



MIAMI UNIVERSITY

DISCOVERY CENTER

Evaluation • Research • Professional Learning

Evaluation of *STEM in the PlayScape*

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for

EVALUATION, RESEARCH, AND PROFESSIONAL LEARNING

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Executive Summary

The Discovery Center for Evaluation, Research, and Professional Learning (Discovery Center) served as external evaluator for the *STEM in the PlayScape* project. The broad purpose of the evaluation was to provide annual feedback and a final summative assessment of the project's ability to meet its stated objectives. Project objectives were to:

1. Create early childhood digital modules to promote STEM learning on playscapes,
2. Investigate the impact of trained teachers on children's STEM learning on playscapes, and
3. Investigate what critical elements of playscapes are portable and adaptable to other preschool play areas and create a *Digital Module for Building and Using PlayScapes* that can be packaged with the instructional modules developed as part of the project.

The *STEM in the PlayScape* project was funded through an Advancing Informal STEM Learning (AISL) program grant from the National Science Foundation (NSF). This project was an investigation of preschool students' STEM learning in an intentionally-designed natural play area, or playscape. This mixed methods evaluation of the project asked the following evaluation questions:

1. To what extent did the *STEM in the PlayScape* project create early childhood digital modules as professional development tools to promote STEM learning with playscapes?
2. To what extent did the *STEM in the PlayScape* project investigate the impact of trained teachers on children's STEM learning on playscapes?
3. To what extent did the *STEM in the PlayScape* project investigate the critical playscape elements that are portable and adaptable and include these elements in a digital module for building and using playscapes?

This executive summary provides a final summative assessment of the project's ability to meet its stated aims and recommendations for the project team to consider.

Project Aim 1: Create Digital Modules

Thematic analysis of meeting minutes and qualitative content analysis of module content confirmed the project team completed Modules 1 and 2 in Project Year 2 and completed Module 3 in Project Year 3. Qualitative analysis of module content confirmed that the completed modules followed a storyline format and provided research-based information and multi-media resources that served as professional development tools for early childhood educators to learn about the benefits of outdoor play (Module 1), inquiry-based STEM learning in preschool (Module 2), and instructional strategies for STEM learning on the playscape

(Module 3). The project team used teacher feedback to revise and improve the modules through Project Year 3. These modules are available to the public through permanent web links.

Recommendation: Work with Information Technology services at the home university (University of Cincinnati) to ensure links to modules are available in multiple locations, including the Arlitt Center for Education, Research, and Sustainability homepage; university's main search page; and the College of Education, Criminal Justice, and Human Services' elmodules page.

Project Aim 2: Investigate STEM Learning

Thematic analysis of meeting minutes confirmed that the project team collected a variety of qualitative and quantitative data from multiple sources and at multiple time points to investigate STEM learning on the playscape. Qualitative data included audio-visual analysis; focus groups; reflective journaling; and behavior mapping, and quantitative data included a self-efficacy questionnaire; a science teaching questionnaire (P-TABS); a curriculum-based assessment (CBA); and a parent survey. In Project Year 3, the project team re-framed the research design from a pre-post investigation of teacher learning to a multiple case study with teachers as collaborative partners, which reflected the actual trajectory of teacher learning and change.

Recommendation: Continue to publish using these rich data. These data have the potential to illuminate many aspects of teaching and learning on a playscape in diverse settings and for a diverse group of children and teachers. In addition, the project team should further disseminate the rich set of measurement tools they developed for collecting data regarding STEM teaching and learning in the playscape setting.

Project Aim 3: Investigate Elements that are Portable

The project team planned mini playscapes at participating sites with input from participating faculty and administrators (Year 1), built mini playscapes adapted to each site's unique needs (Years 2-3), collected data on teaching and learning on these mini playscapes (Years 2-3), and gathered stakeholder feedback about the entire process to develop Module 4 (Year 3), which focuses on building a playscape. At the end of the no-cost extension year, Module 4 was in the process of being completed.

Recommendation: Continue to disseminate findings in settings beyond academia, as playscapes offer an opportunity for nature-based play that likely appeals to a cross-section of disciplines and fields.

Introduction

The Discovery Center for Evaluation, Research, and Professional Learning (Discovery Center) completed the fourth and final year of an evaluation of the *STEM in the PlayScape* project. The broad purpose of the evaluation was to provide annual feedback and a final summative assessment of the project's ability to meet its stated objectives. Project objectives were to:

1. Create early childhood digital modules to promote STEM learning on playscapes,
2. Investigate the impact of trained teachers on children's STEM learning on playscapes, and
3. Investigate what critical elements of playscapes are portable and adaptable to other preschool play areas and create a *Digital Module for Building and Using PlayScapes* that can be packaged with the instructional modules developed as part of the project.

The *STEM in the PlayScape* project was funded through an Advancing Informal STEM Learning (AISL) program grant from the National Science Foundation (NSF). This project was an investigation of preschool students' STEM learning in an intentionally-designed natural play area, or playscape. The final year of this project primarily consisted of data collection and analysis, teacher professional development on Module 3, revision and development of Module 4, and stakeholder focus groups that provided feedback about building and maintaining playscapes. Project team members met regularly to discuss data collection and analysis to support and improve the implementation of the research program and mini playscapes created as part of the project.

For this project, the Discovery Center evaluation team consisted of Dr. Sarah B. Woodruff, Principal Investigator for the evaluation; Yue Li, Senior Research Associate and Project Team Leader; and Maressa Dixon, Senior Research Associate. This final report provides a final summative assessment of the project overall in the Executive Summary and describes evaluation activities conducted in the final year of the project, and findings from those activities, in the body of the report

This mixed methods evaluation asked the following evaluation questions:

1. To what extent did the *STEM in the PlayScape* project create early childhood digital modules as professional development tools to promote STEM learning with playscapes?
2. To what extent did the *STEM in the PlayScape* project investigate the impact of trained teachers on children's STEM learning on playscapes?
3. To what extent did the *STEM in the PlayScape* project investigate the critical playscape elements that are portable and adaptable and include these elements in a digital module for building and using playscapes?

Table 1 summarizes the evaluation questions, evaluation sub-questions, and data analysis methods for this reporting period.

Table 1. *Evaluation Questions, Evaluation Sub-Questions, and Data Analysis, No-Cost Extension Year*

| Evaluation Question | Evaluation Sub-Question | Data Analysis |
|---|--|---|
| 1. To what extent did the <i>STEM in the PlayScape</i> project create early childhood digital modules as professional development tools to promote STEM learning with playscapes? | <ul style="list-style-type: none"> • Describe the major steps in the process of module development. | <p>Document Review: Analyze meeting notes for decision-making about creation of digital modules.</p> <p>Teacher Focus Group Summary: Analyze a summary of teacher feedback provided in teacher focus groups.</p> |
| 2. To what extent did the <i>STEM in the PlayScape</i> project investigate the impact of trained teachers on children’s STEM learning on playscapes? | <ul style="list-style-type: none"> • Describe the major steps in the investigation of playscape participation on teachers and students. • In what ways did research activities support project goal #2? | <p>Document Review: Analyze meeting notes for decision-making about investigation of STEM learning.</p> |
| 3. To what extent did the <i>STEM in the PlayScapes</i> project investigate the critical playscape elements that are portable and adaptable and include these elements in a digital module for building and using playscapes? | <ul style="list-style-type: none"> • Describe the major steps in the investigation of ways to support sustainability of playscapes created in this project. • Identify research team publications that resulted from this project. | <p>Document Review: Analyze meeting notes for decision-making about sustainability.</p> <p>Stakeholder Focus Groups: Analyze notes from stakeholder focus groups for feedback about playscape development and maintenance.</p> <p>Dissemination: Identify and list publications resulting from this project.</p> |

The Discovery Center evaluation team analyzed qualitative data from meeting minutes, a summary of teacher feedback provided in focus groups following professional development with Module 3, and notes from stakeholder focus groups. Also, the evaluation team identified publications that resulted from this project in a literature search. The next section of this report describes evaluation methods and findings.

Evaluation Methods and Findings

Document Review and Content Analysis

The Discovery Center evaluation team used findings from a review of meeting minutes to inform all three evaluation questions. Particularly, the analysis focused on project team decision-making about module development, the research process, and project sustainability. The evaluation team used a summary of teacher feedback from teacher focus groups conducted by the research team following professional development with Module 3 to partially inform evaluation question 1. The evaluation team used a summary of focus groups with project stakeholders to partially inform evaluation question 3.

Data Sources

The evaluation team used meeting minutes from project team meetings, a summary of teacher feedback from teacher focus groups, and a summary of stakeholder feedback from stakeholder focus groups to conduct this analysis. Meeting minutes were created and provided to the evaluation team by the project team. Following professional development with Module 3, the project team conducted focus groups with participating teachers to understand how teachers benefitted from the module and what teachers would like to see improved about the module. Similarly, the project team conducted focus groups with stakeholders at each preschool location to understand the ways site-based stakeholders experienced mini playscape development, how they used their mini playscapes, and what challenges they faced in terms of maintaining mini-playscapes in the future. Summaries of these focus groups were provided to the evaluation team by the project team.

Data Analysis

NVivo (version 12) data analysis software facilitated the analysis of these data sources. In Project Year 1, the evaluation team developed nine codes, deductively, based on the concepts of interest as outlined in the original evaluation plan. During the course of analysis in Project Years 1 and 2, the evaluation team developed an additional six codes, inductively, based on the data. These codes and their operational definitions are presented in Table 2.

Table 2. *Deductive Codes and their Operational Definitions, Document Analysis, No-Cost Extension Year*

| Code | Operational Definition |
|----------------------|---|
| Decision-Making (DM) | References to, discussion about, and/or instances of the process whereby team members consider and/or determine an action regarding project activities. |
| Research (RE) | References to, discussion about, and/or instances of data collection and/or analysis. |

| Code | Operational Definition |
|-------------------------------|--|
| Theory (TH) | References to and/or discussion about educational, developmental, or other relevant theory(ries) or prior research to inform the project's activities. Definitions for concepts/terms relevant to the project. |
| Module Development (MD) | References to and/or discussion about the look, content, and/or implementation of digital modules. |
| Professional Development (PD) | References to or discussion about the design and/or implementation of preschool teacher professional development, as it relates to PD for the <i>Playscapes</i> project. |
| Learning (LE) | References to or discussion about preschool student and/or teacher learning. References to knowledge building and/or content knowledge. |
| Sustainability (SU) | References to or discussion about sustaining elements of the <i>Playscapes</i> project beyond the funding period. Discussions of mini-playscapes. |
| Resources (RS) | References to or discussions about resources used, consulted, and/or considered to facilitate the project. References to the resources teachers need for learning in the playscape. |
| Instructional Practices (IP) | References to or discussion about instructional practices for preschool. |
| Display (DIS) | Discussions about or references to the way items appear on the module screen (organization) and/or what items appear on the module screen (content). |
| Navigation (NAV) | Discussions of or references to movement through module screens. |
| Technology (TEC) | Discussions of or references to technology, in general. |
| Parents (PAR) | Discussions of or references to parents, particularly the influence of parents on preschool activities and the interaction teachers have with parents. |
| Play (PLA) | References to the nature of children's play, on or off the playscape. General references to student interaction in playscape or classroom spaces. |
| Interaction (INT) | References to student interaction/engagement with one another. |

The evaluation team applied these codes to all text from meeting minutes and focus group summaries.

Findings: Module Development

Analysis of meeting minutes and the teacher focus group summary data enabled the evaluation team to describe project team decisions regarding Modules 3 and 4. This description was used to partially inform Evaluation Question 1 (*To what extent did the STEM in the PlayScapes project*

create early childhood digital modules as professional development tools to promote STEM learning with playscapes?).

In Project Year 2, teachers from participating preschool sites provided feedback in real time using a talk-back protocol while using Modules 1 and 2 and provided post-professional development feedback in focus groups. In Project Year 3, the project team provided professional development to teachers using Module 3 and conducted focus groups with teachers to gather feedback regarding the module. This change was the result of a revised research design, which better reflected the iterative nature of the professional learning process that resulted from this project than the pre-post design the project team proposed originally. The research team's revision of the research design was discussed in detail in the Project Year 3 Annual Report (Woodruff, Dixon, & Li, 2018). The remainder of this section summarizes teacher feedback about Module 3 and provides a description of project team decision-making about development of Module 4.

Teacher feedback about Module 3. In general, teachers expressed a great deal of satisfaction with Module 3. Teachers believed the content was worthwhile and the storyline was authentic. Of the three modules, teachers gave Module 3 the most positive feedback.

The module was very informative. It was clear and understandable and had some great ideas that I would use w/ our children. (Teacher feedback, Module 3)

Teachers provided positive feedback regarding navigation through the module. Also, teachers provided useful feedback to the project team regarding aspects of the module's display and content, mostly in terms of minor technology issues such as lagging videos. Teachers believed the module was easy to navigate, the navigation was intuitive, and the information and resources were relevant to their interests and needs.

I think that this module was wonderfully written and prepared. The photos, videos and storyline all fit very well. I didn't feel confused or wonder what was going on. This was a great experience for me, and I would like to revisit some of the articles. (Teacher feedback, Module 3)

In terms of the influence of Module 3 on teachers' *instructional practices*, teachers expressed the module was most impactful for encouraging them to engage children in discussion, exploration, and problem-solving; allow children to take risks and persist through frustration; and have positive discussions with children about nature, insects, and bees in particular.

I will stop feeling as if I need to know all the answers when exploring with children. I will continue to remind myself and my children that science is a tool and technique, not an answer. I will show the children that failure is ok, and even good because it means you tried something new. (Teacher feedback, Module 3).

I wouldn't change anything to Module 3! I really enjoyed it and learned so much about nature. Especially risky play and positive language surrounding nature. All of the information was needed and the scenarios flowed with the educational content. There were some words that were cut off on the screen in the "Conversation Wrap Up" and the video with the child and the bee repeated. Other than that, it was a great learning tool! (Teacher feedback, Module 3)

Module feedback from teachers was an important resource not only for the project team's ability to revise and improve the modules but also for their investigation of STEM teaching and learning in nature, in general, and on a playscape, in particular.

Development of Module 4. In the No-Cost Extension Year, the project team decided to modify the format for Module 4. Modules 1-3 followed the storyline of a teacher—Alaina—who learned about playscapes and enlisted her colleagues and her preschool director to incorporate more nature-based play and STEM learning into their curricula. The project's original plan was for Module 4 to use the same storyline to culminate in the preschool's development of their own playscape. In the No-Cost Extension Year, the project team decided that Module 4 would be presented as a podcast with a landscape architect who discusses the elements necessary to build a playscape. Module 4 was still in the process of being created at the end of 2019.

Module development did not follow the schedule as proposed in the original project proposal, due to delays beyond the control of the project team. The project team re-framed these delays as an opportunity to develop the modules in the context of teacher practice. Module development became an iterative process informed by direct teacher feedback when using the modules and observations of children and teachers using playscapes collected as part of project research. Modules 1-3 are accessible on the UC website because of a permanent link.

Findings: Investigation of STEM Learning

Analysis of meeting minutes enabled the evaluation team to understand the nature and timing of decisions made by the project team with regard to the investigation of STEM learning on the playscape. In the final year of the project, the project team focused its attention on identifying ways to ensure existing data addressed the project's aims. The team acknowledged that they had collected a vast amount of data over the course of this project. The majority of these data concerned teacher learning and teaching on the playscape (e.g., audio logs, teacher focus groups, and teacher surveys) and student learning (e.g., content-based assessments (CBAs), behavior mapping, and video logs). In the final project year, the team connected the data they had collected to potential analyses to respond to their research questions.

Of particular focus was Aim 2 of the project, which shifted throughout the course of the project as a result of delays in the module development timeline and the richness of data collected from teachers and students. Because the module development timeline did not match what the team had planned previously, in Project Year 3 the team revised the research design from a focus on "trained teachers" (i.e., pre/post design) to a case study design. Additionally, because the team used data provided by teachers in talk-aloud feedback protocols and post-professional development focus groups to support further module development, the research design focused on the iterative process of teacher professional learning. These changes to the research focus and design better reflected the realities of the project, as well as the actual impact of participating teachers on module development, than the original design that measured teaching and learning in a pre-professional development/post-professional development fashion.

In the final year of the project, team members used project meetings as a platform to further articulate theory about what a playscape is and is not. Team members reviewed literature, findings from previous research conducted by team members, and analyses from this project to build on the theory of a playscape and differentiate playscapes from "greenified" playgrounds, playgrounds in nature, and natural environments.

Findings: Sustainability

In the final year of the project, the project team focused project sustainability in three areas: module development, dissemination, and feedback from stakeholders using focus groups. This section of the report describes stakeholder focus groups. The project team held focus groups with diverse stakeholders at three preschool sites: Child Focus, the Cincinnati Nature Center,

and Cincinnati Union Bethel. These focus groups centered on stakeholder experiences with mini playscape development at their sites. The project team used stakeholder focus groups to investigate elements of the playscape that were portable (Project Aim 3) and supported the development of Module 4. For the purposes of this evaluation, discussion of these focus groups centers on three themes held in common across the three preschool sites: expenses and budget, the master plan and mission, and stakeholder participation.

Expenses and budget. Across the three sites where mini playscapes were built as part of this project, expenses exceeded the budget allotted for mini playscape development. Each preschool site expressed a desire for particular features that were too expensive to build in this initial mini playscape development. For Child Focus, the water feature was too expensive to build according to the desires of site stakeholders, so the contractor chose a less expensive alternative. The Cincinnati Nature Center ran out of funds for plants, and therefore nurtured whatever native plants grew naturally in the mini playscape. Cincinnati Union Bethel had a “wish list” of additional features they hoped to add to the mini playscape, including plants and a platform for gathering. All sites discussed their mini playscapes as works in progress in which they expected to invest in the future.

Master plan and mission. Stakeholders at all sites agreed that mini playscapes supported their preschools’ missions. Mini playscapes provided opportunities for children to explore and learn, which was central to the missions of all participating preschool sites. Stakeholders at all sites indicated that children enjoyed the mini playscapes and that the ways children engaged with and in the space exceeded their original expectations.

Stakeholder participation. At all sites, focus group participants agreed that early buy-in and participation among all relevant stakeholders—even children—were important facilitators of mini playscape development. Active participation facilitated stakeholders’ understanding of the purpose and value of the mini playscape, allowed stakeholders to provide input unique to their experiences, and encouraged use of mini playscapes once they were built.

Conclusions

Module development, the investigation of STEM learning, and investigation of portable aspects of playscapes were integrated aims the project team pursued through the final year of the project. In this culminating year, these three aims merged. For example, teachers provided feedback about the modules, the project team used that feedback to improve the modules and understand teaching and learning on the playscape, and the modules will be sustained beyond the life of the project. Although not all aspects of the project occurred in the timeline the project team originally anticipated, they used what they learned throughout the project to respond to available opportunities and meet the general aims of the project.

Dissemination

The evaluation team used CAISE: informalscience.org website, Google Scholar (www.scholar.google.com), ResearchGate (www.researchgate.net), University of Cincinnati's website (<https://www.uc.edu/>), and Cincinnati local online community outlets to identify publications that have resulted from this project so far. Table 3 shows a list of sources identified by the evaluation team that were published across the project duration. Although this list might not cover the entire set of publications, it suggests that this project has disseminated the *playscape* as a concept and as a concrete product, measurement tools used in this project, and knowledge generated from this project to academic audiences—including informal STEM educators and early childhood practitioners—and to the broader public—including local parents and other local community stakeholders. In addition, communications between the evaluation team and the project PI suggested that the project team would continuously disseminate playscape modules to local and national academic, practitioner, and other communities through various venues.

Table 3. *Dissemination List, 2016-2019*

| Year | Dissemination | Outlet | Audience |
|------|---|--------------------------|--|
| 2016 | McCosham, S. (2016). Arlitt Playscape: A Place for Imaginative Kids. Retrieved from https://cincinnati-parent.com/arlitt-playscape-a-place-for-imaginative-kids/ | Local online resource | Local community: parents |
| 2016 | The Arlitt Nature PlayScape: 2016 Cincinnati Design Awards. Retrieved from https://www.cincinnati-designawards.com/cda_entries/the-arlitt-nature-playscape/ | Local online outlet | Local community |
| 2017 | Carr, V., Brown, R., Schlembach, S., & Kochanowski, L. (2017). Nature by Design: Playscape affordances support the use of executive function in preschoolers. <i>Children, Youth & Environments</i> , 27(2), 25-46. | Peer-reviewed journal | Academic community |
| 2017 | Rossmiller, A., & Carr, V. (2017). Parental Influence on Children's Nature Play: A Sociocultural Approach. Poster presented at University of Cincinnati. Retrieved from https://www.researchgate.net/publication/335432761_Parental_Influence_on_Children's_Nature_Play_A_Sociocultural_Approach | Local academic community | Academic community and local community |
| 2018 | 2018 STEM FOR ALL VIDEO SHOWCASE: Transforming the Educational Landscape, May 14-21. Retrieved from https://stemforall2018.videohall.com/presentations/1320 | STEM Resource Center | Academic community |
| 2018 | Kloos, H., Maltbie, C., Brown, R., & Carr, V. (2018). Listening in: Spontaneous Teacher Talk on Playscapes. <i>Creative Education</i> , 9, 426-441. https://doi.org/10.4236/ce.2018.93030 | Peer-reviewed journal | Academic community |

| Year | Dissemination | Outlet | Audience |
|------|--|-----------------------|--------------------|
| 2018 | Kloos, H., Waltzer, T., Maltbie, C., Brown, R., & Carr, V. (2018). Inconsistencies in early science education: can nature help streamline state standards? <i>Ecopsychology</i> , 10(4), 243–258. | Peer-reviewed journal | Academic community |
| 2018 | Schlembach, S., Kochanowski, L., Brown R. D., & Carr. V. (2018). Early childhood educators' perceptions of play and inquiry on a nature playscape. <i>Child Youth Environ</i> , 28, 82–101. | Peer-reviewed journal | Academic community |
| 2019 | Carr, V., & Rossmiller, A. (2019). STEM in the playscape: Tools for research and education. Poster. Retrieved from https://www.researchgate.net/publication/335432788_STEM_in_the_playscape_Tools_for_research_and_education | Unclear | Academic community |
| 2019 | Fuller, D. (2019). Climb, dig, splash, explore. UC Magazine. Retrieved from https://magazine.uc.edu/issues/1013/playscape.html | Local online outlet | Local community |
| 2019 | Lindberg, R., Carr, V., Schlembach, S., & Rossmiller, A. (2019). Exploring How Winter Weather Enhances Preschool Children's Outdoor Play. Paper presented at The Association for the Study of Play (TASP) & The American Association for the Child's Right to Play (IPAUSA) Joint Conference. | Academic conference | Academic community |

Summary

Evaluation Question 1: To what extent did the *STEM in the PlayScape* project create early childhood digital modules as professional development tools to promote STEM learning with playscapes?

Analysis of meeting minutes and teacher feedback summaries confirmed that the project team completed and revised Module 3 based on teacher feedback.

Evaluation Question 2: To what extent did the *STEM in the PlayScape* project investigate the impact of trained teachers on children’s STEM learning on playscapes?

Analysis of meeting minutes, teacher feedback summaries, and stakeholder focus group summaries confirmed that the project team continued to analyze data from a variety of sources to understand STEM teaching and learning on playscapes and build research-based theory about what playscapes do and do not entail. In response to delays in module development, the project team adjusted this aim to reflect the iterative nature of teacher professional development regarding STEM teaching and learning on a playscape using intentionally designed modules.

Evaluation Question 3: To what extent did the *STEM in the PlayScape* project investigate the critical playscape elements that are portable and adaptable and include these elements in a digital module for building and using playscapes?

In the final year of the project, the project team used stakeholder focus groups and analyzed data about STEM teaching and learning on mini playscapes to investigate playscape elements that are portable and adaptable. The project team used these data to begin to develop Module 4, which is designed to inform future playscape development.

References

Woodruff, S. B., Dixon, M. L., & Li, Y. (2018). *Evaluation of STEM in the PlayScape: Annual report 2018*. Oxford, OH: Miami University, Discovery Center for Evaluation, Research, and Professional Learning.