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Teachers' Corner

Why teachers need to play to provide the best UDL supports when teaching STEM

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In early childhood and elementary classrooms across the country, Science, Technology, Engineering and Math (STEM) activities are the daily routines, but it is likely that the focus is more on science and math. Engineering is often left out, not because teachers do not believe that it is important, but because many teachers are uncomfortable with or scared of engineering and STEM in general (Adams, Miller, Saul, & Pegg, 2014; Sharapan, 2012; Stone-MacDonald, Bartolini, Douglass, & Love, 2011). As a teacher educator, I see this fear and reticence in my university classes preparing educators to teach STEM in inclusive settings. Many even think I am a little weird, because on the first day of class I am excited to get to the engineering section and do the fun exercises. During the engineering classes, pre-service educators practice the various activities and get to play themselves. They realize that it is not only fun but also that they know so much more about engineering and how to support students in learning the various integrated STEM concepts through engineering experiences or investigations than they realized. Because we did the engineering investigations in class and discussed UDL supports and more intensive accommodations for various students and their needs, they are better prepared to plan UDL supports that lead to meaningful participation by all students in investigations, resulting in improved student outcomes on STEM standards.

Experiential learning benefits all children by providing hands-on learning activities (Council, 2018; Cunningham, Lachapelle, & Davis, 2018; McClure et al., 2017). As special educators, we know that all children should have access to high quality STEM experiences and hands-on learning. UDL principles help teachers plan meaningful ways to actively engage all children—including those with developmental disabilities and autism—to participate in hands-on learning experiences to increase their problem-solving skills (Butera, Horn, Palmer, Friesen, & Lieber, 2016; CAST, 2012; Stone-MacDonald, Wendell, Douglass, & Love, 2015). Students with developmental disabilities may need more intensive interventions or strategies for success in an inclusive classroom. Some studies have shown that peer-mediated instruction and task analysis support teaching inquiry-based science to students with severe disabilities (Courtade, Browder, Spooner, & DiBiase, 2010; Jimenez, Browder, Spooner, & Dibiase, 2012).

Engineering in the Classroom

When engineering educators talk about engineering design practices, they are referring to ways of thinking and acting that are typical of adult engineers and that are productive for accomplishing engineering tasks (NRC, 2012). In the work that I have done with colleagues around inclusive engineering experiences for young children, children and adults work together through four phases of engineering design that are appropriate for young children. These phases are 1) Think about it, 2) Try it, 3) Fix it, and 4) Share it (Stone-MacDonald et al., 2015). This engineering process is designed to promote emergent engineering thinking and problem solving. While students with disabilities or younger students might never do more than one or two of these phases in a single lesson, through the course of a full engineering experience or investigation, students and adults would complete all four phases to solve their problem and develop more questions for the next investigation. Hands-on engineering or STEM experiences—because engineering experiences often use most or all of the areas of STEM—use both open exploration and focused investigations. An *open exploration* provides initial experiences with the relevant science that build a foundation. In an open exploration, students are provided the materials with which to play and become familiar, and can explore them and try different activities or pose their own questions. *Focused investigations* start with specific questions to answer or problems to solve, usually generated by the students from open explorations.

Balls and Ramps

When I teach pre-service educators in my university classes, I bring in the balls and ramps and require that my students play and experience the activity just as their students would. In my college classroom and in many professional development trainings I have done, we use balls and ramps as an engineering experience to model open and focused explorations and to plan for students with disabilities. First, the teachers get to try the different balls and ramps, and see how they work. They then develop 5–10 questions they want to potentially explore as part of a focused investigation. These questions might include: Which ball goes faster? Which ramp is steeper? Does the width of the ramp matter? What makes a ball move slower?

The purpose of having the educators do the investigations is not just to help them become more comfortable with the materials and the activity, but also to help them think through their own inquiry to better understand how their students will process and engage meaningfully in the activity. This allows teachers to have an understanding not only of the general concepts, but also to explore the fun and sometimes silly assumptions they are going to make, in anticipation that kids also will experience the activity in a similar way. Instead of simply looking at the grown-up concept of the activity, I require that my students experience the activity themselves.

Providing hands-on activities to understand STEM gives students access to the curriculum in multiple modes through UDL supports. When educators are participating in the investigations themselves, they are learning through their own hands-on experiences how to apply UDL supports for their individual students. Here are some questions to ask to check that UDL strategies are being used:

1. Are you providing several different materials of the same type to explore the concept? (e.g., different sizes and textures of balls)
2. Do students have several opportunities to try and repeat the activity?
3. Are you using media to document the students' learning? Are you showing the students pictures and reflecting on the activities?
4. Are the materials accessible with scaffolds based on the mobility of the student?
5. Are you incorporating preferred items, reinforcers, or adults to support the students?
6. Do students have the necessary supports for communication about the activity?
7. Are you using multiple modes of assessment to assess the product and process, such as photos, checklists, and discussion with the student?

As educators, we are able to best meet the needs of all our students when we can understand how they experience learning activities. Each of our students with developmental disabilities will have unique UDL support needs to participate meaningfully in engineering/STEM explorations, but our willingness to play and understand the material ourselves will ensure that we are fully prepared to support them.

For additional information and resources, please see this blog post from one of my past trainings: **http://blogs.umb.edu/angelastone/2016/07/**. ■

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