

Doctoral Student Research Briefs

School of Education
Drexel University

Research Brief no. 1

**Developing a 4D Curricular Unit for Middle School Students: Combining Next
Generation Science Standards with Career Awareness**

by

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Abstract

This research is focused on designing a curriculum that incorporates Next Generation Science Standards with Career Awareness pieces for students in fourth - sixth grade. The curriculum fosters the use of professional science technology through a mobile data application, which allows students to gather data alongside scientists to create a biodiversity index of their urban city. Web-based resources allow for large-scale data sharing, visualization, and analysis in order to foster solution generation. The 4D curriculum aims to provide youth with an opportunity for science learning to gain career awareness and make a real-world impact on urban planning in their city.

Aim

Students in low socioeconomic urban areas have been found to not see science content as useful, and frequently have a decreased interest in classroom science (Songer, Lee & Kam, 2002). A decreased interest in science education is particularly problematic in light of extensive research that confirms that young students are capable and supported when such knowledge development should begin well before secondary school (Metz, 2000; NRC, 2012). This research focuses on creating a middle school curriculum that fuses Next Generation Science Standards with Career Awareness and technology-integrated activities for fourth - sixth grade students. Designing corresponding professional development and supportive curriculum for teachers is a necessary component of the curriculum design, particularly with the science and technology content. Each piece of the project is designed to foster 21st century critical thinking about urban ecology.

Problem

In 2014, the Obama administration created the Promise Zone designation for an area of West Philadelphia that includes a population faced with challenges of deep and persistent poverty (The White House, 2014). The “Philly Scientists” project seeks to interweave biodiversity activities with career awareness and mentoring opportunities that put students in the role of knowledge-providers rather than just knowledge-consumers. The students and their teachers, including in-school and out-of-school-time instructors in the Promise Zone, are being supported with a mobile application and 13-hour curriculum. By combining youth science knowledge and career awareness, this project is designed to challenge the patterns of persistent poverty through engaging science and technology learning and mentoring by university students and professionals. All resources are

designed to support youth's abilities to gather, analyze and generate evidence-based solutions to increase the biodiversity of their urban neighborhoods.

Research Findings

The primary focus of this project thus far has been developing the 13-hour curricular unit (fourth - sixth grade) with a team of scientists, doctoral students and education experts. Bybee et al. provided the 5E (Engage, Explore, Explain, Elaborate, and Evaluate) structure for the order of the lessons and types of activities included (1990). The 5 E's were modified to 4E's and an S (Engage, Explore, Explain, Elaborate, and Synthesize) to better fit the goals of this curriculum. The 5Es have been used both in the individual lessons as well as to guide the overall curricular unit which ends with a student presentation of biodiversity findings and solutions. Because of the comprehensiveness of this project, several persons of varying expertise, including technology with badging and professional development experts have been working diligently alongside the curriculum development team to ensure continuity of lessons and activities throughout all aspects of this work.

"Philly Scientists" will conduct its first beta test in the Fall of 2017. This will include a professional development workshop for the participating in-school and out-of-school instructors. A smaller scale beta test conducted previously to measure student engagement with the curricular activities and mobile application provided insight on how to best modify the lessons for the Fall beta. After the Fall beta test, the students' urban biodiversity solution and teacher professional development feedback will be analyzed in the re-design for a Spring 2018 beta test.

Conclusion/Discussion

In conclusion, beta tests indicated that the students' knowledge has value for urban ecology planning and the capability to become a local resource for their area of their city. Students think critically about the data they have collected in order to analyze their data and propose a solution that draws from their evidence-based conclusions. Through these activities, students not only participate in actual science activities, but they recognize the value of presenting and discussing valid solutions for what can be done to improve their city. These activities require the students to demonstrate a suite of 21st century skills including communicating, critical thinking, problem solving, and interpersonal skills.

Research Implications

This curriculum design is tailored specifically for students in the West Philadelphia Promise Zone to provide the experience of interacting with career science professionals they may not have otherwise encountered. A goal of this research is to provide students with an immersive learning experience by "acting as scientists" in their urban neighborhood. With this curriculum, students are encouraged to think critically about the data they have collected for analysis, and to propose a solution from their evidence-based conclusions. Through these activities, students not only participate in

actual science activities, but they recognize the value of presenting and discussing valid solutions for what can be done to improve their city.

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Author Biography

Rasheda Likely received her Bachelors of Science and Masters of Science in Biology from the University of North Florida. Before moving to Philadelphia, she worked in Virology (the study of viruses) for the Florida Department of Health for three years testing patients exposed to the Zika virus. While working in Virology, she also taught "Principles of Biology" laboratory sections at University of North Florida. Rasheda is currently in her second year in the PhD program at Drexel focusing on STEM education. While at Drexel, she has been a teacher assistant for the Biology department, and is the newest member of the Critical Conversations in Urban Education Committee. Her research interests include underrepresented minorities in Biology, including teachers and college students.