Blocks: Great Learning Tools From Infancy Through the Primary Grades

Karen Wise Lindeman and Elizabeth McKendry Anderson



Preschool

Using Blocks to Develop 21st Century Skills

During lunch, several 4-year-olds begin telling stories about machines that do various jobs. Mrs. Michelson writes down the stories as the children share them. Later, she reads the stories, which include tales about machines that feed the cat and make beds, to the class. After reading the children's stories, Mrs. Michelson says, "I really enjoyed hearing about your machines at lunch today. I was wondering what they might look like. I think that you could create these machines in the block center. And before you build your machines, you can plan them on paper in the writing center."

The children transition to the writing center to draw their plans. As they work, they excitedly discuss their drawings with Mrs. Michelson and each other. Mrs. Michelson takes this opportunity to scaffold their learning by asking questions during the design stage. She says to Jelani, "I see you have gears on your machine. Do you think the unit blocks or the magnetic blocks might work better for your building?" Mrs. Michelson tells Alice, "I noticed your machine has a long, thin base. What shape blocks will you need to create the base?" With a hypothesized plan and some ideas for materials, the children eagerly head to the block center to begin building.

EW INITIATIVES, SUCH AS Educate to Innovate (The White House 2009) and the recent emphasis on college and career readiness, represent a movement toward 21st

century skills (Partnership for 21st Century Skills 2011). As a result, such skills have become



part of the early childhood landscape too. Many early childhood educators are struggling to create a balance between addressing new initiatives and providing children with the active, dynamic, and integrated learning experiences that block play offers. Although in theory teachers value children's play with blocks, classrooms may not reflect this belief (Murphy 2014). Many teachers find themselves under pressure to implement new required curricula and are encountering space constraints as other learning centers begin to encroach on the block area. Rather than abandon block play in order to concentrate on building skills (e.g., rote counting, labeling shapes), we propose that educators support new initiatives using blocks—a long-standing and developmentally appropriate learning tool.

New initiatives: 21st century skills

The White House (2009) introduced the initiative Educate to Innovate to help children in the United States build the skills needed to become more globally competitive in the technology industry. The initiative outlines the need for a stronger educational focus on science, technology, engineering, and mathematics (STEM) in the United States. To support the initiative, some states developed prekindergarten standards that mirror the elementary-level Common Core State Standards (Brown 2011). The intent is to prepare all students, regardless of where they live or which schools they attend, to be college and career ready. Together these new initiatives have spotlighted a range of important skills that the Partnership for 21st Century Skills (2011) identifies as media and technology skills, life and career skills, core subject skills, and a collection of learning and innovation skills referred to as the 4 Cs: creativity, critical thinking, collaboration, and communication.

Beyond the framework designed by the partnership, research suggests that additional skills, such as using imagination, being inquisitive and self-directed, working as a team member, and taking risks, are also important 21st century skills (Jerald 2009; Garriock 2011). Although the emphasis on STEM education, Common Core State Standards, and 21st century skills creates new challenges, early childhood educators can effectively support these new initiatives using tools such as blocks and developmentally appropriate practices. This includes adding an *A* to STEM, for the *arts*, to create STEAM (Piro 2010; Sharapan 2012; Lindeman, Jabot, & Berkley 2013).

STEAM

Science and mathematics are the main pillars supporting the STEAM initiative. Science and mathematics concepts and processes are the content areas children engage in during STEAM activities (see "Technology, Engineering, and Art Activities for Young Children Within the Contexts of Mathematics and Science," p. 38). However, technology, engineering, and the arts can all take place *within* science (biology, physics, etc.) content and mathematics (algebra, geometry, etc.) content. For example, when a child builds a high tower during block play, she uses engineering principles that directly lead to understanding the scientific concept of gravity. It is through the use of art and technology, however, that young children may begin to grasp the concept of number or shape. For example, children could build and design symmetrically and then count the number of each shape on either side, or they might try to replicate a structure from a photo of a past creation by noting that the structure started with seven red rectangles for the base. So rather than educators focusing solely on content by asking children to name shapes or numerals out of context, we encourage them to embrace a more interdisciplinary and integrated approach. By engaging children in scientific and mathematical concepts through technology, engineering, and the arts, educators offer children authentic learning experiences in ways that still meet early learning standards (Drew et al. 2008).

We propose that educators support new initiatives using blocks—a longstanding and developmentally appropriate learning tool.

Because mathematics and science curricula feature prominently in national standards, Common Core State Standards, and curriculum guides, it is important to consider how educators can use technology, engineering, and the arts to engage children in mathematics and science content in ways that align with learning standards and foster 21st century skills.

Technology

Many early childhood educators think of technology primarily in terms of screen technology (tablets, computers, smartphones, etc.) or digital technologies (software

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When children engage in authentic learning, they actively explore the way things work and fit together. When they play with blocks, children are actually engaging in design technology-the creation of something that is useful or helpful or that solves a problem. The discussion of form and function regarding tool use is also an important part of design technology. A tool's design, or form, is what makes it useful. By interacting with simple forms and shapes of blocks (pillars versus circular curves in wood unit blocks) as well as with various types of blocks (magnetic, interlocking, waffle), children have multiple opportunities to learn about design technology by engaging with shape, form, and function.

Mr. Madori shows the children photographs of buildings they created individually in the block center the previous week. The class decides to collectively

re-create each building to make a town. Mr. Madori aligns this project in the block center with a social studies lesson on community. After the children re-create several block structures, 4-year-old Madison attempts to connect them by building a road using only one size and shape block. When the road doesn't fit between two buildings and the cars can't get into the garage, Mr. Madori wonders aloud what would happen if Madison used a different shape block and rotated them. Through trial and error, she completes her road using a variety of sizes and shapes, including a ramp (simple machine: incline plane). Mr. Madori photographs Madison's road and ramp for her portfolio.

Engineering

Having children engage in design technology by using tools meaningfully leads to engineering. Like scientists, engineers are problem solvers. When faced with a block-building problem, children have opportunities to engage in both engineering and designing (Van Meeteren & Zan 2010).

Ronaldo, a 3-year-old, is building a tower in the block center. He is unable to build it very high before it falls over. Ronaldo redesigns his tower multiple times to try to solve this problem. Eventually he rebuilds the base, adding several blocks. Ronaldo discovers that a larger base provides greater stability.

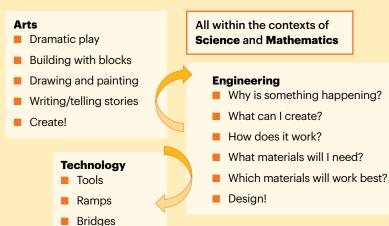
> Through trial and error, Ronaldo has engaged in an authentic, hands-on, and meaningful learning experience with blocks while developing 21st century skills.

> For young children, the desire to find an answer, design a solution, and think critically is intrinsically motivating. In other words, real problems lead to real solutions.

When adapting the engineering design process (Engineering is Elementary 2015) for the early childhood classroom, improving and in turn redesigning are valuable steps in block play. In your work with young children, remember that when their designs, structures, or creations don't work, resolving difficulties is an integral part of their learning experience. Block play offers opportunities to build, knock down, and rebuild, which are critical for both learning and social-emotional development. These opportunities also support young children in developing

Children Within the Contexts of Mathematics and Science

Provide Extended Time on Task • Ask Questions Work in Context • Extend Thinking



Utensils

Machines

Transportation

Created by Lindeman (2013). Previously published in Lindeman, K.W., Jabot, M., & Berkley, M.T. (2013). The Role of STEM (or STEAM) in early childhood education. In Cohen & Waite-Stupiansky (Eds.), Learning Across the Early Childhood Curriculum. Cambridge, MA: Emerald. Adapted and used with permission.

Technology, Engineering, and Art Activities for Young

Teacher's Role



persistence and perseverance in a safe, secure environment. Pawlina and Stanford (2011) encourage early childhood educators to view children's mistakes as opportunities to "grow their brains" (34). It is important to keep in mind, however, that to solve every problem, young children do not need to move through each stage of engineering design in the exact order, nor do they need to move through the entire engineering cycle (Van Meeteren & Zan 2010).

Early childhood educators may also keep in mind that for young children, the engineering cycle is never ending. Young children need to come back to their block structures and creations again and again to improve on and expand their skills. Tackling an authentic and meaningful blockbuilding challenge, as well as finding a way to solve it, supports communication and collaboration with peers and adults. Here, appropriate use of a sophisticated technological tool—a digital camera or smartphone—to document the block creation in a photograph, as part of an individual or a collaborative effort, is valuable. The planning stages for initial design and for redesign lead us to the arts, which, when added to STEM, create STEAM.

The arts

The arts allow young children to further expand their block area engineering and designing experiences by representing or communicating what the children see, using a range of materials (e.g., paints, clay, paper and pencil). Re-creating what one sees in the real world is a feature of art that can serve as either a precursor to block building or a natural extension. Hirsch (1996) refers to children using blocks to re-create buildings from their own life experiences and using the block structures to engage in dramatic play at the representational stage. In addition, taking field trips to visit structures similar to those children build or viewing photographic representations of their past creations can extend young children's learning and provide a shared topic for discussion, design, or improvement. Paula Rogovin's first grade class at the Manhattan New School visited elevated railways and subways around New York City, painted a mural of them, and then created block replicas. Conducting observations of building structures and then using art to represent these observations further enriches young children's learning opportunities in the block center.

The arts can also play an important role in block planning, redesign, collaboration, and communication. Architects create blueprints and small models before moving to the construction phase. These drawings and models encourage collaboration and discussion. By providing pencils, crayons, paper, chalkboards, and books on topics such as building structures or bridges, early childhood educators can integrate authentic and meaningful literacy skills in block areas. When young children develop building plans for block play, they learn how to organize materials, plan for the stages of implementation, and identify who will be responsible for what job. Builders refer back to their plans (literacy skills) to discuss additions (communication and collaboration skills), make changes (problem solving), and count and measure (math). As illustrated in the opening vignette, Mrs. Michelson engages children in this process when she encourages them to begin creating their machines by designing them in the art center.





March 2015 Youn



Evaluate Your Block Center Around 21st Century Skills: A Checklist for Teachers

Note: The term *blocks* in this checklist refers to any type of block, including unit blocks, cubes, dominoes, interlocking, waffle, magnetic, outdoor, cardboard, hollow, and foam blocks; teacher-made blocks; and blocks in any and all commercial kits. Think about the classroom's block area as you complete the following checklist.

Creativity

- □ There is a designated area for block play.
- The block area is open daily for extended periods of time.
- □ A variety of blocks are available.
- Blocks are arranged on open shelves so children have easy access and can see what is available.
- Fiction and nonfiction books are readily available to clarify and extend science and mathematics curriculum content.
- There are items from nature (e.g., pinecones, sticks, stones) and recycled items (e.g., coffee cans, plastic butter tubs with lids).
- □ Children use art materials while building (e.g., Popsicle sticks, pipe cleaners, clay).
- Block building is integrated with design (and aligns with relevant learning standards).
- Teachers encourage children to creatively solve meaningful building problems.
- Children have opportunities to express their ideas in multiple ways.

Communication

- There are props (e.g., small figures of people, dinosaurs, farm animals, cars) available in the block area to encourage representational play.
- □ I post written prompts for adults in the block area, with questions for children that support content (like questions that start with *why* and *how*).
- □ Children can move from the art center to the writing center and then to the block center and back again.
- □ There are paper, pens, and pencils for blueprint designs and redesign in the block area.
- □ I give children opportunities to use their block creations for dramatic play and storytelling.
- Children can help others see their viewpoint or idea. They help others make sense of a concept or solution.
- Children have access to digital technologies to use in documenting, sharing, and discussing work.
 Children use digital literacies to communicate their design or to problem solve.
- □ There are opportunities for multiple means of representation before, during, and after play.

Critical Thinking

- □ I allow children's block creations to "fail" (i.e., I resist the urge to intervene to save or fix creations).
- I encourage children to be resilient in the face of mistakes and frustrations.
- □ I encourage children to try again (knock it down and try again using different or better ideas).
- □ I encourage children to try a different shape or type of block when re-creating.
- □ There are opportunities for children to share solutions and provide suggestions.
- I provide ways for children to save and document their building. Children can "sign out" a technology tool to photograph or video-record their work.
- Children can return to their structures frequently to improve and redesign them.
- Children have independent access to nonfiction books and electronic resources (e.g., the Internet) to expand building and to ask questions and find answers.
- I encourage children to engage in science and mathematics content and processes (physical science properties, seriation and measurement, the scientific process, problem solving) while building and designing.
- □ I differentiate block play for children with disabilities (content, process, and/or product).

Collaboration

- There are enough blocks for groups of children to build with, but not so many that children can each have enough to build alone without collaborating with peers.
- □ I use the surrounding community as a resource for expanding block building and design.
- □ I ask children to discuss and set up plans for creations and structures before building.
- □ I identify tools and other simple machines (forms of technology) to use to problem solve, and encourage children to do the same.
- □ Children discuss, share views, and even argue about block use, design, or purpose.
- Final block constructions are displayed or documented for sharing with others (classmates, families, friends, community).
- Blocks and props have been modified/adapted as appropriate for individual children's needs (e.g., Velcro added to blocks to assist children with fine motor needs).

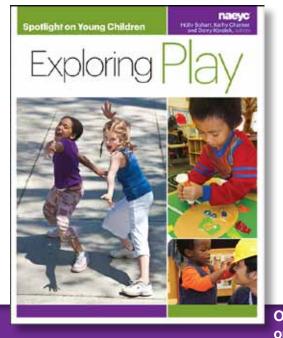
Young children need opportunities to showcase their block-building creations just as artists need opportunities to showcase their final work. Block structures built by young children over time, either individually or collectively, can be shared and then extended. Stages 6 and 7 of block building (see Hirsch 1996, 142-48 [Appendix 1, "Stages of Block Building"]) include elaborate dramatic play with the structures. By adding other materials such as cars, people, and dinosaurs, children use 21st century skills that include creativity and imagination to design narratives for dramatic play and for writing. These narratives can then become minibooks that align with language and literacy standards. For a developmentally appropriate use of screen technology, children might use iMovie, VideoShow, or another app to create the story as a movie or digital narrative to share with peers, families, and the community. As illustrated in the opening vignette, Mrs. Michelson displays the children's art and stories and the photographs of their machines for others to see and enjoy.

The children return to their machine-building activity every day, making improvements and modifications and adjusting their plans accordingly. Upon project completion, Mrs. Michelson and the children reflect on the process. Mrs. Michelson says, "Remember how the rectangles didn't fit and you had to change them to squares?" and "I noticed you ended up getting a pipe cleaner to hold these together. That was a good way to solve your problem." The children and teacher work together to choose the best photos and drawings to display, and Mrs. Michelson mounts the children's stories about the machines, their design sketches, and photos of the final products on colored paper and posts them on a classroom wall. The children share their stories, sketches, and photos with each other and their families.

Recommendations for early childhood educators

NAEYC challenges the field of early childhood education to move from an *either/or* orientation (e.g., either higher learning standards and evidence-based instructional methods or integrated and authentic learning experiences) to a *both/and* way of thinking (e.g., both higher learning standards/evidence-based instructional methods and integrated/authentic learning experiences) (Copple & Bredekamp 2009). This article highlights several ways in which early childhood educators can embrace both/and ways of thinking by intentionally integrating authentic, meaningful block play with STEAM goals, the 4 Cs, and learning standards.

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By integrating learning standards, STEAM, and 21st century skills, educators can provide all children, including children who are gifted, those with special needs, and children who are dual language learners, learning opportunities that support optimal outcomes. Collaboration with special education teachers and related service providers can further enhance such opportunities to explore, build, and discover for children with special needs. For example, by aligning a child's Individualized Education Program (IEP) goals with content standards and then supporting them through block play, everyone working with the child is able to embed individualized goals in child-directed play that occurs during routine classroom activities (Pretti-Frontczak & Bricker 2004).

During circle time, Mrs. Gibson's class, consisting of children whose home language is not English and children with and without special needs, decides to build a castle. As a group, the children brainstorm the potential uses for the natural and recyclable materials before going to the center. Sam suggests that the pinecones can be trees, and Sarah adds that the jar lids can be windows. As Mike, a dual language learner, heads to the block center, Mrs. Gibson hands him picture cue cards of pinecones, trees, lids, and windows to support his English language learning. Mikaia, a student who has been identified as gifted, prints a picture from the Internet of an actual castle in Europe that he plans to replicate.

Educators can use the checklist "Evaluate Your Block Center Around 21st Century Skills: A Checklist for Teachers" (p. 40) to identify teachable moments during block play that support developmentally appropriate practices *along with* children's development of 21st century skills. In addition to integrating block play with 21st century skills, we encourage educators to use elements of UDL (universal design for learning), where all materials and instruction are designed for children with a range of abilities (Dinnebeil, Boat, & Bae 2013) (Read more about UDL at www. udlcenter.org.) A UDL approach encourages teachers to consider the materials needed for building, the number and types of blocks, and the ways to differentiate the activity to effectively support children with a range of abilities.

During a time of diminished resources and increased budgetary constraints, early childhood educators may have to be even more creative when providing children with materials that support rich, meaningful, and engaging block play. One idea for cost-effective block play materials is using recyclable materials for building and design (Nell & Drew 2013). For example, young children in the first stage of block building, stacking (Hirsch 1996), might stack plastic coffee cans. The same design principles and problem solving can be afforded with plastic butter tubs with lids, and cardboard paper towel tubes. We can expand the representation stage by adding plastic caps, jar lids, PVC pipe scraps, and colored fabric. The blue fabric becomes the water under the castle's moat, and the lids are boats floating in the water.

Be sure to invite children to join in the designing process by asking for their input on creative materials. When children turn a clean, recycled milk carton into a house to add to the other buildings they created in the block area, it represents an important part of the process in design and engineering. Again, form and function can become part of this collaborative process: "Does a milk carton make a better stacking item than a coffee can? Why [or why not]?," "I wonder what will happen if we . . . Let's give it a try. If it doesn't work, try it again in a different way." And so, the creating, designing, and engineering process continues.

Conclusion

Young children need to be prepared to live in the technologyrich, ever changing, 21st century. With intentional planning, teaching, and ongoing assessment, block play can ensure young children have opportunities to develop the skills needed to face whatever challenges the future brings. Block play allows children to interact with both science and mathematics content in authentic, meaningful, and hands-on ways. Young children can use blocks to interact with numeracy, area, and geometry. Block play supports their learning about simple machines, gravity, and force. All of these constructive learning experiences align with content standards (Drew et al. 2008). Block play also engages young children in designing, engineering, and the arts in the context of the scientific process and logical/mathematical problems. By encouraging children to creatively solve meaningful problems during their block play in collaboration with peers, educators help them learn how to communicate using literacy and written expression and digital technology with peers and adults. Through observation, problem solving, design, and redesign of their block structures, young children learn to think critically in intrinsically motivating ways. Rather than trying to either meet the new initiatives around STEAM, standards, and technology or engage children in developmentally appropriate activities through block play, let's do both by meeting new initiatives with an old tool-blocks!

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