The Power of Tinkering

Tinkering is an open-ended approach to STEAM learning that offers children opportunities to identify problems and work on solving them in playful, creative ways. It involves using tools, playing with materials, and collaborating with others to build, test, and develop new understanding about the world. Tinkering investigations involve Science, Technology, Engineering, Arts, and Math (STEAM) learning and rely on direct experiences with real phenomena. Playful exploration brings joy and empowers children to pursue investigations that interest them, and the collaborative nature of tinkering supports children to work with and learn from peers and adults. Tinkering leads to deepened knowledge, stronger skills, and increased agency and confidence for all learners.

The tinkering approach can open up new possibilities for children *and* adults. It empowers educators to shift their practice in ways they hadn't imagined or thought possible, all without expecting them to change themselves or their educational programming. Small shifts in how adults support children's play and learning, a focus on process, iteration, and reflection, and a growing community of practice are part of what makes this transition possible and easy.

The tinkering approach works well in a range of settings. Educators and providers working both in home-based settings and more traditional preschool centers can integrate tinkering into their work with children. Additionally, informal environments including libraries, after-school activities, and family learning are well suited to tinkering.

Tinkering and Child Development

Tinkering Together seeks to build on theoretical foundations by making connections between well-established child development theories and their relationship with early childhood learning.

Tinkering is grounded in *constructivism*, an educational psychology theory that conceives of learning as a process of taking in information, as we int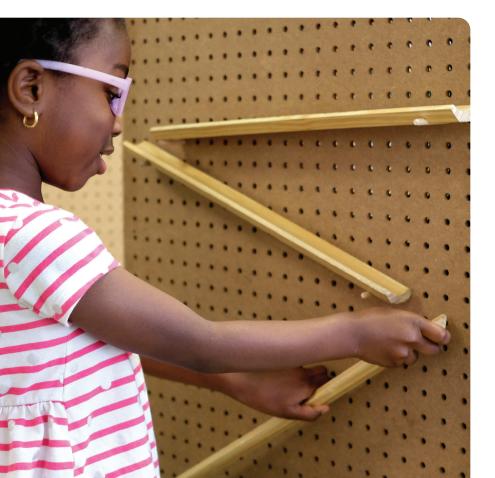eract with the world, and then assimilating newly acquired knowledge into what we already understand. Rooted in the seminal work of developmentalist Jean Piaget, constructivism is widely influential in early childhood settings because of its focus on how knowledge builds over time and with age (Piaget, 1968). Constructivist teaching looks different than traditional models of education, where an instructor provides students information or teaches to particular outcomes. Instead, constructivist educators act as facilitators of learning, paying attention to what learners know and how their cognition is progressing. Constructivist learning experiences are intentionally designed to build

upon schema, the ideas and understanding a learner has already assimilated.

While constructivism focuses on the way an individual makes meaning from experience, social constructivist theory emphasizes how our understanding is built through shared learning and interaction (Vygotsky, 1978). Vygotsky's notion of the "zone of proximal development" is particularly important to the tinkering approach, as it highlights the role of thoughtfully guided, socially-mediated experiences in learner's development of understanding. Tinkering is strongly grounded in this conception of learning as both socially and cognitively constructed. Additionally, tinkering draws from *constructionism*, a constructivist learning theory articulated by Seymour Papert, that posits that our strongest understanding results from problem-based learning through the creation of tangible products.

Tinkering has deep potential to support children in developing their growing understanding of the world by building on prior knowledge; engaging with real-world phenomena, tools, and materials; reflecting on their learning with the support of adult engagement; and, practicing learning in a collaborative, social environment (Gutwill et al., 2015; Bevan et al., 2018). While the impacts of tinkering experiences on learners have been well-documented, work-to-date has focused on elementary through adult-aged learners (see Appendix A). Integrating tinkering into the learning experiences of young children (ages three to five), as supported by families, educators, and care providers, represents a new and emerging area of research-based practice.

Tinkering is a natural fit for informal learning environments due to its playful nature and because it is driven by the learners' questions. Research demonstrates children's natural inquisitiveness and their tendency to approach the world like a scientist (Gopnik, Meltzoff, & Kuhl, 1999), and tinkering capitalizes on these innate tendencies. Tinkering as a practice offers a compelling entry point to STEM learning, interest, and identity development (Vossoughi & Bevan, 2014; Bevan et. al., 2015) for young children, as it aligns with play-to-learn methodologies, the effectiveness of which are well-established (Zosh, Hopkins, Jensen, Liu, Neale, Hirsch-Pasek, Solis, & Whitebread, 2017; Lillard, et al., 2013). The nascent understanding of the impacts tinkering could have on early learners made it compelling to convene the field to consider how to shape future research and learning.

Tinkering Together offers discussions, visual case studies, and resources that illustrate informal science learning in early childhood through the tinkering approach.