Perpetual Tunnel Vision: An Inherent Barrier to STEM Discovery

ABSTRACT

It has been well documented that Science, Technology, Engineering, and Mathematics (STEM) exposure and participation in STEM activities during adolescence is a positive predictive factor for students pursuing STEM careers. In underrepresented communities, most of the current literature focuses on the socioeconomic barriers that hinder high STEM performance and interest. Research has demonstrated that early exposure to STEM disciplines instills confidence and stronger academic performance in math and science disciplines. STEM Saturdays is a concerted effort to understand the effects that underexposure and resource disparity may have on children’s interest in STEM disciplines. Additionally, the program sought to pique the interest of its participants. The program was implemented at an elementary school in Montgomery County, MD where 79.9% of student’s receive free and reduced lunch.

BACKGROUND

Our partnership for this project was Kemp Mill Elementary School (KMES). KMES is a Pre-K – 5th grade elementary school built in 1960 and is located in the boarder of Washington, D.C. and Maryland in Montgomery County. It has approximately 530 students, of which 79.9% of students receive free or reduced lunch. Demographically, KMES student racial/ethnic composition is 14.8% Black, and 77.1% Hispanic/Latino. White, American Indian or Alaskan, Asian, Multiple Races, and Native Hawaiian or Other Pacific Islander make up ≤ 5.0% respectively.

KMES is apart of a consortium of schools that have adopted the Curriculum 2.0 Mathematics program. This program structures the students learning and mathematics comprehension around a model that emphasizes understanding, computing, applying, reasoning, and engaging. Despite deliberate intentions of creating a robust, comprehensive math and science curriculum, KMES standardized test score performance fall below average on statewide math and science tests.

OBJECTIVES

- Elucidate the idea of high adverse childhood experiences (ACE) scores and aversion to Science, Technology, Engineering, and Mathematics (STEM)
- Understand if socio-economic status (SES) can be a critical variable that affects knowledge, interest & direction in STEM disciplines
- Determine if exposure to new disciplines will pique interests in STEM disciplines, increase confidence in those topics and foster problem solving & discovery-based skills

METHODS

The program provided academic enrichment and early exploration in STEM topics. Additionally, the program works to increase underrepresented populations in STEM fields. Through a hands-on instructional approach, students increased their mastery of STEM subjects, strengthened their understanding of the practical application of math and science concepts, and discovered new academic and professional opportunities. They included:
- Biology
- Chemistry
- Microbiology
- Medicine
- Engineering (with mathematical applications)

Each session began with a pre-session assessment/quiz to gauge the students’ interest and knowledge in the discipline being taught. Subsequently, a scientific lecture and hands-on activity occurred to explore a scientific topic, which was followed by a post-activity survey to measure any changes in the student’s responses.

Student’s were asked a series of questions and could respond using a numerical value that best represented their level of knowledge and interest in the subject. Numerical values ranged from 1-4: 1) Nothing, 2) A little bit, 3) Somewhat, and 4) A Lot. Each question’s response was compared between pre and post-survey responses. Questions were categorized into the following categories - Exposure, Interest, and Vision. The exposure category assessed the student’s exposure to the topic and the STEM discipline it fell under. Interest in STEM topics and disciplines were assessed by inquiring about how much the student learned from the activity and if they had a new interest in STEM. The vision category was measured by asking the students questions about their future goals and their desire to attend college. The concept was to gauge deltas in these three categories before & after the activity.

RESULTS

The results of the project were based on the 150 pre-activity surveys and 150 post-activity surveys. Students were designated a number to ensure identity matching for pre and post-activity surveys. In the exposure and familiarity to STEM concepts and disciplines category, 57% of students (pre-activity “somewhat” and “A lot”, when compared with post activity “somewhat” and “a lot”) responses jumped from 33% to 88%, respectively; reported increased knowledge, exposure and familiarity in the studied STEM disciplines. Student’s interest in STEM disciplines increased by 53% post-activity (pre-activity interest in STEM- 31%, post-activity interest in STEM- 64%). In the vision category continued interest in STEM and the pursuit of a career in the STEM increased by 9% when compared between pre- and post-activity surveys.

CONCLUSIONS

STEM Saturdays was successful in its venture to provide early exposure to STEM disciplines to students from low-SES backgrounds. The project demonstrated the idea that one cannot be what they cannot see. The data suggests that early exposure may be advantageous for students from low-SES backgrounds, as these vulnerable populations must overcome a number of barriers (familial, social, academic, financial) in to achieve academic success. KMES is an underperforming elementary school (according to statewide testing) where >90% of it’s students are of underrepresented populations and 79.9% of it’s students are eligible for free and reduce meals. Additionally, it was previously reported that ACE scores are not correlative to low-SES but pervasive irrespective of SES status. From this, it can be implied that high ACE scores may be an exacerbator for students from low-SES. Despite this, STEM Saturday’s showed that achievement gaps and interest in STEM can be mitigated if properly designed interventions are implemented in the student’s curriculum. A greater (nationwide) implementation of this project has positive implications on the future of students, specifically from vulnerable populations, that have low amounts of exposure to STEM.

STEM Saturdays Success

- Annual increase in student’s interest in STEM
- Increased awareness of STEM disciplines
- Improved performance in STEM subjects

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