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A Balanced Approach to Building STEM College and Career Readiness in High School: Combining STEM Intervention and Enrichment Programs

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ABSTRACT

Often STEM schools and STEM enrichment programs attract primarily high achieving students or those with strong motivation or interest. However, to ensure that more students pursue interest in STEM, steps must be taken to provide access for all students. For a balanced and integrated career development focus, schools must provide learning opportunities that are appropriate for all students. This paper outlines two approaches to the creation of a comprehensive STEM College and Career development pathway in high schools.

Keywords: high school STEM program development, STEM education, STEM college and career development

INTRODUCTION

TEM workers currently make up nearly 20% of the workforce in the U.S. and are projected to expand further in the next decade (Xue & Larson, 2015); however, whether or not the U.S. can produce enough STEM professionals to meet future demand is the more important question. The President's Council of Advisors on Science and Technology projected that the country will need one million more STEM workers in the next decade to remain globally competitive in science and technology (PCAST, 2012). However, the Census Bureau predicts that the number of STEM undergraduates will decline by a million students by 2025 (NSB, 2014).

One potential contributing factor cited in the current STEM gap debate is the low number of diverse and rigorous STEM courses in American high schools (USDOEOCR, 2014). According to the data from U.S. Department of Education (DOE) Civil Rights Data Collection only 50% and 63% high schools nationwide offer calculus and physics, respectively (2014, page 1). Furthermore, about 10-25% of high schools in the country offer no more than one STEM core courses (USDOEOCR, 2014, page 1). These statistics highlight the importance of building a STEM college and career pathway for high school students, which will lead to increased interest and participation in STEM.

Another concern often discussed among educators is the limited or lack of connections between STEM learning experiences inside and outside of the classroom. The U.S. government has spent $2.8 billion to 3.4 billion funding STEM education annually (Gonzalez & Kuenzi, 2012), much of which is allocated to intervention and enrichment programs that are outside of the school day. Since many of these programs operate apart from the school, many educators are often left in the dark about program outcomes, content, and how to create extension learning opportunities within the classroom. Many schools continue to struggle to find the best approach to building a comprehensive STEM college and career pathway to meet the needs of all high school students. The purpose of this article is to illustrate an integrated approach to designing an inclusive STEM college and career pathway.

Approaches to High School STEM College and Career Readiness

Creating a pathway to STEM college and career readiness in high schools includes both access to rigorous college and career preparatory coursework (i.e. Advanced Placement courses, STEM elective classes) and opportunities to extend STEM learning during out-of-school time (i.e. afterschool STEM clubs, fieldtrips, summer programs, afterschool tutoring/mentoring). Approaches to development can be either short-term or long-term depending on program goals, school resources, and student needs. Common short-term approaches may include single-day events (fieldtrip, guest speaker) or short-duration programs (weekend workshop series). Examples of long-term strategies may include a sequence of courses or activities that provide continuous STEM learning opportunities distributed over longer periods of time. The frequency and duration of these programs can vary and can be utilized during both in-school and out-of-school time (Wilkerson & Haden, 2014). It is important to keep in mind that emphasis on any one approach will often fall short of meeting the college and career development needs of all students.

The first step for educators is to critically reflect on the strategies and approaches to STEM college and career development they utilize and identify opportunities outside of the school that can be incorporated during school to further enhance student development (Buckner & Boyd, 2015). Creating a comprehensive program to address student needs requires careful planning which is guided by a thorough student-driven needs assessment, includes the voices of all stakeholders, and leverages all resources and funding strategically. As in the design of any academic program, specific objectives and outcomes measures must be the driving force in the program development and evaluation. If planned and implemented adequately, these programs produce not just short-term, but also long-term positive effects, which include increased student engagement and achievement in coursework, enrollment in a higher education STEM programs, and interest in pursuing STEM careers (Markowitz, 2014).

Enrichment and Intervention: Goals of High School STEM Education Programs

High school supplemental STEM programs generally fall within two categories: Enrichment or Intervention. Enrichment programs typically attract high-achieving and highly motivated students, while intervention programs target specific groups of students such as women, ethnic minorities, low achieving students, etc., in hope of elevating motivation and skills. Both types of programs aim to increase exposure and engagement in STEM learning, and both are necessary components in a comprehensive approach to developing students' college and career readiness in STEM. The goals for high school STEM programs should be twofold: first develop students' interest in STEM fields, then bridge the gap between interest, skill, and knowledge to provide students the requisite preparation for STEM majors and careers (Valla & Williams, 2012).

Enrichment Programs. STEM enrichment programs or activities are specifically designed to enhance core instruction and provide addition extension opportunities for application of learning. For example, schools who offer an elective robotics course will also offer an after school robotics club where students are given the opportunity to work on class projects and incorporate new learning that may not be covered in the course curricula. These programs are essential to address the growing concern over the inability to cover all course concepts in depth due to time constraints. Another example, created by North Carolina School of Science and Mathematics, is a distance education and extension program that includes live sessions with interactive opportunities to provide additional hands-on activities and online "do-it-yourself" enrichment lessons that offer materials, videos, and guidance for independent study (http://fluorine.ncssm.edu/learn/stem_enrichments).

Intervention Programs. Without STEM intervention programs many underrepresented populations may have lacking or negative STEM experiences, which may lead to misconceptions about STEM careers, disinterest, or low perceptions of ability (Valla & Williams, 2012). Although, some of these programs also have an enrichment focus, the primary emphasis is fostering equity in experience and opportunity for a population where there is current or historic evidence of disparity in access, achievement, or participation in STEM fields. One example is offing a guest speaker series for students with disabilities where the speakers are individuals with disabilities who work in STEM fields and discuss both aspects of their job and overcoming barriers to attaining their career goals. Examples of a few popular after school or summer intervention programs include: Girls Who Code, For Inspiration and Recognition of Science and Technology (FIRST), Boosting Engineering Science and Technology (BEST), Advanced Technological Education (ATE), Operation SMART, AHC Mentor Program, Build IT, Digital Wave, VEX.

A Comprehensive STEM College and Career Readiness Program

A comprehensive STEM college and career readiness program can be achieved when schools offer both enrichment and intervention programs that combine short-term/long-term and in-school/out-of-school learning opportunities. Research on supplemental after school STEM programs indicate a correlation between program participation and an increase in pursuit of a higher education study in a STEM field (After School Alliance Report, 2011). Other positive effects of both short-term and long-term STEM programs are improved attitude in STEM fields, increased STEM knowledge and skills, higher chance of graduation and pursuing STEM careers (Afterschool Alliance, 2011). Combining both after school and during school STEM programs and activities that provide students with intervention and enrichment opportunities are key to developing a STEM College and Career Pathway that ensures readiness for all students.

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