

Chapter 6

Virtual Manipulatives as Assistive Technology

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ABSTRACT

Virtual manipulatives are a form of technology that support the mathematics teaching and learning of students with high-incidence and low-incidence (or extensive support needs) disabilities. The purpose of this chapter is to present virtual manipulatives as an assistive technology. Access to and use of virtual manipulatives have increased over the last decade, resulting in virtual manipulatives serving as a modern assistive technology to support students with a wide range of disabilities in mathematics. This chapter will present an overview of virtual manipulatives as assistive technology for students with disabilities and the research base supporting the effectiveness of this technology.

TYPES OF ACADEMIC MATHEMATICS-BASED ASSISTIVE TECHNOLOGY

Students with disabilities benefit from assistive technology to support mathematics (Kiru et al., 2018). However, a common question is what assistive technology tools and devices are unique to mathematics. Over a decade ago, Bouck & Flanagan (2009)

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identified three main types of technology in mathematics to support students with high-incidence disabilities: anchored instruction, calculators, and computer-assisted instruction. Kiru et al. (2018), more recently, presented technology interventions to support students with a math learning disability or those at risk for a math learning disability. For those with more extensive educational needs, researchers also identified technology or assistive technology to support mathematics, such as computer-assisted instruction, video-based instruction (e.g., video prompting or modeling), and manipulatives (King et al., 2016; Spooner et al., 2018).

Calculators

Although calculators are a common tool used in the teaching and learning of mathematics by students with and without disabilities, they are not without controversy. As noted, students with disabilities commonly receive calculators as well as calculators are a tool most people have access to on a regular basis now with smartphones (Altman et al., 2012; Lai & Berkeley, 2012; Maccini & Gagnon, 2000; Tindal & Ketterlin-Geller, 2004; Thurlow et al., 2005; Wilson et al., 2011). However, for students with disabilities, calculator use raises questions (Close et al., 2012; Lazarus et al., 2009). Critics argue calculators promote laziness, discourage the learning of basic facts, and are unfair when only provided to students with disabilities as an accommodation (D'Ambrosio et al., 2004; Loveless, 2004; Pomerantz, 1997; Rubenstein, 2001; Schmidt, 1999). Proponents, on the other hand, suggest calculators benefit students with—and without—disabilities but do not distract from learning computation or other mathematical skills (Burrill et al., 2002; Ellington, 2004; Hembree & Dessart, 1986; Smith, 1997).

Much of the previous attention to calculators by researchers involved examining the tool as an accommodation to support students on assessments. Researchers suggested calculator use benefits elementary and secondary students with disabilities, at least on computational problems or others involving number and operations (Engelhard et al., 2011; Lee et al., 2010; Scarpato et al., 2011). Research by Bouck and colleagues (Bouck, 2009; Bouck & Bouck, 2008; Bouck & Yadav, 2008) found students with and without disabilities benefit from calculator use, raising questions regarding the validity of calculators as an assessment accommodation. More recently, Bouck et al. (2015) found middle school students with disabilities answered more questions correctly with access to a calculator than without.

Computer-Aided Instruction

Computer-aided instruction (CAI)—or expanded to be technology-mediated instruction (TMI) as it may more aptly be referred to now with mobile devices and

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