Informal STEM Teaching and Learning Through Infusing Computational Thinking into Scientific Project-based Inquiry

Dazhi Yang, Yu-hui Ching, Sasha Wang, Youngkyun Baek, Steve Swanson, Bhaskar Chittoori

I. Project Objectives

This STEM+C project aims to build and pilot a community model for integrating computational thinking (CT) across 4th to 6th grade STEM disciplines (STEM+C) at community centers and their affiliated afterschool programs (6 locations), serving high needs, Title I schools in Boise, Idaho. The project focuses on both student learning and teacher professional development (PD) through pre- and in-service teacher-led, project-based, integrated STEM+C scientific inquiry.

A Community Approach
1. Higher Education - Boise State STEM Educators/Researchers & Pre-service teachers.
2. Boise School District - Schools (teachers & students).
3. Boise Parks & Recreation Dept. - Three community centers & their affiliated programs (6 locations) serving Title I schools.

Research Questions
1. How can the CT elements be effectively integrated into project-based learning (PBL) STEM inquiry activities?
2. How do students acquire STEM knowledge and skills using CT during PBL?
3. What forms of interactions are teachers engaged in during PBL STEM inquiry projects?
4. What is the impact of integrating CT within PBL STEM inquiry projects on students as a result of their participation in the STEM+C project in terms of attitude towards STEM?
5. What is the impact of integrating CT in STEM inquiries on teachers as a result of their participation in the project?

II. Design and Development of A STEM + C Curriculum

Project-based STEM + C Curriculum
- Curriculum guided by PBL model with guiding questions
- Used an integrated STEM approach - Applying knowledge & skills of STEM to solve problems
- Implemented four STEM+C projects (1. Life on Mars; 2. Bridge Design; 3. Airplane Design; and 4. Soil Reinforcement)
- CT components are integrated into hands-on, scientific inquiry and problem solving
- Using different technology/tools to facilitate the PBL (see below).
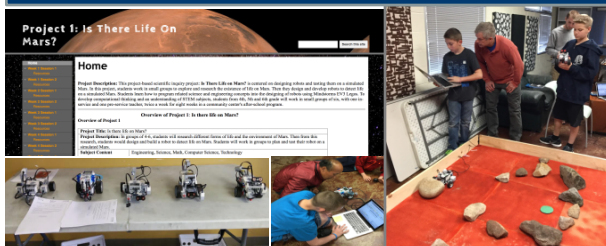

III. Implementation of the Curriculum

1. Projects are being implemented in community centers' after school programs.
2. Each project has been/will be implemented twice at different school and community centers.
3. Implementation uses pre- & in-service teacher-led, small groups (4-6 students).
4. Three groups of six students (18 in total) are for each project and location.
5. Project implementation is eight weeks (two 90-minute sessions per week).
6. A problem-solving chart is used to communicate CT.
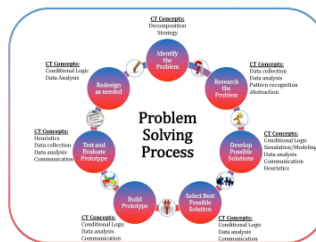
IV. Preliminary Results

- Students and teachers viewed the STEM +C integrated, PBL projects positively; attitude toward math improved (Ching, Yang, Wang, Baek, Swanson & Chittoori, 2018; Yang, Swanson, Chittoori & Baek, 2018).
- Analysis of video recordings of students' group work revealed various CT skills and components (Yang et al., 2018).
- Students used measurement skills to complete programming tasks in the robotic activity (Wang et al., 2018).
- Building a functional robot from scratch challenged participating students (Ching et al., 2018).

The Project-based STEM+C Inquiry

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