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**STEM in the Playscape:**

**Building Knowledge for Educational Practice**

(NSF #1516191)

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**The Project**

**N**ature playscapes, outdoor play environments focused on natural phenomena, are becoming more common in child care, preschools, and non-formal education programs at zoos, parks, and museums. They are designed to result in complex, sensory-rich environments with extensive access to native plants, loose parts, and affordances that inspire young children’s investigative and exploratory behaviors. Building upon previous NSF supported research (NSF #1114674) that substantiated playscapes potential for exposing young children to STEM-related phenomena, concepts, and processes, this *STEM in the Playscape* project investigated pedagogy, children’s learning, and the utility of professional digital learning modules for early childhood education stakeholders. The aim was to create, test, and improve upon the playscape concept to build knowledge about educational practices related to STEM learning in the outdoors, specifically utilizing intentionally designed playscapes, including teachers as authoritative sources in the knowledge building. We utilized data as described in this report, teachers’ and researchers’ feedback, and iterative idea generation to develop three digital learning modules for promoting STEM learning in playscapes and other nature-rich settings that align with the pragmatic manner in which transformation occurs in early childhood settings. A fourth module provides guidance and resources for building playscapes.

Specifically, we partnered with three diverse early childhood programs to gather insight from participating teachers and collect data on teacher-child interactions. We engaged a landscape architect to work with teachers to create a plan to enhance programs’ outdoor play spaces using a participatory design process specific to building playscapes. Simultaneously, we investigated preschool children’s movement and behavior patterns within existing play spaces to compare to patterns post-play space enhancement. Using videography, behavior mapping, and informants, we identified critical elements within playscapes that elicit STEM behaviors. We also assessed growth in children’s knowledge about natural phenomena and scientific thinking. Through focus groups, journals, and surveys, we studied changes in teachers’ self-efficacy, usage of their own of other playscapes, and pedagogy. These data optimized the production of our digital learning modules.

***Video-Based Fieldwork*.** A large number of video logs revealed children’s sustained language related to the natural environment and investigations of phenomena. Children also used posted maps of the playscapes located within the space for wayfinding so we added an assessment of wayfinding to our child assessment measure. Video analyses indicate that children not only used science, technology, engineering, and mathematical concepts during time spent at the playscapes, but they also demonstrated a strong sense of self-determination. Moreover, we found that affordances within playscapes provide many opportunities to strengthen children’s executive function, particularly through goal-directed and focused problem-solving during free play.

***Behavior Mapping*.** We created an iPad app version of behavior mapping to strategically observe individual children on playscapes in five second segments. We documented information on where children play, their peer interactions, adult presence, environmental interactions, the use of affordances and loose parts, and more. We observed a strong relationship between children’s play in creeks (water features), digging areas (sand box or gravel pits), and in areas with forts and hiding locations (woods, rocks, grass and tall plants) to science learning. In addition, children’s interactions on circuitous paths and posted maps of the play space indicate they are important spatial intelligence affordances within well-designed playscapes.

***STEM in the Playscape Curriculum-Based Assessment*.** To assess changes in children’s scientific and mathematical thinking, we used a 20-item curriculum-based assessment (CBA) to measure growth at three points during each year of the project. Overall, repeated-measures General Linear Modeling (GLM) revealed that CBA scores showed statistically significant increases from pre-tests to post-tests during each year of the project. More specifically, preschoolers showed gains in: 1) correctly classifying living and non-living natural materials, 2) subitizing and counting natural materials (i.e., number sense), 3) understanding plant life and seasonal changes, 4) engaging in inquiry while using tools to find worms in soil and forming a question, and 5) using a map of a playscape for locating features and wayfinding. These results provide evidence that children’s STEM learning in playscapes shows increases over time during the preschool years. We also discovered that children who had daily access and weekly access to nature had CBA scores that improved at similar rates, significantly different than children who visited playscapes on intermittent visits. This suggests that weekly visits to playscapes or nature-based learning environments may be the minimum nature immersion dose that enhances scientific thinking and knowledge about the natural environment.

***Digital Learning Modules*.** Our STEM in the Playscape digital learning modules highlight pedagogical content and effective instructional practices that foster informal STEM leaning in nature-based learning settings, particularly playscapes, based on results from our collective inquiry. Told through a story that transpires in an early childhood program, each module has multiple levels of information and resources that will help teachers deepen and broaden their knowledge and skills related to the following module topics:

1. *The Importance of Play in Nature*
2. *STEM Learning in Early Childhood Education*
3. *Teaching Strategies and Dispositions that Support STEM* Learning in Nature

Module 4, *Basics of Designing Nature Playscapes,* is useful for interdisciplinary stakeholders interested in building a playscape or enhancing current outdoor play environments. These modules can be accessed for free on the University of Cincinnati’s Office of Professional Learning and Continuing Education’s website:

<https://www.uc.edu/about/continuing-ed/continuing-education-courses/STEM_Playscape.html>

**Conclusion**

Playscapes are viable and equitable options for transcending the boundaries between formal and informal learning environments to nurture STEM learning in young children. They support child development, including foundational executive function skills. Using our digital learning modules, teachers can elevate their effectiveness in supporting STEM learning. Thus, transformational change may occur with regard to access to greenspace and STEM learning in early childhood settings as playgrounds are morphed into playscapes.