

What is a STEM course: Identifying High School STEM students for research purposes

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Community Colleges of Spokane (CCS) are attempting to identify Science, Technology, Engineering, and Mathematics (STEM) pathway students and track GPA, college enrollment, academic focus, and academic completions and transfers from high school through college to provide local high schools with information regarding the success of their students. In the data team's attempt to determine an appropriate method for identifying STEM students, it has become apparent that there is a lack of consensus on what courses and programs of study qualify as STEM. This paper hopes to address the inconsistencies of STEM classifications as a method of obtaining consensus for what STEM is.

Though there has been much research regarding STEM programs, there is ambiguity in the types of programs that should be considered STEM. For example, while the National Science Foundation (NSF) identifies STEM programs as mathematics, natural sciences, engineering, computer and information sciences, psychology, economics, sociology, and political science, the National Governors Association (NGA) focuses only on Science, Technology, Engineering and Mathematics (National Governors Associations, 2007).

Research related to the identification of STEM college students relies on declaration of an intended major, although there are variations of demarcation there as well. Rask (2010) identified courses more in alignment with the NSF STEM categorization while excluding sociology and political science programs. Conversely, Chen (2009) subscribed to the NGA definition, which included mathematics, natural sciences (including physical and biological/agricultural sciences), engineering/engineering technologies; and computer or information sciences. Chen (2009) excluded the social or behavioral sciences.

Most high school student STEM research analyzes those students retroactively, meaning students self-identify based on their college program selections. (Price, 2010; Wai, Lubinski, Benbow, & Steiger, 2010) The research that identifies STEM pathways students while in high school is more limited in approach, focusing on only one or two academic programs (mathematics and science) that are most easily defined. Wai et al. (2010) identified STEM students during high school and tracked their STEM achievements over a span of 25 years. However, this research was limited to only students who were designated as mathematically gifted. Federman (2007) also identified STEM students during high school and evaluated the impact of state graduation requirements on course-taking behavior and related that to high school and math course taking and college major choice. The focus of this study was limited to only mathematics and science programs.

Community Colleges of Spokane's STEM pathways study aims to look at students from high school through post-secondary, rather than from college and backward. The result of this approach is that students are not able to be identified as a STEM pathway student based on a college major selection. The original intent was to identify course-taking behavior that would designate a student as a STEM pathway student. Unfortunately, the ambiguity in defining STEM programs poses a challenge to organizations as well as practitioners charged with supporting a STEM pathway or pathways for students. The absence of any formal demarcation and subsequent coding prohibits valid and reliable data collection/analysis.

In the CCS study, many strategies have been considered for identifying STEM courses, but the ideal solution is yet to be found. Originally, high schools were asked to self report the class hours spent in STEM courses above and below a C grade level. Locally, several high school administrators indicated this may not be the best approach because the data might not be consistent across schools as the definition of STEM varies and consistent, accurate high school coding is virtually non-existent. While a

course might be identified as STEM in one high school, another nearby district may not agree. Other districts have argued that all courses are STEM courses.

Classification of Instructional Programs (CIP) codes were pursued as a way to reliably identify STEM courses, but these codes have not been used long enough by high schools for meaningful data tracking. There are also concerns that they may not be used consistently across districts to provide meaningful groups. A further limitation is that CIP code usage by some districts in Washington State is currently limited to career and technical courses.

The BERG Group, hired by Washington Office of the Superintendent and Public Instruction (OSPI) looked at STEM course-taking behavior by manually inspecting high school transcripts and highlighting the courses determined to be a STEM course based on Washington Higher Educating Coordinating (HEC) board requirements and the National Collegiate Athletic Association (NCAA) approved courses for NCAA initial eligibility list. This appears to be the most thorough attempt to define STEM students by course-taking behavior in high school in Washington; however, individually inspecting transcripts for students will be quite time consuming and may not be the most cost effective way to identify STEM students.

For further research and conceptualization, there is a real need to reach a consensus on what constitutes a STEM program and what courses should be considered STEM. With so much focus on STEM in the classroom and at the policy level, it is imperative to have a uniform definition of what STEM is and what it is not. At the very least, the essential characteristics or defining attributes of STEM courses or outcomes as well as their desired, demonstrated mastery must be identified. A national literature review provided little direction toward defining a STEM student or identifying STEM courses. What is apparent, however, is the need to develop a local, regional, and, perhaps, national definition across the education spectrum.

A clear definition of STEM would provide consistent coding. Consistent coding allows evaluation and continuous improvement; and the pooling of resources and best practices around programs and

students. Because STEM courses are often considered the purview of the high-achieving pre-engineering or science major, clearly identifying STEM outcomes may assist those being marginalized and not included in the STEM fold. Consistent coding would also help ensure informed decision-making processes, while responding reliably to data-driven initiatives. It would also allow institutions to be positioned well to respond to grant solicitation requests and assist in leveraging funding and resources across systems. Clearly, further discussion and decisions are required.

References

- Chen, X (2009). Students Who Study Science, Technology, Engineering, and Mathematics (STEM) in Postsecondary Education. *Stats in Brief, NCES 2009*, 161.
- Federman, M (2007). State Graduation Requirements, High School Course Taking, and Choosing a Technical College Major. *The B.E. Journal of Economic Analysis & Policy*, 7, 1-32.
- Green, M (2007). Science and Engineering Degrees: 1966-2004 (NSF 07-307). Arlington, VA: National Science Foundation.
- National Governors Association (NGA) (2007). Building a Science, Technology, Engineering and Math Agenda. Washington, DC.
- Price, K. M. (2010). *Undergraduate Women in STEM: Does Participation in STEM Extracurricular Programs Enhance Success Among Students?* Retrieved from Florida State University College of Education, Dissertations and Theses Database. (
- Rask, K (2010). Attrition in STEM Fields at a Liberal Arts College: The Importance of Grades and Pre-Collegiate Preferences. *Economics of Education Review*, 29, 892-900.
- Wai, J., Lubinski, D., Benbow, C. P., Steiger, J. H. (2010). Accomplishment in Science, Technology, Engineering, and Mathematics (STEM) and Its Relation to STEM Educational Dose: A 25-Year Longitudinal Study. *The Journal of Educational Psychology*, 102, 860-871.