How might we ensure teachers have access to quality STEM instructional materials?

TEACHERS LACK FUNDING TO PROVIDE QUALITY STEM INSTRUCTIONAL EXPERIENCES.

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01 CONTEXT AND TRENDS

Many science, technology, engineering, and math (STEM) courses and content require or benefit from specific facilities and materials, such as laboratories, microscopes, electronics, and plants. Many schools have cited shortages in funding for STEM for materials like these; in some cases, these shortages may be due to how funds are allocated rather than the available funding (National Science Foundation, 2014). Funding systems for STEM that are not consistent, centralized, or coherent may lead to irregular funding and limited access to STEM courses at the local level, particularly for science, technology, and engineering subjects that are not prioritized in terms of school accountability and performance (U.S. Department of Education Office for Civil Rights, 2014). Although some schools and districts have leveraged corporate, nonprofit, and foundation support to help fund STEM programs in the absence of targeted federal funding, not all schools are able to access these resources, nor are these funding streams stable and reliable over time (Westervelt, 2015). This lack of targeted funding support for STEM specifically has resulted in inadequate resource allocation for STEM facilities and materials at the school and classroom levels.

02 DISCUSSION

There is substantial anecdotal evidence describing the lack of access to funding, facilities, and materials for STEM at the classroom level. A few studies have noted that many schools do not have the physical infrastructure (including school buildings themselves), equipment, or materials needed to adequately provide STEM learning experiences (Ejiwale, 2013). Others have recognized that some STEM programs, such as those focused on robotics, require costly equipment and materials that are too expensive for individual schools to purchase (Chiu, Price, & Ovrahim, 2015).

Some of the most compelling evidence on teachers' lack of access to STEM funding comes from the testimonies of teachers themselves. In 2007, the president of the National Science Teachers Association shared selected quotes from the hundreds of comments they received from teachers about inadequate local funding for science facilities and materials.

These comments focused on inadequate funding for materials, improper or poor-quality instruments, a lack of any suitable spaces to be used for laboratories, or inadequate safety materials. Other comments indicated that the lack of proper equipment left students less engaged and underprepared for post-secondary STEM courses, and led to higher dropout rates for postsecondary STEM courses (U. S. House of Representatives Subcommittee on Research and Science Education, Committee on Science, 2007).

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With school and district budgets shrinking, there is some evidence that teachers have attempted to close the funding gap for instructional materials by purchasing their own materials. Recent research indicates that teachers are personally covering the majority of the cost of instructional materials, and that nearly all teachers are spending at least some of their own money on materials (National School Supply and Equipment Association, 2013; NPD Group, 2015). However, many teachers cannot afford to purchase more expensive instructional materials for STEM education. For example, robotics equipment can often cost hundreds of dollars, which may be supported by districts but often not by individual teachers (Mataric, Koenig, & Feil-Seifer, 2007). Some teachers have reported purchasing relatively low-cost materials for science courses that are easily accessible, such as chemistry experiment ingredients that can be purchased at a grocery store or gardening materials (Wantanabe, 2011; Href & Durand, 2016). However, many teachers have stressed that low-cost materials do not provide students with sufficiently rigorous learning in STEM subjects (U. S. House of Representatives Subcommittee on Research and Science Education, Committee on Science, 2007)

03 BRIGHT SPOTS

Many teachers access supplemental funding for STEM materials and facilities through grants, such as those offered by the Toshiba America Foundation or the S.P.A.R.K.S. Foundation, or through crowdfunding websites, such as GoFundMe pages. There are other sites (such as donorchoose.org and pledgecents.com) that focus specifically on soliciting funding for classroom projects or needs.

For teachers without access to adequate laboratory spaces, there are also opportunities for schools and teachers to access lab learning experiences or programs from colleges and universities. While most colleges and universities do not offer schools or teachers unstructured access to labs, many offer programs that provide learning experiences to students and teachers. For example, the University of Utah hosts a free science day of workshops for high school students, parents, and educators each fall. Likewise, the University of Washington has established partnership programs with students and teachers at local high schools to provide lab-learning experiences.

Other learning labs opportunities are offered through partnerships. For example, Boston Public Schools has partnered with local universities and business partners to host STEM learning labs in their classrooms (Walsh, 2016). In Pittsburgh, a physics teacher partnered with Carnegie Mellon University and the University of Pittsburgh to create and house a

series of science learning kits in physics and chemistry, which can be loaned out to teachers and have been used across Pittsburgh Public Schools (Wodzak, 2015). These kits combine materials with curriculums to allow teachers to provide ongoing science instruction without consistently seeking additional funding or support.

Thousands of schools nationwide have used a program called Project Lead the Way to procure funding for STEM while also promoting STEM integration, rather than one-shot opportunities. Project Lead the Way utilizes third-party grant funding to provide schools with a structured STEM curriculum, a train-the-trainer model to help teachers integrate the lessons into their instruction, and at least one Project Lead the Way Lead Teacher that works with both teachers and administrators to support the implementation of the model. The program also includes tools and support to help schools determine how much funding they will need to contribute to support program implementation. The program includes elementary, middle, and high school STEM integration programs (Bennett, 2012; Project Lead the Way, 2016).

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Schools and teachers who cannot access supplemental funding, materials, or laboratory spaces can promote STEM in other ways. Many teachers have worked to integrate STEM practices into daily instruction, including inquiry, experimentation, logic, and use of evidence. By promoting small-scale learning activities, teachers (especially elementary teachers) can help prepare students academically for more advanced STEM courses. For example, some teachers in Chicago Public Schools have worked to integrate mathematical thinking into preschool classes by using technology, hoping to improve students' inquiry skills from an early age (Asa, 2016). Some leaders have advocated for STEM-focused elementary and middle schools to ensure that STEM skills are emphasized throughout classroom instruction. Many programs taking this approach work to utilize free STEM resources or bring-your-own policies to ensure that this approach is fiscally feasible (Wulfenstein, 2013; Johnson et al., 2013). For example, New York City schools has launched a bring-your-own initiative where students use their personal cellphones to gather information, collaborate with other students, and share questions. The program also includes efforts to supply students without their own phones with refurbished models they can use in the classroom (Huseman, 2015).

04 CONCLUSION

The preponderance of teacher reports on inadequate STEM funding at the classroom level, in tandem with the many programs and grants focused on providing supplemental resources and experiences, clearly point to a need for better funding for STEM materials and resources. Given the limited data, however, there is a need for more research clarifying whether this limited access to resources stems from funding shortages or budget allocation decisions at the local levels. When STEM funding is treated as a supplemental cost, rather than a priority, these funds may be reallocated or used in ways that leave classroom teachers of STEM subjects without adequate resources.

In the short term, direct grants for teachers to purchase STEM teaching materials, resources helping teachers to implement low-cost STEM teaching practices, and opportunities to use external learning lab spaces are helpful. However, these "Band-Aid" or stopgap solutions are not sufficient to support consistent, high-quality STEM education for all students. Targeted resources for STEM education need to be incentivized and prioritized to ensure that districts, schools, and teachers can ensure high-quality and equitable access to STEM learning experiences and coursework for all students.

ABOUT THE GRAND CHALLENGES WHITE PAPERS

In 2017, 100Kin10 released an unprecedented representation of the big, systemic challenges to preparing and supporting STEM teachers following over two years of extensive research alongside more than 1,500 STEM teachers and hundreds of other education experts. As a part of this work, 100Kin10 commissioned a series of short white papers from well-versed thinkers and practice-oriented researchers to synthesize the most relevant research around the specific challenge areas. Together, they compose a thoughtful and well-rounded examination of the systemic challenges currently facing STEM teaching.

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