Math on the Path to STEM Fields

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Ensuring that there is a sufficient and well-equipped workforce to contribute to Science, Technology, Engineering, and Mathematics (STEM) fields is key to keeping pace with workforce needs in sectors ranging from health care to energy to manufacturing to economy (Committee on STEM (CoSTEM), 2018). However, the STEM workforce lacks diversity, where women, Black and Latinx persons, and persons with disabilities continue to be underrepresented. This means their perspectives are not well-represented and they have limited access to the socioeconomic benefits that are associated with employment in STEM fields (Carnevale et al., 2014). The underrepresentation of these groups in STEM fields is apparent in college and even in K-12 education. Engaging students in STEM pathways early on will increase the likelihood that they enter and persist in these fields throughout their secondary education and beyond. Given that school psychologists work with all stakeholders within the school community – students, teachers, administrators, and parents – they are uniquely positioned to facilitate efforts for engaging students in STEM pathways. One such pathway is taking advanced math courses in high school.

Students who enroll in advanced math courses in high school are more likely to attend and graduate from college, major in and persist in STEM fields, and enter STEM-related careers (e.g., Aud et al., 2012). The likelihood of entry in STEM fields is increased by enrollment in calculus or more advanced math courses, as compared to algebra or trigonometry. However, Black and Latinx students are less likely to take these courses than their White peers (Tyson et al., 2007). Although more female students are now enrolled in advanced mathematics courses than in the past, they are still underrepresented in the most advanced courses, such as Advanced Placement Calculus. Underrepresentation of these groups is apparent even among students with similar achievement levels or prerequisite math coursework (Andersen & Ward, 2014). To inform efforts to improve representation of students in advanced math, it is important to consider what helps with student engagement.

In a recent study we examined why students who demonstrated strong mathematics ability enrolled in high school calculus courses, because not all do. Additionally, we wanted to look not just at race/ethnicity or gender differences, but at how race/ethnicity and gender together play a role in student enrollment. Considering both characteristics acknowledges that students have multiple identities (e.g., Black female), which is especially important to consider when one or more identities are traditionally marginalized or underserved.

We used a nationally representative data set to examine what motivational and contextual factors predicted calculus enrollment for each of six groups—Black female and male, Hispanic female and male, and White female and male students. The students included in our study were considered to have strong math ability as indicated by scoring in the top two quintiles on a standardized math assessment. Students answered survey questions about their motivation for math, including enjoyment and usefulness of math, confidence in math skills, and identity as a "math person." In addition to these motivators, we considered external and contextual factors, such as the encouragement they received to take math and if they were on an academic track.

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There were no motivational factors that explained student enrollment for all groups. Motivational factors were most predictive for White male and female students and least predictive for Black male and female students, which is consistent with other research (Wang, 2013). This suggests the need to better understand and engage students who are the least represented in STEM fields. Academic track explained calculus enrollment for nearly all groups, and was the only factor that explained calculus enrollment for Black female students. Interestingly, all or nearly all Black female and Hispanic male students who were enrolled in calculus were on an academic track compared to only about 75% of students in other groups, which indicates inequities in how this systemic school structure shapes students' academic experiences (Reyes & Domina, 2017). Working with students, families, teachers, administrators, and the broader community, school psychologists can leverage these connections and resources to address issues of motivation and school structures that can help strengthen student engagement in STEM pathways.

Preparing students for engagement in STEM pathways begins early. Differences in resources that young children and their families have access to lead to differences in the skills and knowledge that children have when they begin school. Parents may need advice on how to support their children's learning (Sonnenschein & Stites, 2019). School psychologists can work with parents to identify inexpensive or no-cost resources and activities to do at home to build on children's curiosity and promote their interest and skills in STEM.

Within school settings, school psychologists can help teachers identify resources to make STEM-related learning more equitable, which involves building on student interest and identity and using culturally relevant instructional approaches that place value on students' identities (Garibay & Teasdale, 2019). Tailoring efforts to your own unique school community will help to strengthen motivation - one way to do this is building in opportunities for students and families to share ideas, interests, and experiences.

Many schools and districts employ mechanisms like academic tracking to guide students' course trajectories but may need support to ensure that tracking does not limit students' access to advanced courses long-term. Though math is cumulative in nature and requires foundational knowledge to do well in more advanced courses, schools should develop ways for students to obtain the requisite knowledge if they did not have earlier opportunities to do so or simply developed an interest later in their schooling experience. Removing forms of tracking altogether may be difficult or not always desirable, but organizations such as the Century Foundation have resources to expand access to enriching school experiences for all students (Potter, 2019). Additionally, raising parents' awareness of course trajectories early on will help them to advocate for opportunities that will benefit their child over time.

Schools may not have all resources in-house, which is where strong community partnerships may help to fulfill needs or complement efforts. For engaging underrepresented students, school psychologists can identify community resources or organizations that provide students with hands-on experience and learning opportunities. Organizations such as Black Girls CODE aim to strengthen STEM participation of Black girls ages 7 to 17 by introducing them to computer coding via community outreach programs (e.g., workshops, afterschool programs; (Black Girls CODE, n.d.). Your community may have this or other similar programs that can provide useful informal learning experiences for students. Such experiences also can help to strengthen students' own STEM identities by seeing role models with whom they can identify.

Schools want the best for their students. As our knowledge grows so too do our strategies to more effectively engage and provide opportunities for students. School psychologists can help to strengthen student representation and engagement in STEM pathways well before college and career.

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