



## English in Mathematics : Trends, Benefits, and Challenges in Southeast Asia Countries

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**Abstract:** This study aims to identify the application of English in mathematics teaching in Southeast Asia countries, focusing on trends across countries, methods, benefits, and challenges. This study employed a systematic literature review (SLR) method adapted from the PRISMA model, resulting in 17 relevant articles obtained from 141 articles in the Scopus and Web of Science databases. The data analysis technique of this research applied thematic analysis to review, identify, and analyze the data. The findings revealed that emerging research focused on learning policies and media, improving pedagogical practices, educational quality, and student learning outcomes. Malaysia is the country that has conducted the most research on this topic, with 11 articles, followed by the Philippines and Thailand, each with 2 articles. The majority of studies used qualitative methods and mixed methods. The benefits of using English in mathematics instruction included avoiding translation errors, supporting the implementation of global learning, enhancing soft skills and problem-solving abilities, supporting future career prospects, and improving the quality of learning with support from teachers and related parties. Some challenges faced include varying skills and readiness of teachers and students, the availability and utilization of resources, and the different impacts on students, especially those from diverse demographics. Additionally, cultural and linguistic gaps between English and students' mother tongue, the rapid adoption of English policies in mathematics teaching, and necessary pedagogical adjustments also present challenges.

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## Introduction

Mathematics serves as a framework for understanding the universe and is often described as the "language of the universe." This characterization is reflected in recent research that emphasizes mathematics as a crucial tool for explaining natural phenomena and advancing technological innovation (Gowers et al., 2008). Thus, the universality of mathematics facilitates effective communication and collaboration, which are essential for addressing global challenges and advancing scientific knowledge (Sevinc & Lesh, 2022). The close relationship between mathematics and science underscores the growing importance of mathematics in academia and beyond. For example, recent research highlights how mathematical modeling and data analysis are integral to advances in biology, physics, and environmental science. This symbiotic relationship is critical to educational curricula, preparing students for careers in science, technology, engineering, and mathematics (STEM), which are essential for economic growth and societal development (Wilson, 2021).

Currently, English has emerged as a powerful lingua franca in academia, commerce, and international communication, leading to its widespread application as a teaching medium



in various educational contexts, including mathematics education. The dominance of English in global discourse is evident in academic publications, international conferences, and cross-border collaborations, making it an important language for aspiring scientists and professionals (Sah & Li, 2022). Additionally, the use of English in mathematics education can exacerbate educational disparities, as highlighted by Hamid and Honan (2012). These studies show that students from urban areas with better access to quality English education tend to perform better than students from rural areas, who may experience the dual difficulty of learning mathematics and English simultaneously. These disparities underscore the need for targeted interventions and support mechanisms to ensure equitable access to quality education for all students, regardless of their background.

Exploring the complex relationships between these domains is critical to understanding how adopting English as a medium of instruction affects mathematics education, especially in regions where English is not the primary spoken language and where there is significant linguistic diversity. Southeast Asia countries exemplify these characteristics. It is important to conduct research in Southeast Asia to gain a more comprehensive understanding of the benefits and challenges of using English for English language learners, ensuring that all students receive equal benefits and can overcome the challenges they face. However, we did not find any current literature that thoroughly reviews the benefits and challenges of using English in mathematics in the Southeast Asia context. For example, an article by Jourdain and Sharma (2016) discussed the challenges that English language learners face in mathematics education due to the complexity of the mathematical language. This study also explored strategies that teachers can use to support English language learners in overcoming these challenges.

Another example is a literature review conducted by De Araujo et al. (2018), which discussed how English language learners face unique challenges in mathematics education in K-12 schools in the United States. This paper also examines the tension between maintaining instruction in English and the benefits of allowing students to use their mother tongue in learning mathematics. Additionally, research conducted by Meaney (2013) discussed the dominance of English in mathematics education research. This study highlighted that non-English-speaking countries often struggle to fully participate in the international mathematics education community due to language barriers.

From the three examples of literature reviews mentioned above and further searches, we did not find any literature reviews that thoroughly discuss the benefits and challenges of using English in mathematics within the Southeast Asia context. Moreover, we did not find any papers addressing research trends regarding the use of English in mathematics. Trend discussions are also necessary to understand the direction of future research and help researchers identify gaps in the overall understanding of this topic. Based on the urgency of this research and the existing gap in the current literature, this research aims to explore global trends, benefits, and challenges in using English as a medium of instruction in mathematics, focusing on the context of Southeast Asia countries.

## **Research Method**

This research is a systematic literature review conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Page et al., 2021) guidelines for selecting papers for analysis. The articles we analyzed were obtained from two of the most trusted academic databases, namely Scopus and Web of Science. These databases were chosen because they are the most widely used reference databases by researchers in Asia, including those in Southeast Asia. We anticipate that selecting these databases will



provide us with high-quality articles. The search procedure to obtain metadata for analysis involved a combination of keywords found in the title, abstract, or body of the research text, as listed in Table 1 below.

**Table 1. Keywords used to search for papers on the Scopus and Web of Science website**

	Keywords
Population and location	indonesia OR malay* OR brunei OR cambodia OR thai* OR vietnam OR philippines OR laos OR myanmar OR "timor leste"
Query on Scopus website	(TITLE-ABS-KEY (english AND education) AND TITLE-ABS-KEY (math* AND edu*) AND TITLE-ABS-KEY (indonesia OR malay* OR brunei OR cambodia OR thai* OR vietnam OR philippines OR laos OR myanmar OR "timor leste") ) AND ( LIMIT-TO ( LANGUAGE , "English" ) ) AND ( LIMIT-TO ( PUBSTAGE , "final" ) ) AND ( LIMIT-TO ( DOCTYPE , "ar" ) )
Query on Web of Science website	english education (Topic) and math* edu* (Topic) and indonesia OR malay* OR brunei OR cambodia OR thai* OR vietnam OR philippines OR laos OR myanmar OR "timor leste" (Topic) and Article (Document Types) and English (Languages)

The following criteria were used to select the papers:

- 1) Research theme: Teaching Math in English
- 2) Location: One of Southeast Asia countries
- 3) Research method: Empirical study
- 4) Types of papers: Journal article
- 5) Language: English

We did not set a specific year limit for our search to obtain a comprehensive understanding of the overall trends regarding the use of English in mathematics in Southeast Asia. This area of research is still unexplored and requires more in-depth investigation. Setting a year limit would have resulted in fewer selected papers and restricted our ability to thoroughly address the research questions in this study.

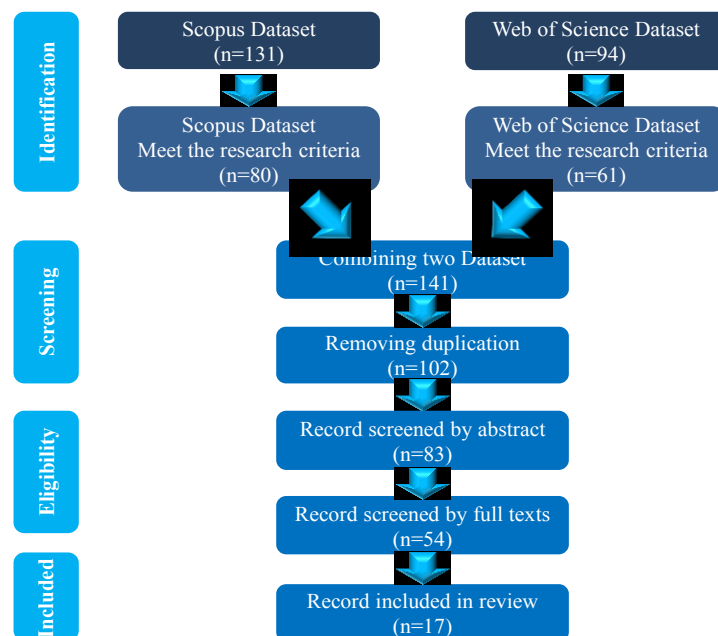
The data analysis technique employed in this research is thematic analysis. This approach enabled us to uncover meaningful themes, patterns, and trends that addressed our research questions. The thematic analysis was carried out through a series of systematic steps. First, we began by clearly formulating the research questions and objectives and conducted a thorough search of academic databases to gather a comprehensive list of studies relevant to the research questions. After selecting the relevant studies, we proceeded with data extraction, where key information such as methodologies, findings, and theoretical frameworks were systematically gathered and organized. Subsequently, the coding scheme was applied to the entire dataset, allowing us to systematically categorize and identify emerging themes. In addition, we conducted frequency and co-occurrence analyses to quantify the prevalence of certain themes and to examine how different themes were interrelated within the literature. Finally, the findings were presented in a structured format to convey the key themes and patterns uncovered through the thematic analysis.

## Results and Discussion

The basis for conducting this research is to review the current research reports available from academic literature databases, namely Scopus and Web of Science, providing researchers with an overview of current research that has been conducted. These two databases are valuable for summarizing the focus, empirical evidence, and systematic research that has been conducted (Petersen et al., 2008). Using keywords related to mathematics, English, and Southeast Asia countries, we found 131 articles in the Scopus

database and 94 articles in the Web of Science database. We then applied additional criteria, limiting the search to only journal articles published in English and already published, not those in press. After applying these criteria, 80 articles were obtained from Scopus and 61 articles from Web of Science.

Next, we combined data from the two databases, resulting in a total of 141 articles. After removing duplicate articles found in both databases, we had 102 articles. We then conducted an abstract analysis of the 102 articles to determine whether they discussed teaching mathematics using English. From this analysis, we identified 83 articles that addressed this topic. We downloaded and thoroughly read these 83 articles to identify those that specifically discussed the use of English in mathematics. After this second eligibility process, only 54 articles remained that specifically addressed the use of English in mathematics. We then read these 54 articles in more depth and selected those that explained the benefits and challenges of using English in mathematics within the Southeast Asia context. The final result of this process was 17 articles that could be used to answer our research questions.



**Figure 1. Screening Process to Obtain Record Included in Review**

### Selected Articles

There were 17 selected articles used to answer the research questions in this study. We explain each article in outline, referring to the information contained in Table 2. The explanation of each article is as follows:

- 1) Albury (2020): This research explores the preference for using English in the education of Malaysia's younger generation. The aim is to understand Malaysian youth's perspectives on language policy, particularly their preferences for the language of instruction for mathematics and science.
- 2) Basree (2009): Conducted in Malaysia, this research explores the perceptions of various stakeholders, including school principals, teachers, and pupils, regarding the Contemporary Children's Literature Program implemented in elementary schools.
- 3) Feryok (2009): This research discusses the implementation and challenges of teaching mathematics and science using English in Malaysia.



- 4) Iyer and Moore (2017): Conducted by Young Lives in Ethiopia, India, and Vietnam, this research explores concepts and measurements of learning quality in primary and secondary education to observe school effectiveness. One challenge is comparing learning quality across the three countries and addressing systematic differences when the same level of difficulty is presented in different languages.
- 5) Jarvis et al. (2014): This research discusses teaching mathematics in English, directly related to the Malaysian government policy “Pengajaran dan Pembelajaran Sains dan Matematik dalam Bahasa Inggeris (PPSMI).” The aim is to explore participants’ experiences and views regarding aspects of pedagogy and collaboration.
- 6) Kewara (2017): The aim of this research is to enhance language proficiency and improve understanding of mathematical concepts. Thailand created a program on content and language integrated learning, an approach to teaching and learning English.
- 7) Khalid et al. (2014): This research discusses the importance of combining cognitive, collaborative, and technical constructivist educational principles in computer-based learning, specifically focusing on mathematics education.
- 8) Maasum et al. (2012): This paper focuses on teachers’ pedagogical skills and content knowledge, including subject matter content, pedagogical approaches, classroom management, resource use, assessment, preparation of teaching materials, student management, teacher communication strategies, first language use, and perspectives in teaching content mathematics in English.
- 9) Mahmud et al. (2018): The aim of this research is to provide training for science teachers to gain insight into any changes to the science curriculum. Science teachers are required to integrate Science, Technology, Engineering, and Mathematics (STEM) in their teaching and to teach science in English through dual language programs.
- 10) Mamba et al. (2020): This research addresses the readiness of students in the Philippines for higher education. The real challenge is the disparity in the readiness of students from different backgrounds to transition effectively to college.
- 11) Manakul et al. (2023): This research aims to improve students’ knowledge, skills, and attitudes in English, Mathematics, and Science, for students in grades 7-9. Teachers participating in this research are expected to have smart teaching abilities.
- 12) Othman et al. (2020): This study examines the beliefs of science teachers in elementary schools regarding teaching science using English and the extent to which these beliefs are consistent with their classroom practices.
- 13) Pan et al. (2022): Researchers examined whether parents’ interest in English or mathematics was associated with their respective performance in those subjects.
- 14) Sharbawi and Jaidin (2020): This study evaluates the efficacy of English language-in-education policies, focusing on the interface between macro planning and micro practices and assessing the effectiveness of the macro-to-micro transmission process.
- 15) Sua (2007): This research examines the policy of teaching science and mathematics in English within the Malaysian educational system, focusing on the attitudes and achievement orientations of secondary school students.
- 16) Suliman et al. (2017): The aims of this research are to identify the level of readiness and self-confidence among students in dual language programs to find differences in readiness levels between Form One and Form Two students.
- 17) Suliman et al. (2018): This research demonstrates that learning Mathematics and Science using English can help students improve their English skills, beneficial for both professional and academic environments.





**Table 2. The Selected Articles: Authors, Titles, and Countries**

No	Authors and year	Title	Country
1	Albury (2020)	Beyond economy and culture: language-in education preferences of Malaysian youth	Malaysia
2	Basree (2009)	The implementation of contemporary children's literature program (CCL) in Malaysian primary schools: Feedback from stakeholders	Malaysia
3	Feryok (2009)	Activity theory, imitation and their role in teacher development	Malaysia
4	Iyer and Moore (2017)	Measuring Learning Quality in School Effectiveness Surveys	Vietnam
5	Jarvis et al. (2014)	The Action - Reflection - Modelling (ARM) Pedagogical Approach for Teacher Education: a Malaysia-UK Project	Malaysia
6	Kewara (2017)	Phrasebook: A Way Out for CLIL Teachers in Thailand	Thailand
7	Khalid et al. (2014)	Teaching and Learning Using Computers: How Should We Tread on Its Changing Technology?	Malaysia
8	Maasum et al. (2012)	An Investigation of Teachers' Pedagogical Skills and Content Knowledge in a Content-based Instruction Context	Malaysia
9	Mahmud et al. (2018)	Science teacher education in Malaysia: Challenges and way forward	Malaysia
10	Mamba et al. (2020)	College Readiness of Filipino K to 12 Graduates: Insights from a Criterion-Referenced Test	Philippines
11	Manakul et al. (2023)	Smart teaching abilities of junior high school teachers in Thailand	Thailand
12	Othman et al. (2020)	Dual Language Programme: Teachers' Beliefs and Practices in Teaching Science through English	Malaysia
13	Pan et al. (2022)	Variability in Asian Parents' English and Mathematics Skills: A Family-Based Study	Philippines
14	Sharbawi and Jaidin (2020)	Brunei's SPN21 English Language-in-Education Policy: A Macro-to-Micro Evaluation	Brunei
15	Sua (2007)	Attitudes and Achievement Orientations of Students towards Learning of Science and Mathematics in English	Malaysia
16	Suliman et al. (2017)	Dual-Language Programme in Malaysian Secondary Schools: Glancing Through the Students' Readiness and Unravelling the Unheard Voices	Malaysia
17	Suliman et al. (2018)	Gleaning into Students' Perspectives in Learning Science and Mathematics Using the English Language	Malaysia

## Discussion

The articles selected in this systematic review identified several factors related to teaching mathematics using English in terms of: 1. trends, including topics, methods, and countries of research; 2. benefits; and 3. challenges. Based on these three categories and the research questions in this study, we have developed a comprehensive discussion, which is presented in the section below.



### **Trends of this Research**

Based on the selected articles, the results reveal several notable research trends, which are outlined by research focus, geographic location, and methodological approach. These trends highlight prevalent academic questions in the field of education, particularly concerning the teaching of mathematics using English, English language policies in various countries, pedagogical methodologies, and educational outcomes in diverse socio-cultural contexts.

#### **Country**

Malaysia emerged as a focal point in the literature reviewed, with 11 of the total selected papers originating from this country. These findings underscore Malaysia's proactive stance in addressing various aspects of language policy within the educational framework, particularly those relating to the integration of English in the teaching of mathematics and science (Albury, 2020; Sua, 2007). Research from Malaysia has largely examined policy implementation, critically evaluating its impact on educational paradigms, student dispositions, and scholastic achievement.

In addition, significant research contributions have come from the Philippines and Thailand. These observations highlight these countries' commitment to advancing the educational agenda, shedding light on the opportunities and obstacles inherent in pedagogical efforts to teach mathematics and science in English, as well as in curriculum enactment and educational restructuring (Mamba et al., 2020; Pan et al., 2022; Kewara, 2017; Manakul et al., 2023). Investigations in this context explore a range of educational endeavors, including linguistic aptitude, conceptual understanding, curriculum appropriateness, and student readiness.

#### **Methodological Approaches**

We identified two research approaches, namely qualitative and mixed-method approach. The primary methodology observed throughout the studies is qualitative research, conducted through methods including surveys, interviews, and case studies (Iyer and Moore, 2017; Suliman et al., 2018; Albury, 2020). This approach allows researchers to explore diverse stakeholder perspectives, experiences, and attitudes, thereby enhancing investigations into language policy in mathematics teaching, pedagogical effectiveness, and educational reform. Some studies adopt a mixed methods approach, combining qualitative and quantitative techniques to comprehensively explore research questions, validate findings, and gather diverse insights (Jarvis et al., 2014; Sharbawi and Jaidin, 2020).

#### **Benefits**

The benefits identified from this research include the ease of learning mathematical concepts in English, which can help avoid misinterpretations due to translation errors (Albury, 2020). Misinterpretations can be avoided because a good understanding of English automatically aids students in comprehending mathematical problems. Since most mathematics literature is originally in English, translations can sometimes present technical difficulties. That being said, a strong grasp of English can eliminate these obstacles.

Additionally, Kewara (2017) stated that integrating language into mathematics teaching can help students better understand complex mathematical concepts. Similarly, Feryok (2009) argued that conceptual understanding, supported by experiential learning, is essential for the effective use of English-based mathematics teaching practices in concrete classroom situations.

Improved reading habits contribute to increased English language proficiency, which in turn enhances learning in subjects like mathematics taught in English (Basree, 2009). English proficiency allows students to access a wider range of resources, participate in global discussions, and pursue opportunities requiring English skills (Sua, 2007). In other words,



using English as the language of instruction in mathematics enables students to access broader scientific and mathematical knowledge globally. Since most scientific documentation and global communication are conducted in English, proficiency in this language is essential for students to compete internationally (Suliman et al., 2018). English language skills are thus crucial for supporting students in global learning, especially in mathematics. By studying mathematics in English, students are better prepared for further studies and careers, where English is often a fundamental requirement (Sua, 2007). Mastering English through subjects like mathematics can open up more career opportunities for students (Suliman et al., 2018).

Moreover, solving mathematical problems in English can enhance both students' and teachers' soft skills and problem-solving abilities. According to (Jarvis et al., 2014), soft skills such as teamwork, communication, and mutual respect can be developed by learning mathematics in English. Khalid et al. (2014) also concur that students in collaborative learning groups gain leadership experience by supporting peers in presenting mathematical problem-solving strategies. This opportunity allows students to develop soft skills and teamwork abilities. The use of coordinate dynamics and collaborative learning processes provides opportunities for students to improve their mathematical understanding and problem-solving abilities. Research conducted by Iyer and Moore (2017) includes cognitive test designs that assess mathematics, functional English skills, and transferable skills such as problem-solving and critical thinking.

### **Challenges**

The transition to using English as the medium of instruction for mathematics in Southeast Asia presents significant challenges due to the varying abilities and readiness of teachers and students. Teachers, particularly those whose exposure to English was limited to their own schooling, often struggle to sustain academic discourse in English due to their limited proficiency (Basree, 2009). The rapid implementation of these policies left little time to address these disparities, further exacerbating the challenges (Albury, 2020). Similarly, students' readiness to learn in English varies widely, which complicates the transition and affects learning outcomes (Suliman et al., 2017).

Resource availability and utilization are significant hurdles in implementing English-medium instruction. The adequacy of English-medium textbooks has been questioned, with teachers often reverting to their native languages when explaining complex concepts due to a lack of sufficient resources in English (Albury, 2020). Additionally, issues like the insufficient supply of books and delays in program continuity hinder the effective implementation of these policies (Basree, 2009). Teachers also require additional resources, such as lesson plans and worksheets, yet these are often lacking, impacting the quality of instruction (Kewara, 2017; Othman et al., 2020).

The impact of switching to English for teaching mathematics is particularly challenging for students from diverse demographics. Students' proficiency in English significantly influences their ability to understand and excel in mathematics, leading to varied learning outcomes (Suliman et al., 2018). This language barrier not only affects academic performance but also shapes students' attitudes toward learning these subjects (Sua, 2007). The varied readiness among students to transition to English-medium instruction further complicates the situation, resulting in different educational experiences and outcomes (Suliman et al., 2017).

Cultural and linguistic gaps between English and students' mother tongues pose significant challenges during this transition. The policy shift to English has elicited mixed reactions, with resistance from parents and local communities who prefer education in native languages (Albury, 2020; Suliman et al., 2017). The cultural and linguistic distance between





English and students' native languages makes it harder for them to relate to and understand instruction, complicating the learning process (Sharbawi & Jaidin, 2020).

The rapid adoption of English as the medium of instruction for mathematics has introduced several policy and implementation challenges. The extensive changes in the education system, such as new examination formats, have raised concerns among educators (Basree, 2009). The swift implementation, without gradual or well-considered approaches, has sometimes led to policy reversals, as seen in Malaysia's decision to revert to teaching mathematics in Malay in 2013 (Jarvis et al., 2014; Khalid et al., 2014). Pedagogical adjustments are necessary to accommodate the shift to English-medium instruction. Teaching mathematics in a second language requires significant changes in teaching methods to ensure effective learning (Suliman et al., 2017). The difficulty that students face with higher-order thinking skills in a second language further complicates this transition (Mahmud et al., 2018). Teachers need to adapt to new pedagogical models, such as Active Reflective Modeling (ARM), to address these challenges and ensure successful instruction (Jarvis et al., 2014).

### **Conclusion**

Based on the analysis of the literature sources presented, it can be concluded that Malaysia is the country that has conducted the most research on this topic, with 11 articles, followed by the Philippines and Thailand, each with 2 articles. The majority of studies use qualitative methods and mixed methods. The benefits of using English in mathematics instruction include avoiding translation errors, supporting the implementation of global learning, enhancing soft skills and problem-solving abilities, supporting future career prospects, and improving the quality of learning with support from teachers and related parties. Some of the challenges faced include varying abilities and readiness of teachers and students, the availability and utilization of resources, and the different impacts on students, especially those from diverse demographics. Additionally, cultural and linguistic gaps between English and students' mother tongue, the rapid adoption of English policies in mathematics teaching, and necessary pedagogical adjustments also present challenges.

### **Recommendation**

While the integration of English as a medium of instruction in mathematics offers significant advantages, including enhanced language proficiency and better career prospects, it also presents considerable challenges, such as varying levels of teacher preparedness and the availability of adequate resources. To address these challenges, teachers need to implement targeted interventions and establish robust support mechanisms that ensure equitable access to quality education for all students, regardless of their socio-economic or linguistic backgrounds. Ongoing research and careful policy refinement are crucial to maximize the benefits and mitigate the challenges associated with using English in mathematics instruction within Southeast Asia. This approach will help to create a more inclusive and effective educational environment that supports diverse learners in achieving academic success.

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