Investigating Conceptual Foundations for a Transdisciplinary Model Integrating Computer Science into the Elementary STEM Curriculum

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Introduction

This project was a research-practice partnership between Outlier Research & Evaluation | Outlier | Broward County Public Schools (BCPS). The project’s goal is to find first-time computer science (CS) in the already full elementary day. BCPS’s strategy was to embed CS lessons in the non-negotiable literacy time block. To do so, BCPS developed two "transdisciplinary" problem-based-learning modules for each 3rd and 5th grade ("Time4CS") modules integrating science, reading, and social studies content with CS and computational thinking (CT) concepts and incorporate lessons from Code.org’s "CS Fundamentals" course.

Research Questions

The project’s overarching research question was: "What are the effects of implementing computer science within a transdisciplinary curriculum on grade 3-5 students’ academic achievement and on their attitudes toward CS?"

Outlier examined two sub-questions: RQ 1: Is the implementation of an integrated STEM/ELA and CS curriculum associated with grade 3-5 students’ academic achievement outcomes? RQ 2: Is the implementation of an integrated STEM/ELA and CS curriculum associated with increases in grade 3-5 students’ attitudes toward CS?

Study Methods

Teacher and Student Sample

16 schools participated:
- 8 Treatment, which implemented 2 Time4CS Modules per grade 3-5
- 8 Comparison, which did not implement the modules

Implementation Measures

- Did teachers implement the module (yes/no)?
- Were lessons omitted from the module (yes/no)?
- Were lessons modified in the module (yes/no)?
- Were lessons added to the module (yes/no)?

Lessons Learned: Regardless of when professional development and follow-up training takes place, attempting to isolate the training away from other new content and technology helps Teachers to absorb and retain the STEM+C materials without feeling overwhelmed. In addition, providing a Quarter between training and implementation provides time for Teachers to reflect on the material, prepare their lessons, and ask questions.

My students became engaged and enthusiastic about integrating technology in every aspect of our study. I also love to learn new things and challenge my students. Even my students with disabilities were engaged and enlightened.

(Teacher, Grade 4)

Key Takeaways: Variables examined in this study were related to students’ academic achievement outcomes.

More-detailed findings are summarized here:

- Implementation of the Time4CS transdisciplinary module was not related to students’ attitudes or academic achievement outcomes.

- Regardless of school condition (across all students):
  - Students had higher Achieve 3000 Lexile scores, and higher FSA ELA and Math scores in classrooms where teachers carried out higher levels of "Extra," non-grade-level specific Code.org lessons compared to teachers in comparison schools.
  - No differences resulted between treatment and comparison school teachers for "additional," non-Code.org computer science activities, such as Khan Academy or Barefoot Coding.

Student demographic characteristics were also related to academic achievement:

- Low-income students (receiving free/reduced lunches) scored significantly lower on Achieve 3000 Lexile scores, and FSA ELA, Math, and Science scores.
- Compared to White students, Asian students performed better on FSA Math and Science exams, whereas African Americans performed worse on FSA ELA, Math, and Science exams.

- Female students performed worse on the FSA Science exam.

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- Comparison: Bayview, Deerfield Park, Gator Run, Lion’s Den, Panther Run, Sunset Lakes, Sunset Lakes, Sunrise, and Village

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