

MEMORANDUM

April 3, 2017

TO: Caleen Allen
General Manager, Strategic Partnerships

FROM: Carla Stevens
Assistant Superintendent, Research and Accountability

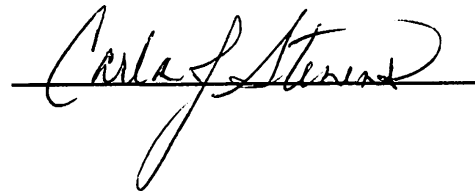
SUBJECT: **CAPITAL ONE DREAM ON/STEAM ON INITIATIVE: PREPARING STUDENTS FOR STEAM COLLEGE AND CAREERS THROUGH PROJECT-BASED LEARNING, 2016–2017**

During the 2016–2017 academic year, with financial support from Capital One Bank, the Houston Independent School District's (HISD) Strategic Partnerships Department collaborated with community partners, HISD's Academic Services, and School Offices to implement the Dream On/STEAM On initiative. Planning for the initiative began during the 2015–2016 school year. Dream On/STEAM On was designed to prepare global graduates who are leaders, critical thinkers, college-ready, adaptable, productive, and responsible decision makers. More than 350 students at nine HISD campuses, along with their teachers, were impacted by the initiative.

Through the application of project-based learning (PBL) strategies and activities, students designed projects, such as drones and robots, and showcased the projects among a panel of judges in a competition. A survey administered prior to the initiative revealed that participating students may have had few experiences engaging in competitions, study groups, or after-school activities about science, math, or technology. Students' art experiences may have been limited to mostly use of electronic media to view or listen to art rather than viewing live visual or performing arts. At the same time, students recognized the benefits of STEAM to advance their education and careers. At follow-up, students emphasized their need to demonstrate strong leadership skills, to be critical thinkers, flexible, good planners, cooperative and respectful toward others. These behaviors enabled students to effectively communicate as teams with peers and teachers, while refining their skills in STEAM to complete their projects.

The use of PBL created an active-learning environment for students to demonstrate critical skills to be successful in college and careers. Additional teacher training and more showcase opportunities for students may help both students and teachers bridge the gap between arts and STEM, while strengthening students' skills and interest in STEAM.

Further distribution of this report is at your discretion. Should you have any further questions, please contact me at 713-556-6700.

 CJS

Attachment

cc: Grenita Lathan
Sam Sarabia
Chief School Officers

Annie Wolfe
Rose Adams
Caleen Allen



RESEARCH

Educational Program Report

**CAPITAL ONE DREAM ON/STEAM ON INITIATIVE:
PREPARING STUDENTS FOR STEAM COLLEGE
AND CAREERS THROUGH PROJECT-BASED
LEARNING, 2016-2017**



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EVALUATION REPORT

BUREAU OF PROGRAM EVALUATION

Capital One Dream On/STEAM On Initiative: Preparing Students for STEAM College and Careers through Project-based Learning

Prepared by Venita R. Holmes, Dr.P.H.

Introduction

As the United States strives to meet the economic demands of the 21st century, a shift toward strengthening science, technology, engineering, arts, and math (STEAM) skills of the future workforce is at the forefront of educators' goals (Piro, 2010; Feldman, 2015). Research has shown that integrating arts into science and technology successfully engages minority and disadvantaged students, resulting in improved academic competencies (Clark, 2014; Stoelinga, Silk, Reddy & Rahman, 2015). Problem-based learning (PBL) has been found to have a positive influence on student educational outcomes (Condliffe, 2016; Ravitz, 2010). To that end, educators have emerged to use PBL to promote STEAM learning, with emphasis on student creativity and expression (Delaney, 2014; Jolly, 2014). Efforts to explore the benefits of STEAM are widely supported by organizations, such as the National Science Foundation and the U.S. Department of Education.

Background

With financial support from Capital One Bank, the Houston Independent School District's (HISD) Strategic Partnerships Department collaborated with community partners, HISD's Academic Services, and School Offices to implement the *Dream On/STEAM On* initiative at nine campuses. Planning for the initiative began during the 2015–2016 school year to prepare global graduates who are leaders, critical thinkers, college-ready, adaptable, productive, and responsible decision makers.

During the 2016–2017 school year, a "White Coat" ceremony was held to build collaboration among stakeholders (**Appendix A**). In addition, students began active engagement in PBL activities. Teachers were encouraged to support students' learning, with the long-term goal of improving their academic performance and stimulating their interest in STEAM-related college and career opportunities. Students orally showcased projects in a competition held at Northside High School during the spring of 2017.

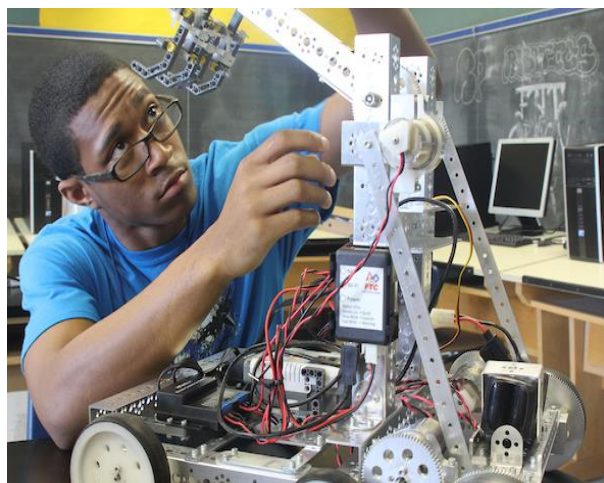


Figure 1: HISD student designing Vex robot

The *Dream On/STEAM On* initiative incorporated at least one of the following:

- Teacher professional development based on the school's needs.
- Supplies and Materials, including books, projects, and activities, such as drones (**Figure 1**).
- Field trips and lessons designed to expand and enhance students' knowledge of STEAM (**Figure 2**), incorporating art and design.



Figure 2: Beets surviving freeze in Washington HS students' garden

More than 350 students across the nine targeted campuses were impacted by the initiative. However, 63 students presented their projects for the culminating showcase that was held in February 2017. **Tables 1, 2, and 3** depict information about participating elementary, middle, and high schools including their presentation title, a description of the presentation, and the number of student presenters (24 students at the elementary level, 10 at the middle-school level, and 19 students at the high-school level). **Figure 3** shows students at Osborne Elementary with their Lego robotics equipment upon arrival.

Review of the Literature

Dream On/STEAM On provided an opportunity for K-12 students to bridge science, technology, engineering, and math with the arts as they prepare for college and careers. Pilecki and Sousa (2013) maintain that “Arts and sciences do not compete; they are complementary. The arts create a very subjective view of the world, while science creates an objective view of the world. A person’s brain needs both views in order to make suitable decisions” (p. 10).

Incorporating STEAM in well-implemented PBL activities in the classroom may lead to better learning outcomes for students compared to students who are taught in traditional settings (Strobel & van Barneveld, 2009; Walker & Leary, 2009). This includes long-term retention of content, better performance on tests, improved problem-solving and collaboration skills, and improved attitudes toward learning (Rinne, Gregory, Yarmolinskaya, & Hardiman 2011; Welch, Dunbar, & Rickels, 2015). Chu, Tse, and Chow (2011) found that collaborative and project-based approaches had a positive effect on student

| Participating High School | Presentation Title | Description | Number of Student Presenters |
|---------------------------|------------------------------------|--|------------------------------|
| Northside HS | Drones | Drones in action and their use | 4 |
| Sterling HS | Choreographed Ollies | Ollie robots perform a "dance routine" | 10 |
| Washington HS | BTW Students Surviving Food Desert | Gardening project from beginning stages to present day | 5 |

development of information literacy and information technology skills. There may be additional benefits in urban schools where youth have been found to be more successful in student-centered classroom environments where they can take an active role in their learning (Evans, 2004; Rivet & Krajcik, 2004; Lee, Buxton, Lewis, & LeRoy, 2006; Burke, 2007; Johnson & Marx, 2009).

Several research studies maintain that children are not typically attracted to programs that replicate what occurs in school. Instead, they seek youth-centered rather than curriculum-centered tasks (McLaughlin, 2000; Rahm, Moore, & Martel-Reny, 2005; Hammack, Ivey, Utley, & High, 2015), along with activities that are considered fun (Lumsden, 2003), and projects that provide "a safe place to express themselves and to explore new ideas that make it possible for them to be in charge of their own futures" (Rahm et al., 2005, p. 7). PBL has promise, considering that it demands student-directed scientific inquiry through interpretation of real-world problems (Barak & Dori, 2005). Moreover, students may apply previous or recently-learned knowledge to find strategies to solve problems and recognize the application of knowledge in their lives (Capraro, Capraro, & Morgan, 2013; Han, Capraro, & Capraro, 2016). In PBL, ongoing feedback, engagement, and collaboration with teachers and others in the community facilitate the achievement of a common project goal (Moje, Callazo, Carrillo, & Marx, 2001, p. 469). Teachers play a key role in PBL environments as facilitators, coaches, and resources for students (ChanLin, 2008; Colley, 2008).

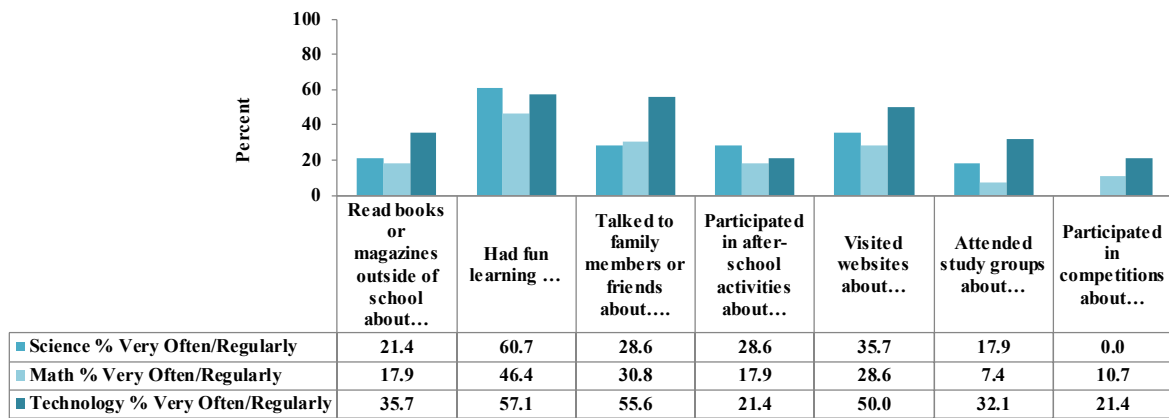
| Participating Elementary School | Presentation Title | Description | Number of Student Presenters |
|---------------------------------|---|--|------------------------------|
| Osborne ES | Animal Allies First Lego League Challenge | Robotics using Robot Lego Mind controller | 4 |
| Looscan ES | Lion Flight - The Best Drone | Ethical use of drones to benefit human communities | 6 |
| C. Martinez ES | My Learning Environment | Collection of pictures and writings | 4 |
| Mading ES | Drones | | 10 |

| Participating Middle School | Presentation Title | Description | Number of Student Presenters |
|-----------------------------|--------------------|--|------------------------------|
| Marshall MS | Drone Project | Use of programming code to make a small drone fly | 5 |
| Williams MS | Call of Eon | Rover model that took on Federal Trade Commission challenge of Velocity Vortex | 5 |



Figure 3: Lego robotics equipment arrives to Osborne ES students

Figure 4: Dream on/STEAM On students’s perceptions about science, math, and technology-related activities



Methods

The HISD HUB, which is a web-based platform, was used to gather pre-survey data from students and follow-up survey data from both students and teachers. Twenty-eight out of 63 students (44%) completed the pre-survey. Eight students and two teachers completed the follow-up survey. Due to the small sample sizes, particularly at follow-up, the findings should not be generalized beyond the targeted population.

Research has shown that students who expressed high interest in STEM outperformed students in science and math who expressed no interest in STEM (Welch, Dunbar, & Rickels, 2015). A link between STEM knowledge and careers is also supported in the research (Robinson & Kenny, 2003). To assess the potential long-term impact of the initiative on learning, pre-survey questions focused on students’ interests in science, math, technology, art, and STEAM, independently. The survey items were adapted from the Trends in International Mathematics and Science Study (TIMSS) survey. A 4-point Likert-type scale was for items related to science, math, technology, and art: “very often,” “regularly,” “sometimes,” and “never hardly ever.” The data were analyzed by combining the first two categories to show the percentage of students who either “very often” or “regularly” showed interest and by combining the last two categories which were “sometimes” and “never hardly ever.” The survey results reflect percent agreement and disagreement with items related to STEAM. Finally, an open-ended, follow-up survey was administered to students and teachers to gather data on how they acquired the skills to complete their projects, what they learned from participating in the initiative, how

the initiative will benefit them in the future, and suggestions to improve the initiative.

Pre-survey Results

Science, Math, Technology

- **Figure 4** shows the highest percentage of student respondents indicated that they “very often” or “regularly” had fun learning science prior to the initiative (60.7%). Comparatively, none of the students indicated that they participated in competitions about science during that time (0.0%).
- Survey items that measured experiences in math revealed that 46.4% of student respondents “very often” or “regularly” had fun learning math; whereas, 10.7% indicated participation in math competitions prior to the initiative (Figure 4).
- On items related to technology, the majority of students expressed that they “very often” or “regularly” had fun learning (57.1%), talked to family members or friends (55.6%), or visited websites (50.0%) about technology before the initiative (Figure 4). The lowest percentage of students (21.4%) “very often” or “regularly” participated in after-school activities or competitions about technology before the initiative.

Art

- **Figure 5** shows the highest percentage of student respondents “very often” or “regularly” used electronic media to view or listen to art (60.7%) prior to the initiative. Comparatively, even higher percentages of respondents “sometimes” or “never

Figure 5: Percent of Dream On/STEAM On students who participated in art-related activities

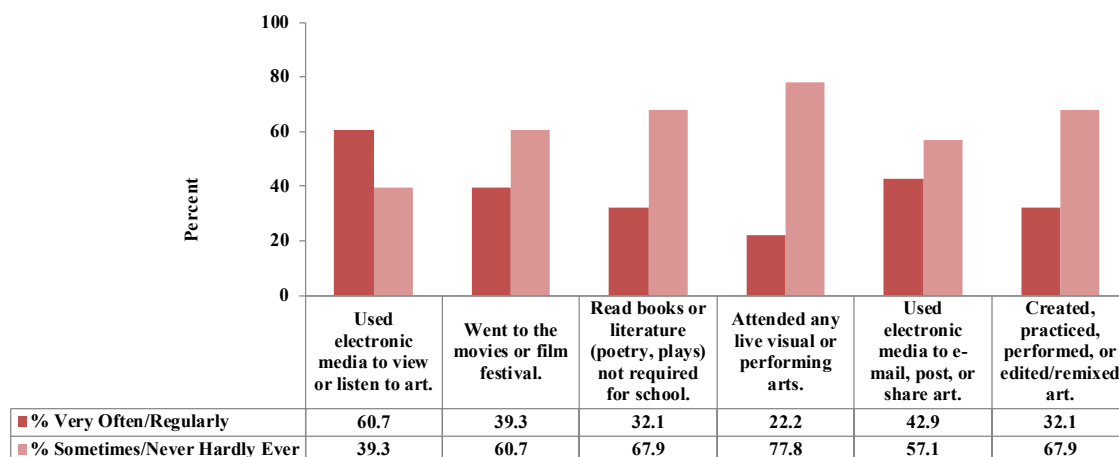
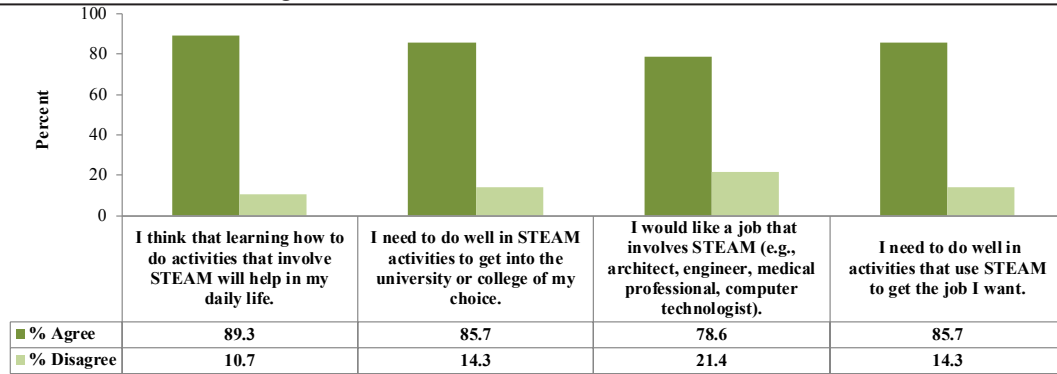


Figure 6: Dream On/STEAM On students' agreement about STEAM



hardly ever” attended live visual/performing arts (77.8%); read books/literature (poetry, plays) not required for school (67.9%); or created, practiced, performed, or edited/remixed art before the *Dream On/STEAM On* initiative (67.9%).

STEAM:

- **Figure 6** depicts students' responses relative to STEAM before the *Dream On/STEAM On* initiative. The highest percentage of respondents agreed that learning how do activities involving STEAM will help in their daily life (89.3%).
- In addition, 85.7% of respondents indicated that they need to do well in STEAM to get into a university or college of their choice or get the job that they want.
- Nearly 79% of respondents revealed that they would like a job that involves STEAM.

Project-based Learning Demonstrations

A showcase activity allowed students to demonstrate learning. Prior to the showcase, a variety of PBL tasks were required to complete the projects over the four-month period (October 2016 to February 2017). For example, Future Farmers of America (FFA) students at Washington High School prepared their gardens for harvest (**Figure 7**). The Robotics and Photo Journalism team at Osborne Elementary School constructed a table on which to design Lego robots (**Figure 8**).

The showcase was held in February at Northside High School amid a panel of judges, including executives and administrators from Capital One Bank, Rice University, and Young Audiences



Figure 8: Osborne ES students constructing robotics table

of Houston who drive STEAM education in the area. HISD parents, teachers, students, and school administrators were also in attendance. Projects were judged on ten criteria, including creativity, originality, knowledge, understanding, level of skill required to complete the project, and coherence of oral presentation. The criteria were captured within five main categories: (1) objectives, (2) design, (3) execution, (4) conclusions, and (5) presentation.

Figure 9 shows Williams Middle School students displaying a robot that was built by the team. **Figure 10** depicts Sterling High students programming an Ollie robot to perform a dance



Figure 7: Washington HS students preparing garden for harvest



Figure 9: Williams MS students present robot designed from Legos



Figure 10: Sterling HS students' Ollie robot performs a dance routine

routine. **Figure 11** displays Northside High students using a drone to deliver a message to the school principal. Northside students built the payload for the drone using a 3D printer.

A certificate was awarded at the elementary, middle, and high school levels based on the judging criteria. Looscan Elementary School students displayed their winning certificate after a PowerPoint presentation about various types of drones (**Figure 12**). During the presentation, Looscan students explained how drones can be used in our daily lives for problem solving.



Figure 11: Northside HS students' drone delivers message to principal

Students at Marshall won at the middle school level by demonstrating their coding skills (**Figure 13**, p. 6). The high-school winners at Northside are shown with their drone and teacher in **Figure 14** (p. 6).

Follow-up

Eight students and two teachers completed a follow-up survey to convey how they acquired the skills to complete their project, what they learned from participating in the initiative, how the initiative will benefit them in the future, and suggestions to improve the initiative. One student indicated that they needed to



“The skills needed to complete the project were the determination of never giving up no matter how many times we failed, while keeping an open intellect to new ideas and a sharp mind to find out our mistakes that were made during the process.”

- HS student

be a “leader, competitive, responsible, have good communication, [be] accountable, and trustworthy.” Another student pointed out the need to “work as a team” and “think creative ideas.”

Students were also asked what contribution they made to the group and what they learned from group members. One student noted helping to “establish organizational rules and a schedule which every one can agree on.” The student also noted that “you learn better and understand things better with people that you feel comfortable with.” Another student expressed “helping with ideas and the design of the team’s model.”



“...I taught the others who had difficulty learning. I learned that we all must work together otherwise we would all be confused and not know where to start in our project.”

- HS student

When asked how the *Dream On/STEAM On* initiative will benefit them in the future, one student wrote “develop mature behavior, good leadership skills, and ways to be more cooperative and respectable with others.” Another student noted that the project will benefit by “improving my ability to talk and make plans with other people. It will also get me used to the process of making and designing projects.”

When asked for suggestions on how to improve the initiative, a student wrote “more showcases,” while a teacher noted “more support and training on skills required for the project.”



Figure 12: Looscan ES students display Showcase Certificate for winning with multicolored drone presentation



Figure 13: Marshall MS students win on coding to fly drones



Figure 14: Northside HS students and teacher with winning drone

Discussion

The *Dream On/STEAM On* initiative provided opportunities for students to develop college and career-related skills by participating in STEAM-focused project-based learning activities. Through financial support from Capital One Bank, community partners, and key HISD departments, 63 students on nine HISD campuses collaboratively designed and showcased their projects for judging. More than 350 students were impacted by the initiative. A survey administered prior to the initiative revealed that participating students may have had few experiences engaging in competitions, study groups, or after-school activities about science, math, or technology. Students' art experiences may have been limited to mostly use of electronic media to view or listen to art rather than viewing live visual or performing arts prior to the initiative. At the same time, students recognized the benefits of STEAM to advance their education and careers. The follow-up survey data captured the perceptions of few students and teachers; however, the need for strong leadership skills, to be critical thinkers, flexible, good planners, cooperative and respectful toward others were acknowledged

by participants. These behaviors enabled participants to effectively communicate as teams with peers and teachers, while refining their skills in STEAM to complete their projects.

To that end, the *Dream On/STEAM On* initiative expanded students' exposure to activities found to increase academic achievement. The use of PBL created an active-learning environment for students and teachers to demonstrate their skills. Additional teacher training and more showcase opportunities for students may help both students and teachers bridge the gap between arts and STEM, while strengthening their skills and interest in STEAM fields. Plans to expand the program should be considered by stakeholders. Future program evaluations may incorporate post analyses of students' perceptions of STEAM following the program.

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APPENDIX A

THE PURPOSE OF THE WHITE COAT CEREMONY

The White Coat Ceremony is a rite of passage that, traditionally, welcomes a new medical student into the medical profession. It is worn by physicians as well as scientists and those who perform laboratory work. The white coat originated in scientific laboratories and was adopted as the standard of dress by physicians in the late 19th century as physicians sought to incorporate scientific principles in the practice of medicine. There are practical reasons for wearing the white coat. The large pockets allow for the ease of carrying medical items and reference books.

For the "Dream On/STEAM On" initiative, white coats serve as a repository for information. A journal is provided. The cover has "Never Stop Dreaming," which relates to the name of the program, "Dream On, STEAM On." The journal is used to document brainstorming, problem-solving, best practices, etc. and other things that can be shared with other teachers, including teachers at Dream On/STEAM On sister schools. Many have already begun the process of collaboration.

Educators are bound by the same commitments that bind physicians and scientists. Much that educators have committed to aligns with the Hippocratic Oath.

The respected, hard-won scientific gains of educators (as opposed to physicians) in whose steps educators walk to gladly share knowledge with those who follow. With that said, educators' names are called to receive THEIR white coat.