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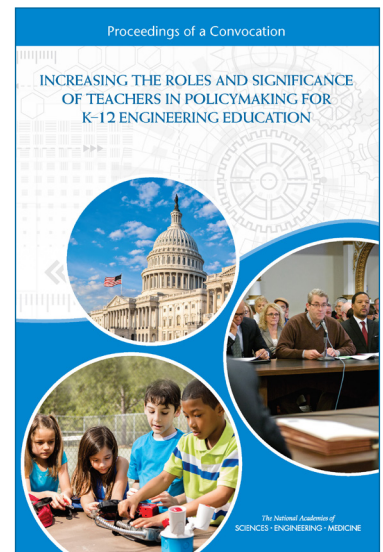
## Increasing the Roles and Significance of Teachers in Policymaking for K-12 Engineering Education: Proceedings of a Convocation

Engineering is a growing part of K-12 education. Teachers at all grade levels increasingly are using the principles and practices of engineering to capture the attention of students, improve their learning of science, technology, engineering, and mathematics (STEM), and spark their interest in engineering careers. Reforms stimulated by the Next Generation Science Standards are reinforcing this trend. At its most ambitious, K-12 engineering education has the potential to foster much more integrated forms of STEM education by serving as a central organizing approach to teaching and learning.

However, as has often been the case with K-12 education reform, many of the policies and practices that are shaping K-12 engineering education have not been fully or, in some cases, even marginally, informed by the knowledge of practicing teachers. The result is that education policy and decisionmakers may be missing promising opportunities to improve teaching and learning that arise from teachers' experiences, insights, and "wisdom of practice."

To address the current lack of teacher leadership in engineering education policymaking and how this problem might be mitigated as engineering education becomes more widespread in K-12 education, the National Academies of Sciences, Engineering, and Medicine's Teacher Advisory Council (TAC), in collaboration with the National Academy of Engineering (NAE), held a convocation in Washington, D.C., September 30-October 1, 2016. Funded by a grant from 100Kin10 and with additional support from the Samueli Foundation, the convocation brought together more than 100 experts and teacher leaders to explore how new avenues of teacher preparation and professional development, integrated curriculum development, and more comprehensive assessments could be shaped by policies informed by input from teachers.

This document presents highlights of the convocation and is based on the publication *Increasing the Roles and Significance of Teachers' Voices in Policymaking for K-12 Engineering Education: Proceedings of a Convocation* (2017), available for download without cost at [http://nas.edu/K12\\_Teachers\\_Voices\\_in\\_Engineering](http://nas.edu/K12_Teachers_Voices_in_Engineering).



The possible actions noted in this summary do not represent the consensus views of convocation participants, the Teacher Advisory Council, or the National Academies of Sciences, Engineering, and Medicine. Rather, they are meant to raise possible ideas about teacher leadership and contributions to policymaking in K-12 engineering education as a basis for continued outreach and conversation among local, regional, and national stakeholders.

## THE NEED FOR TEACHER LEADERS WHO CAN SHAPE POLICIES IN K-12 ENGINEERING EDUCATION

Teachers are typically not policymakers, but they possess the knowledge and information that can contribute to the development of effective policies, observed Donna Migdol, a STEM teacher and professional developer for the six elementary schools in Oceanside, New York, and co-chair of the planning committee for the convocation. They know how students learn and the importance of students' emotional, social, and intellectual well-being. They have a deep understanding of the needs of students at different grade levels and in different contexts. They know how policies can affect their classrooms, schools, districts, and states. "For policies to have important and positive impacts on our students as learners and teachers as practitioners, teachers' and students' voices must be heard," said Migdol.

Opinions differ on the best way to teach K-12 engineering, noted Norman Fortenberry, executive director of the American Society for Engineering Education and the other co-chair of the planning committee. Engineering can be taught as a stand-alone subject, as part of a science or mathematics class, or as an integrator of other STEM subjects. The expertise of teachers is particularly valuable in resolving different approaches and establishing effective engineering education policies, he said.

To create meaningful policies, diverse sources of expertise need to be acknowledged and combined, said Laura Bottomley, teaching associate professor in the colleges of engineering and education at North Carolina State University. "To me, that's one of the greatest challenges in getting teachers' voices, because of all the [groups involved in education] teachers are the ones who are underestimated and undervalued perhaps the most."

Teacher leaders can take on a wide variety of roles, including those that affect policy. They can assist with informing the development of curricula or other teaching materials, present at school board and other meetings, take on leadership roles within their schools, represent teachers outside of schools, become involved in politics, engage in research expe-

riences or fellowships that promote leadership and bring that new expertise back to their schools, and work with other organizations at everything from the local to national levels.

To have an influence on policy, teachers cannot "wait for someone to ask," said Peggy Brookins, the president and CEO of the National Board for Professional Teaching Standards. "You have to be involved, you have to be at the table. We always say that if you're not at the table, you're on the menu." Taking on leadership roles requires training and raising "the expectations that we have of ourselves," she added.

At several points throughout both days of the convocation, participants broke into subgroups to discuss possible actions that might be taken to address the issues associated with teacher leadership in K-12 engineering education and policymaking. In subsequent plenary sessions, representatives of the subgroups recounted the ideas generated during the breakout sessions. **Because they were generated during the discussions of the subgroups, the ideas presented below are not attributed to individuals. They should be considered as possible actions proposed by individual convocation participants and not as consensus statements of the breakout groups or of the convocation as a whole.**

## IDEAS GENERATED IN THE BREAKOUT SESSIONS

### POSSIBLE ACTIONS FOR TEACHER LEADERS

Teacher leaders could contribute to the development of standards for engineering education at different grade levels, drawing on their experience of teaching engineering as a stand-alone subject and as a component of other STEM classes. In this way, they could help incorporate the subject into existing classes and strike an effective balance between engineering and other subjects, both within classes and across classes.

Teacher leaders could form partnerships with organizations outside of schools, in both the private and public sectors and at levels ranging from the local to the national, to further engineering education and influence relevant policies.

Teacher leaders could identify and vet resources on K-12 engineering education and post those resources on Websites for local teachers while providing support for their colleagues in using and implementing those resources.

Teacher leaders could help their colleagues, schools, and districts get access to the tools, knowledge, and resources they need to do much more extensive networking and be involved in policymaking.

Teacher leaders could help design and deliver professional development and help exert quality control over these activities, with mentoring, coaching, and other forms of support embedded in professional development experiences.

Teacher leaders could help design and deliver mentoring programs for new engineering teachers, for teachers making the transition from another subject to engineering, or for teachers who are attempting to incorporate engineering into other STEM courses.

Teacher leaders could work with teacher professional societies to develop what might be considered a model law or a model regulation of a certification for engineering education, which would allow teachers to advocate for particular outcomes within the contexts of their states.

Teacher leaders could act as resources for universities as they frame their preservice programs, enabling universities to facilitate conversations between teachers and the state about certification policies and regulations.

#### **POSSIBLE ACTIONS FOR ADMINISTRATORS AND EDUCATION POLICYMAKERS**

Administrators and policymakers could help change the messaging associated with K-12 engineering education to attract more students and teachers to the subject and to promote the voice of teachers in shaping policy.

Administrators and policymakers could conduct surveys of teachers in their districts to gauge their interests in engineering education and their needs in teaching the subject.

Administrators and policymakers could work with teachers to identify best practices based on consistent pedagogical principles across districts, grades, and subject-matter areas and gauge whether those practices are being implemented.

Administrators could be champions for their teacher leaders, creating environments for success by allowing teachers to raise concerns, ask questions, and come up with their own ideas.

Administrators and policymakers could support professional development that is based on and tailored to teachers' needs, including their levels of experience in teaching and their familiarity with engineering concepts.

Administrators could be partners by participating with teachers in professional development so they experience the learning that can help them support engineering education, with connections in place linking the local, district, state, and national levels.

Administrators and policymakers could support technology education teachers who want to expand their instruc-

tion to include engineering concepts and practices.

Administrators and policymakers could facilitate the creation of groups that can gather information regarding an assessment system for engineering education and develop material for field testing.

#### **POSSIBLE ACTIONS FOR EDUCATION RESEARCHERS, COLLEGE AND UNIVERSITY FACULTY MEMBERS, AND PROFESSIONAL ORGANIZATIONS**

Researchers could support the development and work of teacher leaders, in part by accepting and acting on feedback from them about the kinds of research that would be most helpful to practitioners.

Researchers could help teacher leaders to pioneer new roles that combine teaching with research or other activities, thereby helping teachers to develop expertise in fields outside of teaching and enabling them to bring that expertise back into the classroom while remaining teachers.

Researchers and college and university faculty members could help identify characteristics of teacher leadership in engineering education by developing an overarching framework and through case studies that encompass teachers with many different backgrounds and working circumstances.

College and university faculty members could help develop future teachers' identity as engineering educators by bringing education policymakers into the classroom, defining teacher career arcs, involving professional societies, avoiding conveying oversimplified messages about the nature and roles of engineering, and requiring engineering methods courses as part of all K-12 teacher preservice programs.

College and university faculty members could study and recognize the multiple entry points and pathways in preparing future K-12 engineering teachers.

Researchers and college and university faculty members could develop alternative pathways through colleges of engineering for future teachers while working with the state to help rewrite requirements for certification.

Researchers and college and university faculty members could participate in a study of certification models for K-12 engineering education across states.

Engineering faculty members and teacher-preparation faculty members in colleges and universities could engage in much higher levels of collaboration than exist today to prepare future K-12 engineering teachers.

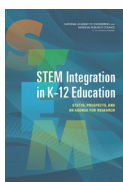
STEM professional societies could form partnerships with teacher leaders and administrators to promote their involvement in policy making and match available resources with teachers' needs.

**For More Information . . .** This Convocation Highlights was prepared by the Teacher Advisory Council and the National Academy of Engineering based on the convocation proceedings *Increasing the Roles and Significance of Teachers in Policymaking for K-12 Engineering Education: Proceedings of a Convocation* (2017). The convocation was sponsored by the 100Kin10, and the Samueli Foundation, and by in-kind support from the Teaching Channel. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author and do not necessarily reflect the views of any organization or agency that provided support for the project. Copies of the proceedings are available from the National Academies Press, (800) 624-6242; <http://www.nap.edu> or via the Website at [http://nas.edu/K12\\_Teachers\\_Voices\\_in\\_Engineering](http://nas.edu/K12_Teachers_Voices_in_Engineering).

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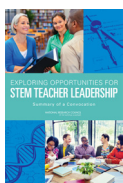
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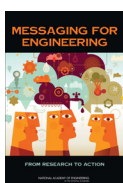
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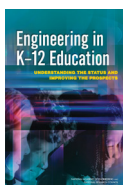
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