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Student Dispositions in Mathematics Education: Perspectives, Practices, and Possibilities

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AIMS AND SCOPE

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JMETC readers are educators from pre-kindergarten through twelfth-grade teachers, principals, superintendents, professors of education, and other leaders in education. Articles appearing in the *JMETC* include research reports, commentaries on practice, historical analyses, and responses to issues and recommendations of professional interest.

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PREFACE

While the mathematics education community has long recognized that surface-level metrics—such as quiet compliance, fast procedural recall, or providing correct answers—are inadequate measures of deep mathematical understanding, mathematics educators frequently default to these superficial indicators in the classroom. As Kilpatrick et al. (2001) established in the foundational volume, *Adding It Up*, mathematical proficiency demands not only conceptual understanding and procedural fluency, but also a *productive disposition*, which refers to the inclination to view mathematics as sensible, useful, and worthwhile and to believe in one's own mathematical efficacy. The Spring 2026 issue of the *Journal of Mathematics Education at Teachers College* brings together three contributions that explore how educators can foster this holistic proficiency by expanding inclusive participation, navigating structural course constraints, and repairing damaged student-mathematics relationships.

Recognizing students' thinking requires classrooms in which all learners have meaningful opportunities to demonstrate it. The research article, by Puotier and Obeng, presents a systematic literature review of inclusive practices and academic achievement in mathematics and English Language of students with disabilities. Their review identifies differentiated instruction, assistive technology, collaborative learning, flexible assessment, and physical manipulatives as critical supports for equitable participation. The authors demonstrate that inclusion is not simply a matter of classroom placement; rather, it depends on intentional instructional and institutional conditions that allow students to engage deeply with mathematical concepts.

In this issue's notes from the field, Mei and Schwartz provide an insightful comparison of secondary and undergraduate precalculus teaching in New York City. Through two reflective accounts, the authors show how educators across these distinct settings confront related systemic pressures: limited time, rigid curricular demands, high-stakes examinations, varied student preparation, and the ongoing challenge of sustaining exploratory learning. Their article suggests that secondary and postsecondary mathematics education need not operate as separate worlds; instead, sustained dialogue across these levels can help educators exchange pedagogical practices, reconsider assumptions about student readiness, and better support students' transitions into advanced mathematics.

The issue concludes with Kankam's reflective commentary, "What Have We Done to People in the Name of Math?" Grounded in a conversation with a former student, Kankam asks readers to confront the ways school mathematics can leave individuals with lasting feelings of fear, shame, alienation, and the belief that they are fundamentally not 'math people'. Rather than treating these responses as individual deficits, he frames them as the direct consequences of educational environments that have historically prioritized speed and compliance over genuine sense-making. His call for mathematical repair challenges educators to rebuild students' relationships with the discipline through student agency, multiple representations, real-world inquiry, and opportunities to understand mathematics as a deeply human practice.

Daria Chudnovsky
Samantha Moroney

Guest Editors

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Inclusive Practices in Mathematics and English Language and their Effects on the Academic Achievement of Students with Disabilities: A Systematic Literature Review

Zutaah Puotier
Department of Mathematics and ICT, Presbyterian College of Education

Eunice Obeng
Department of Languages, Presbyterian Senior High School

ABSTRACT This systematic literature review investigates the impact of inclusive educational practices in mathematics and English Language on the aademic achievement of seconday school students with disabilities. The objectives of this study are to identify practices that promote academic achievement in the specified subjects, as well as their effects on academic success in those subjects for individuals with disabilities. Utilizing PRISMA standards, the study analyzed 23 peer-reviewed articles selected from an initial pool of 110, sourced from databases including Google Scholar, ERIC, and Dimensions. The findings revealed that inclusive practices in mathematics encompass differentiated instruction, technology integration (like GeoGebra), flexible assessments, collaborative learning, and manipulative use. In the English Language, they include co-teaching, assistive technologies, and individualized education plans. These practices also scaffold mathematics learning by enhancing understanding of vocabulary and communication skills for solving problems. Successful implementation relies on professional development, community involvement, and ongoing assessment. The study concludes that such inclusive methods improve problem-solving in mathematics and boost engagement, self-esteem, advocacy skills, and peer interaction, all of which promote collaborative learning. Ultimately, the study advocates for equitable learning environments in both mathematics and English Language to improve achievements for students with disabilities.

KEYWORDS *Mathematics, English Language, inclusive, achievement, and disabilities*

Introduction

In recent decades, inclusive education has gained prominence as a strategy to promote fairness and diversity in schools. It is defined as a teaching approach ensuring that all students, regardless of their abilities or learning needs, have equal access to education. Sahani and Patel (2023) characterize it as creating effective classrooms for all learners, including those with disabilities. Singh and Prajapati (2021) note that inclusive education accommodates diverse learning needs in regular classrooms. According to the United Nations Children's Fund (United Nations Children's Fund [UNICEF], 2017), it ensures access to appropriate instruction and facilities for all learners. Inclusive practices integrate learners with various needs into mainstream education, aligning with global commitments like the United Nations (UN) Sustainable Development Goal 4, which advocates for inclusive and equitable quality education for all. The UN Convention on the Rights of Persons with Disabilities supports the right to inclusive education for learners with disabilities.

Inclusive education is a vital approach for closing educational gaps and ensuring equity for learners with disabilities. Rooted in social justice, it seeks to provide all students with access to meaningful learning in mainstream classes. This shift from segregation to inclusion has been advanced by international conventions such as the Convention on the Rights of Persions with Disabilities (CRPD), which emphasizes the participation of individuals with disabilities in all areas of society, including education (United Nations [UN], 2006).

Research on inclusive practices highlights techniques to enhance learning for students with disabilities. According to Sambhav and Yu (2022), strategies for mathematics include clear modeling, immediate feedback, problem-solving techniques, manipulatives, and technology. An example is the George Polya problem-solving model, which guides students through understanding problems, developing strategies, executing plans, and reflecting on solutions, which can be aided by tools like GeoGebra. In English, differentiated instruction and co-teaching are emphasized, allowing varying reading levels for students while engaging with the same material. Challenges to implementing these inclusive methods include a lack of teacher training, resources, and negative attitudes.

Mathematics and the English Language are fundamental academic disciplines that have a substantial impact on students' overall educational progress and prospects. National Council of Teachers in Mathematics (NCTM, 2013) recommends that early childhood educators actively introduce mathematical ideas, procedures, and language through a range of suitable experiences and research-based teaching methodologies. Teachers should help students identify links between ideas in mathematics and other subjects, allowing them to expand their mathematical knowledge throughout the day and curriculum. They must encourage learners to speak, expressing their reasoning as they connect with significant mathematics in profound and persistent ways. A variety of hurdles, including cognitive, physical, and systemic problems, can make it difficult for students with disabilities to achieve proficiency in these disciplines. As a result, educators, policymakers, and academics must understand the consequences of inclusive practices on students' academic progress in these subjects.

Students with impairments' academic achievements in disciplines such as mathematics and the English language have sparked increased interest in educational studies. These courses are essential for cognitive growth, communication abilities, and professional preparedness. Despite the growing use of inclusive policies, gaps in academic achievement continue, emphasizing the need for a better understanding of the variables that influence these results. Al-zoubi and Younes (2015) present some factors that contribute to students' low academic achievement, such as using traditional methods instead of modern teaching methods in the classroom, as well as poor relationships between teachers and students, which create a teaching environment devoid of respect, resulting in students' lack of acceptance of the learning process as a whole.

Disability encompasses conditions that limit a person's ability to perform tasks or engage with their environment similarly to others. In mathematics and English education, it refers to impairments that hinder a learner's ability to access and demonstrate knowledge in standard ways, requiring adjustments or alternative methods. This study conducts a systematic literature review to explore inclusive practices that enhance academic performance in these subjects for learners with disabilities.

Statement of the Problem

Despite progress in inclusive educational practices, students with disabilities still face barriers in achieving success in subjects like mathematics and English Language. Disparities in performance reveal systemic issues and inconsistent implementation of strategies across schools. Challenges such as inadequate teacher training, limited resources, and insufficient specialized support contribute to these issues. There's an urgent need to evaluate the long-term effects of inclusivity and to identify effective practices. This study aims to review existing literature to enhance educational methods and promote achievement for all learners, particularly those with disabilities.

Research Objectives

This study was guided by the following research objectives:

1. To investigate the practices that promote learners with disabilities' academic achievement in mathematics and the English Language.
2. To investigate how inclusive practices affect learners with disabilities' academic performance in mathematics and the English Language.

Research Questions

This article investigated the following research questions:

1. What are the practices that promote learners with disabilities' academic achievement in mathematics and the English Language?
2. How can inclusive practices affect learners with disabilities' academic performance in mathematics and the English Language?

Literature Review

Inclusive education aims to provide equal learning opportunities for students with impairments, which is fundamental to inclusive classroom practices that address diverse needs. This research review analyzes the effects of inclusive practices on the academic achievement in mathematics and English of students with disabilities identifying effective strategies and research gaps.

Inclusive Practices in Mathematics and English Language

Mathematics shares features with language, such as symbolic representation and structured communication, which are important for learning. Based on this, mathematics can be described as a type of language. Yadav (2017) defines mathematics as the study of assumptions, their properties, and applications. Mathematics is a field of study that frequently poses special obstacles for learners with disabilities, necessitating both conceptual comprehension and operational fluency. Several studies have looked into inclusive methods in mathematics classes and how they affect students with disabilities' academic ability.

English is an academic field that educates about the English language, its history, and the culture of English-speaking nations. Students learn to listen, speak, read, and write while also honing their communication, presentation, analytical, and problem-solving abilities. In the United States, English Language is a core component of K–12 education, with grade-specific standards addressing reading, writing, speaking, listening, and language (Common Core State Standards Initiative, 2010). As one of the instrumental subjects in school, English not only allows students to formulate and develop their communicative competencies in English, but it also helps to form and develop general competencies for living and working more effectively, learning other subjects well, and lifelong learning.

Globally, inclusive education is seen as a human rights requirement. The CRPD advocates for the inclusion of students with disabilities in mainstream educational settings (UN, 2006). Furthermore, Gordon (2013) asserts that inclusive education for all students is a moral human right. The study of Riga et al. (2016) further shows that Education for All (EFA) is widely recognized by international human rights law, and it is based on the generally held belief that education plays a crucial role in individual well-being as well as national development. According to Waddington and Toepke (2014), inclusive education is both a requirement under international law and a way of meeting the extra-legal obligation to make education accessible to children with disabilities. Inclusive education is more than just an educational system; it is also a strategy and mindset that meets the learning requirements of all students and provides the most educational possibilities imaginable. Inclusive education prevents exclusion and encourages all students to participate in school settings and beyond. Research demonstrates that inclusive practices, such as differentiated instruction and co-teaching, increase the academic achievement of students with impairments in mathematics and English Language. For example, Sambhav and Yu (2022) found that inclusive practices such as the use of technology, peer teaching, differentiated instruction, immediate feedback, and the use of manipulatives can improve arithmetic and English language outcomes. However, issues such as limited resources and cultural attitudes regarding disability continue to hamper full adoption.

Nations such as the United States and Australia have built robust legislative frameworks, such as the Individuals with Disabilities Education Act (IDEA) and the Disability Standards for Education 2005 *(Individuals with Disabilities Education Act, 2004; Disability Standards for Education* [Cth]*)*. Studies suggest that learners with impairments do significantly better in school when inclusive policies are well-funded and teachers get professional development. For example, Lei et al. (2020) found that kinesthetic and linguistic scaffolds can assist students in excelling in mathematics and the English Language. Nonetheless, policy implementation differs across schools and districts, emphasizing the need for more uniform and equitable approaches.

In endeavoring to understand ways for students to improve their mathematics and English skills, other significant findings from the US focus on technology and teaching style. Ok et al. (2020) evaluated the impact of computer-assisted education on mathematics performance in students with learning disabilities and discovered that computer-assisted instruction can hep students flourish in mathematics. King-Sears et al. (2021) found that co-teaching can increase academic progress for learners with disabilities.

Xin et al. (2020) indicate that inclusive strategies, including assistive technology and peer tutoring, can enhance learning outcomes in math and English. However, in developing regions like Sub-Saharan Africa and Southeast Asia, prpomoting inclusive education faces structural challenges such as limited funcing, insufficient teacher training, and poor infrastructure. While initiatives like the "Education for All" campaign (Education for All, n.d.) have made progress in providing education, regardless of economic standing or personal background, disparities in access to necessary resources for students with disabilities remain between rural and urban areas, and continue to pose significant issues.

In Ghana, Gidisu et al. (2026) examined the impact of assistive technologies on inclusive education for visually impaired students at colleges. The study highlights the connection between access to these technologies and equitable educational practices but acknowledges significant limitations, notably its small sample size of 20 students from only three institutions, affecting the generalizability of the findings. To address these limitations, the researchers conducted a systematic literature review of 23 relevant publications on assistive technology and inclusion, covering various educational landscapes. The findings aim to inform strategies for improving educational outcomes in mathematics and English Language for students with disabilities.

Effects of Inclusive Practices in Mathematics and English Learning

Inclusive education aims to ensure equitable learning opportunities for all students, regardless of their aptitudes or backgrounds (Ainscow, 2020). The methods employed in teaching English and mathematics have garnered significant attention due to their impact on student success, engagement, and social development. This literature overview explores research on inclusive practices from diverse perspectives, highlighting both their benefits and challenges.

Policies like the Sustainable Development Goal (SDG 4; UN, 2015) and the CRPD (UN, 2006) have strengthened the recognition of inclusive education as a basic right on a global scale (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2020). The advantages and drawbacks of inclusive teaching methods in mathematics and English classes have been studied in a number of nations.

According to research, inclusive pedagogical approaches like differentiated instruction and Universal Design for Learning (UDL) improve students' mathematical comprehension and problem-solving skills (Florian & Black-Hawkins, 2011). In Australia, Finkelstein et al. (2021) discovered that collaboration and teamwork support improved learning outcomes for students with disabilities in mathematics classrooms.

Similarly, inclusive techniques in English education, such as collaborative learning and multimodal instruction, have been found to improve reading abilities across a wide range of students. According to research from the United States, inclusive classrooms boost language learning for learners with Special Educational Needs (SEN) and English as a Second Language (ESL) learners. Additionally, a study from Cameroon and Canada found that assistive technologies and peer-assisted learning have been shown to improve reading and writing skills (Yonge, 2022).

Adaptive curricula and assistive technology have been shown to improve the performance of students with disabilities in inclusive mathematics classrooms in the United States (McLeskey et al., 2017). Similarly, phonics-based interventions in inclusive English instruction are beneficial for dyslexic students (Fletcher et al., 2021). In the United Kingdom, inclusive education is strongly promoted through frameworks like the Special Educational Needs and Disability Code of Practice. Molbaek (2018) found that inclusive teaching strategies, such as metacognitive training and collaborative learning, benefited both mainstream and SEN students in mathematics and English classes.

The emphasis on fairness and inclusion in the Canadian education system has a positive impact on students' learning of English and mathematics. According to research by Choi et al. (2017), learners with a range of learning difficulties showed improvements in their literacy and mathematics thinking when they received tailored instruction in inclusive classrooms.

Through equity-promoting policies, Latin American nations have advanced inclusive education. In Brazil, bilingual education policies address several distinct linguistic contexts, including education for Indigenous and deaf students, although these contexts continue to require more comprehensive policy guidance (de Oliveira & Höfling, 2021).

In Asia, inclusive education is included in national education strategies, especially in nations like India and Japan. According to research conducted in India by Anis and Khan (2023), inclusive English courses that included multimodal resources, such as technology, visual aids, and creative activities, greatly improved learners' retention and understanding.

In South Africa, Walton and Engelbrecht (2022) found that inclusive strategies, like flexible grouping and individualized instruction, increased student engagement in mathematics, but they also pointed out that large class sizes impede effective implementation. Ewa (2020) explains that challenges on inclusive education in Sub-Saharan Africa are due to social order at the local level, and discusses the efforts to increase enrollment, attendance, engagement, and completion. Although focused on primary-aged students, findings showed that educators in the region appear to be struggling with the concept of inclusion, which is having an impact on the provision of education, emphasizing the need for inclusionary practices to not only be available and practiced, but embraced by the society and educators themselves. In Ghana, inclusive education is becoming more and more important, but infrastructure constraints and teacher readiness continue to be issues (Djietror et al., 2011).

Theoretical Framework

The study integrates three core theories to interpret these findings. These include

i. A rights-based framework for inclusive education establishes equitable access to education as a fundemental right and requires that students with disabilities not be excluded from general education on the basis of disability (UN, 2006).
ii. Universal Design for Learning (UDL) provides a framework for designing flexible learning environments through multiple means of engagement, representation, and action and expression (CAST, 2024).
iii. Vygotsky's Social Constructivist Theory emphasizes the role of scaffolding and social interaction (Zone of Proximal Development) in overcoming learning gaps (Vygotsky, 1978).

Justification for a Dual-Subject Focus

Adopting a dual-subject focus on mathematics and English Language enhances this review's contribution to the Journal of Mathematics Education at Teachers College by emphasizing the interdisciplinary links between these fields. The approach highlights how language skills support mathematical understanding, identifying the challenges faced by students, especially those with disabilities. It also provides a broader lens for examining inclusive practices, revealing both subject-specific adaptations and common pedagogical strategies across disciplines. This dual focus is crucial for teacher education, demonstrating how integrated methods can meet diverse student needs. Additionally, it addresses a gap in existing literature by offering cross-disciplinary insights, ultimately aligning with JMETC's goals to situate mathematical learning within broader social and linguistic contexts, thus enriching educational practices and outcomes.

Methodology

This study employed a Systematic Literature Review (SLR) approach to examine inclusive practices and their effects on the academic achievement in mathematics and English Language of students with disabilities. The SLR method provided a rigorous, transparent, and reproducible process for identifying, analyzing, and synthesizing relevant research evidence (Shaheen et al., 2023).

This review focused on learners with disabilities, primarily at the secondary school level. From an initial pool of 110 studies, 23 peer-reviewed articles were purposively selected based on their relevance, methodological quality, and contribution to understanding inclusive practices and academic achievement. The selected studies represented different disability categories, educational contexts, and geographical settings.

Relevant literature was obtained through systematic searches in databases such as ERIC (Education Resources Information Center), Dimensions, and Google Scholar. Search terms combined concepts related to inclusive education, students with disabilities, academic achievement, mathematics, and English Language using Boolean operators. Inclusion criteria limited studies to peer-reviewed, English-language articles published from 2011 onward, while studies unrelated to inclusive practices or lacking accessible full texts were excluded.

The study followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines for study selection, involving identification, screening, eligibility, and inclusion stages (Page et al., 2021). Data from the selected studies were extracted using a structured coding process that captured study characteristics, participant details, subject focus, inclusive practices, and academic outcomes. Both deductive and inductive coding approaches were used to identify key themes and emerging patterns.

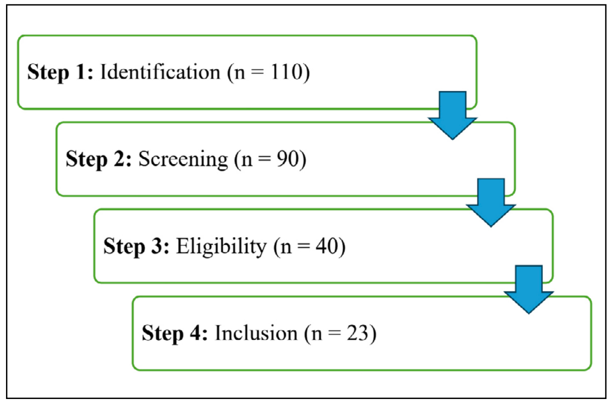
To ensure reliability, the methodological quality and risk of bias of the included studies were assessed using established appraisal criteria such as research design, sample adequacy, validity, transparency, and bias control. Data analysis was conducted through thematic synthesis and comparative analysis, with findings summarized in a PRISMA Evidence Table (Table 1). The analysis aimed to identify inclusive practices that enhance the achievement in mathematics and English Language of students with disabilities.

Results and Discussions

The analysis of literature highlights significant benefits of inclusive practices in mathematics and English Language on the academic progress of students with disabilities. The findings were structured under specific subheadings, including the Study Selection process following PRISMA guidelines. A total of 110 records were initially identified, with 20 duplicates removed, leaving 90 for screening. This process resulted in the exclusion of 50 irrelevant records, ultimately leading to the inclusion of 40 studies that met the criteria for the systematic review. Figure 1 presents the PRISMA flow diagram of the study selection process. It consists of four (4) steps in the order from steps 1 to 4.

Figure 1

PRISMA Flow Diagram for an SLR



Characteristics of Included Studies (PRISMA Evidence Table)

Table 1 presents the characteristics of the included studies. It highlights the author's year, country, study design, study focus, inclusive practices, key findings, and limitations.

Table 1 outlines PRISMA evidence on inclusive practices that enhance academic performance in mathematics and English Language for students with disabilities. Key strategies identified include differentiated instruction, co-teaching, assistive technology, peer teaching, immediate feedback, and manipulatives.

Table 1

PRISMA Evidence Table

Author, Year	Country/ Context	Study Design	Focus	Inclusive Practice(s)	Key Outcomes on Achievement	Limitations / Risk of Bias
Yadav (2017)	General	Conceptual	Mathematics	Theoretical framing	Defines mathematics as a structured anguage	No empirical data
Ministry of Education and Teaching (2018)	General	Descriptive	Mathematics & English	Curriculum perspective	Highlights the importance of English competencies	No inclusion focus
Gordon (2013)	Global	Conceptual	General	Rights-based inclusion	Positions inclusion as a human right	No empirical evidence
Riga et al. (2016)	Global	Policy review	General	EFA framework	Education supports development outcomes	Broad, not subject-specific
Waddington & Toepke (2014)	Global	Legal analysis	General	Differentiated instruction	Inclusion as a legal obligation	No classroom data
Sambhav and Yu (2022)	Global	Empirical (mixed/ quantitative)	Mathematics & English	Technology, peer teaching, and manipulatives	Improved Math & English outcomes	Resource constraints
Lei et al. (2020)	USA/ Australia	Empirical	Mathematics & English	Kinesthetic & linguistic scaffolds	Improved performance in both subjects	Policy variability
Ok et al. (2020)	Not specified	Experimental	Mathematics	Computer-assisted instruction	Improved math performance	Only Math-focused
King-Sears et al. (2021)	Not specified	Empirical	Mathematics & English	Co-teaching	Increased academic progress	Limited subject comparison
Xin et al. (2020)	China	Empirical	Mathematics & English	Assistive technology, peer tutoring	Improved learning outcomes	Rural–urban disparities

Table 1
PRISMA Evidence Table

Author, Year	Country/ Context	Study Design	Focus	Inclusive Practice(s)	Key Outcomes on Achievement	Limitations / Risk of Bias
Gidisu et al. (2026)	Ghana	Mixed-methods	Mathematics & English	Assistive technology	Enhanced equitable learning	Small sample size
Florian & Black-Hawkins (2011)	Global	Empirical	Mathematics	UDL	Improved conceptual understanding	Limited longitudinal data
Finkelstein et al. (2021)	Australia	Empirical	Mathematics	Collaboration, teamwork	Improved learning outcomes	Context-specific
Yonge (2022)	Cameroon/ Canada	Comparative	English	Assistive technology, peer learning	Improved literacy skills	Limited generalisation
McLeskey et al. (2017)	USA	Empirical	Mathematics	Adaptive curriculum, assistive technology	Improved performance	Implementation challenges
Fletcher et al. (2021)	Not specified	Experimental	English	Phonics-based instruction	Improved reading skills	Focus on one disability
Molbaek (2018)	UK	Empirical	Mathematics & English	Metacognition, collaboration	Improved outcomes in both subjects	Scalability unclear
Choi et al. (2017)	Canada	Empirical	Mathematics & English	Tailored instruction	Improved literacy & math thinking	Context-specific
de Oliveira & Höfling (2021)	Brazil	Empirical	English	Multilingual inclusion	Improved literacy & integration	Limited Math focus
Anis and Khan (2023)	India	Empirical	English	Multimodal instruction	Improved retention & understanding	Technology dependence
Walton & Engelbrecht (2022)	South Africa	Empirical	Mathematics	Flexible grouping, individualisation	Increased engagement	Large class sizes
Ewa (2020)	Sub-Saharan Africa	Review	General	Inclusion strategies	Implementation challenges	Not subject-specific
Djietror et al., 2011	Ghana	Descriptive	General	Policy implementation	Growing inclusion awareness	Infrastructure issues

Thematic Synthesis

This study examines practices that enhance academic achievement in mathematics and English for learners with disabilities. It highlights inclusive instructional practices, such as differentiated instruction, cooperative learning, assistive technology, and the use of manipulatives, which positively influence student performance across both subjects. Evidence indicates that these approaches improve conceptual understanding and problem-solving in mathematics while also strengthening reading, vocabulary, and writing skills in English. Importantly, the literacy and communication skills developed through inclusive English Language instruction provide a critical foundation for mathematics learning. Improved reading comprehension and vocabulary enable learners to better interpret mathematical terminology, understand word problems, follow complex instructions, and communicate their mathematical reasoning effectively. Similarly, writing and discussion activities in English support the development of logical thinking and explanation skills that are essential for mathematical problem-solving.

The findings suggest that gains in English Language learning can facilitate access to mathematical concepts and contribute to improved mathematics achievement, particularly for learners with disabilities who may experience challenges with language-intensive mathematical tasks. These results align with the work of Sambhav and Yu (2022), Xin et al. (2020), and Ok et al. (2020), who advocate differentiated instruction and co-teaching models to address diverse learning needs. Additionally, Universal Design for Learning (UDL) is recommended to ensure accessibility and provide multiple means of engagement, representation, and expression. The effective use of technology and structured peer collaboration further supports student engagement by enhancing both literacy and mathematical understanding. Ongoing professional development for teachers and active parental involvement remain essential for reinforcing these inclusive practices. Regular assessment and instructional adjustments based on learner feedback are also necessary to maximize the transfer of literacy gains into improved mathematical learning outcomes and overall academic success.

Effects of Inclusive Practices in Mathematics and English

Inclusive practices in mathematics and English, such as individualized instruction and Universal Design for Learning (UDL), can significantly enhance academic performance for learners with disabilities. These approaches promote tailored learning, increased engagement, and equitable opportunities, improving skills in arithmetic, problem-solving, reading, and writing. Importantly, the benefits observed in English Language learning extend beyond literacy outcomes and serve as critical scaffolds for mathematics achievement. Through inclusive English instruction, learners develop reading comprehension, vocabulary, communication, and critical-thinking skills that are essential for interpreting mathematical terminology, understanding word problems, following instructions, and articulating mathematical reasoning. Consequently, improvements in literacy can facilitate greater access to mathematical concepts and enhance learners' ability to engage in problem-solving activities. The findings therefore suggest that successful inclusive practices in English Language education can indirectly strengthen mathematics learning by providing the linguistic and cognitive foundations required for mathematical understanding. These results underscore the positive implications of inclusive strategies on both academic achievement and social development, aligning with earlier research by Anis and Khan (2023) and related studies.

Comparative Analysis

The findings from this study indicate that inclusive practices in mathematics and English Language encompass differentiated instruction, co-teaching models, assistive technologies, peer support, individualized education plans, and multimodal instruction. However, inclusive practices in mathematics further emphasize technology integration (such as GeoGebra and computer-assisted instruction), flexible assessment methods, collaborative learning, and the use of manipulatives and visual aids. Importantly, these English Language strategies enhance mathematics learning by helping students understand mathematical vocabulary, interpret word problems, and communicate their reasoning and solutions effectively.

Additionally, the success of these inclusive practices is bolstered by professional development, parental and community involvement, and consistent monitoring and assessment. These strategies lead to improved problem-solving in mathematics as well as advancements in reading, writing, and vocabulary knowledge, thereby fostering student engagement in mathematical tasks. Other positive outcomes associated with these practices include increased engagement, heightened self-esteem, enhanced self-advocacy skills, and better peer interactions, all of which promote participation in collaborative mathematical learning experiences. Inclusive practices significantly enhance mathematics achievement for students with disabilities, with English Language supports acting as essential tools that facilitate access to mathematical concepts, reasoning, and communication. The study advocates for educators to foster more equitable learning environments for students in mathematics and the English Language.

Inclusive Practices Model for Mathematics and English Language

Figure 2 outlines the Inclusive Practices Model for mathematics and English Language, comprising components such as Rights-Based Foundation, Inclusive Pedagogy, Instructional Strategies, Support Mechanisms, Contextual Enablers, and Improved Achievements.

The Inclusive Practices Model for mathematics and English Language advocates for a rights-based approach to education, ensuring fair access and participation for all learners, particularly those with disabilities. It promotes learner-centered techniques such as differentiated instruction, UDL, and scaffolding, tailored with subject-specific methods like manipulatives and digital tools for mathematics, phonics, and collaborative learning for English. Inclusion is further supported through assistive technology, peer assistance, and an adapted curriculum. The model's success relies on enabling factors like teacher training and resources, while challenges such as limited resources and large class sizes may hinder its full implementation. When effectively applied, it enhances academic success, engagement, and equality.

Limitations/Gaps

This study faced several limitations, including a scarcity of randomized controlled trials, the absence of longitudinal impact studies, low representation of Africans, insufficient resources, few studies integrating both mathematics and English, and weak reporting on bias risk and methodological rigor.

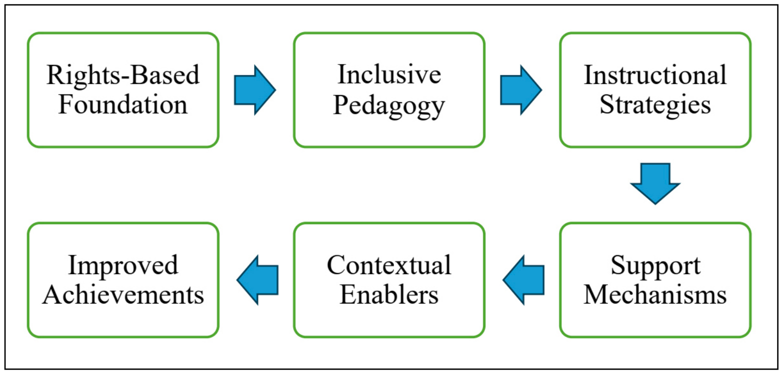
Conclusions

The comprehensive study of inclusive practices and their effects on the academic success in mathematics and English Language of students with disabilities emphasizes the crucial relevance of building equal educational settings. The data show that:

i. Differentiated instruction, universal design for learning, and the use of assistive technology have all been found to increase engagement, individualized learning, and improved learning outcome.
ii. When inclusive policies are properly implemented, students with impairments do much better academically and socially.

Figure 2

Inclusive Practices Model



Recommendations

Based on a systematic literature review, recommendations for improving inclusive practices for students with disabilities in mathematics and English Language include:

i. Ensure heads of high schools provide adequate resources, such as assistive technologies and suitable learning materials.
ii. Promote comprehensive teacher training programs focused on inclusive education and subject-specific strategies.
iii. Further studies should investigate the impact of inclusive practices in diverse educational settings.
iv. Explore the role of assistive technology, such as screen readers and speech-to-text software, in students' academic performance.

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NOTES FROM THE FIELD

Comparing and Contrasting Secondary and Undergraduate Precalculus Teaching

Baldwin Mei
Hostos Community College

Maya Schwartz
Teachers College, Columbia University

ABSTRACT Precalculus is a course that bridges the divide between early secondary mathematics and early tertiary mathematics. As such, it exists in both high schools and colleges, taking different forms depending on the curricular and pedagogical requirements of each institution and student body. Each precalculus class, secondary and tertiary, can benefit from the other's instructional methods. To begin this exchange of ideas, two perspectives of precalculus teaching are presented and contrasted: one from a high school teacher and one from a college instructor. Teaching contexts, key issues, and active learning pedagogical techniques are described, and potential pedagogical takeaways for each teacher's specific concerns are suggested.

Introduction

Precalculus is designed to reinforce previous algebra knowledge so that students can transition to higher mathematics. It is therefore often encountered at two levels: secondary and tertiary education.While the content is similar, often the pedagogies involved are tailored as answers to specific challenges in each context, pedagogies that could prove useful when shared between levels of education. We'd like to catalyze this sharing of ideas with two reflective accounts of precalculus teachers in public New York City educational institutions: one secondary and one tertiary, both of whom believe in using active, exploratory learning to teach mathematics. We dive into each teacher's pedagogical choices, the reasoning behind them, and their consequences, culminating in a discussion about how some of the habits in secondary precalculus could be beneficial to college precalculus, and vice versa.

Secondary Precalculus

The public high school instructor's precalculus course, taught during the 2023-24 academic year, met five days a week for 40-minute class periods. The curriculum covered functions, the unit circle, trigonometry, polar coordinates, linear algebra, sequences and series, parametric equations of conic sections, rational functions, and an introduction to calculus. The school emphasized college preparation through rigorous academics, varied student clubs and productions, and counseling services to assist with college applications and logistical questions. The school was an NYC Specialized High School, so students needed to test into it through the SHSAT.

This teacher's class sessions started with an independent or group work Do Now activity for approximately 5 minutes, designed to activate prior knowledge. The instructor supported their instruction by making printed worksheets and notes, keeping everything students needed for the day's lesson in one place. The printed materials often contained setups for exploratory activities, new vocabulary words, and example problems. Exploratory activities were emphasized because they allowed students to generate and discuss their own ideas and because the school's mathematics department pushed for more widespread use of active learning in the 2023-24 school year. Throughout each unit, key concepts were introduced and reinforced frequently so students could internalize and apply them in STEM contexts both within and beyond precalculus.

The instructor held office hours every weekday and was available by email seven days a week.

Pedagogically, an important capstone of this teacher's teaching was mathematical projects. Students were assigned projects twice during the school year: once during the laws of trigonometry unit, and once during the rational functions unit. Projects were designed to provide a novel classroom experience for students that allowed for more peer-to-peer interaction and deeper engagement with the material. However, the instructor felt only one of the projects achieved this. The failure: a project assigned in the laws of trigonometry unit where students formed groups of four and developed a lesson plan based on one of the unit's topics. The major problem related to workload distribution, as not all students contributed to their group equally, resulting in uneven motivation and learning during the project (and frustratingly, lower scores on the midterm's trigonometry questions!). On the other hand, the project in the rational functions unit had pairs of students create an exam with solutions, which was more successful as it corrected the workload distribution issue and truly allowed students to learn about common misconceptions through discovery learning.

Undergraduate Precalculus

The undergraduate instructor's precalculus course was also taught in the 2023-24 academic year, but at a public college serving a significant population of students from historically underrepresented groups (71%) and first-generation (56%) students. The curriculum was department mandated, cutting topics such as conic sections, sequences and series, trigonometry, polar coordinates, and parametric equations, while stressing linear and quadratic functions, limits, the definition of the derivative, and the derivative laws. The real-world applications of these topics were narrowly focused on business and financial use cases. Classes were 75 minutes and met four times per week, with one of the four meetings reserved for practice with a teaching assistant. This TA session was mandatory and run by an undergraduate teaching assistant who had taken the course previously.

Many of the undergraduate instructor's students had taken precalculus in high school, allowing the instructor the flexibility to position certain students as "experts" and peer supports throughout the course. Students ranged from first to third year undergraduates, so the instructor felt it prudent to focus on establishing class norms early in the semester. The course final exam was high stakes, as students who scored below a certain threshold would automatically fail the course, preventing them from advancing further into their degree. This was especially notable as students were only allowed to attempt a course three times before they could no longer take the course again. Given this fact and the compressed nature of college math courses, the pedagogical choices the instructor made were primarily influenced by these factors. Specifically, the instructor was selective with the topics given exploratory learning time during class, giving priority to topics that would be more difficult and have a larger presence on the final exam. Some students' prior experience with the material did allow the instructor to implement some peer learning, with students teaching other students as a regular feature of the classroom. Near the end of the semester, the instructor also scheduled review days as a final "boost" prior to the final exam.

Allow us to use an example undergraduate precalculus class about limits to illustrate these considerations and practices. The class started with a discussion question to activate prior knowledge: what's a limit? Students listed examples and properties of limits, so the instructor filled in the gaps by providing the formal, mathematical definition of a limit, but also made sure to describe limits in more colloquial language to bridge students' intrinsic understanding and mathematical formalism. From here, limit theorems (and informal proofs of said theorems) were presented as extensions of the limit definition, with practice focused on how to use these theorems due to the relevance this had to questions on the final exam. Practice problems had numeric or algebraic answers, with students required to explain their reasoning to hopefully develop both procedural and conceptual understanding. Lastly, an exit ticket was given out to students as a combined form of attendance and formative assessment.

What Can We Learn from Each Other: Starting the Conversation

As research has noted, precalculus is a mutable course that can cover a variety of topics and utilize a wide spectrum of pedagogical strategies (Voigt et al., 2020). We see this in these two reflections of secondary and precalculus teaching: while both teachers sought to use exploratory learning, the ways they manifested this were different. The main points of this comparison can be seen in Table 1:

Table 1

Summary of Secondary and Undergraduate Precalculus Reflection Differences

Secondary Precalculus	Undergraduate Precalculus
Curriculum: functions, the unit circle, trigonometry, polar coordinates, linear algebra, sequences and series, parametric equations of conic sections, rational functions, and an introduction to calculus.	*Curriculum:* linear equations, quadratic functions, functions, the circle, linear regression, economic functions, limits, continuity and differentiability, asymptotes, derivative rules, related rates, marginal functions.
Class Structure and Key Concerns: 40-minutes classes with printed worksheets containing lesson materials. Lessons spiraled key concepts throughout a unit to ensure students could internalize and apply them to other areas of mathematics. The math department also pushed for more active learning in the classroom.	*Class Structure and Key Concerns:* 75 minutes with projected slides as notes for each class session. The final exam determined if students could pass the course, and was a primary concern for the instructor. Time was allotted for practice and exploration of specific topics contingent on the topic's relevance to the final exam.
Exploratory Pedagogy Example: math projects for out-of-classroom exploration and group work that encouraged students to extend their understanding to a novel task.	*Exploratory Pedagogy Example:* peer-led instruction to facilitate student-to-student interactions and provide variety in classroom activities.

Looking specifically at the exploratory pedagogy described, the secondary teacher's use of out-of-class explorations was an interesting pedagogical technique for incorporating exploratory learning without having to use class time. Such a time-efficient method could have been useful in the college precalculus class, and we can use the experience described here to create a preliminary structure for such a project. A college mathematics project would likely benefit from:

- pairs of students working together;
- defined group roles or project requirements that clearly demarcate tasks; and
- using project tasks that students have experience doing (e.g., exams, quizzes, and lessons).

In addition to this project outline solving the conundrum faced by the college instructor, mathematics projects also provide the additional benefit of supporting students' conceptions of mathematical representations, connections, and problem solving by exposing students to multiple ways a single topic can be approached mathematically (National Council of Teachers of Mathematics [NCTM], 2000; NGA Center for Best Practices & CCSSO, 2010" with "Common Core State Standards Initiative, 2010).

On the flipside, the secondary teacher can draw from the college instructor's experience with peer learning and teaching to increase students' motivation and (equal) engagement in mathematics learning. Specifically, peer learning has been shown to improve students' motivation, with some research showing that near-peer learning can significantly improve students' views and attitudes towards mathematics (Wilson & Grigorian, 2019). Taking the college instructor's experience and mapping it onto the secondary teacher's parameters, the following could be a light framework for thinking about implementing peer learning:

- identify students who have prior knowledge or mastery of a given topic;
- check the maturity level of the class and the relationships between students to ensure a peer leader would not cause a classroom management issue;
- provide clear materials and guidance for what the peer leader is expected to do (e.g., work with students on practice problems, teach a small topic, etc.); and
- have consistent time each week for peer learning and teaching to build the habit for the class.

Beyond the pedagogical, the specialized nature of the undergraduate instructor's precalculus course is a trove of real-world applications that the secondary teacher could draw from to motivate students by answering the age-old question, "when are we going to use this?" This is especially relevant to the pair of educators in these reflections, as NYC is a financial hub where being able to understand and use mathematics through a financial lens could be an important tool for opening career paths.

In summary, while secondary and tertiary mathematics education sometimes feel like disconnected worlds, important lessons can be learned from each other's successes and tribulations. These lessons can then be adapted, implemented, and evaluated again to create a synergistic feedback loop of pedagogical improvement that helps both secondary and tertiary mathematics teaching. And of course, more broadly, stronger interconnections between secondary and tertiary mathematics educators can only serve to strengthen the math teaching community, opening future opportunities for collaboration.

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NOTES FROM THE FIELD

What Have We Done to People in the Name of Math?

Samuel A. Kankam
Teachers College, Columbia University

ABSTRACT This reflective commentary examines how mathematics education shapes students' identities, anxieties, and long-term relationships with mathematics. Grounded in a personal conversation with a former student who described mathematics as useless and manipulative, the article explores how harmful mathematical experiences can lead students to see mathematics as a source of judgment rather than a tool for understanding. Drawing on scholarship about math anxiety, relational understanding, mathematics as a human and cultural practice, and mathematics for social justice, the article argues that educators must distinguish mathematics itself from the ways school mathematics has often been taught, assessed, and used to sort students. It concludes by proposing a repair-oriented approach to mathematics teaching that centers sense-making, student agency, multiple representations, and real-world investigation.

KEYWORDS *mathematics education, mathematical repair, math anxiety, relational understanding, mathematics identity, social justice*

Introduction

As a mathematics teacher, enthusiast, and self-proclaimed "math person," I can almost guarantee what people will ask when they find out what I do: "Where and when will I ever use these math concepts?"

In my calculus class, my students once asked, "Mr. K, when are we ever going to use derivatives in our lives after here?" I smiled and answered, which I will share later in this piece.

Not long ago, I got into a debate with a former student about math and its place in our lives. She argued that math is a useless subject, that it does not give meaning to anything, and that it is mostly used to dramatize or manipulate information. To be fair, she had just written a term paper and been told to "ground her position in data." That feedback set her off: Why did she have to add math before her ideas could make sense? We talked for a long time. At one point, I told her that if she left my class believing math is useless, then I had failed her as a mathematics teacher.

That conversation made old questions feel more urgent: Are we teaching math the right way? Are students leaving our classrooms with the understanding we hope they will gain? Why do so many people feel not just distant from math, but actively harmed by it?

The big question I am trying to answer is this: What have we done to people in the name of math?

In this piece, I want to push the conversation about mathematics education in a different direction. I aim to (a) name some of the harm mathematics education has caused, (b) show that mathematics is deeply woven into our lives, and (c) challenge the idea that math is only about numbers, equations, and textbook exercises.

I frame this work as a call for *mathematical repair:* the intentional effort to rebuild students' relationships with mathematics after years of fear, shame, exclusion, or procedural learning without meaning. Mathematical repair requires educators to do more than make math "relevant." It asks us to recognize the affective wounds students carry, separate mathematics from the harmful ways it has been taught or used, and create classrooms where mathematics becomes a language for sense-making, critique, and agency.

The Wounds Math Leaves Behind

When I replay that conversation with my former student, I do not hear only an intellectual disagreement. I hear pain. I hear years of tests, grades, and teacher comments that told her, directly or indirectly, that she was "not a math person." Saying "math is useless" was not just an opinion about a school subject; it was a way of pushing back against something that had felt cold and unforgiving for most of her life. Many students do not just dislike math; they fear it.

Researchers use the term *math anxiety* to describe intense feelings of tension and worry that arise when a person faces a math problem or even thinks about math. These feelings can show up physically: through a racing heartbeat, sweaty palms, or nausea and they make it harder to think clearly in the moment (Luttenberger et al., 2018). Math anxiety does not appear out of nowhere. It often grows out of repeated experiences: timed tests, ridicule after a wrong answer, being told "this is easy" when it clearly is not, or hearing adults casually say, "I've always been bad at math." Over time, some students protect themselves by shutting down in math class or by saying "I just hate math" before math can hurt them again.

As these students become adults, their stories harden into beliefs:

- "Math is pointless."
- "Math is just used to manipulate people." Meaning people use numbers dishonestly and it makes situations feel more serious than they are.
- "Math is always wrong."

When my former student said that "math is just used to manipulate people," she was not claiming that numbers themselves are inherently false or deceptive. Rather, she was criticizing the rhetorical force that numerical language can carry in public and personal discourse. Her example of debt makes this concern especially clear. A statement such as "people are in debt" names a social and economic problem in general terms, but the addition of dollar amounts, percentages, interest rates, or national totals can make that same issue feel more overwhelming, threatening, and immediate. From her perspective, quantitative detail does not always deepen understanding; sometimes it intensifies emotion and encourages acceptance of a particular interpretation.

Her example helped me see that her frustration was not with mathematics as a descriptive tool, but with the ways numerical information can be presented to shape perception. I had suggested that quantifying an issue can make it easier to understand, but her response revealed a different concern: numbers can also be framed in ways that make people feel alarmed, judged, or powerless. This distinction matters. Mathematics can clarify complex realities by making them measurable and comparable, yet it can also be used selectively to influence emotional reactions and guide interpretation. In that sense, her comment raises an important question about whether mathematics functions only as a neutral language of description or also as a persuasive instrument in social discourse.

In this sense, such a reaction can be understood as a form of self-protection. If mathematics has become associated with embarrassment, exclusion, or failure, then rejecting it may serve as a way of reclaiming agency. The dismissal of math, therefore, is not necessarily a rejection of reasoning itself, but a response to the social meanings and emotional consequences that have become attached to it.

Viewed from this perspective, the question "What have we done to people in the name of math?" becomes even more unsettling. Mathematics is fundamentally a human practice of pattern recognition, problem solving, and meaning making; yet in educational settings it has too often been reduced to a mechanism for ranking ability and assigning worth. Rather than inviting curiosity and intellectual growth, the way it is frequently taught can produce shame, alienation, and defensiveness. If students come to see mathematics as a source of judgment rather than understanding, then their resistance is not simply academic failure, but a reflection of how mathematics has been socially and pedagogically framed.

Is Math Itself the Problem?

One mistake we often make is confusing school math with mathematics itself.

School math, as many students experience it, is a long list of rules:

- "Bring down the 2."
- "Flip the second fraction and multiply."
- "Change the sign when you move it to the other side."

Students are told to memorize, repeat, and move quickly. If they ask "why," they are often told, "You'll understand later," or "You just have to do it this way."

British educator Richard Skemp (1976) described this style of learning as *instrumental understanding*, or "rules without reasons." His distinction matters because it helps explain why many students can complete assignments yet still leave math class feeling that mathematics makes no sense. A student may learn how to carry out a procedure without understanding the relationships that make it work. When mathematics is experienced primarily as rule-following, it is easier for students to see it as arbitrary, disconnected, or even oppressive. By contrast, *relational understanding* means knowing not only how to do something, but also why it works. It treats mathematics as a connected web of ideas that makes sense. Skemp (1976) argued that relational understanding is both more satisfying and more flexible because it enables students to adapt to new problems rather than simply repeat familiar steps.

The problem, then, is not that mathematics itself is broken. Rather, the problem is that our educational systems often stop at instrumental understanding. We emphasize rules and procedures, then judge students harshly when they cannot remember or apply them quickly. Too rarely do we give students the time and space they need to build relational understanding.

This distinction also helps clarify a larger point. Philosopher Paul Ernest (1998) argues that mathematics is not a cold, perfect object floating above humanity; it is a human creation shaped by people, culture, and history. Similarly, Alan Bishop (1988) shows that every culture develops mathematical ideas to meet its own needs, whether through counting, building, navigating, or designing patterns. If mathematics is a human activity, then the way we present it in schools is a choice. We can present it as creative, sense-making, and deeply human, or we can reduce it to a list of commands. When people say that "math is manipulative," then, it is worth asking whether mathematics itself is the problem, or whether the issue lies in how mathematics has been packaged and used.

Together, Ernest and Bishop challenge the idea that mathematics is merely a fixed body of neutral facts handed down to students. Their work helps frame mathematics as a cultural and human activity shaped by the questions people ask, the problems communities face, and the values embedded in what societies choose to measure. This matters because if mathematics is human, then mathematics teaching is also a human and ethical act.

What Mathematics Really Is

Before I return to derivatives, I want to describe what I believe mathematics really is. At its heart, mathematics is the study of patterns, relationships, and structure. It is what happens when curious people ask:

- "What happens if this pattern keeps going?"
- "Is there a more efficient way to solve this problem?"
- "Is there a fairer way to divide resources, represent people, or make decisions?"
- "How can we measure or compare these things in a meaningful way?"

Mathematician Francis Su (2020) describes mathematics as something that speaks to deep human desires: play, beauty, truth, freedom, and justice. Su's framing is useful because it moves mathematics away from the narrow question of utility alone. Mathematics matters not only because it helps people calculate, but because it can cultivate curiosity, persistence, play, beauty, and a sense of belonging. This broader view is essential for students who have only experienced mathematics as pressure, speed, and judgment. When someone solves a puzzle, notices a pattern in music or art, or figures out a clever shortcut in a game, they are using the same kinds of thinking that drive mathematics. When we reduce this rich, human activity to copying examples from a board, we shrink mathematics to its least interesting form. It becomes something done to students, not by them. No wonder people walk away thinking math is meaningless. We have hidden its meaning.

Where Math Shows Up in Real Life

Students love to ask, "When are we ever going to use this?" Let me answer that in three ways.

Everyday Decisions: Health, Money, and Risk

Consider health. When you read that a medicine reduces the chance of a certain disease "from 10% to 5%," you need to understand what that means. Are we talking about 5 fewer people out of 100? Or something else? When you see a graph of COVID-19 cases or a chart of heart rates from a smartwatch, you are reading mathematical information. Research on health numeracy shows that people who struggle to interpret numbers, percentages, and graphs often have more trouble making good medical decisions, following treatment plans, or weighing risks, such as whether to get a screening test (Reyna et al., 2009). In other words, math is literally connected to how well we can navigate life-and-death choices.

The same is true for money. Interest rates on credit cards and loans, the difference between a fixed-rate and an adjustable mortgage, and the long-term impact of saving early all involve mathematical ideas. Economists have found that people with stronger numeracy skills make better financial decisions and are less likely to fall into certain kinds of debt traps (Lusardi, 2012). You may never solve a quadratic equation on paper while standing in a bank, but the habits of mind that come from understanding math: checking assumptions, comparing options, and thinking about long-term growth or decay, are exactly what help protect you financially.

Rates of Change: What Derivatives Really Mean

So, what did I tell my calculus students when they asked, "When are we ever going to use derivatives?" I told them: whenever you care about how fast something is changing, you are thinking about derivatives.

- A speedometer shows how quickly your position is changing.
- A heart monitor shows how your heartbeat changes over time.
- A business tracks how quickly profits are growing or shrinking.
- Climate scientists study how temperature or sea level changes over years, not just what it is today.

Most people will never be asked to take the derivative of a complicated function by hand. But understanding the idea behind derivatives: change, growth, and decay, is essential for reading graphs, interpreting trends, and making predictions. It helps people recognize when a situation is improving slowly, worsening quickly, or holding steady. Mathematics gives us language for talking about these patterns clearly rather than relying on guesswork.

Power, Media, and Justice

Math also shows up in who gets power and who does not.

Our world runs on data: algorithms influence which ads we see, which neighborhoods receive extra police patrols, which loan applications are approved, and even which students are labeled "gifted." In *Weapons of Math Destruction*, Cathy O'Neil (2016) describes how many of these mathematical models are "opaque, unregulated, and incontestable," and how they often reinforce existing inequalities. Her work is especially relevant to students who believe mathematics is manipulative because it shows that mathematical systems can, in fact, be used harmfully when they are hidden from public scrutiny. Yet her argument does not require us to reject mathematics. Instead, it suggests that mathematical literacy is necessary if people are going to recognize, question, and challenge the systems shaping their lives. If ordinary people do not understand basic math and statistics, they have little power to question these systems. They may not recognize when a graph is misleading, when a risk is exaggerated, or when an "objective score" is deeply unfair. Saying "I don't do math" in a world of data is a bit like saying "I don't read" in a world governed by written laws.

At the same time, educators like Eric Gutstein argue that mathematics can be used to challenge injustice, not just support it. In Reading and Writing the World with Mathematics, he shows how students can use math to investigate issues like housing discrimination, wage gaps, and environmental racism in their own communities (Gutstein, 2006). Gutstein's work provides an important counterpoint to the idea that mathematics only functions as a gatekeeper. If mathematics can be used to expose housing discrimination, wage gaps, environmental racism, and unequal access to resources, then mathematics can also become a tool of civic participation. In this sense, mathematics education is not only about preparing students for tests or careers; it is also about preparing them to read and act on the world around them. In that view, math is not just a school subject; it is a tool for making sense of the world and acting in it.

When Math Becomes a Weapon

If mathematics can help us make good decisions and fight injustice, why do so many people feel that math itself is harmful?

Part of the answer is how math has been used as a weapon in education.

Think about high-stakes standardized tests, early tracking, and labels like "remedial math." From a young age, students are sorted based on timed tests that mainly measure speed with procedures. These labels often follow them for years, shaping which courses they can take and which futures they can imagine.

Alan Bishop (1988) draws attention to the ways mathematics has been used as a "secret weapon" of cultural power. When one culture's style of math is treated as the only "real" mathematics, it can become a tool for judging and controlling others. From a different angle, Paul Ernest (1998) argues that when we teach math as absolute and value-free, we hide the human choices built into it: what to count, what to ignore, and whose problems are worth solving. Outside the classroom, math-based systems: credit scores, school ratings, predictive policing algorithms, and more, can function as "weapons of math destruction" when they are unregulated, biased, and shielded from public understanding (O'Neil, 2016).

So, my former student is not entirely wrong when she senses that math can be used to manipulate or harm. She is noticing a real pattern. We have indeed used math to:

- Rank and label students.
- Gatekeep college majors and careers.
- Justify unequal funding and harsh policies.
- Wrap questionable decisions in the language of "data" and "objectivity."

But the key point is this: the problem is not that mathematics itself is evil. The problem is that powerful people and institutions have chosen to use mathematical tools without care, transparency, or justice. If we respond by rejecting math altogether, we lose the very tools we need to uncover and challenge those abuses.

Rethinking How We Teach Math

If we have harmed people in the name of math, what would it look like to repair that harm?

From "Get the Answer" to "Make Sense"

First, we must move from purely instrumental teaching ("follow these steps") to relational teaching ("here is why this works"). Skemp's (1976) distinction between instrumental and relational understanding gives us language for this shift.

In a traditional classroom:

1. The teacher shows an example.
2. The teacher works through a few similar problems.
3. Students do many almost-identical problems while the teacher checks answers.

Students who already memorized the procedure look "good at math." Students who need more time or a different approach often feel lost and embarrassed. There is little room for questions like "Why does this make sense?" or "Could we solve this another way?"

In a reimagined classroom:

- Students start with a problem that is understandable but not instantly solvable.
- They explore patterns and test ideas in pairs or groups.
- The teacher asks, "What do you notice?" and "Why do you think that works?"
- Multiple solution paths are shared and compared.
- Formal methods are connected to the ideas students uncovered.

Jo Boaler (2016) describes this as developing mathematical mindsets. Her work matters here because students' beliefs about their own mathematical ability are not separate from instruction; they are shaped by classroom experiences. When students repeatedly encounter mathematics as speed, correctness, and comparison, they may come to believe that mathematical ability is fixed. A classroom that values mistakes, multiple strategies, and discussion can interrupt that belief. When students are encouraged to see mistakes as opportunities, use visual and creative strategies, and talk through their thinking, they are more likely to believe that everyone can grow in math, not just a few "naturally gifted" students.

Naming and Healing Math Anxiety

Second, we need to name math anxiety and trauma openly. If students have been carrying negative experiences for years, pretending everything is fine will not work.

Simple moves can help:

- Sharing our own moments of struggle or confusion with math.
- Giving students time to think before asking for answers.
- Allowing multiple representations (words, pictures, tables, graphs).
- Praising reasoning and persistence, not just speed or correctness.

Luttenberger et al. (2018) point out that math anxiety is shaped by family and classroom environments, not just something inside the student. That means teachers and schools have real power to either intensify or reduce that anxiety.

Math as a Tool for Seeing the World

Third, we can design tasks that connect math to students' real lives and to questions of fairness. Following Gutstein's vision of teaching math for social justice, we might ask students to:

- Analyze data on local housing prices or eviction rates.
- Compare graduation rates for different groups of students.
- Study how voting districts are drawn and how that affects representation.
- Model the spread of a rumor or a disease in a school.

These are not just "applications" added to the end of a unit. They communicate to students that their world is worth studying carefully, that their questions about fairness matter, and that math can help them investigate those questions (Gutstein, 2006). Even in calculus, we can do more than talk about abstract functions. When I answer the derivatives question now, I try to connect it to students' own experiences:

- How fast is your follower count growing?
- How quickly is your bank account balance changing after you start a job?
- How fast does your sprint speed increase when you train over a season?

We sketch graphs, talk about rates of change, and connect that to the derivative they are learning to compute. The goal is not just to prove that derivatives are "useful," but to show that the underlying idea is already living in their world.

The contribution of this reflection is not to claim that math anxiety, relational understanding, or mathematics for social justice are new ideas. Rather, it is to bring these ideas together under the language of repair. If mathematics education has contributed to fear, shame, and exclusion, then mathematics teaching must become intentionally repair-oriented. This means designing classrooms where students can rebuild trust with mathematics while also learning to use it critically in the world.

Conclusion: Repairing What We Broke

So, what have we done to people in the name of math?

We have told children, often very young, that speed with procedures equals intelligence. We have used tests and scores to track and limit their futures. We have treated one narrow style of mathematics as neutral and universal, while ignoring the ways it can support or challenge power. We have allowed harmful uses of algorithms and data to hide behind the authority of mathematics. Then, when those same children grow up and say, "Math is useless" or "Math is just manipulation," we act surprised.

I do not blame my former student for her anger. In many ways, her reaction is honest. She is refusing to worship a subject that, in her experience, has mostly brought stress and judgment. But abandoning mathematics entirely is not the answer.

Math is already woven into our lives, our health decisions, financial choices, news feeds, laws, and struggles for justice. The question is not whether we will use math, but whether we will use it blindly or wisely; whether it will serve as a tool of domination or a language for understanding and transformation.

As educators, we have a responsibility to:

- Teach math as sense-making, not just symbol-pushing.
- Create classrooms where students can question, explore, and see themselves as capable thinkers.
- Help students use mathematics to read and write about the world, not just pass a test.
- Name past harms and work intentionally to heal them.

If we can do that, then perhaps one day, when someone discovers that you are "a math person," the question will not be, "When will I ever use this?" but instead, "What has math helped you understand about life?" More importantly, our students will be able to answer that question for themselves.

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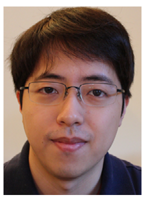
ABOUT THE AUTHORS

Samuel Kankam is a doctoral student in Mathematics Education at Teachers College, Columbia University, and a mathematics educator in New Jersey. His background includes secondary mathematics teaching, higher education instruction, curriculum development, and instructional coaching. His broader professional interests center on improving mathematics teaching and learning, supporting student persistence, and creating more accessible and meaningful mathematical experiences for learners.



Baldwin Mei is an Assistant Professor at Hostos Community College who holds an EdD in Mathematics Education from Teachers College, Columbia University. His research interests straddle secondary and tertiary mathematics education, with specific interest in students' transition from secondary to undergraduate mathematics, technology in the math classroom, andmulticultural education.

Eunice Obeng holds a Bachelor of Education in English from the University of Education, Winneba-Ghana. She is a teacher by profession and is currently teaching English Language at the Presbyterian Senior High School, Mampong Akuapem-Ghana. She is also an assistant examiner in both Basic Education Certificate Examination (BECE) and West African Senior School Certificate Examination (WASSCE). Her interest is to see students excel in their examinations. Therefore, she teaches with passion and involves all students in her lessons. She is a member of the Ghana National Association of teachers of English.

Zutaah Puotier is a Ghanaian mathematician, who holds a Doctor of Philosophy in Mathematics Education from Kenyatta University. His research interests include technology integration, gender issues, STEM education, and inclusive education. He has published peer-reviewed research papers, textbooks, and has presented at conferences both internationally and nationally. He is a member of ASFI, Ife Summer Institute of Advance Studies, and the Mathematics Association of Ghana.

Maya Schwartz is a doctoral (EdD) candidate in Mathematics Education at Teachers College, Columbia University. She earned a Bachelor of Arts degree in mathematics at Bard College and a Master of Science degree in mathematics education at Teachers College, Columbia University. She has taught at the Bronx High School of Science and Stuyvesant High School. She currently teaches sixth grade math at Mott Hall 2. She has a passion for mental health, equity in mathematics, and is an anti-AI advocate.

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