Expanding Mathematics Equity Initiatives for Greater Inclusivity

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We call upon teacher educators to expand equity-based initiatives in mathematics education to be more inclusive of students with disabilities. Though researchers have addressed equity and access across race, class, and gender (Bartell et al., 2017; Gutstein, 2009), they have stopped short of fully considering all learners. As mathematics educators continue to redefine what it means to do mathematics, it is necessary to consider students who receive services and supports. Although this paper will offer suggestions for how the process can look, our purpose is to identify the need for change and suggest familiar structures to support this change from which teachers can then build more specific strategies to expand mathematics equity. Specially designed instruction is based on the student's individual needs and is designed to provide access to the curriculum and to meet grade-level content standards (*Individuals with Disabilities Education Act*, IDEA, 2004). For mathematics education to be inclusive of all learners, we must embrace the premise that all learners can and should have ownership over their own mathematics (Lambert & Tan, 2017). Additionally, teachers must be supported in their growth toward making mathematics accessible to students who receive services and supports.

The National Council of Teachers of Mathematics (NCTM, n.d.) recommends: "all students should have the support necessary to learn significant mathematics with depth and understanding" (p.1). Research in mathematics education emphasizes using low floor and high ceiling tasks (Boaler et al., 2021), differentiated instruction (Tomlinson, 1999), and eliciting and building on student thinking to honor and encourage diversity in students' approaches to mathematics (Carpenter et al., 2015; Smith & Stein, 2018). Although important, none of this work describes specific modifications and adaptations needed for students who require specially designed instruction. Students served under IDEA often lack access to or support to make progress in the general education curriculum (Gilmour et al., 2019). Additionally, some learners experience mathematics through behavioral or information-processing approaches with a focus on memorizing and executing procedures without understanding underlying concepts (Lambert & Tan, 2017). This conflicts with constructivist, student-centered approaches called for by mathematics educators (Steffe & Kieren, 1994). Described here is the use of the Universal Design for Learning (UDL) framework to guide recommendations for mathematics teacher education programs.

Universal Design for Learning

We agree that while UDL is a critical approach for supporting all students in an inclusive learning environment (Hunt & Andreasen, 2011), intentional planning is necessary to meet the needs of students entitled to uniquely designed instruction in their IEP, which is best developed by highly qualified mathematics *and* special educators. Critical to UDL is the assumption that the learning environment should adapt to the learner rather than the learner adapting to the environment, with the goal of creating expert learners who are purposeful and motivated, strategic, and goal-directed,

and resourceful and knowledgeable (CAST, 2018). Three principles guide the development of UDL lessons: engagement, representation, and action and expression. Guidelines in each principle describe pathways to create access, build varied ways to interact with content, and internalize learning. To make learning appropriate for all students within the UDL framework, teachers should honor students' choices, provide varied ways to interact with content, and support students in expressing or communicating their ideas and self-monitoring their learning. It is common in UDL for learners to explore topics or demonstrate learning in individualized ways within the same lesson. For example, some students might complete a mathematics problem using a formal algorithm, while others might represent it pictorially or include an audiotaped description of their solution (see Figure 1).

Figure 1 - Mathematics and Special Education Comparison with Universal Design for Learning

Mathematics Education	UDL Principles and Characteristics	Examples of Inclusive UDL Mathematics	Special Education
● Relevant learning topics ● Relevance to student experiences ● Low floor, high ceiling	**Engagement Principle** ● Recruiting Interest ● Sustaining Effort & Persistence ● Self-Regulation	● Problems that explore relevant issues using mathematics ● Student use of rubrics and self-evaluation tools	● Real-world examples and authentic problems ● Multiple strategies for each skill ● Choice and agency
● Varied and connected representations ● Varied entry points ● Build procedural fluency from conceptual understanding	**Representation Principle** ● Perception ● Language and Symbols ● Comprehension	● Focus on sense-making rather than procedural understanding. ● Student-selected tools to support sense-making	● Manipulatives, and tangible representations ● Tools for differentiating ideas like highlighters, bold text, and checklists
● Appropriate tools to facilitate understanding ● Self-monitoring and metacognition ● Encourage student thinking and strategies ● Varied representations based on student thinking	**Action & Expression Principle** ● Physical Action ● Expression & Communication ● Executive Function	●Class-wide practice of soliciting varied responses ● Varied methods to contribute thinking: video, audio, retelling to a teacher, photograph of manipulative work	● Verbal, recorded, dictated opportunities to respond ● Visible connections ● Multiple tools to facilitate understanding ● Build understanding into broader project-based learning

Recommendations

The principle that all students should be supported in learning mathematics undergirds work in mathematics education, special education, and UDL, and to support this principle we offer three recommendations. First, establish strong connections between high-quality mathematics education and special education practices as a clear goal, beginning with teacher education and continuing through professional development. Second, mathematics educators need increased support to develop specially designed instruction for learners who receive services and supports. Third,

effective collaboration between special and general education professionals at all levels should be prioritized to capitalize on the unique expertise that each possesses.

Strong connections between high-quality mathematics education and special education practices are needed because preservice teachers often fail to receive clear messages about inclusive education (Kurth & Foley, 2014) and lack adequate opportunities to expand beliefs about inclusive education and develop a robust conception of inclusive mathematics (Boyd & Bargerhuff, 2009). Inservice teachers express feeling unprepared to develop specialized mathematics instruction in inclusive classrooms but cite that effective collaboration between professionals mediates the challenges (DeSimone & Parmar, 2006).

Teachers need ways to select and implement adaptations and modifications that are specially designed for individual learners, and to make and evaluate adaptations and more opportunities for preservice and practicing teachers to practice these skills. Teacher preparation and professional development should model the expectations in the field and create collaborative learning experiences for special, general, and content-specific educators (Kurth & Foley, 2014). Additionally, professional development for inservice teachers should continue to support these learning goals. Teacher candidates' conceptions of how to collaborate may vary and lack specificity (Hamilton-Jones & Vail, 2014), increasing the complexity and importance of this task. Prioritizing collaboration within teacher preparation programs and professional development is necessary to meet the needs of students receiving services and supports in the general education mathematics classroom.

We recommend three initiatives described and supported here: a) better connections between mathematics and special education, b) support to develop specially designed instruction, and c) a focus on effective collaboration. Further dialogue and joint research between both professional communities are warranted, knowing that this brief call to action cannot be considered the blueprint necessary to initiate change.

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