). Hambatan guru matematika dalam mengimplementasikan kurikulum merdeka di sekolah dasar [Obstacles for mathematics teachers in implementing the independent curriculum in elementary schools]. *Wacana Akademika: Majalah Ilmiah Kependidikan*, *6*(3), 377–384.

Nurhidayah, N., & Yahya, A. (2023). Implementation of the merdeka curriculum through the application of the project-based blended learning model in mathematics learning. *MaPan*, *11*(2), 273–284. https://doi.org/10.24252/mapan.2023v11n2a5

OECD. (2010). *PISA 2009 results: What students know and can do*. OECD. https://doi.org/10.1787/9789264091450-en

OECD. (2013). *PISA 2012 assessment and analytical framework*. OECD. https://doi.org/10.1787/9789264190511-en

OECD. (2014). *PISA 2012 results: What students know and can do (Volume I, Revised edition, February 2014)*. OECD. https://doi.org/10.1787/9789264208780-en

OECD. (2016). *PISA 2015 results (Volume I)*. OECD. https://doi.org/10.1787/9789264266490-en

OECD. (2017). *PISA 2015 assessment and analytical framework*. OECD. https://doi.org/10.1787/9789264281820-en

OECD. (2019a). *PISA 2018 assessment and analytical framework*. OECD. https://doi.org/10.1787/b25efab8-en

OECD. (2019b). *Programme for international student assessment (PISA) results from PISA 2018*. OECD.

OECD. (2023a). *PISA 2022 assessment and analytical framework*. OECD. https://doi.org/10.1787/dfe0bf9c-en

OECD. (2023b). *PISA 2022 results (volume i)*. OECD. https://doi.org/10.1787/53f23881-en

Omuralieva, M., Bazhenov, R., Biymursaeva, B., & Eshenkulova, A. (2020). Improving the efficiency of the educational process using smart notebook. In *Proceedings of INTCESS 2020- 7th International Conference on Education and Social Sciences*, (pp. 560–566).

Pajares, F., & Miller, M. (1994). Role of self-efficacy and self-concept beliefs in mathematical problem solving: A path analysis. *Journal of educational psychology*, *86*(2), 193–203. https://doi.org/10.1037/0022-0663.86.2.193

Plomp, T. (2013). Educational design research: An introduction. In T. Plomp & N. Nieveen (Eds.), *Educational design research* (Vol. 1, pp. 11–50). Netherlands Institute for Curriculum Development (SLO).

Pujiastuti, H., & Haryadi, R. (2022). Enhancing mathematical literacy ability through guided inquiry learning with augmented reality. *Journal of Education and e-Learning Research*, *10*(1), 43–50. https://doi.org/10.20448/jeelr.v10i1.4338

Purbaningrum, M., & Manoy, J. (2022). Students' mathematical literacy based on covid-19 context. *MATHEdunesa*, *11*(1), 26–35. https://doi.org/10.26740/mathedunesa.v11n1.p26-35

Putri, W., Hidayanti, D., Muzhafran, M., & Ramadhan, I. (2023). Analisis problematika kurikulum merdeka pada pembelajaran matematika di SDN 012 Babakan Ciparay kota Bandung [Analysis of the problems of the independent curriculum in mathematics learning at SDN 012 Babakan Ciparay, Bandung City]. *Jurnal Riset Rumpun Matematika dan Ilmu Pengetahuan Alam*, *3*(1), 119–128. https://doi.org/10.55606/jurrimipa.v3i1.2288

Rachmaningtyas, N., Kartowagiran, B., Sugiman, S., Retnawati, H., & Hassan, A. (2022). Habituation of mathematical literacy trained in junior high school. *International Journal of Educational Methodology*, *8*(2), 321–330. https://doi.org/10.12973/ijem.8.2.321

Rohman, S., Susanto, S., Hobri, H., Saiful, S., & Sahnawi, S. (2019). An analysis of students' literacy ability in mathematics teaching with realistic mathematics education based on lesson study for learning community. *Journal of Physics: Conference Series*, *1265*(1), 012004. https://doi.org/10.1088/1742-6596/1265/1/012004

Rozhenko, O., Darzhania, A., Bondar, V., Mirzoyan, M., & Skvortsova, O. (2022). Comparative analysis of the mathematical literacy level in first-year students of the north-caucasus federal university, based on the international PISA studies. In A. Tchernykh, A. Alikhanov, M. Babenko, & I. Samoylenko (Eds.), *Mathematics and its Applications in New Computer Systems* (pp. 175–183). Springer International Publishing.

Rusdiana, A., Samsuddin, A. U., Muhtadin, A., & Fendiyanto, P. (2023). Development of mathematical literacy problems using east kalimantan context. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *7*(1), 197–210. https://doi.org/10.31004/cendekia.v7i1.1885

Ryan, R. M., & Deci, E. L. (2000). Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary Educational Psychology*, *25*(1), 54–67. https://doi.org/10.1006/ceps.1999.1020

Sampaio, P., & Coutinho, C. (2015). Teachers as curriculum builders: Integrating technology to learning activities in mathematics. *Revista Brasileira de Educação*, *20*(62), 635–661. https://doi.org/10.1590/S1413-24782015206205

Serçe, F., & Acar, F. (2021). A comparative study of secondary mathematics curricula of Turkey, Estonia, Canada, and Singapore. *Journal of Pedagogical Research*, *5*(1), 216–242. https://doi.org/10.33902/JPR.2021167798

Setyawardani, I., & Edy, S. (2024). Effect of problem-based learning assisted by e-LKPD wizer.me on students mathematical literacy skills. *Mathline : Jurnal Matematika dan Pendidikan Matematika*, *9*(2), 433–446. https://doi.org/10.31943/mathline.v9i2.611

Suharta, I. G., & Suarjan, I. (2018). A case study on mathematical literacy of prospective elementary school teachers. *International Journal of Instruction*, *11*(2), 413–424. https://doi.org/10.12973/iji.2018.11228a

Sunarti, V., Hafizah, H., Rusdinal, R., Ananda, A., & Gistituati, N. (2022). Comparison of Indonesian and finnish education curriculum. *Journal of Social, Humanity, and Education*, *2*(2), 141–152. https://doi.org/10.35912/jshe.v2i2.808

Susanta, A., Sumardi, H., & Zulkardi, Z. (2022). Development of mathematical literacy problems using bengkulu context. In *Conference: Eighth Southeast Asia Design Research (SEA-DR) & the Second Science, Technology, Education, Arts, Culture, and Humanity (STEACH) International Conference (SEADR-STEACH 2021)*. https://doi.org/10.2991/assehr.k.211229.029

Umbara, U., & Nuraeni, Z. (2019). Implementation of realistic mathematics education based on adobe flash professional cs6 to improve mathematical literacy. *Infinity Journal*, *8*(2), 167–178. https://doi.org/10.22460/infinity.v8i2.p167-178

Van den Akker, J. (2010). Building bridges: How research may improve curriculum policies and classroom practices. In *Beyond Lisbon 2010: Perspectives from research and development for educational policy in Europe* (pp. 175–195). CIDREE.

Vicente, S., Sánchez, R., & Verschaffel, L. (2020). Word problem solving approaches in mathematics textbooks: a comparison between Singapore and Spain. *European Journal of Psychology of Education*, *35*(3), 567–587. https://doi.org/10.1007/s10212-019-00447-3

Walsh, T. (2016). 100 years of primary curriculum development and implementation in Ireland: A tale of a swinging pendulum. *Irish Educational Studies*, *35*(1), 1–16. https://doi.org/10.1080/03323315.2016.1147975

Weyant, E. (2022). Research design: Qualitative, quantitative, and mixed methods approaches, 5th. *Journal of Electronic Resources in Medical Libraries*, *19*(1-2), 54–55. https://doi.org/10.1080/15424065.2022.2046231

Widodo, S., Turmudi, T., Dahlan, J., Watcharapunyawong, S., Robiasih, H., & Mustadin, M. (2023). The sociograph: Friendship-based group learning in the mathematics class. *Infinity Journal*, *12*(1), 27–40. https://doi.org/10.22460/infinity.v12i1.p27-40