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Using embedded computer-assisted explicit instruction to teach science to students with autism spectrum disorder

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ABSTRACT

For students with Autism Spectrum Disorders and intellectual disability, the need for scientific literacy is further complicated by the need for individualized instruction necessary to teach new skills, especially when those skills are academic. This study investigated the effects of embedded, computer-assisted explicit instruction to teach science terms and application of those terms to three middle school students with autism and intellectual disability. This study was implemented within an inclusive science classroom and a multiple probe across participants design was used to examine the effectiveness of the intervention. Results showed a functional relationship between the number of correct responses made during probe sessions and introduction of the intervention. Implications for practice and suggestions for future research are also discussed.

Contents

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[1] The conceptualization and analysis for this project took place while Bethany R. Smith was a doctoral student at the University of North Carolina at Charlotte.

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1. Introduction

Education reform over the past decade has targeted the need for scientific literacy as evidenced by the rise in the science, technology, engineering, and mathematics (STEM) education movement. Since the push for education reform, many programs have begun to specifically target the need for STEM for all students from kindergarten through high school. Despite efforts to increase the scientific literacy, many students will graduate from high school without a working knowledge of science concepts, processes, or skills (Roseman & Koppal, 2008). According to the Trend in International Mathematics and Science Study (TIMSS, 2008), while student scores in mathematics have risen in the past decade, scores in science have remained stagnant since 1995.

When compared to their same aged peers, students with disabilities have increased challenges in science that result in lower performance outcomes (Carnine & Carnine, 2004; Cawley, Kahn, & Tedesco, 1989; Lynch et al., 2007). Similarly, the literature focused on teaching science to students with disabilities, particularly developmental disabilities (e.g., intellectual disability, Autism Spectrum Disorders [ASD]), is sparse. In a comprehensive literature review, Spooner, Knight, Browder, Jimenez, and DiBiase (2011) found 17 published single-subject studies that examined instruction for students with a severe intellectual disability, including students with ASD. The studies included instruction on skills that fell within the eight National Science Education Standards (NSES, National Research Council, 1996) content standards. Of those 17 studies, 14 met quality indicators outlined by Horner et al. (2005) and were retained for analysis. Analysis of these 14 studies revealed that the majority of studies fell into NSES Standard F: Science in Personal and Social Perspectives. These studies focused predominately on teaching skills that fell within a traditional functional curriculum (e.g., skills relating to health, safety, and nutrition [Collins & Griffen, 1996; Gast, Winterling, Wolery, & Farmer, 1992; Marchand-Martella, Martella, Christensen, Agran, & Young, 1992; Spooner, Stem, & Test, 1989]).

The research base on teaching functional skills to students with intellectual disability is well established; however, research on academic science skills is emerging. For example, Smith, Spooner, Jimenez, and Browder (in press) used a multiple probe across behaviors with concurrent replication across participants research design to examine the effectiveness of an early science curriculum, specifically designed for students with intellectual disability, on the acquisition of science vocabulary and concepts for three elementary aged students with multiple developmental disabilities (e.g., physical impairments, severe intellectual disability, Cri du Chat Syndrome). In this study, the special education teacher received semi-scripted lessons and instructional materials. These scripted lessons also included an experiment and activity, as well as opportunities for students to make and reflect on predictions, which are all components of the NSES content standard science as inquiry. Similar to the Courtade, Browder, Spooner, and DiBiase (2010) study, the researchers collected data on both the teacher's ability to implement these lessons with fidelity and the number of correct responses participating students made during unit assessment probes. Results of this study demonstrate a functional relationship between the number of correct responses made by participants in the unit assessment probes and introduction of the intervention (i.e., semi-scripted science lessons). Additionally, the teacher was successful in implementing these lessons with high levels of fidelity (mean 97.5%) despite not meeting the definition of highly qualified according to NCLB (2002). Both studies demonstrate a special educator's ability to deliver quality grade-aligned academic instruction with minimal training. These studies also showed that once the academic instruction was provided, students with varying level of disability acquired the targeted grade-level content (e.g., vocabulary, concept statements).

One systematic instructional procedure used to deliver academic science instruction to students with intellectual disability or students with ASD is explicit instruction. Explicit instruction involves teacher modeling, guided practice, and many opportunities for students to practice a target skill (Goeke, 2009). To date several studies have examined the use of explicit instruction to teach academics to students with ASD or intellectual disability (Bethune & Wood, in press; Flores & Ganz, 2007; Ganz & Flores, 2009; Hicks, Bethune, Wood, Cooke, & Mims, 2011; Knight, Smith, Spooner, & Browder, 2011). While most of the studies focused on teaching literacy skills (i.e., reading comprehension, symbol identification, prepositions), some studies have specifically evaluated the use of explicit instruction to teach science skills (e.g., Knight, Smith, & Saunders, 2012).

Knight et al. (2011) used a multiple probe across behaviors with concurrent replication across participants to examine the effect of explicit instruction in a model-lead-test format to teach science descriptors (e.g., heavy, change, living, dead) to three elementary aged students with ASD and a severe intellectual disability. Results of this study demonstrated a functional relationship between explicit instruction and all behaviors (i.e., receptive identification of science descriptors) and like both