

2016 Sun Works Curriculum and Science Achievement Report

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Evaluation Goals & Measures

The aim of this evaluation was to determine if elementary school students who receive the New York Sun Works curriculum perform better on the New York State Science Achievement test in 4th grade. Science achievement scores were obtained for all New York City 4th graders during the 2014-2015 school years. The NY Sun Works schools included in the analysis were: PS 208, NEST + m, PS 147, PS 376, PS 354, PS 6, PS 84, PS 212, and PS 333. BSNBCS, PS 165, PS 41, PS 150 and PS 21 were omitted from this analysis because students do not receive the curriculum. PS 89 was omitted from the analysis because there were unexplainable inconsistencies in their data.

Peer schools were obtained from the New York City Department of Education's School Quality Guides. A school's peer is one that serves a similar student population, according to 4 characteristics: economic need index, % students with disabilities, % black or Hispanic, and % English Language Learners. K-8 schools have up to 30 peer schools. For this study, two peer schools were randomly selected from a list of peer schools for comparison. In sum, this study analyzed data from 502 students receiving the New York Sun Works curriculum and 1274 students data used as a control group. Table 1 summarizes the New York Sun Works schools and the two peer schools used as controls. The analysis only utilized data from the Sun Works schools and their matched controls during the 2014-2015 school year.

Table 1 – NY Sun Works and Peer Schools

New York Sun Works School	Peer Schools
PS 208	PS 208K, PS 136Q
NEST + m	PS175X, PS 266Q
PS 147	PS 55X, PS 329K
PS 376	PS173M, PS 73X
PS 354	PS 136Q, PS 203K
PS 6	PS 89M, PS36SI
PS 84	PS 201Q, PS13 SI
PS 212	PS 205Q, PS 116M
PS 333	PS 217M, PS 49Q

Results

The mean scaled score for Sun Works schools was 85.13546 while the mean scaled score for control schools was 76.13265. A Welch two sample t-test was conducted. The difference in students' scaled science scores between Sun Works schools and NYCDOE peer schools is significant ($p < .001$). *Students who receive the New York Sun Works curriculum are more likely to score higher on the 4th grade science achievement test than students who do not receive the New York Sun Works curriculum.*

However, we know that students who attend the same school are similar in some ways, called clustering. When controlling for clustering at the school level, there was no evidence of a significant influence of Sun Works on science achievement. This implies that there is something about the treatment (New York Sun Works) schools that both makes them better at science and also choose to work with Sun Works. These multilevel models were conducted with a treatment variable and a “dose” variable (e.g. the number of years that students received the curriculum) and neither produced significant results. Lastly, the lack of significant results is also likely related to the fact that these calculations were underpowered at the school level (more schools would be needed to find significant results).

Discussion

While some research has examined effects of environmentally-focused curricula on knowledge and beliefs regarding sustainable practices (Kabir, Rahman, Smith, Lusha & Milton, 2015; Pascua & Chang 2015; Carver & Wasserman 2012), none prior to the current study have examined the effects on academic school performance. The results of this study indicate that students who receive the New York Sun Works program are more likely to score higher on the fourth grade New York State science achievement test.

These results may be related to the hands-on approach of hydroponic farming and inquiry-based lessons in the New York Sun Works program. Actively engaging students in hands-on study not only increases conceptual understanding of science, but doing so daily (or almost daily) is correlated with higher test scores (Minner, DD, Levy, AJ, and Century, J, 2010; IES 2012).

The New York Sun Works program may engage students in science (and ultimately improve students attitudes toward science) more than a traditional curriculum. In high school students, unusual learning activities have been shown to improve students attitudes toward science (Myers and Fouts 1992). Hydroponic gardening, though gaining popularity, remains an uncommon activity for students and may present a unique opportunity for student engagement. More specifically, building and maintaining hydroponic gardens in classrooms motivates students to learn about science (Carver and Wasserman, 2012). Higher achievement scores are also correlated with liking science (IES 2012).

Ensuring that subject matter like climate change and sustainability is integrated into current science class curricula has become a major mission of the National Center for Science Education (Liu, 2012), as a strong science program helps students understand complex systems and the interdependency of their environment. In 2013, new educational guidelines, the Next Generation Science Standards (NGSS), were established recommending that climate change be integrated in elementary and intermediate classrooms (overhauling national recommendations for the first time since 1996), in order to engender evidence-based findings on the reality of climate change and encourage more students to pursue scientific and technical careers after college. Although New York was one of 26 states that supported writing the NGSS standards, they have not yet been adopted statewide.

Further, the United Nations Educational, Scientific and Cultural Organization (UNESCO) recently declared that climate change is one of the most important topics of this decade, and

through its Framework Convention on Climate Change (FCCC) and Education for Sustainable Development (ESD), one of UNESCO's goals, is to foster the appropriate societal skills and behaviors needed for a sustainable future including the enforcement of a global education system that can support a lifelong process of learning methodologies for critical thinking and problem-solving in regards to the causes and effects of climate change in a cross-curricular, multidisciplinary approach (UN CC:Learn, 2013). Clearly, science and environmental education are trending toward a greater focus on climate change and sustainability however, they have not yet been integrated into the curriculum in New York State.

The current New York State standards are the Common Core for Science (adopted July 2010), the New York State Learning Standards for Mathematics, Science, and Technology (MST), and the New York State Education Department Instruction in Science's New York State Education Law: Article 17, Sections 809–810. New York City Science Scope and Sequence are based on the Common Core and are also aligned with the Excellence in Environmental Education: Guidelines for Learning (K-12) as well as the NGSS standards.

The results of this study indicate that the New York Sun Works program may not only meet core science requirements but also integrate climate change and sustainability education in a way that improves students' understanding of science as a whole. As many states have both adopted the core curriculum and may be looking to integrate climate change and sustainability into their curriculum, the New York Sun Works program may be an ideal model that meets their needs.