2020 Faculty Research Award - **"Infusing a Culture-based Computational Thinking Curriculum in Urban Preschools"**

Final Report

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Abstract

Educating early childhood educators in the basics of computational thinking is a national effort in the United States. This case study discusses the challenges of conducting culture-based educational design research for early childhood educators (ECE) in an online environment that is further complicated by an international pandemic. It focuses on how culture-based educational research design may evolve because of various challenges researchers face in the research process of early childhood education settings. Based on a research project on Computational Thinking (CT) at an east coast university, the project investigated the knowledge, skills, and abilities of early childhood educators regarding CT and whether an e-learning module and professional development workshop could develop their knowledge, skills, and abilities. Twelve early childhood educators from a variety of urban elementary schools and preschool centers based in Maryland completed a CT-focused pre and post-assessment, e-learning module, and the professional development workshop. Digital data from pre-assessment and post-assessment surveys were aggregated and analyzed to see whether a process or path of learning (i.e., pre and post-assessment, e-learning module, and professional development) could significantly develop educators' CT competence.

Project Summary

Concerned about the state of Maryland's desire to educate children with 21st century computer science skills, the principal investigators set out to meet this need through the development of a systematic process to learning computational thinking and the development of instructional materials that included the principles and pedagogy of computational thinking. The title of the project was *Infusing a Culture-based Computational Thinking Curriculum in Urban Preschools*. This research was funded by the Sherman Center's Faculty Research Award in 2020.

In Phase 1, participants included 12 early childhood educators; this included preschool teachers, paraprofessionals, and administrators based in Maryland. Participants completed a pre-assessment, elearning module, one-day professional development and post-assessment. All of these interventions were original and specifically designed for this project. The pre-assessment collected demographic and other work-related information (such as names, age, race/ ethnicity, educational qualification, pedagogical role, their preschool location, and their linguistic abilities). Other questions obtained information on participants' views, knowledge, and skills on computational thinking. Participants were also asked what comes to their mind when they hear or see the phrase "computer science," "computational thinking," whether they have taken a computer science class before, and their comfortability with computational thinking and applying their computational thinking knowledge in their respective classrooms. The survey also asked participants to state their feelings about the following computer science concepts: data collection, abstraction, data analysis, algorithms, automation, decomposition, parallelization, simulation, and data representation. We used facial expressions to better elicit how participants felt. See example below in Figure 1.

Automation is the "process of linking disparate systems and software so that they become self-acting or self-regulating" (MCSS, 2018, p. 29). This robot assembles boxes.

Based on the statement and figure above, select an option that best fits how you feel about automation?

The elearning module covered the same computer science concepts in the pre-assessment. It was developed to educate adults and students in the basics of computational thinking in PreK-20. Each concept was defined, explained through practice activities and reinforced with knowledge checks throughout the module. The module concluded with lesson plan ideas for educators interested in Early Childhood, Elementary and Secondary.

The consistent collection of data was stifled by the pandemic. That is, we were supposed to have a 2 day professional development. Instead, we moved to a one day online professional development.

Participants completed the post-assessment that repeated all questions, except the demographic data.

The findings suggest the following:

- Participants had a more positive outlook on their ability to teach and integrate computational thinking into their curriculum

- Participants felt comfortable with the process of learning through multiple means (e.g., pre-assessment, elearning module, post-assessment and professional development). Further, they realized that depth of computational thinking and wanted to learn more.

Some conclusions from Phase 1 of this research indicated the following:

1. There needs to be ongoing professional development and support for any computational thinking initiative.
2. The commitment to educating all in computational thinking must come from state mandates, school districts, accrediting agencies, administrators, teacher education programs, and college instructors of preservice and in-service teachers.
3. The classroom curriculum must reflect approaches to computational thinking so that early childhood educators are engaged in these practices as part of their daily instruction.

In Phase 2, we developed two instructional materials: a parent's guide and a Culture based Computational Thinking Curriculum (CCTC). *Kids Computing: A Parent's Guide* provided 4 lessons that are considered unplugged. Unplugged means that no computer is needed. Families can conduct these computational thinking lessons at home with household materials. CCTC is a prototype instructional tool that can teach children about problem decomposition which means breaking down a problem or system into components. The prototype was preliminarily field tested in an early childhood classroom, but further design iterations are needed.

The Sherman Center's Faculty Research Award supported our efforts to teach educators about the benefits of computational thinking and to impact the need for a STEM workforce. We hope to make computational thinking an integral part of our continued work as computer science educators.

The research-based version of this report can be found in the forthcoming publication:

Young, P. A., Hossain, S., Kariuki, D., (in press). Challenges in developing a systematic process to understanding computational thinking: A culture-based study. Sage Research Methods: Doing Research Online.