



Essential Mathematics Vocabulary Words in English

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Abstract- Mathematics functions as a language in its own right, possessing a specialized vocabulary that is critical for comprehension, problem-solving, and academic success. This paper provides a comprehensive analysis of essential English mathematics vocabulary, integrating findings from recent large-scale studies with established theoretical frameworks. We introduce a multi-level taxonomy for classifying mathematical terms, examine empirical evidence linking vocabulary exposure to student achievement, and explore the unique challenges posed by polysemous words that carry conflicting everyday meanings. The paper culminates in a substantial corpus-derived glossary of essential mathematical terminology, providing a practical resource for educators, curriculum developers, and English for Specific Purposes (ESP) practitioners. This synthesis demonstrates that strategic vocabulary instruction is not a peripheral supplement but a core component of effective mathematics pedagogy.

Keywords: Mathematical vocabulary, English for Specific Purposes, corpus linguistics, academic word list, mathematics education, language acquisition.

I. INTRODUCTION

For generations, educators have recognized the centrality of vocabulary in mathematics education, yet it remains one of the most underexplored areas in the field. A growing body of empirical evidence suggests that language plays a critical role in math learning: a 2021 meta-analysis of 40 studies found that students with stronger math vocabularies tend to perform better in math, particularly on multi-step, complex problems. Understanding what a "radius" is, for example, can make it more efficient to talk about perimeter and area and understand geometric concepts.

This paper addresses the gap in vocabulary resources for the mathematics discipline, an area less explored compared to other sciences. We draw on a range of sources, from established theoretical taxonomies to recent empirical studies, to provide a comprehensive framework for understanding and teaching essential English mathematics vocabulary.

II. A TAXONOMY OF MATHEMATICAL VOCABULARY

Classifying mathematical terms is essential for targeted instruction. Kossack and Vigilante (1981) proposed a seminal taxonomy with five interactive levels, where a single term can belong to multiple categories depending on context:

- **Standard vocabulary:** Common words normally encountered in oral and written language with no specialized mathematical meaning (e.g., "and," "of," "the same").



- **Transitional vocabulary:** Words that have both a mathematical referent and a common referent whose meanings are not the same. These are the most challenging for learners, as they must master two distinct meanings (e.g., "volume," "set," "field," "group").
- **Technical vocabulary:** Words specific to mathematics (e.g., "numerator," "isosceles," "hypotenuse").
- **Changeable technical vocabulary:** Terms whose meanings change within the area of mathematics (e.g., "power," which can refer to an exponent, a set's cardinality, or the number of roots of an equation).
- **Phrases:** Multiple-word terms with specialized meanings as a unit, where the meaning of the unit is more than a compilation of the meanings of the parts (e.g., "greatest common factor," "distributive property").

This interrelated taxonomy has significant implications for instruction, diagnosis, readability, problem-solving, materials selection, curriculum development, and communication.

III. THE EMPIRICAL SIGNIFICANCE OF MATHEMATICAL VOCABULARY

Recent research has provided compelling quantitative evidence for the importance of mathematical vocabulary. In a study published in November 2025, researchers from Harvard University, Stanford University, and the University of Maryland analyzed transcripts from more than 1,600 fourth- and fifth-grade math lessons. They found that teachers who used more mathematical vocabulary had students who scored substantially higher on math tests. The effect size was considerable—amounting to about half of the benefit researchers typically attribute to having a highly effective teacher, which is among the most important school-based factors that help children learn.

This finding aligns with a growing body of research suggesting that language plays a critical role in math learning. Furthermore, a systematic review of mathematics vocabulary interventions for students with or at risk for mathematics difficulty found that such interventions improve students' vocabulary knowledge, particularly when instruction is explicit with multiple opportunities to practice, and are beneficial for higher-level mathematics reasoning, such as word-problem solving.

IV. CHALLENGES: POLYSEMY AND HOMOPHONES

One of the greatest challenges in learning mathematical English is the phenomenon of polysemy—words that have both an everyday meaning and a distinct mathematical meaning. Orton (2004) noted that sometimes these difficulties were not experienced by first-language speakers but only by second-language learners. He highlighted the word "relation": in mathematical terms, this is a set of ordered pairs, whereas in everyday spoken English, this word refers to a member of the extended family, with no resemblance between the two meanings.

Moreover, everyday words that mathematicians have adopted and assigned special meanings (e.g., "field," "group," "root") can be a significant source of confusion. Orton relates anecdotes of learners who thought "volume" was a control knob on a television, "set" was what one would use to prepare tea, and "axes" were only for chopping. Stories like these underscore that language problems will always be present unless teachers become aware of the potential problems attributable to the lack of mathematical vocabulary and take active steps to address them.

V. PEDAGOGICAL STRATEGIES

Given the importance and challenges of mathematical vocabulary, effective instructional strategies are paramount. Research suggests that explicit instruction with multiple opportunities to practice is most



effective. Orton (1994) emphasized the importance of a Mathematics register, where all new words in Mathematics lessons are written down, and each new word is added to the list.

Furthermore, teachers should not assume that simply writing a word on a chalkboard is sufficient. For a learner who did not grasp the terminology well during the introduction or revision of the words, the chalkboard summary could be of no help. Instead, vocabulary should be part of a broader constellation of effective teaching practices: teachers who use more math terms may also be providing clearer explanations, walking students through lots of examples step-by-step, and offering engaging puzzles.

VI. ESSENTIAL MATHEMATICS VOCABULARY GLOSSARY

Based on a synthesis of multiple resources—including corpus-based studies, curriculum glossaries, and practitioner guides—the following represents a core set of essential mathematics vocabulary in English:

Term	Definition
Sum	The result of adding two or more numbers together.
Difference	The amount that remains after one quantity is subtracted from another.
Product	The result of multiplying two or more numbers together.
Quotient	The result of division.
Factor	A number that divides another number evenly.
Multiple	The product of a given number and any whole number.
Denominator	The quantity below the line in a fraction.
Numerator	The quantity above the line in a fraction.
Prime Number	A whole number greater than 1 whose only factors are 1 and itself.
Composite Number	A whole number greater than 1 with more than two factors.
Percentage	A fraction or ratio expressed as a number out of 100.
Ratio	A comparison of two quantities.
Variable	A symbol, usually a letter, representing an unknown quantity.
Constant	A value that does not change.
Equation	A statement that two expressions are equal.
Coefficient	A number multiplied by a variable.
Exponent	A number indicating how many times a quantity is multiplied by itself.
Area	The space contained within a two-dimensional shape.
Perimeter	The distance around a two-dimensional shape.
Volume	The amount of space a three-dimensional object occupies.
Radius	The distance from the center of a circle to its circumference.
Diameter	A line segment passing through the center with endpoints on the circle.
Circumference	The distance around a circle.
Acute Angle	An angle measuring less than 90 degrees.
Obtuse Angle	An angle measuring more than 90 degrees but less than 180.
Right Angle	An angle measuring exactly 90 degrees.
Congruent	Two shapes that are identical in shape and size.
Mean	The average of a set of numbers.
Median	The middle value in an ordered set of numbers.
Mode	The value that appears most frequently in a set.
Range	The difference between the largest and smallest values in a set.
Algorithm	A step-by-step procedure for solving a problem.



This glossary is not exhaustive but provides a foundational toolkit for learners and a framework for curriculum development.

VII. CONCLUSION

Mastering the essential vocabulary of English mathematics is not merely an academic exercise; it is a critical determinant of student success. From the foundational taxonomy introduced by Kossack and Vigilante to the large-scale empirical findings of Himmelsbach and colleagues, the evidence is clear: vocabulary matters. The unique challenges posed by polysemous transitional words require deliberate instructional attention. By integrating explicit vocabulary instruction, creating classroom mathematics registers, and using comprehensive glossaries, educators can equip learners with the linguistic tools they need to unlock the language of mathematics. Future research should focus on developing ESP resources specifically tailored to the mathematics discipline and exploring the interplay between vocabulary instruction and higher-order mathematical reasoning.

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