CREATIVE INVESTIGATIONS IN EARLY ENGINEERING & TECHNOLOGY

Angela Eckhoff, PhD

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Contents

Dedication

To my favorite makers and tinkerers, Griffin and Cullen. Thank you for the inspiration!

Introduction

The excitement level is high in Mr. Adams's classroom because the children are anxious to modify—by painting, cutting, and gluing—the found objects they have been collecting during the week. Mr. Adams and his students are working on a long-term project on recycling and reuse. For this part of the project, the children are using discarded objects to create three-dimensional (3-D) sculptures. They have been studying artists who create assemblage art out of natural and man-made materials—assemblage is art that is made by putting together dissimilar elements, often everyday objects, found and reinvented by the artist. As a design-based learning project, the assemblage project is an iterative process where the children are actively involved in every step: investigating the context through studying the need for recycling and reuse; learning about the ways in which people, including assemblage artists, reuse discarded objects; deciding what objects can be reused in art; collecting and sharing their found objects; thinking through and drafting designs for their artworks; modifying and assembling objects to create their artworks and reworking any aspect of their designs once they have assembled their artwork.

This marks the beginning of the point in the project where the children must transfer their 2-D drawings of their imagined artwork into a 3-D work using the objects they have collected and modified. The design-based nature of this project encourages the children to try out their ideas and revise or change them as necessary when they run into unexpected challenges. As a first step, Finn has decided to use brass door hinges to create a "robot family." In his drawing, he has the door hinges making up the torso of the robots. The robots are each different colors, so Finn decides that he must paint the hinges before assembling the robot. Finn carefully chooses colors that match the colors he drew on his robot sketch. As he paints, Mr. Adams checks in and asks Finn how the painting process is going. Finn shares that he is frustrated that the paint isn't drying quickly, so he won't be able to glue his pieces together today. Mr.

Adams pauses to remind Finn that the assemblage artworks don't have to be finished quickly and that he should take the time he needs to paint and put together his robot. "All week?" asks Finn, and Mr. Adams replies, "You can work on it all week and even into next week. Remember the artwork we looked at on the iPad? Those artists worked for months and even years designing and making those sculptures. You have to remember that your robot isn't going to lay flat, so you can see it from all sides." Finn stops painting and picks up one of his hinges; flipping it over, he says, "I'm going to paint the back too. It's the back of his robot shirt." "Right," says Mr. Adams. "Now you've got it; think it through!"

Finn reinvents the door hinges into colorful robot bodies.

As Mr. Adams shared with Finn, design-based learning is typically project based and encourages the students to work on a project over an extended period of time. Project-based work takes time. Ample time is needed so that students are provided the space to think deeply about a topic, problem, or area of interest. Often, in preschool classrooms, we don't provide children with enough opportunities to engage with their thinking at a deep level, but that can be changed when we integrate design-based thinking and project work into our daily routines. Design-based work connects well with content areas of engineering and technology as children engage in cycles of exploration, problem solving, and solution finding.

This book is designed to provide you with knowledge and lesson ideas that scaffold young children's experiences with engineering and technology while also building inquiry and creative thinking skills. You will find information on contemporary creativity and design-based pedagogical practices that early childhood educators can use to implement engineering and technology learning experiences for preschoolers. This book will broaden understandings of the relationship between engineering and technology content, the role of the learning environment, and supportive pedagogical practices for preschool-aged children. Many early childhood teachers are uncertain about whether engineering and technology experiences are developmentally appropriate for preschoolers and when and how they should introduce these topics to their students. When engineering and technology experiences build upon student interests and connect to other areas of content learning—literacy, science, the arts, mathematics, and social studies—young children are able to experience meaningful connections among each content area.

This book stresses the importance of encouraging minds-on learning experiences in the early childhood classroom through guided and independent investigations where every child is actively involved in meaningful ways. Early childhood educators have important roles in early engineering and technology experiences and will act as both guides and facilitators throughout the planning, implementation, and assessment of the creative, design-based experiences presented throughout this book. For young children, technology experiences involve using tools, identifying and acting on problems, being creative and inventive, and making things work. Engineering experiences involve exploring problems, using a variety of materials, and designing and building things that work.

Creative Investigations in Early Engineering and Technology will support your development of creative engineering and technology experiences in the classroom by helping you to:

- understand the links among engineering content, design learning, and project-based learning.

- plan cooperative engineering and technology lessons that will engage all children in your classroom as individuals or when working in small or whole groups.
- implement classroom experiences that support children's engagement with engineering and technology in everyday experiences.
- recognize children's understandings of engineering and technology concepts to build upon their current understandings to support knowledge growth.
- document children's knowledge development with authentic work samples and classroom artifacts.

Playful Learning

Play is an important element for learning in early childhood. Through play, young children learn about themselves, their environment, people, and the world around them. Playful learning encourages children to explore and experiment in situations where they feel comfortable taking risks and delving into the unknown. Children's play in the early childhood classroom can take on many different forms and functions. When children explore, experiment, and cooperate through play, they learn about how the world works. Children need teachers who are supportive of children's play and who work to carefully identify play situations where teacher guidance or involvement are welcome and needed.

Young children use their knowledge and understandings by bringing these ideas into their play to further experiment and clarify their understandings. This process is child driven; the role of the adult is one of supporter, guide, and facilitator. The adult meets each child at his own stage of understanding with intentional pedagogical practices that promote questioning and exploration. Teachers can create early childhood classrooms that honor the ways in which children learn and explore by ensuring that young children have ample opportunities for playful learning and exploration. In the role of supporter, guide, and facilitator, the teacher

carefully observes children's play and helps to scaffold children's thinking through questioning and by providing opportunities for guided learning with additional supportive materials.

Design Learning

You may have heard of the terms *problem-based learning, discovery learning, project-based learning,* and *design-based learning*. These are all approaches to curriculum and lesson development that come from a constructivist learning model where students are actively involved in the process of discovery. In early childhood settings, the ideas of design-based approaches can be directly linked to our use of project-based learning. In design-based approaches in early childhood classrooms, young children learn what they need to learn in a "just-in-time" manner while taking the next steps in the learning process. Essentially, design-based experiences are authentic and hands on; have clearly defined outcomes that allow for multiple solution pathways; promote student-centered, collaborative, thinking-focused work; include familiar and easy-to-work-with materials; allow for multiple design iterations to improve the work; and have clear connections to science, technology, engineering, and math concepts, or STEM. For young learners, design challenges can involve problem-solving tasks that are complex, open ended, and have no one correct pathway to a solution. Teachers play a critical role in design learning and project-based work because the teacher needs to be supportive and encouraging throughout the cycle of problem exploration and solution finding. In this supportive role, teachers can work to provide children with needed materials, provide time and space for exploration, and scaffold student thinking through close observation and open-ended questioning.

Building Creative Engineering and Technology Experiences in the Classroom

Early childhood educators have essential roles in the development of children's creative thinking skills because they can create supportive classroom environments or classrooms in which children's creative

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TINKER, make, innovate, ask questions, AND EXPLORE... SPARK CURIOSITY!

STEM learning is so important for today's young learners. *Creative Investigations in Early Engineering and Technology,* a follow-up to *Creative Investigations in Early Math,* will help you guide your preschoolers' learning as they build structures using basic architectural concepts, learn about computers and the technology behind machines, and so much more. Instead of teaching engineering and technology to preschoolers, you can be their guide as they research, experiment, and investigate in their day-to-day learning.

Teachers will learn practical ideas for intentionally fostering young children's hands-on explorations in the following areas:

- Design concepts
- Force and motion
- Computer coding
- Recording observations
- Understanding measurements

Students will love to learn as they explore on their own and collaboratively to learn about how and why our world works.

Angela Eckhoff, PhD, is an associate professor of teaching and learning in the Early Childhood Education program and codirector of the Virginia Early Childhood Policy Center at Old Dominion University in Virginia. She holds a dual PhD from the University of Colorado–Boulder in educational psychology and cognitive science. She is a coeditor of the Growing in STEM column for *Young Children*, published by the National Association for the Education of Young Children. Her research is focused on understanding the pedagogical practices that support and extend creativity and content area learning during early childhood, informal learning environments, and early childhood education and development policy.

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