How might we raise the prestige of the STEM teaching profession?

TEACHERS LACK COLLABORATIVE WORK ENVIRONMENTS

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01
CONTEXT AND TRENDS

For K–12 science, technology, engineering, and mathematics (STEM) teaching to be an attractive career choice for STEM college graduates, the job needs to have some of the same sort of working conditions that draw the best and brightest to places like Google, Cisco, Intel, and high-tech startups. That's a tall order on a limited budget. The challenge is that K–12 STEM college graduates who choose K–12 teaching carry the same student debt, but do not make the same salaries, garner the same prestige, or live their work lives in the same ultra-cool working environments we hear about in the 10 Best Places to Work lists. (Of course, teachers do change the lives of the next generation every day, but teachers should not have to trade off everything else for their noble calling.) One aspect of the working environment that high-achieving STEM college graduates desire and may not cost that much to create in schools is an atmosphere of collaboration.

STEM industry professionals desire collaboration, as it is widely understood to fuel good thinking and innovation and provides community and support in the midst of challenging work (Lafargue, 2016). Studies show that when employees work in teams and have the trust and cooperation of their team members, they outperform individuals and teams which lack good relationships. Great leaders are team-builders; they create an environment that fosters trust and collaboration (Marshall, 1995).

Unfortunately, K–12 teaching is not the first place most people would look for a collaborative work environment. Traditionally, each teacher has spent most of the day in a single room, separated from other teachers, and has rarely been provided the time to plan lessons, share instructional practices, assess students, or design curriculums together with other teachers. Researchers have noted cultural norms of isolation and privacy and a lack of teacher collaboration for decades (Lortie, 1975; Little, 1982; Rosenholtz, 1989; Sarason, 1996). U.S. teachers report little professional collaboration in designing curriculums and sharing practices, and the collaboration that occurs often tends to be weak and not focused

on strengthening teaching and learning. This need not be the case. Teachers in many countries with high-achieving students, like Japan, Netherlands, Sweden, and Singapore, experience many more opportunities for collaboration (Organisation for Economic Cooperation and Development [OECD], 2007; Barber & Mourshed, 2007).

02 DISCUSSION

Collaboration is simply the action of working with others to produce or create something. In STEM education, collaboration takes many forms, ranging from co-teaching to common planning among teachers, and has many purposes, ranging from curriculum development to shared problem-solving. In terms of practice, collaboration to enhance STEM teaching and learning can involve STEM teachers working with each other, a mentor/coach, special education professionals, or English learner specialists. It can take place among teachers of a single STEM subject, teachers of STEM disciplines, or teachers of both STEM and non-STEM areas. It also can involve STEM teachers working with external STEM industry or higher education experts or professionals in the field, including parents or other community members who are in STEM occupations.

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Collaboration is one of several positive working conditions that are associated with higher levels of teacher satisfaction and retention (Ingersoll & Kralik, 2004; Smith & Ingersoll, 2004). Effective collaboration exposes teachers to improved practices and builds social capital to support professional learning, which leads to stronger pedagogy and greater student learning. Research has linked higher levels of teacher collaboration with higher levels of student achievement (Goddard, Goddard, & Tschannen-Moran, 2007; Ronfeldt et al., 2015). But keep in mind that teacher autonomy also matters for teacher satisfaction and retention (Ingersoll, 2006), and there are indications that teacher autonomy has been declining during the past decade (Sparks, Malkus, & Ralph, 2015). As we increase collaboration, we also need to ensure that teachers retain autonomy or control over what happens in their classrooms (Johnson, 2003). Furthermore, all collaboration is not effective collaboration. Collaborations focused closely around student learning and assessment of that learning appear most effective, while vague, general, or unsustained collaborations were not associated with positive student outcomes (Ronfeldt et al., 2015).

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Despite research showing its benefits, schools are not always designed or led with collaboration at the center. Many teachers believe that principals do not prioritize time for

teacher-to-teacher learning and collaboration, and that principals are often unsure of how to foster a collaborative learning environment for teachers. Many teachers also believe that districts do not hold school leaders accountable for creating positive working conditions like an atmosphere of collaboration (Leithwood, 2006). These issues and the problematic working conditions they engender are especially salient in high-poverty schools (Johnson, Kraft, & Papay, 2012). Research suggests that principals may be in the best position to influence school working conditions (Burkhauser, 2016).

Despite the challenges faced in this area for many years, some teacher surveys have indicated that teacher collaboration is on the rise (Markow & Pieters, 2010), but the intensity and quality of teachers' opportunities for sustained collaboration are not clear (Darling-Hammond, Wei, & Adamson, 2010). There also is a growing recognition in the field that teachers need common planning time, and there appear to be increases in coaching, mentoring, induction, and professional learning communities in recent years. It is critical that these experiences are high-quality collaborations. There are several resources that provide guidance on ways to make the most out of common planning time, organize professional learning communities, and facilitate other opportunities for teacher collaboration (College & Career Academy Support Network, 2016).

03 BRIGHT SPOTS

Several bright spots demonstrate the recent trend of STEM teaching becoming a more collaborative enterprise. As previously discussed, common planning time is becoming more prevalent, and in some schools, principals are stepping up to create better working conditions for their teachers. An example of the critical role a principal plays can be seen in a case study of Wildwood IB World Magnet School, a K–8 school in Chicago, where teacher collaboration fosters a collaborative culture that puts the students' learning first, lessens teacher conflict, and turns one teacher's best practice into a schoolwide norm. Additionally, project-based learning (PBL) and interdisciplinary instruction are becoming less rare, and technology and internet connectivity allow peer-to-peer networks to be much more robust venues for teacher collaboration.

PBL and interdisciplinary instruction are obvious vehicles for collaboration. In PBL, teachers and students typically integrate concepts and skills from one or more disciplines while investigating a problem and codeveloping potential solutions. The interdisciplinary nature of the instruction requires teachers to connect with each other in order to develop their curricula, share resources and best practices, and learn how to best support each other in this work (Jones, Rasmussen, & Moffitt, 1997). But also, importantly, instruction that connects students to potential careers and postsecondary experiences builds critical relationships for sustainable career-themed teaching, where teachers are afforded the opportunity to collaborate with local STEM industry, institutes of higher learning, and professional subject matter experts. For example, see case studies of two innovative programs, in Milwaukee, Wisconsin, and Appalachian Ohio, supported by the NEA Foundation and the AT&T Foundation.

Although it remains a challenge to get STEM teachers to take full advantage of technology and participation in social networks and research has found that teachers do not appear to naturally build advice networks that would cultivate the highest levels of practitioner-based social capital (Baker-Doyle & Yoon, 2011), there are several promising efforts to build the infrastructure for such online social networks where STEM teachers can collaborate.

States, districts and nonprofits, as well as other nations, are developing thriving online networks of STEM teachers, which can provide educators access to the kind of intensive, peer-to-peer professional development that allows individuals to collaborate, to feel connected and empowered, to continue to learn and be challenged, and to sustain their interest and job satisfaction over a long career. Examples of such networks include:

- American Federation of Teachers' ShareMyLesson website, an online network with over 1 million educator members, which provides access to thousands of mathematics and science lesson plans sorted by grade level and topic.
- The Facebook group NGSS Biology Teachers, whose members are encouraged to share any advice, lesson planning tips, and constructive input that can improve the methods other teachers use to approach biology according to the Next Generation Science Standards.
- The Knowles Science Teaching Foundation's online network, made up of hundreds of STEM teacher leaders across 39 states.

04 CONCLUSION

Teaching in STEM disciplines is challenging work. Ensuring that STEM teachers feel part of a collaborative enterprise is a key pathway toward recruiting and retaining excellent STEM teachers ready to take on this challenge. There is a major opportunity to make STEM teaching attractive with the trends toward districts and schools providing teachers with more time locally to collaborate, and advancements in technology that provide greater ease of collaboration via digitally enabled peer-to-peer social networks. If administrators do not ensure that STEM teachers experience a high-quality collaborative workplace, however, this important opportunity may be missed.

- **If you are a STEM teacher,** reach out to serve as a teacher leader. Serving in this type of role as a facilitator of common planning time, mentor, or coach, you can act as a vital collaborator for one or more of your peers. Consider expanding your instruction into projects and activities that allow you to draw in collaborators from STEM postsecondary institutions and industry. If your local situation does not offer what you need, expand your professional network using technology and social networks to work with STEM educators and leaders around the country and world.

- **If you are a principal or district administrator,** take action to create an environment of workable schedules, consistent shared priorities, access to external resources, and peer-to-peer professional learning that allow STEM teachers to take on the challenge of providing excellent STEM instruction together.

- **If you are a researcher,** you might examine teachers' social networks more closely or evaluate whether any of the recent efforts designed to promote teacher collaboration are in fact changing the nature of teaching into a more collaborative enterprise.

- **If you are a champion of STEM,** spread the word that STEM teaching appears to be more collaborative than ever before. Look into the programs and strategies like those highlighted in this paper, or other promising programs that are on the leading edge of creating peer-to-peer networks that offer STEM teachers the sort of collaborative environment that supports their efforts to engage in ambitious STEM instruction. You can join the movement to provide America's classrooms with 100,000 excellent STEM teachers by working with a 100Kin10 partner.

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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