



Supporting Play and Problem Solving in Young Children in the Context of a Universally Designed Early Learning Environment

This *Question and Answer (Q&A)* resource explores several key issues in efforts to implement universally designed learning (UDL) environments for young children. It looks specifically at means of promoting early math literacy.

The ideas in this Q&A were drawn from the CTD webinar [Supporting Play & Problem Solving in Young Children in the Context of a UDL Early Learning Environment](http://ctdinstitute.org/library/2015-11-03/supporting-play-and-problem-solving-young-children-context-udl-early-learning) and from additional sources of information. The CTD webinar featured Beth Poss, Coordinator at Montgomery County Infants and Toddlers Program (MCITP), Montgomery County Public Schools, MD. The archived webinar can be viewed at: <http://ctdinstitute.org/library/2015-11-03/supporting-play-and-problem-solving-young-children-context-udl-early-learning>

Understanding the relationship between play, problem solving and learning is increasingly important as the education field recognizes the impact of early learning on a child's later educational outcomes. Researchers have found that math skills in kindergarten can predict third-grade test scores in both reading and math. This link is recognized by a joint position statement issued by the National Association for the Education of Young Children (NAEYC) and the National Council of Teachers of Mathematics (NCTM). The statement affirms that "high-quality, challenging, and accessible mathematics education for 3- to 6-year-old children is a vital foundation for future mathematics learning. In every early childhood setting, children should experience effective, research-based curriculum and teaching practices."

1- What does universal design for learning (UDL) look like in an early childhood setting?

The concept of "universal design for learning (UDL)" provides a framework to guide educational practice. It provides educators with flexibility in the ways information is presented, in the ways students respond or demonstrate knowledge and skills, and in the ways students are engaged. These principles are meant to reduce barriers in instruction and provide students with appropriate accommodations and supports. The principles also aim at maintaining high expectations for all students, including students with disabilities and students with limited English proficiency.

When using UDL principles it is important to keep in mind that there is:

- no one best way to learn
- no one best way to demonstrate attainment of proficiency
- no one best way to motivate and engage students

In an early childhood setting, teachers can use UDL guidelines to provide students with:

- a choice of materials and activities
- enhanced and extended opportunities for communication and interactions
- play-based resources that can be accessed by the widest range of children, including those with, or at risk of developing, physical, sensory, developmental and behavioral disabilities, as well as by English language learners
- multi-sensory and engaging learning experiences that meets varied development needs

2- Why is play important to the development of early math ability?

Teachers and other professionals involved in early childhood learning can enhance children's natural interest in mathematics and their disposition to use it to make sense of their physical and social worlds. Provided with ample time, materials, and opportunities for teacher-child interaction, children engage in play, explore their environment/context and manipulate mathematical ideas with keen interest.

The more classroom teachers talk with children about numbers and reinforce math concepts, the more children learn about them. It is important to interact with children during play, where the opportunities to enhance children's understanding of math are natural and engaging. There is a growing body of evidence documenting measurable gains in math literacy when a good teacher-child-play fit exists. This fit is likelier to happen when teachers employ UDL principles within early learning environments.

3- What are some of the foundational math skills appropriate for children age three to six?

Foundational skills for math proficiency within this age range include:

- Number sense (counting, measurements and data analysis)
- Sets and shapes
- Patterns and spatial relationships

4- How do these foundational skills promote math proficiency?

Below is some basic information on foundational math skills. They are explored in greater depth in the CTD webinar and in the resources cited at the end.

Number Sense

- Quantity is an attribute of a set of objects and we use numbers to name specific quantities
- The quantity of a small collection can be intuitively perceived without counting

Counting - Counting can be used to find out how many are in a collection or set. Counting has rules that apply to any collection:

- Phase 1: Stable Order
- Phase 2: One-to-One Correspondence
- Phase 3: Order Irrelevance
- Phase 4: Cardinality

Sets

- Attributes can be used to sort collections into sets
- The same collection can be sorted in different ways
- Sets can be compared and ordered

Number operations - involves the understanding of sets

- Sets can be changed by adding or taking away items
- Sets can be compared using the attribute of numerosity and ordered by more than, less than and equal to
- A quantity (whole) can be decomposed into equal or unequal parts; the parts can be composed to form the whole

Patterns are sequences (repeating or growing) governed by a rule; they exist both in the world and in mathematics.

- Identifying the rule of a pattern brings predictability and allows us to make generalizations.
- The same pattern can be found in many different forms.

Shapes can be

- defined and classified by their attributes
- combined and separated (composed and decomposed) to make new shapes

5- How can classroom teachers and other key personnel encourage mathematical thinking through play?

- Recognize and label measurable attributes of objects
- Notice and copy simple repeating patterns
- Use shapes to create an object or picture
- See and label with the correct number patterned collections
- Compare and sort according to attributes
- Group objects by amount
- Differentiate quantity
- Understand that numbers can be composed and decomposed in a variety of ways
- Understand that shapes can be composed and decomposed in a variety of ways

6- What makes an effective early childhood mobile app?

- Is open-ended to support play and problem solving
- Promotes concept development, literacy, and language through play and exploration
- Includes rich, engaging activities that invite a high degree of interactivity and control by the user
- Encourages movement--fine and gross motor
- Enhances and encourages interactions with adults or peers, rather than promoting solitary exploration
- Is culturally diverse and free of stereotypes
- Meets a developmental need

Selected information sources

- *Big Ideas of Early Mathematics: What Teachers of Young Children Need to Know*; The Early Math Collaborative, The Erikson Institute; Pearson Education. <https://www.pearsonhighered.com/product/The-Early-Math-Collaborative-Erikson-Institute-Big-Ideas-of-Early-Mathematics-What-Teachers-of-Young-Children-Need-to-Know/9780132946971.html>
- Erikson Early Math Collaborative. <http://www.erikson.edu/early-math-collaborative/>
- *Numerical Mechanisms and Children's Concept of Numbers* http://web.media.mit.edu/~stefanm/society/som_final.html
- Webinar: *Supporting Play and Problem Solving in Young Children in the Context of a UDL Early Learning Environment*. Center on Technology and Disability. <http://ctdinstitute.org/library/2015-11-03/supporting-play-and-problem-solving-young-children-context-udl-early-learning>
- Computer-based math-related programs
 - **Drawing Pad**: provides opportunities for the development of pre-literacy skills with stickers and stamps; helps to develop math vocabulary; includes drawing tools and papers; allows a child to flip and resize objects, import pictures from a camera, and move objects to create and recreate sets
 - **Patch Tool**: (online interactive, not an app): promotes fine motor skills, selection of patterns, understanding of patterns and shapes, and development of spatial compositions and de-construction

- **Magnetic ABC**: provides different sets and opportunities to illustrate numerosity (counting), sets and collections, and number operations
 - **Toca-Bocas Robots STEM**: provides design choices and opportunities for children to work with experimentation, positional concepts and trial and error; to test hypotheses and examine results
 - **Toca Boca: Toca Band**: provides children with opportunities to create their own band and learn math concepts (sequence, counting beats, measure, fractions, patterns).
 - **WoodBlocks for kids**: for children with motor needs, this app can support inclusive play time
- Early Years Foundation Stage Activities. NRICH Project.
<https://nrich.maths.org/early-years>
 - Video: *The Relationship Between Play, Teacher-Child Interactions, and Math Ability*. Eastern Connecticut State University.
<https://www.youtube.com/watch?v=JEdWdE0l6r8>



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