TeachME PROFESSIONAL DEVELOPMENT

CEU's for Teachers and Educators

The Essential Elements of STEM Education

other underrepresented groups, leave STEM fields. The metaphor suggests that somewhere in the course of their preK–16 education, these groups either lose interest in STEM-related learning, lose confidence in their abilities to perform in these fields (Wells, Sanchez, & Attridge 2007; Unfried, Faber, & Wiebe 2014), or feel that the "STEM culture" is not welcoming to them (Good, Rattan, & Dweck 2012; Smith, Lewis, Hawthorne, & Hodges 2013), resulting in large numbers of students opting out of (or not opting into) STEM majors and careers (e.g., Blickenstaff 2006; Wickware 1997). Thus, many efforts to improve STEM education seek to grow student interest and achievement through increased time and emphasis on STEM subjects, different approaches to the content, and the use of a variety of instructional strategies. One such strategy is the creation of inclusive STEM high schools, which aim to provide rigorous STEM learning (Riley et al. 2013) to students of all socio-economic, demographic, and achievement backgrounds (Peters-Burton et al. 2014).

Despite the attention and resources being given to STEM and STEM schools, there remains little consensus about what STEM schools should look like in practice and even about what "STEM" actually is in the operational context of K12 education. Some definitions of STEM focus on disciplinary integration. For example, Merrill (2009) defines STEM as

> a standards-based, meta-discipline residing at the school level where all teachers, especially science, technology, engineering, and mathematics (STEM) teachers, teach an integrated approach to teaching and learning, where discipline-specific content is not divided, but addressed and treated as one dynamic, fluid study (pg. 1).

Others take the interdisciplinary nature one step further by proposing that efforts to integrate STEM subjects should expand to encompass the arts, thus shifting the "STEM" initiative to the "STEAM" initiative (Science, Technology, Engineering, Arts, and Mathematics; Platz 2007).

In contrast, still others see the STEM movement as an opportunity to highlight subject-specific content that had previously been overlooked. More specifically, they highlight the "T" or the "E" in STEM (e.g., "Staking the Claim for the 'T' in STEM" [Kelley, 2010], "Supporting the T and the E in STEM" [Harrison, 2011], "Advancing the "E" in K-12 STEM Education" (Rockland et al. 2010)).

Despite this lack of shared definition, there are numerous schools around the country that identify themselves—in name, mission, or otherwise—as *STEM schools.* Selective enrollment math- and science-focused high schools, which admit based on achievement, have existed for several decades (e.g., Subotnik, Tai, & Almarode 2011). These often highly competitive schools, however, serve only a small portion of the student population, and enrollment of minority students has typically been low (Means, Confrey, House, & Bhanot 2008). Inclusive STEM high schools, which are the focus of the current study, have no admissions criteria for students and as such serve a broader and often more diverse population of students (Means et al. 2008; NRC 2011). These schools have more recently emerged as a trend and are now found around the country. Beyond the surface-level characteristic of their enrollment structure, however, the ways and extent to which inclusive STEM high schools are similar or different in their intended models and practice has been to largely unknown—which poses a problem for research on STEM schools as a singular innovation.

Researchers are already beginning to engage in comparative studies of inclusive STEM schools and their surrounding non-STEM counterparts (e.g. Young et al. 2011); however, what is lacking from the current body of literature on STEM schools is an examination of what STEM schools *are* in actuality—what they do, how they interpret the term "STEM," what their goals are—and thus what outcomes we can and should expect from them. Without shared language to describe STEM schools, findings about impact will not contribute to a developing knowledge base that can inform continued growth and improvement.

In this study, we address the questions: What is an inclusive STEM high school? What specific components are present in these schools? Why are components present, meaning, what specific outcomes are intended for students, staff, and the community at large? We examine how inclusive STEM high schools *themselves* articulate what they are; how this may (or may not) align with the national push for improved science, technology, engineering, and math education; and the outcomes they intend for their students. Understanding the intended models and specific model components of functioning inclusive STEM schools allows us to examine the implementation of strategies and how that implementation relates to outcomes, as well as to develop a comprehensive theoretical framework of common STEM school practices, which we present here. This framework can inform future research and suggest a widely applicable model that will provide policy-makers and practitioners with common ground for discussion and collaboration. It can also help interested practitioners understand, implement, and improve the practices these STEM schools use. The insight gained from this study about what STEM school leaders believe makes their schools "STEM schools" also illuminates the definition of STEM that these leaders are employing, which has important implications for understanding student STEM outcomes.

Methods

Theoretical approach

This paper describes the findings of the "STEM School Study" (S3; NSF #1238552), which examined 20 inclusive