BACKGROUND AND RESEARCH

Research Basis

Research has shown that students with extensive support needs (e.g., moderate-to-severe intellectual disabilities, autism spectrum disorder) can learn mathematical concepts (Spooner, Root, Saunders, & Browder, 2019) and further, can learn skills to solve problems aligned to secondary math standards (Browder, Jimenez, & Trela, 2012; Browder, Trela et al., 2012; Creech-Galloway, Collins, Knight, & Bausch, 2013; Heinrich, Collins, Knight, & Spriggs, 2016; Jimenez, Browder, & Courtade, 2008; Root, Cox, Hammons, Saunders, & Gilley, 2018). Additionally, the National Council for Teachers of Mathematics (NCTM) lists "Access and Equity in Mathematics Education" as one of the six principles for school mathematics (NCTM, 2000). Therefore, *Access Geometry* utilizes three carefully chosen research and evidence-based strategies found to support students in solving problems that required complex thinking skills. These three strategies — task analytic instruction, problems stated in a story context, and use of graphic organizers — may provide guidance for teachers in adapting instruction to additional standards taught in a Geometry course.

In 2008, a meta-analysis of literature on teaching math to students with moderate-to-severe disabilities showed that students could learn math concepts organized under the National Council of Teachers of Mathematics' previous content strands of Measurement, Numbers & Operations, Algebra, Data Analysis, & Geometry (Browder et al., 2008). These researchers found that while most studies targeted Measurement concepts (such as money and time) and Basic Numbers & Operations skills (like counting and number recognition), few studies targeted Geometry and Data Analysis, and none targeted Algebra. Then in 2019, Spooner and colleagues extended this review, finding an increased focus, over the last decade, on Algebra and a decreased focus on Measurement. They also noted that the number of studies targeting Geometry standards also increased, with a focus on grade-aligned skills. Practices found to be effective in both reviews for teaching math skills to students with extensive support needs included systematic instruction (e.g., task analysis, use of systematic prompting) and in-vivo instruction (e.g., applying skills in real-life contexts that reflect situations typical of most young adults, such as engaging in school and community events, doing research for a paper, looking for part-time work, or doing chores at home). Spooner et al. (2019) also found instructional procedures of graphic organizers, manipulatives, and explicit instruction to be evidence-based practices in teaching mathematics to this population.

Based on findings from these meta-analysis and further research on practices found to be effective in teaching standards-based math for students without disabilities, an instructional package was developed by Browder and colleagues at the University of North Carolina, Charlotte's (UNCC's) Curriculum Projects to investigate how best to design and implement standards-based instruction to students with moderate-to-severe disabilities. In studies conducted with middle and high school students of this population, researchers used task analytic instruction, graphic organizers, systematic instruction, and math problems presented in the context of a story to teach math skills aligned to secondary standards in Algebra, Geometry, Data Analysis, and Measurement (Browder, Jimenez, et al., 2012; Browder, Trela, et al., 2012). Results from these studies showed that students with extensive support needs (e.g., moderate-to-severe intellectual disability and autism) could learn skills aligned with secondary math standards. In fact, materials and methods developed for these studies were incorporated into Attainment's *Teaching to Standards: Math* curriculum for secondary students (Trela, Jimenez, & Browder, 2008). Furthermore, in 2013, findings from the two 2012 Browder and colleagues' studies were confirmed by Creech-Galloway et al., who incorporated use of video-based presentation of story problems, simultaneous prompting, and use of a student task analysis to teach secondary students with moderate-to-severe disabilities to solve geometry problems using the Pythagorean Theorem.

Embedded Non-Geometry Skills for Post-Secondary Success

Throughout elementary and middle school, students are taught math via standards adopted by their state, such as the Common Core State Standards (National Governors Association Center for Best Practices and Council of Chief State School Officers, 2010) or other state standards. Under the Every Student Succeeds Act (ESSA, 2015), federal guidelines stipulate that students with significant cognitive disabilities may be assessed to grade-appropriate alternate achievement standards aligned to their state's general education curriculum. At the high school level, math standards are organized by content, rather than grade level, to reflect a change in focus from development of foundational math skills in all 11 domains (e.g., Counting & Cardinality; Numbers & Operations in Base 10; Numbers & Operations — Fractions; Operations & Algebraic Thinking; Measurement & Data; Geometry; Ratios & Proportional Relationships; The Number System; Expressions & Equations; Functions; and Statistics & Probability) to integration and application of foundational math skills to more complex problem solving within specific courses of study (e.g., Algebra, Geometry, Calculus, Math 1, Math 2). The ideas of geometry are essential in mathematics, as they are used across most mathematics concepts and skills (e.g., diagrams). Geometric language and images provide a context and a tool for developing and applying ideas to other areas of mathematics (Sinclair, Primm, Skelin, & Zbiek, 2013).

High school is also the point at which most students focus more closely on skills that prepare them for successful post-secondary settings. Wehmeyer and Schwartz (1997) noted that students who leave high school with strong self-determination skills have a greater chance of achieving positive post-secondary outcomes than those who do not. For high school teachers of students with moderate-to-severe disabilities, addressing the need to promote higher order thinking skills and support development of self-determined behaviors can be a daunting task. *Access Geometry* provides a resource for teachers as they balance the need to align instruction to secondary math standards and promote self-determination skills.

Based on earlier research showing that students can learn skills that promote more abstract thinking (Browder, Jimenez, et al., 2012), *Access Geometry* applies task analytic instruction, systematic prompting and feedback procedures, problems presented in a story context, and use of graphic organizers to teach students problem-solving skills that require more complex thought (e.g., transformations, geometric proofs, volume of 3-D objects, and tessellations). This curriculum also supports students in self-monitoring their work by means of a Task Analysis, which outlines the steps needed to solve math problems in context (e.g., math story problems depicting youth actively engaged in their homes, schools, and communities).

Although *Access Geometry* does not address all domains of all high school Geometry courses, the units provide guidance on how to approach problems that require access to more-complex thinking skills through meaningful application of mathematical concepts (e.g., graphic design and coding transformations, planning construction of a book shelf using triangles and proofs, restocking candy jars based upon potential volume of cylinders, designing tile flooring with a repeating tessellation pattern).

Strategies to Guide Adapting Instruction Aligned With CCSS

In 2013, based on their research showing positive results when teaching to standards for students with significant disabilities, researchers from UNCC's Curriculum Projects group shared the following guiding strategies for teachers who were facing a new task of aligning math instruction to state standards (Saunders, Bethune, Spooner, & Browder, 2013):

1. Select a topic and create objectives.
2. Identify a real-life activity that uses the skill.
3. Incorporate evidence-based practices using the skill.
4. Include instructional supports.
5. Monitor progress.

Access Geometry combines guidance from research on strategies to teach secondary math standards to students with extensive support needs with guidance from multiple states' websites, as well as NCTM, to identify the conceptual categories and domains typically addressed in a high school Geometry course.

While addressing these conceptual categories (e.g., Algebra, Geometry) is essential, it is also important to develop lessons that consider the varied math skills of students who are assessed on alternate achievement standards. For example, in a 2009 survey in which teachers whose students were assessed on alternate achievement standards were asked to characterize their students' math skills, variations from "no awareness or use of numbers (13%)" to "complete computational problems with or without a calculator (57%)" were reported (Towles-Reeves, Kearns, Kleinert, & Kleinert, 2009, p. 246). *Access Geometry's* Scope and Sequence (see pgs. 10–17) identifies skills in each unit that support students at the emerging (e.g., needs support with early numeracy concepts), target (e.g., applies basic numeracy skills to problem solving with prompting and support provided in the lesson), and advanced (e.g., applies basic numeracy skills independently to solve target and challenge problems) levels so that all students may engage in lessons that promote higher order math skills.