# Increasing College Opportunity in STEM Education through High School Visitation Day at the Two-Year College

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## Abstract

The benefits of a post-secondary STEM education are well documented in the literature. However, for many underrepresented students and especially those who are low-income and first generation, the culture of obtaining a STEM degree presents barriers. These students often lack guidance, encouragement, and support to attend college. They are less likely to attend schools with a strong "college-going" culture or engage in exposure experiences. Georgia State University, Perimeter College attempts to address these barriers through a program aimed at increasing exposure to STEM for K-12 students. Funded in part by the National Science Foundation, the goals of High School Visitation Day (HSVD) are to provide an exposure experience that introduces a collegiate setting, encourages a college-going mindset and equips students with information on STEM majors and the college application process. In this paper, we discuss the importance and impact of increasing college opportunity and STEM education awareness through HSVD.

## Keywords

Belongingness, College-going mindset, High school, STEM education, STEM preparedness

## Introduction

The United States Department of Commerce, Economics and Statistics Administration in its July 2011 report stated that science, technology, engineering, and mathematics (STEM) occupations are projected to grow by 17.0 percent between 2008 and 2018, compared to 9.8 percent growth for non-STEM occupations.[1] These statistics paint an advantageous portrait of STEM careers and elucidate why more students should choose STEM disciplines in college and why so much emphasis has been placed on STEM education. However, a common theme at the *U.S. News & World Report* STEM Solutions 2012 Leadership Summit in Dallas, Texas, was the lack of prepared stem workforce; despite there being nearly 14 million unemployed people in the United States, American companies could not find workers skilled enough in math and technology to fill an estimated 3 million permanent job openings.[2]

There are numerous reasons as to why some argue that there are not enough skilled STEM workers. For example, according to The New York Times' Christopher Drew, studies note that approximately 40 percent of students who choose to pursue a STEM area either switch their major in college or do not graduate at all.[3] Others suggest that societal stereotypes, environmental and cultural factors, lack of visible role models, and different interests and experiences are some of the reasons that students do not choose STEM [4-7]. Yet, according to the National Math and Science Initiative, a public-private partnership led by private donors and U.S. corporations, it is the declining number of students who are prepared to take rigorous college courses in science and math and who are trained for careers in those fields that has fueled the STEM Crisis.[8] A report from the U.S. Department of Education Office for Civil Rights, Civil Rights Data Collection, Data Snapshot: College and Career Readiness found that only 50 % of high schools offer calculus, and only 63% offer physics.[9] Furthermore, the report noted that between 10-25% of high schools do not offer more than one of the core courses in the typical sequence of high school math and science education such as Algebra I and II, geometry, biology, and chemistry and that for black, Latino, American Indian, and Alaska Native students there is even less access where only a quarter of high schools with the highest percentage of black and Latino students do not offer Algebra II and a third of these schools do not offer chemistry.[9]

In an article entitled "The Economic Impact of Early Exposure to STEM Education," Oberoi posits one of the most important factors that limit the United States' ability to stay ahead of the STEM curve is the lack of introduction or exposure to STEM educational areas at an early age.[10] Oberoi suggests it is early exposure which enables students to understand whether or not they are interested in further pursuing a particular STEM career.[10]

The lack of exposure and access to STEM is even more significant among first-generation, low-income and minority students as evidenced in the lack of core high school STEM classes. According to Alvarez, Edwards, and Harris,[11] programs that allow underrepresented students to overcome barriers linked to educational underachievement, including socioeconomic status, cultural trends, and lack of awareness of STEM opportunities and career field may be beneficial; hence the focus of the current research builds on this premise by exploring the idea of revamping a traditional college visit into a STEM High School Visitation Day (HSVD).

This paper focuses on the development and implementation of a STEM program funded in part by the National Science Foundation and the University System of Georgia STEM II Initiative. The HSVD program was created with a goal to increase college awareness and STEM literacy among populations that have been traditionally underrepresented in STEM, particularly those attending Title I schools. The work is unique because it takes place at the two-year arm of a Research I university and utilizes the idea of a traditional college visit and restructures it into a half-day program where students attend a college class while also being introduced to a "college-going mindset," the application process, and an overview of how to "fund" college.

## Background

Educational attainment is more important to economic success than ever before. Over the past three decades, higher education has become a virtual must for American workers. Between 1973 and 2008, the share of jobs in the U.S. economy which required post-secondary education increased from 28 percent to 59 percent.[12] The core mechanism at work in increasing demand for post-secondary education and training is the computer, which automates repetitive tasks and increases the value of non-repetitive functions in all jobs. Occupations with high levels of non-repetitive tasks, such as STEM jobs, tend to require post-secondary education and training.[13]

A post-secondary STEM education leads to greater lifetime earnings, lower unemployment, and lower poverty;[14,15] yet each year many low-income students face barriers to college access. Without access to a post-secondary education, a STEM career is often out of reach for this student group.

Access to Post-secondary Education

For over 50 years, researchers have been examining college access for underrepresented and disadvantaged students; however, underrepresentation of minority students continues.[16] When looking at these aspirations through a socio-economic culture lens, the disparity is even more evident: 71% of students whose parents are college graduates enroll in a college or university compared to 26% of students whose parents have a high school diploma.[17]

Systemic Educational Barriers for STEM Preparedness

Low income students face barriers to college success at every stage of their academic career. Listed below are a few of the systemic barriers leading to the lack of STEM preparedness in the low-income educational community.

1. According to the National Survey of Science and Math Education,[18] when these students reach middle school, approximately 36 percent of middle school science teachers and 30 percent of middle school math teachers didn't have enough training in their subjects. This is problematic as middle school algebra is a gateway course to higher-level math in high school and beyond;
2. Seventy-eight percent of high schools serving the lowest percentages of Black and Latino students offer high-level chemistry and 83 percent offer high-level math, while just 66 percent of high schools serving the highest percentages of Black and Latino students offer chemistry, and 74 percent offer Algebra II;[9]
3. Nearly 20 percent of African-American high school students attend a high school that does not offer any AP courses.[19]

Systemic Barriers for Post-secondary Education Preparedness

Low-income students typically attend Title 1 schools. Title 1 schools are defined as having a least 40% of the student population enrolled in a free or reduced lunch program. Many Title 1 high schools have a guidance counselor student ratio two to three times more than the national average, thus resulting in less human resources to help navigate college preparation (i.e., college entrance exams, application procedures, and financial aid).[20] Additionally, these schools typically do not have a strong "college-going" culture or engage in exposure experiences, i.e., college visits.

"College-going" Culture

High schools with a "college-going" culture foster and promote aspirations and behaviors conducive to preparing for, applying to, and enrolling in college to all students regardless of income.[21] High schools with a "college-going" culture cultivate activities and programming that encompass the following nine-essential principles: college talk (intertwining and relating college in the classroom and throughout the school); clear expectations (establishing the expectation that all students can go to college); information and resources (teaching college-knowledge and identifying resources); testing and curriculum (highlighting college admission tests and test taking skills and knowledge of A-G curriculum); faculty involvement (engaging staff members in creating and sustaining a college culture); family involvement (engaging parents in creating and sustaining a college culture); college partnerships (relationship between local colleges/universities and schools to promote the educational pipeline), and articulation (collaborating across grade levels to build College-Knowledge curriculum).[22-24]

In addition to these principles, a "college-going" culture is further enhanced by self-identity and belonging and educational aspirations. Self-perceptions regarding student progression from educational aspirations to college enrollment has three phases (predisposition, search, and choice)[25] and spans socio-economic boundaries. In the predisposition phase, students make the determination whether they would pre-college curriculum, and socioeconomic status are all central factors of this stage ***like*** to attend college. Parental encouragement and support, pre-college curriculum, and socioeconomic status are all central factors of this stage.[24] Self-identity and belonging are also important factors of this stage because people cannot achieve what they do not dream.[26] For low-income students, belonging to a group that has aspirations of attending a post-secondary institution and envisioning themselves attaining a post-secondary education is paramount if post-secondary educational aspirations are to be achieved.

Demographics of "Feeder" Public School Systems

There are seven major school systems that serve as "feeder" schools to Georgia State University-Perimeter College: Atlanta Public Schools (APS), Gwinnett County Schools, Fulton County Schools, Henry County Schools, Clayton County Schools, DeKalb County Schools, and Douglas County Schools. However, Atlanta Public, DeKalb, Gwinnett, and Clayton County schools have the largest number of majority-minority (African-American and Hispanic) schools in terms of both school quality and student achievement (Title 1).[27]

Institution

Perimeter College is part of Georgia State University, a diverse, multi-campus urban research university in metropolitan Atlanta. The college is the major provider of associate degrees and student transfer opportunities in Georgia and a gateway to higher education, easing students' entry into college-level study. With a student population of more than 21,000 students, representing all ages and backgrounds, Perimeter College serves the largest number of dual enrollment, international, online, transfer and first-time freshman students in the University System of Georgia. The Office of STEM programming supports approximately 3900 students who have chosen a STEM pathway. The goal of STEM programming at Perimeter College is to improve access and success among all STEM students and to promote a culture of inclusive STEM education.

Program Information

High School Visitation Day is coordinated with the assistance of high school counselors, math, science, and /or Career Technical and Agricultural Education (CTAE) teachers from the following Title 1 school systems: DeKalb, Douglas, Clayton, Atlanta Public and Fulton. Invitations are sent to each school in each aforementioned school system twice per year. Schools have the opportunity to attend high school visitation day during the fall or spring semester. Participants are provided information on STEM majors, the expected cost of college attendance, application procedures and documentation, and financial aid. Participants attend classes that a typical college STEM freshman would take (English, Math, Science, Social Science, Fine Arts, Humanities), thus becoming a "college student" for a day and "seeing" themselves as belonging in a post-secondary environment. Participants leave HSVD with information packets, STEM degree information, contact numbers for collegiate resources, and an application fee waiver. The agenda for a typical HSVD is found in Table 1.

**Table 1. Agenda for High School Visitation Day**

| Time | Activity |
|---|---|
| 9:05a-9:10 a | Students Arrive |
| 9:15a - 9:45a | Information Session |
| 10:00a-11:15a | Class |
| 11:30a-12:00p | Campus Tour |
| 12:05p – 12:20p | Wrap-up |
| 12:30p | Students Depart |

## Data Collection and Analysis

Students who participated in the program were asked to complete anonymous surveys at the end of their visits. Surveys probed constructs related to college exposure, aspirations of attending a post-secondary institution, and STEM interest. Additionally, students were asked in retrospective format whether they had intended to apply to GSU-PC prior to the visit and then whether they intended to apply at the time of the survey, at the end of the visit. Similarly, students were asked whether they were interested in a STEM career, both before the visit and upon completion of the activities.

## Results

Approximately 400 students completed the post-visit surveys upon completion of their HSVD experience. As some students chose not to respond to certain items, n values for each of the survey items range from 327-405. Fewer post surveys were completed than pre- surveys, indicating that many students left without completing the post surveys. Unfortunately, as no identifying data was collected, we were unable to remove from the data set the pre- surveys from those students who did not complete a post survey; we acknowledge this limitation in our study design. It is possible that study results are skewed towards more students who demonstrate more interest in college, for instance, but we believe that most of the students who failed to complete the post survey did so because of leaving early or our failure to distribute the surveys to everyone, rather than due to their lack of interest.

Data collected reveal that students demonstrated statistically significant increase ($p < 0.05$) in desire to enroll in college and major in STEM. Figure 1, below, indicates that the students felt more inclined to pursue enrollment in the 2-year program after participating in the experience. Additionally, as evidenced in Figure 2, student interest in STEM majors also increased from before to after the HSVD experience. Before the HSVD program, only 26% state they intended to pursue a post-secondary education. Of the 26%, 44% were considering a STEM major. After the event, 52% stated they would enroll in a post-secondary institution and of the 52%, 82% were considering a STEM major.

In addition to student surveys, guidance counselors from participating high schools were asked to provide feedback on an open-ended survey. They all indicated that they believed the HSVD experience was impactful for students through increasing exposure to college-going and STEM disciplines. In particular, counselors felt that the first-hand experiences of being on campus and attending class were valuable in changing student perspectives.

**Figure 1.** Percent of students indicating that they were considering enrolling in the 2-year program before (pre, n=404) and after (post, n=327) the HSVD experience

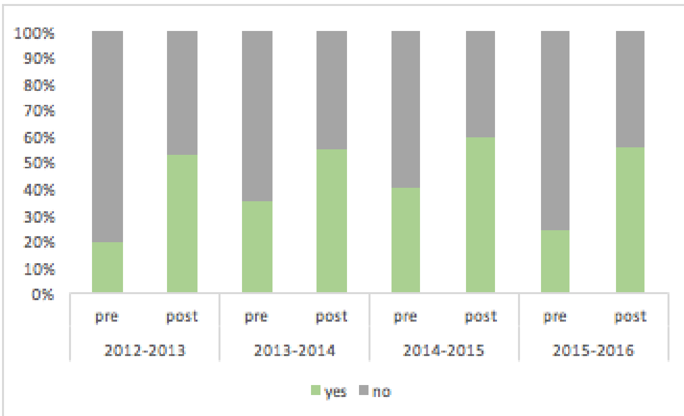
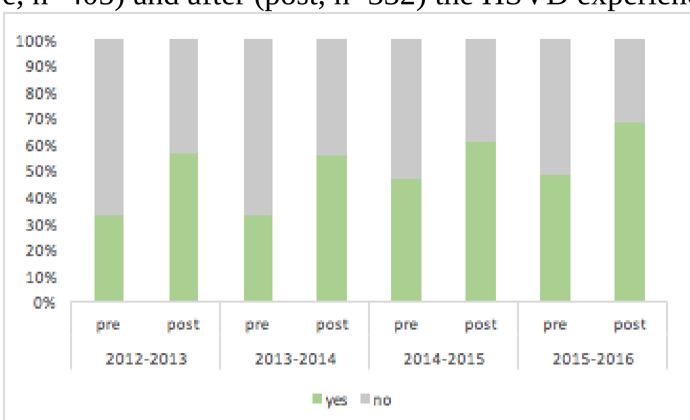



**Figure 2.** Percent of students indicating that they were considering pursuing a STEM major before (pre, n=405) and after (post, n=332) the HSVD experience.




## Conclusion

STEM educational attainment opens the door to many career opportunities. Yet college access and post-secondary degree attainment remains a disparity in today's world. This inequity coupled with the barriers for obtaining a STEM education, adds to the already difficult journey in post-secondary success for students from underrepresented groups (low-income and first generation). Though limited to a single day intervention, the HSVD was designed to address many of these barriers to college-going and pursuit of a STEM career. Our findings from the student survey reveal that, in the short-term, the program led to increased desire to pursue post-secondary education and increased interest in majoring in STEM. This was further corroborated by findings from school counselor surveys, which suggested that the opportunities for students to have first-hand experiences of the college environment and STEM classes were highly valued.

Although the program was not designed to increase exposure to college-going culture specifically for females, we found that the majority (almost 60%) of our attendees were female. Given historically low rates of participation of women in STEM post-secondary education, this exposure for our female participants is particularly encouraging. The study was limited to short-term impact, as student data were anonymous and this precluded tracking the students to determine actual persistence. However, it has been shown that intent to persist is indicative of actual persistence,[42] and thus we can conclude that our students were more likely to enroll in post-secondary education and pursue a STEM degree.

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## References

1. D. Langdon, G. McKittrick, D. Beede, B. Khan and M.Doms. “STEM: Good Jobs Now and for the Future,” 2011. U.S. Department of Commerce, Economics and Statistics Administration. http://www.esa.doc.gov/sites/default/files/ reports/documents/stemfinalyjuly14_1.pdf. [Retrieved: October, 2016].
2. M. Price. Pushing Students toward STEM. 2012. Science. http://sciencecareers.sciencemag.org/ career_magazine/previous_issues/articles/2012_07_06/caredit.a1200076. [Retrieved November 2016].
3. C. Drew. (2011). Why Science Majors Change Their Minds (It’s Just So Darn Hard). New York Times. http://www.nytimes.com/2011/11/06/education/edlife/why-science-majors-change-their-mind-its-just-so-darn-hard.html?pagewanted=all [Retrieved: November 2016].
4. J. Cooper and K.D. Weaver. (2003). *Gender and Computers.* New Jersey: Lawrence Erlbaum Associates
5. C. Y. Lester. (2005). The Influence of Vicarious Learning on Computer Self-efficacy and Computing Performance. Doctoral Dissertation (UMI No. 6133310).
6. E.D. Bunderson and M.E. Christensen. (1995). An analysis of retention problems for female students in university computer science program. *Journal of Research and Computing in Education* 28 (1): 1 – 18.
7. S. Clegg and D. Trayhurn. (2000). Gender and computing: Not the same old problem. *British Educational Research Journal* 26 (1):75-90.
8. The STEM Crisis (2013). National Math + Science Initiative. http://nms.org/Education/ TheSTEMCrisis.aspx [Retrieved October 2016].
9. Civil Rights Data Collection, Issue Brief #3, page 8, U.S. Dept. of Education, March 2014. http://www2.ed.gov/about/offices/list/ocr/docs/crdc-college-and-career-readiness-snapshot.pdf [Retrieved October 2016].
10. S. Oberoi. The Economic Impact of Early Exposure to STEM Education 2016. https://www.ced.org/blog/entry/the-economic-impact-of-early-exposure-to-stem-education. [Retrieved October 2016].
11. Alvarez, C. A., Edwards, D., & Harris, B. (2010). STEM specialty programs: A pathway for under-represented students into STEM fields. NCSSSMST Journal, 16(1), 27–29. Retrieved from http://www.eric.ed.gov/PDFS/EJ930662.pdf [Retrieved November 2016].
14. Anthony P. Carnevale, Nicole Smith, and Jeff Strohl, “Help Wanted: Projections of Jobs and Education Requirements through 2018,” Georgetown University Center on Education and the Workforce, June 2010.
15. Tornatzky, L. G., Cutler, R., & Lee, J. (2002). *College knowledge: What Latino parents need to know and why they don't know it*. Claremont, CA: The Tomas Rivera Policy Institute.

16. The College Board, “Education Pays 2013 -The Benefits of Higher Education for Individuals and Society”, Trends in Higher Education Series, October 2013.
17. U.S. Bureau of Labor Statistics, http://www.bls.gov/emp/ep_table_001.htm
18. Barr, R. D., & Parrett, W. H. (2007). *The kids left behind: Catching up the underachieving children of poverty*. Bloomington, IN: Solution Tree.
19. Perna, L. W., & Swail, W. S. (2001). Pre-college outreach and early intervention programs: An approach to achieving equal educational opportunity. *Thought and Action, 17(1),* 99-110.
20. Horizon Research, Inc., Report of the 2012 National Survey of Science and Mathematics Education, Feb. 2013. http://www.horizonresearch.com/2012nssme/wpcontent/uploads/2013/02/2012-NSSME-Full-Report-up-dated-11-13-13.pdf.)
21. ETS, Access to Success: Patterns of Advanced Placement Participation in U.S. High Schools, July 2008. http://www.ets.org/Media/Research/pdf/PIC-ACCESS.pdf.
22. Haskins, R., Holzer, H., and Lerman, R. (2009) Promoting Economic Mobility by Increasing Postsecondary Education,” Economic Mobility Project, Pew Charitable Trusts, May 2009, pp. 43-44http://www.schoolcounselor.org/asca/media/asca/home/Ratios10-11.pdf.
23. Blumberg, Z., William, C., Tierney, G. (2007) Getting There - and Beyond Building a Culture of College-going in High Schools, Center for Higher Education Policy Analysis. http://files.eric.ed.gov/fulltext/ED498731.pdf.
24. McDonough, P. M., McClaffferty, K., & Nunez, A. (2002). What is college culture? Facilitating college preparation through organizational change. *Paper presented at the Annual Meeting of the American Educational Research Association,* Los Angeles, CA.
25. Hossler, Don and Karen S. Gallagher (1987) Studying College Choices: A Three-Phase Model and the Implication for Policy Makers. College and University, 2: 207-221.
26. Yosso,T. (2005) Whose culture has capital? A critical race theory discussion of community cultural wealth. *Race Ethnicity and Education* Vol. 8, No. 1, March 2005, pp. 69–91.
27. Karen Pooley (2015) Segregation's New Geography: The Atlanta Metro Region, Race, and the Declining Prospects for Upward Mobility. https://southernspaces.org/2015/segregations-new-geography-atlanta-metro-region-race-and-declining-prospects -upward-mobility.


## Biographical Information

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Dr. Pamela Leggett-Robinson is the Associate Department and an Associate Professor of Chemistry on the Decatur campus of Georgia State University-Perimeter College. She earned her B.S. in Chemistry from Georgia State University, M.S. in Bio-Inorganic Chemistry from Tennessee Technological University, and her Ph.D. in Physical Organic Chemistry from Georgia State University. Dr. Leggett-Robinson has served as a program director for several NSF and NIH initiatives and is currently the Principal Investigator of GSU-PC’s NSF STEP grant. Her research and scientific presentations focus on natural product chemistry, surface chemistry, and student support programs in STEM Education.

### Cynthia Y. Lester

Dr. Cynthia Lester is the Department Chair of Computer Science and Engineering and Associate Professor of Computer Science at Georgia State University, Perimeter College, where she also serves as the Executive Director of STEM Initiatives. Prior to that, she was an Associate Professor at Tuskegee University. Her peer-reviewed published and internationally presented research focuses on computer science education, human computer interaction and software engineering. She holds a B.S. degree from Prairie View A&M University and M.S. and Ph.D. degrees from the University of Alabama. Dr. Lester is an International Academy, Research and Industry Association Fellow and has been a White House invitee discussing STEM Inclusion.

**Brandi Villa**

Dr. Brandi Villa did her graduate research in areas of applied and environmental microbiology as well as program evaluation of a science education outreach organization. She has been a science educator at middle school, high school, and undergraduate levels for more than a decade, and thus brings an educator and researcher’s perspective to the design and implementation of education research and program evaluation. In addition to her passion for all aspects of STEM education, Dr. Villa particularly enjoys challenges related to evaluation design, reporting and data visualization.

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Ms. Davis is the NSF GSU-PC Step coordinator. She has worked as a coordinator on several other NSF STEM initiatives over the past 10 years. She is experienced in student data systems. Ms. Davis has a BS in communication with a minor in Public Relations.