Informal STEM Teaching and Learning Through Infusing Computational Thinking into Science Learning (Connecting the STEM+C Dots: Infusing Computational Thinking in Informal STEM Learning)

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Project Goals

✓ Design and implement a Community Center Afterschool Program (CCAP) model for integrating computational thinking (CT) in K-12 STEM learning

✓ Explore how to integrate CT in hands-on, project-based, integrated STEM (STEM+ CT) inquiry/projects for 4th-6th grade students in community center afterschool programs

✓ Evaluate the impact of the curriculum implementation on students, teachers and community centers’ staff
Research Question

How can computational thinking be effectively integrated into PBL STEM inquiry projects (activities) for an afterschool program?
Methods

- Design and develop of a STEM+CT curriculum (4 PBL STEM+CT projects)
- Implement the curriculum in community centers’ afterschool programs
- Implementation was led by in- and pre-service teachers/ Provided PD prior and during the implementation
- 4th to 6th grade school students in small group of 4 to 6
- Two 90-minute sessions (twice per week) for 8 weeks
- Revise and reimplement the curriculum
Methods

Evaluate the impact on students, teachers & community centers’ staff:

✓ Video-tapes of students working with peers, teachers & researchers
✓ Students’ pre- and post- survey (S-STEM Survey (Friday Institute for Educational Innovation, 2012))
✓ Student artifacts produced during the implementation
✓ Student focus group interview
✓ Teacher pre- and post-survey on CT before and after PD
✓ Teachers’ weekly or by-weekly reflection during the implementation
✓ Teacher interview
✓ Community centers’ staff interview
Intended Outcomes

✔ A community partnership model
✔ A project-based, integrated STEM+CT curriculum
✔ CT growth and development in students and teachers
✔ Students’ learning of STEM knowledge
✔ Participating teachers’ adaption of the STEM+CT curriculum in a formal classroom setting
Overview of Outcomes

- Designed and developed four PBL integrated STEM+CT projects
- Implemented the curriculum (facilitated by in- and pre-service teachers) at six community centers/Title I schools over four semesters
- Worked with 24 in-service teachers, 18 pre-service teachers, and more than 140 Title I school students
- 10 teachers adapted the STEM+CT curriculum in formal classrooms
A Community Partnership Model

- STEM Researchers
- Title I Schools
- Parks & Recreation Dept.
- School District
- Community Centers’ Satellite Sites
- Community Centers
STEM+CT Curriculum

- Guided by PBL (driving questions & hands-on activities)
- Integrated STEM - required multiple subjects knowledge to solve the problem
- Mapped with K-12 engineering design process
- Aligned with content standards
- Showcased students’ final products/student competitions
- Implementation of the STEM+CT curriculum led by in- and pre-service teachers
1. How Can We Detect Life on Mars Using a Robot? (Engineering, Science, Math, Computer Science, & Technology) Video Clip
2. How Can We Build a Bridge for the Boise River that is Strong Enough to Resist Earthquake Forces? (Engineering, Physics, Geoscience, Technology, & Math) Video Clip
3. How Do Airplanes Fly? (Engineering, Science, Math, Computer Science, Technology) Video Clip
4. Can We Make Sand Stand Tall? (Engineering, Science, Math, Technology) Video Clip
Problem Solving Process

CT Components:
- Identify the Problem: Decomposition Algorithms
- Redesign as needed: Conditional logic, Data analysis
- Test and Evaluate Prototype: Heuristics, Data collection, Data analysis, Communication
- Build Prototype: Conditional logic, Data analysis, Communication
- Select Best Possible Solution: Conditional logic, Data analysis, Communication
- Develop Possible Solutions: Data collection, Data analysis, Pattern recognition, Abstraction
- Research the Problem: Conditional logic, Simulation/Modeling, Data analysis, Communication, Heuristics
Preliminary Findings

✓ Teachers and students were generally positive towards the STEM+CT curriculum
✓ Students’ improved confidence towards math
✓ The practice of CT is dependent upon the learning tasks (Yang, Swanson, Baek & Chittoori, 2018)
✓ **Challenges:** limited time; complex learning activities; students’ low interest in research and reading
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