

Skyscraper Games: Designing Professional Development for Middle School Teachers to Promote Computational Thinking Using Custom Tools

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Abstract: We are piloting professional development (PD) for six middle-school teachers from a Philadelphia, Pennsylvania, USA. Our goal is to involve students from underrepresented STEM populations in programming through an annual game design competition that allows students to display their game on a large skyscraper in the city through the Skyscraper Games project. The initial PD group includes educators from public schools, charter schools, and afterschool programs. We are using a design-based approach to (1) create a sustainable, ongoing professional development program for educators of middle-school students; (2) develop a library of curricular materials for Skyscraper Games; and (3) enhance and upgrade our website and online programming tool. The goals of these activities are (1) to better understand how the interaction of professional development, curricular materials, and our online tool affect computational thinking for young people and (2) to use these results to iteratively improve our professional development, curriculum, and web-based tools for use by both middle-school students and their teachers in formal and informal settings.

Major issues

Background

On a chilly night in April 2014, Philadelphia residents looked up to see the 29-story Cira Centre briefly transform into the World's Largest Video Game. The players were miles apart, maneuvering the familiar rainbow blocks of Tetris as they cascaded down the 120,000-sq. ft. surface. The spectacle was the culmination of years of careful work and planning by Dr. Frank Lee, director of the Entrepreneurial Game Studio (EGS) at Drexel University's ExCITE Center. For Lee, this was more than just a public art installation. It was the first step in creating a new, exciting platform to engage young people in computer programming. Since that day, EGS has hosted onsite workshops for 82 middle schoolers from diverse backgrounds, with more than half of them identifying as female or gender-nonconforming. Now, the team is working with a small group of STEM educators to encourage middle school students from all backgrounds to participate in an annual game design and development competition, with the opportunity to display their final game on the skyscraper itself.

Current research

We are designing a professional development (PD) training sequence for middle school teachers to help them integrate the Python computer programming language and computational thinking skills into their existing curricula. To do this, they are using our custom web-based Skyscraper Games editor to create games and display them on a virtual skyscraper. This paper focuses on the following research question: *In what ways can a design-based approach to professional development assist middle school STEM teachers with integrating computational thinking skills in their classrooms?*

This pilot study, which is still under way for the 2017 – 2018 school year, includes the design of three different but connected components: (1) the professional development program itself, (2) the accompanying curricular materials, and (3) the online programming tool and associated website. We have adopted a design-based research (DBR) approach. Some key features of DBR are mixed-methods, an intervention, iterative repetitions and refinements, and a recognition of its situated nature (Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003; Gresalfi & Barab, 2011).

For this PD intervention, we are collecting quantitative data that include teacher pre- and post-surveys concerning technology beliefs and classroom integration (Brinkerhoff, Ku, Glazewski, & Brush, 2001), a research-team created Game Design and Creative Code Computational Thinking Assessment for the students, and student computer attitude pre- and post-surveys (Loyd & Gressard, 1984). Qualitative data include audio/video of PD sessions, researcher observation notes and memos, and interviews. Each month, beginning in November 2017 and ending in June 2018, we are meeting with the teachers for a professional development session. The first

session was five hours, and each monthly session after that will be two hours. There are six participants for this pilot study: three males and three females. Four were middle school teachers in formal educational settings; of those four, two taught at urban public schools (mathematics, technology) and two taught at urban charter or private schools (technology, media literacy). The private school is a girls-only school. The other two educators worked with non-school community-based computer programming organizations.

Theoretical approaches

Brinkerhoff (2006) studied a long-term professional development academy for integrating technology into schools in New Mexico. The study identified barriers to effective PD, with the three most relevant to this project being (1) resources, (2) institutional and administrative support, (3) training and experience. The findings also suggested several key components for creating a successful PD program. Those most relevant for our study are (1) extended contact hours for instruction and practice, (2) provision of materials to teachers, and (3) holding participants accountable for integrating their ideas into practice.

Conclusions and implications

We will add more results as we collect and analyze additional data, but the early implications are that the Brinkerhoff guidelines for PD are relevant.

The following barriers have been evident in our preliminary data analysis. (1) Resources: time and equipment are the primary concerns for the teachers. (2) Institutional support has proven to be an issue for some teachers; in one case, the teacher tried unsuccessfully for nearly four months to get the Skyscraper Games website unblocked before the research team was able to help. (3) Of the six teachers, two do not have formal training in computer science. This has been an issue for one of these teachers, who requires additional support in learning programming generally, beyond the specific requirements of the Skyscraper Games tool.

Briefly, this is how we have addressed the elements for successful PD. (1) Extended contact hours: meeting for several hours each month has provided an opportunity to discuss pedagogical approaches, review and request curricular materials, and use the website and coding tool in order to generate a list of action items for improving those. (2) Provision of materials to teachers has been important, both to help them understand the tool and how they might use it, and also to demonstrate that they are being supported by the research team. (3) While we cannot require teachers to actually use the tool in their classrooms, we worked with them to create a timeline for the year that culminates in a student showcase at the end of May 2018. This has helped to motivate them, particularly since the student teams that complete a game will have the opportunity to play their games on the Cira Centre itself later in the summer/early fall of 2018.

This study will provide important information for researchers who are interested in designing effective PD opportunities for computational thinking using custom technological tools, particularly at the middle school level where CS is generally not a required course.

References

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