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The Relationship between English Reading Comprehension and Mathematical Literacy among English Program Students at Thanyaburi School in Pathumthani Province

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Abstract

This study investigated the levels of English reading comprehension and mathematical literacy, and the relationship between these competencies, among 56 students who were enrolled in the English Program at Thanyaburi School, Pathumthani Province, during the 2025 academic year. English reading was assessed using the TOEFL Junior Reading section, while mathematical literacy was measured with a researcher-developed test aligned with the PISA framework. The mathematical literacy test demonstrated strong content and construct validity (IOC = 0.60–1.00; CFA factor loadings = 0.31–1.04) and high reliability (Cronbach's α = 0.763–0.842; EPA = 0.868–0.920). Results indicated moderate-to-high English reading proficiency (M = 233.30, SD = 30.97) and a wide range of mathematical literacy scores (M = 18.32, SD = 5.72). Pearson correlation revealed a very strong positive and statistically significant relationship ($r = 0.897$, $p < .001$), and regression analysis showed that English reading comprehension significantly predicted mathematical literacy, explaining 80.4% of the variance ($R^2 = 0.804$). These findings underscore the critical role of reading skills in facilitating mathematical reasoning, problem-solving, and real-life application in English-medium instruction. The results suggest integrating targeted reading strategies, vocabulary support, and teacher collaboration between language and mathematics educators to enhance students' academic outcomes.

Keywords: English reading comprehension, Mathematical literacy, English Program

1. Introduction

In Thailand, English proficiency has become increasingly important for students' academic success and future opportunities, particularly in English Program (EP) schools where core subjects such as mathematics, science, and computer studies are taught in English. As English serves as the lingua franca of science, technology, and higher education, students are expected to develop not only basic communication skills but also academic language proficiency, which is crucial for understanding subject content. In this context, the Ministry of Education has promoted EP curricula nationwide, including at Thanyaburi School in Pathumthani Province, to simultaneously enhance students' language competence and subject knowledge. English reading comprehension is particularly critical in EP settings. Mathematics instruction frequently involves word problems, instructions, and assessment items written in English, requiring students to accurately interpret and process textual information before applying mathematical reasoning. Research demonstrates that reading proficiency directly influences students' ability to engage in higher-order mathematical thinking, interpret complex data, and solve real-life problems (Alonso

et al., 2022; Chan & Chiu, 2023). Students with strong reading skills can decode mathematical vocabulary, follow multi-step reasoning processes, and integrate information more effectively. Despite widespread implementation of EP curricula, challenges persist. National and international assessments, including PISA, indicate that Thai students often perform below the OECD average in reading and mathematics, suggesting difficulties in integrating language and content learning. Internal reports from Thanyaburi School reveal substantial variation in students' English reading abilities, with some learners struggling to access mathematical knowledge presented in English. This gap may limit learning, reduce problem-solving efficiency, and hinder overall achievement. Given these challenges, this study aims to examine the relationship between English reading comprehension and mathematical literacy among EP students at Thanyaburi School. By analyzing how reading skills contribute to mathematical reasoning, problem-solving, and application, the research seeks to inform curriculum design, teaching strategies, and collaborative practices between language and mathematics educators. The findings are expected to provide evidence-based guidance for improving learning outcomes in English-medium mathematics instruction in Thailand.

2. Research Objectives

1. To investigate the level of English reading comprehension and mathematical literacy of English Program students at Thanyaburi School.
2. To examine the relationship between English reading comprehension and mathematical literacy among English Program students at Thanyaburi School.

3. Literature Review

3.1 Concepts and Related Theories

The relationship between English reading comprehension and mathematical literacy among secondary school students in English Program (EP) curricula involves several key concepts and theoretical perspectives. These frameworks provide insights into how language proficiency—particularly reading comprehension—affects students' ability to learn mathematics in an English-medium context.

3.1.1 English Reading Comprehension

English reading comprehension refers to the ability to decode, interpret, and analyze written English texts, ranging from general vocabulary to subject-specific terminology. In EP programs such as at Thanyaburi School, reading comprehension is essential for understanding mathematics textbooks, instructions, and assessments presented in English.

Canale and Swain's (1980) Communicative Competence Theory emphasizes that effective language use involves grammatical, sociolinguistic, and strategic competence, which go beyond linguistic form to include meaning in context. This is particularly relevant in mathematics classrooms where students must interpret context-specific word problems.

Similarly, Cummins' (1979) BICS/CALP framework distinguishes between Basic Interpersonal Communicative Skills (BICS), which involve conversational English, and Cognitive Academic Language Proficiency (CALP), which involves the complex language required for academic learning. Mathematics learning in EP settings relies heavily on CALP, as students must understand abstract terminology and complex sentence structures in problem-solving tasks.

3.1.2 Mathematical Literacy

Mathematical literacy refers to the ability to apply mathematical knowledge and reasoning to solve real-life problems and communicate mathematical ideas effectively. According to the OECD (2019), mathematical literacy goes beyond procedural computation to encompass reasoning, interpretation of data, and application in practical contexts.

Piaget's (1973) Constructivist Theory suggests that learners build mathematical knowledge through active engagement, connecting new ideas with prior knowledge. In English-medium classrooms, this process requires dual proficiency in mathematics and the language of

instruction.

Vygotsky's (1978) Sociocultural Theory also highlights the role of language as a mediator of thought. In EP contexts, English proficiency directly supports students' mathematical reasoning and collaborative problem-solving, as learners communicate mathematical concepts in a second language.

3.1.3 Bilingual Education Theory

Cummins' (2000) Bilingual Education Theory emphasizes the interdependence of first and second language proficiency in supporting academic development. Strong skills in the first language (Thai) can scaffold second-language (English) learning, which in turn facilitates content mastery. For EP students, bilingual competence is crucial for accessing mathematical knowledge, as cognitive transfer occurs across languages.

3.1.4 Reading Process Theory

Kintsch's (1998) Construction-Integration Model of Reading explains comprehension as a cognitive process involving decoding, integration of information, and connecting new input with prior knowledge. In EP mathematics classrooms, reading comprehension determines whether students can interpret problem statements and apply mathematical reasoning effectively. Weak reading skills increase cognitive load, leaving fewer mental resources available for mathematical processing.

3.2 Related Research

A growing body of research has explored the intersection of language proficiency and mathematics achievement across different contexts. Earlier studies (Rambely et al., 2013; Cinkara et al., 2014) established that students with higher English proficiency performed better in mathematics courses, particularly in English-medium instruction. Recent research from 2021 onward provides more nuanced insights into the cognitive, linguistic, and educational factors influencing this relationship.

Cognitive Overlap Studies

Bernabini, Bonifacci, and de Jong (2021) found that verbal working memory and phonological awareness predicted both reading and mathematics performance among European primary students, underscoring the shared cognitive basis of these skills. Similarly, Giofrè, Donolato, and Mammarella (2018) highlighted that verbal working memory is crucial for solving text-based math problems, while visuospatial memory supports calculation. These studies emphasize that language-related cognitive skills provide a foundation for mathematical cognition, especially in tasks requiring reading comprehension and reasoning.

Bilingual and English-Medium Contexts

Balci and Lynch (2022) demonstrated that English reading proficiency and self-efficacy strongly predicted mathematics achievement among Thai international school students. International evidence aligns with this pattern: Tanko et al. (2022) in Nigeria and Al-Amri and Awaji (2023) in Saudi Arabia found significant positive correlations between English proficiency and mathematics performance. Similarly, du Plooy, Stander, and Scheckle (2025) reported that poor English proficiency hindered South African technical college students' success in mathematics-related subjects, and that English course performance was a better predictor of academic outcomes than standardized language test scores. Collectively, these findings underscore the critical role of functional English proficiency in supporting mathematics learning in bilingual and English-medium education contexts.

Cross-Domain Interactions

Steinhauer, Becker, and Neumann (2022) provided evidence from Germany that reading and mathematics have a bidirectional relationship: gains in one domain support growth in the other over time. Similarly, Galang et al. (2023) in the Philippines found that college students with stronger reading comprehension achieved higher scores in general mathematics courses, further supporting the idea of interdependence between language and mathematics skills.

Large-Scale and Systematic Studies

Karacaoğlu and Kasap (2023), analyzing PISA 2018 data in Turkey, concluded that reading comprehension is a stronger predictor of math performance than some content-specific skills. González-Martín et al. (2024), through a systematic review of 71 studies,

emphasized that language proficiency—not bilingualism per se—explains differences in mathematics performance across contexts. These large-scale findings corroborate the importance of English reading comprehension for achieving high mathematical literacy.

Summary

Taken together, these studies consistently demonstrate that English reading comprehension is a key determinant of mathematics achievement, particularly in bilingual and English-medium instruction settings. The findings align with Cummins' CALP theory and support the notion that strengthening reading skills can directly enhance mathematical literacy.

4. Research Methodology

4.1 Population

The population of this study comprised all students enrolled in the English Program (EP) at Thanyaburi School during the 2025 academic year, specifically those consistent with the OECD PISA target population. These students studied various subjects, including mathematics, using English as the medium of instruction. Because the number of students within this population was relatively small (N = 56), the study included all students to ensure comprehensive coverage and avoid sampling bias.

Table 1 Participants in the Study by Gender

Participants	Male	Female	Total
English Program Students	30	26	56

According to table 1, the participants comprised 30 male and 26 female students, totaling 56 students in the study.

4.2 Research Instruments

4.2.1 The TOEFL Junior® Standard Test

The TOEFL Junior® Standard Test was employed to assess students' English reading comprehension through its Reading Comprehension section. This internationally recognized and standardized instrument, developed by ETS, measures students' ability to understand and interpret both academic and non-academic texts. The use of this test ensured high validity and reliability, providing objective and comparable data relevant to English-medium instruction.

4.2.2 The test of Mathematical Literacy

A researcher-developed test was employed to measure mathematical literacy, aligned with the PISA framework. The development process included the following steps:

Test Design: The test contained eight real-life problem situations, each with four sub-questions, covering four cognitive attributes:

1. Identifying mathematical aspects
2. Translating problems into mathematical language
3. Applying mathematical principles and processes
4. Interpreting, applying, and evaluating results

Content Areas: Quantity, Uncertainty and Data, Change and Relationships, Space and Shape (two scenarios per area)

Item Formats: Sub-questions 1–2 were multiple-choice; sub-questions 3–4 were short-answer. Scoring was dichotomous (1 = correct, 0 = incorrect).

4.2.3 Instrument Quality

Content Validity: Index of Item–Objective Congruence (IOC) evaluated by five experts, with values ranging 0.60–1.00. Items were revised based on expert suggestions.

Reliability: Cronbach's alpha (0.763–0.842) and multidimensional EPA reliability (0.868–0.920) indicated high internal consistency. Item-total correlations (0.360–0.687) exceeded the threshold of 0.20.

Item Analysis: Three-parameter IRT model (discrimination a, difficulty b, guessing c) confirmed acceptable quality for most items.

Construct Validity: Confirmatory Factor Analysis (CFA) confirmed the

four-component model with acceptable factor loadings (0.31–1.04) and excellent model fit indices (GFI = 0.99, AGFI = 0.99, RMSEA = 0.00).

These combined procedures ensured that the mathematical literacy test is both valid and reliable for assessing students' ability to apply mathematics in real-life contexts. Together with the TOEFL Junior Reading test, the instruments provide a comprehensive assessment of English reading comprehension and mathematical literacy.

Table 2 The quality of the Mathematical Literacy Test

Evidence	Method	Results	Conclusion
Content Validity	IOC (5 experts)	0.60–1.00	Adequate
Reliability	Cronbach's α	0.763–0.842	High consistency
Reliability	EPA Reliability	0.868–0.920	Strong
Item Analysis	IRT (a, b, c)	Mostly acceptable	Revised few items
Construct Validity	CFA	Factor loadings 0.31–1.04, GFI=0.99, AGFI=0.99, RMSEA=0.00	Excellent model fit

4.3 Data Collection

Permissions were obtained from Thanyaburi School, and teachers, students, and staff were informed about the procedures. All 56 eligible students participated in the study. The TOEFL Junior Reading test and the mathematical literacy test were administered under standardized conditions. Responses were collected, checked for completeness, and compiled into a dataset. Ethical procedures were observed; participation was voluntary and confidential.

4.4 Data Analysis

Descriptive statistics (mean and SD) were used to summarize students' performance in English reading comprehension and mathematical literacy. Inferential statistics included Pearson Product-Moment Correlation to examine the relationship between reading and mathematical literacy scores, and simple linear regression to predict mathematical literacy scores from English reading comprehension scores.

5. Results

5.1 Levels of English Reading Comprehension and Mathematical Literacy

To address Research Objective 1, descriptive statistics were used to examine the levels of English reading comprehension and mathematical literacy among the 56 English Program students at Thanyaburi School.

Table 3 Descriptive Statistics of English Reading Comprehension and Mathematical Literacy

Variable	Mean	SD	Minimum	Maximum
English Reading Comprehension	233.30	30.97	200	300
Mathematical Literacy	18.32	5.72	8	31

The results indicate that participants demonstrated moderate-to-high English reading proficiency and a wide variation in mathematical literacy, suggesting diverse abilities in applying mathematical reasoning to real-life problems.

5.2 Relationship between English Reading Comprehension and Mathematical Literacy

To examine the relationship between English reading comprehension and mathematical literacy, Pearson correlation analysis and simple linear regression were conducted.

5.2.1 Correlation Analysis

The Pearson correlation analysis showed a very strong, positive, and statistically significant relationship between English reading comprehension and mathematical literacy ($r = 0.897$, $p < .001$). This indicates that students who scored higher in English reading comprehension also tended to achieve higher scores in mathematical literacy.

This strong positive correlation suggests that English reading skills play an important role in understanding and solving mathematical problems presented in English. In other words, students' ability to read and comprehend English texts can directly support their mathematical learning, especially in an English-medium program like the one at Thanyaburi

School. Improving students' reading comprehension may therefore contribute to better mathematical performance, highlighting the need for teaching strategies that integrate both language and mathematical skills.

Table 4 Correlation between English Reading Comprehension and Mathematical Literacy

Variable	1	2
1. English Reading Comprehension	—	
2. Mathematical Literacy	$r = 0.897$, $p < .001$	—

5.2.2 Regression Analysis

A simple linear regression analysis examined the predictive effect of English reading comprehension on mathematical literacy. The regression model was statistically significant, $F(1, 54) = 221.926$, $p < .001$, accounting for 80.4% of the variance in mathematical literacy ($R^2 = 0.804$). The regression equation was: $Y = -20.326+0.166X$, where Y represents the mathematical literacy score and X represents the English reading comprehension score.

This indicates that for each one-point increase in English reading comprehension, the mathematical literacy score increases by 0.166 points, demonstrating that English reading comprehension is a strong predictor of mathematical literacy among EP students.

Table 5 Results of Regression Coefficients Predicting Mathematical Literacy from English Reading Comprehension

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-20.326	3.565	–	-5.702	.000
English Reading Comprehension	.166	.0107	.897	15.525	.000

Table 6 ANOVA Table of the Regression Model

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	1447.906	1	1447.906		
Residual	352.310	54	6.524	221.926	.000
Total	1800.214	55			

6. Conclusion

This study investigated the relationship between English reading comprehension and mathematical literacy among 56 English Program students at Thanyaburi School. Using TOEFL Junior Reading scores and a validated researcher-developed mathematical literacy test, the findings revealed that students generally demonstrated moderate to high English reading proficiency and varying levels of mathematical literacy. Statistical analyses showed a very strong, positive correlation between the two variables, with regression results indicating that English reading comprehension significantly predicted mathematical literacy, accounting for over 80% of the variance. These results underscore the critical role of English reading skills in supporting students' mathematical understanding and problem-solving in an English-medium context.

7. Discussion

The findings of this study clearly affirm the crucial role that English reading comprehension plays in enhancing mathematical literacy among students receiving instruction in English. The very strong positive correlation ($r = 0.897$) and the substantial predictive power of English reading comprehension on mathematical literacy (explaining approximately 80.4% of variance) support the hypothesis that students with stronger English reading skills are better equipped to interpret mathematical problems, understand instructions, and apply reasoning skills effectively. This relationship highlights the interdependence between language proficiency and the cognitive skills required for mathematical problem solving, particularly in English-medium instruction contexts such as the English Program at Thanyaburi School.

These results align closely with previous studies that emphasize the significance of language in mathematics education. Erdoğan and Aycan (2021) and Alonso et al. (2022) similarly found that reading comprehension is a fundamental skill enabling students to decode and comprehend complex mathematical language, including vocabulary, syntax, and discourse structures inherent in problem statements. This is especially relevant in bilingual or English immersion programs, where students must navigate both language and content learning simultaneously. Bernabini, Bonifacci, and de Jong (2021) and Giofrè, Donolato, and Mammarella (2018) also highlight the role of verbal working memory and language-related cognitive skills in supporting both reading and mathematical problem solving, confirming that strong reading skills facilitate more efficient cognitive processing in mathematics.

The high reliability and validity of the mathematical literacy test used in this study lend strong credibility to the results. Content validity was ensured by expert review (IOC values 0.60–1.00), construct validity was confirmed through Confirmatory Factor Analysis (factor loadings 0.31–1.04, excellent model fit indices), and reliability coefficients indicated consistent measurement across cognitive attributes (Cronbach's α = 0.763–0.842; EPA reliability = 0.868–0.920). This comprehensive evaluation minimizes concerns that the observed strong relationships were artifacts of poor measurement or test design, giving educators and policymakers confidence in applying these findings to instructional strategies and curriculum development.

However, the study does have limitations that should be acknowledged. The sample size, though covering the entire eligible population at Thanyaburi School (N = 56), is relatively small and drawn from a single educational institution. Consequently, while the findings are robust for this specific context, caution should be exercised in generalizing them to other schools or regions without further validation. Additionally, this study focused exclusively on students aligned with the OECD PISA framework, which constrains the understanding of how this relationship might vary across other age groups or educational levels. Another consideration is that English reading comprehension was measured using TOEFL Junior scores, which reflect general reading ability but may not fully capture nuances specific to mathematical language proficiency. Future research could explore more specialized instruments assessing reading comprehension in mathematical contexts more directly, potentially yielding deeper insights into language-content interactions.

The findings underscore the urgent need for integrated instructional approaches that simultaneously foster English reading skills and mathematical competencies. Curriculum designers should consider embedding targeted language support into mathematics teaching, including explicit instruction in mathematical vocabulary, sentence structures commonly found in problem statements, and reading strategies that enhance comprehension of complex texts. Scaffolding techniques such as pre-teaching key terms, using visual aids, modeling problem-solving steps aloud, and providing worked examples can help bridge gaps for students with weaker English skills. Implementing collaborative learning strategies and peer-assisted problem-solving can also reinforce both language and content mastery.

Teacher professional development programs must equip educators with the skills and resources needed to implement such integrated instruction effectively. Language teachers and mathematics teachers should collaborate closely to align teaching objectives, share expertise, and create cohesive learning experiences that reinforce both content mastery and language proficiency. This collaboration is particularly important in English Program settings where students face the dual challenge of learning a new language while mastering academic content. Regular monitoring of student progress in both English reading comprehension and mathematical literacy can help identify learners requiring additional support. Tailored interventions, such as remedial reading workshops or math-language tutoring sessions, could be implemented to help struggling students catch up and build confidence. Altogether, these strategies support the intertwined development of language and mathematical skills, enhancing overall academic achievement and preparing students for success in increasingly globalized and knowledge-driven contexts.

8. Suggestions

Based on the findings, it is recommended that educators and curriculum planners integrate

English reading development into mathematics instruction, using scaffolding and explicit vocabulary support to address language-related barriers. School administrators should provide professional development and promote collaboration between language and mathematics teachers to ensure cohesive instruction. Future research should involve larger and more diverse samples, examine additional factors such as socio-economic status and motivation, and develop specialized assessment tools for bilingual and English-medium mathematics education.

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