Elementary grade computer science education is a potentially powerful strategy for increasing learners’ participation in computing. Those who work in elementary education know however, that literacy and mathematics instruction dominate the school day, whereas subjects including science, social studies, arts, and others (such as computer science) are commonly given only secondary attention. Faced with this dilemma, Outlier Research & Evaluation | UChicago STEM Education at the University of Chicago collaborated with Broward County Public Schools (BCPS) on a National Science Foundation study (#1542842) to address this challenge.

BCPS’ strategy was to embed Code.org Fundamentals lessons in BCPS’ non-negotiable elementary literacy block. To do so, BCPS personnel developed “transdisciplinary” “Time for CS” (Time4CS) modules that included science, ELA, and social studies lessons and associated Code.org lessons connected with a problem-based theme. In the 2016-2017 academic year, participating schools implemented two modules for each, 3rd, 4th and 5th grade during BCPS’s existing 180-minute literacy block.

The study sought to bring more CS to elementary students and to explore the relationship between implementing the Time4CS modules and grade 3-5 students’ CS attitudes and academic achievement. The study included 16 schools in a matched-pair, random assignment design with half of the teachers using the Time4CS units (i.e., treatment teachers) and the other half teaching as usual (i.e., control teachers).
Prior to this study, all BCPS teachers had an opportunity to participate in Code.org professional development (PD) and in that PD, they were encouraged to implement Code.org’s “hour of code” and Code.org “Fundamentals” lessons in their classrooms. Accordingly, it was possible that teachers in both, treatment and control groups would teach Code.org lessons during the study; however, only treatment school teachers taught the Time4CS modules that explicitly pointed to the Code.org lessons and included the clear expectation that all of the Code.org lessons for the grade level would be taught. Moreover, treatment school teachers received support from BCPS learning coaches through the Time4CS module implementation process.

While complete findings regarding treatment and control group comparisons will be shared in the future, given that all teachers had the opportunity to use Code.org lessons and other CS activities, the analysis reported here includes data reported from all participating teachers (i.e., treatment and control groups). The analyses reported below investigated associations between teachers’ completion of Code.org lessons and other CS activities and student academic outcomes. Specifically, the analyses focused on their collective use of CS activities measured as follows: 1) the percentage of grade-level Code.org lessons (number of lessons from the Fundamentals course associated with the grade) completed; 2) the percentage of “extra” Code.org lessons (percentage of non-grade Code.org lessons taught from all of those available) completed; and 3) whether (i.e., yes/no) additional CS activities (non-Code.org CS activities) were completed.

Early Reporting of a Sample of Research Findings: Before moving on, we wish to explicitly acknowledge that this post is not intended to take the place of a comprehensive research report, and that a full manuscript with descriptions of instruments, psychometrics, demographics, measurement approach and further findings is under development for publication. However, we have agreed to report some initial findings here because we believe in open research and because the findings are likely to be of interest to the elementary education and CS education communities. With that in mind, we welcome thoughtful comments as we learn and improve computer science education together.

Findings

In summary, the data sources we used in this project included: 1) pre- and post-academic year teacher attitude questionnaires (that measured, among other things, teachers’ perceptions of their own innovativeness as well as their abilities to be resourceful and cope with challenges); 2) teacher implementation questionnaires; 3) pre- and post-academic year student attitude questionnaires; 4) Achieve 3000 Literacy student data (literacy tests administered three times a year to determine student reading level); and 5) Florida State Standardized Assessment data for mathematics, ELA, and science. With the assistance of BCPS personnel who used study IDs, student attitude and achievement data were matched to teacher data. Hierarchical linear modeling (HLM) was used to examine associations between teacher completion of CS activities and students’ academic achievement.
Achieve 3000 Literacy Scores

The analytic sample was composed of 1607 students nested within 157 teachers. The ICC (Intra-Class Correlation) values supported the continuation of the subsequent analysis (ICC = .53). The key finding in this analysis was: Teacher completion of a higher percentage of “extra” Code.org CS lessons was significantly associated with higher Achieve 3000 literacy scores under the condition where the teachers reported themselves as higher in “resourcefulness and coping” (β = 323.58, p = .006).

We also found main effects including: 1) more years of teaching CS were significantly associated with higher Achieve 3000 literacy scores (β = 8.39, p = .03); and 2) higher levels of teacher innovativeness were significantly associated with higher Achieve 3000 literacy scores (β = 58.54, p = .005).

Florida State ELA, Math, and Science Assessments

The analytic sample for ELA and math was composed of 1600 students nested within 156 teachers. Because the science assessment is administered only in 5th grade, the sample for that analysis included 580 5th grade students nested within 51 5th grade teachers. The ICC values supported the continuation of the subsequent analysis of students’ FSA ELA (ICC = .45), math (ICC = .49), and science (ICC = .38) scores.

Key findings in this analysis were:

1) Teacher completion of a higher percentage of “extra” Code.org CS lessons was significantly associated with higher scores on the FSA ELA (β = 24.99, p = .007) and mathematics (β = 27.15, p = .03) assessments under the condition where the teachers reported themselves as higher in “resourcefulness and coping;” and

2) Teacher completion of a higher percentage of “extra” Code.org CS lessons was significantly associated with higher scores on the FSA science assessment under the condition where the teacher also reported high levels of resourcefulness and coping (β = 55.45, p = .006).

We also found a main effect that teacher innovativeness scores were significantly associated with higher scores on the FSA ELA (β = 4.60, p = .001), mathematics (β = 5.59, p = .002) and science (β = 8.62, p = .02) assessments.

What do we make of this?

So, what are we to make of these findings? Like any study, this one elicits a number of new and interesting questions. Why were there significant findings associated with completion of a higher percentage of “extra” Code.org CS lessons and completing “additional” CS activities, whereas completion of grade-level specific Code.org lessons were not associated with student outcomes? What is the role of teacher resourcefulness and coping in a classroom and how might it be related to student academic achievement? What might explain why teachers who report being more innovative have students with higher academic outcomes?

These findings and associated questions are only a small part of the study findings. Further analyses have examined teacher attitudes toward interdisciplinary teaching and CS and associations between student socio-demographic groups and student outcomes. We look forward to sharing more findings in other informal venues as well as publishing and presenting them more formally. And, we are eager to hear about others’ working in elementary CS and those exploring teacher innovativeness and resourcefulness. As we all continue to communicate openly, collaboratively, and with kindness, we will make progress toward creating opportunities for our nation’s youth.