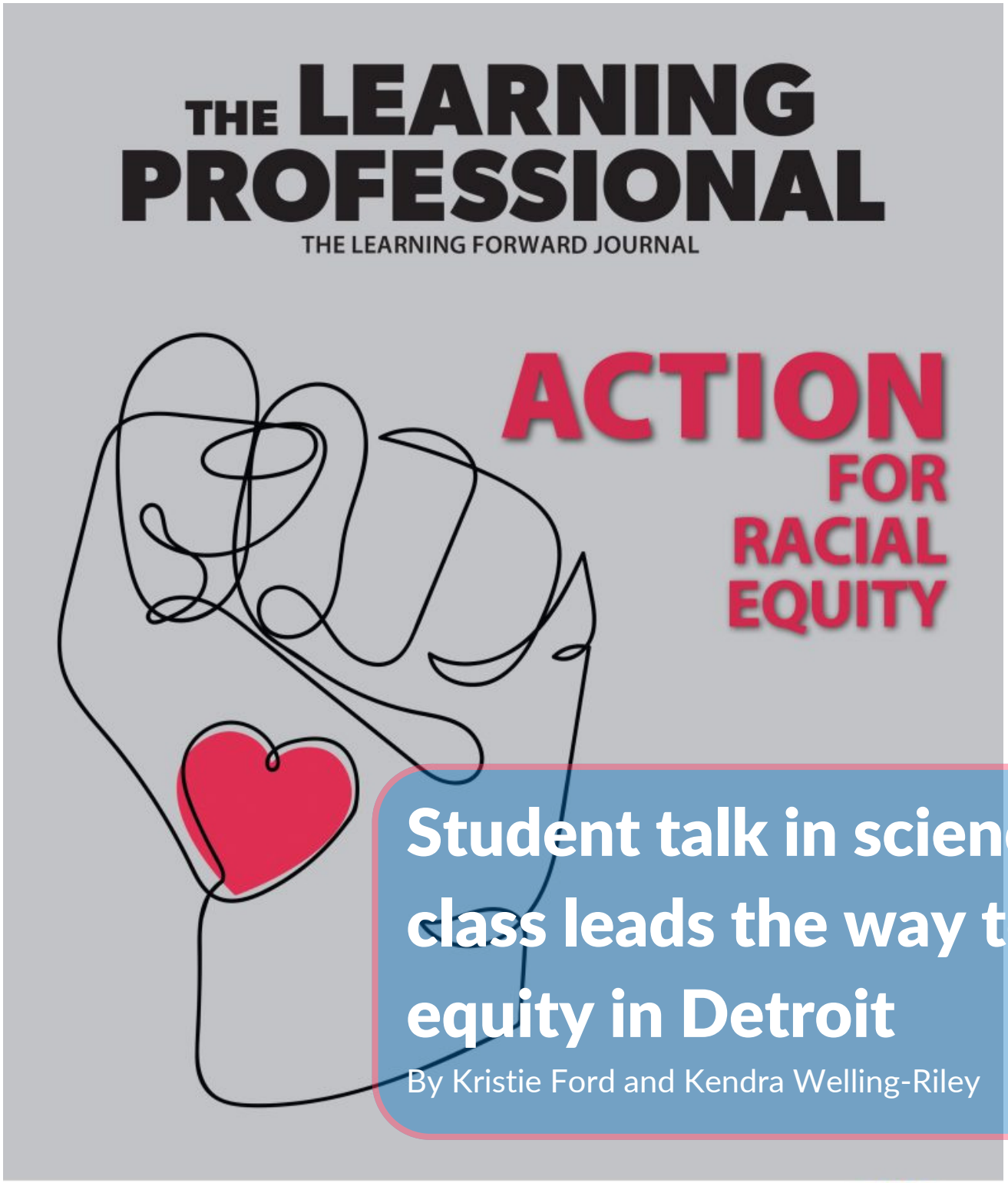

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By Kristie Ford and Kendra Welling-Riley

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The pursuit of racial equity in public education has a long history in the United States. For example, in the 1780s, 14 Black parents in Boston petitioned the Massachusetts Commonwealth's legislature to give their children access to newly formed public schools (Hill, 1981). Since then, Black people, and people of color more broadly, have led heroic efforts for equal access, racial integration, fair school funding, and language equity in public schools.

Although that initial petition was denied, the ongoing work has resulted in enormous changes in our public education system, from desegregation of public schools to dedicated federal funding for schools with low-income families and multilingual students (Stanford University, n.d.).

Yet, despite decades of progress, racial inequities are a persistent, even paralyzing, presence in American public schools. The No Child Left Behind era saw noticeable increases in test scores across all student groups, but outcome differences by race remained pronounced (Smith & Brazer, 2016). Stubborn patterns of inequity in graduation rates, grades, test scores, disciplinary actions, and access to extra- and co-curricular activities still plague our schools (The Education Trust, 2017).

These patterns exist across urban, suburban, and rural schools, and even within schools. Outcomes are sometimes so disparate that white and Black students, for instance, can experience the same school in completely different ways.

Inequities persist across all content areas, but are particularly entrenched in STEM subjects (UNCF, n.d.). The Detroit Public Schools Community District's Office of Science, where we serve as executive director and training and support coordinator, is striving to change that. With our colleagues, we aim to address some of the root causes of racial disparities endemic to science classrooms and across the curricular spectrum by focusing our teacher professional learning on instructional practices that engage students. Specifically, we're focusing our teacher professional learning on student talk in our science classes and whether students of all backgrounds contribute to discussions.

Before addressing the specific interconnections among science talk, equity, and instructional practice, we provide a brief overview of the research on student talk and then connect it to our core mission of racial equity in science instruction.

Equity in student talk matters

Decades of research link student talk to student learning through intra- and interpersonal channels. At the intrapersonal level, talk helps students process information (Fisher, Rothenberg, & Frey, 2008). Talk is a mode of sense-making, a means of creating connections between and among facts and concepts, and a manner of reasoning and problem solving.

From the perspective of the brain, when students are talking they are moving ideas, whether simple or complex, from working memory to long-term memory. This results in higher retention of new concepts, supports development of scientific vocabulary and meaning, and improves student capacity to understand larger systems such as the water cycle, the food web, or organism growth and development, which is why Science Talk is a key evidence-based practice supported by the Next Generation Science Standards (San Diego County Office of Education, n.d.).

Student talk also strengthens learning through interpersonal dynamics with teachers and peers. For example, through checks for understanding, in which students articulate their thinking, teachers can discover what their students know and refine instruction in real time to meet student learning needs (Fisher & Frey, 2015). By talking with peers, students can discover how others answer problems, build on each other's ideas or perspectives, and strengthen associations between concepts (Eberly Center, n.d.).

Student talk also helps with developing a vital skill for adulthood: Articulating ideas in sequential, logical, and persuasive ways. Developing the capacity to communicate accurately and scientifically is essential to progressing in STEM beyond high school. Apart from STEM, learning how to express ideas, take risks in sharing perspectives publicly, and collaborate with peers has enormous social, cognitive, and economic value over time and is therefore central to high-quality education (SINC, 2017).

Because student talk drives student learning, discrepancies in who has the opportunity to talk have enormous implications for racial equity in our classrooms. In groundbreaking equity research, Elizabeth Cohen and Rachel Lotan designed an intervention that created more equal opportunities to speak within a heterogeneous classroom. In these classrooms, the supposed "achievement gap" between various student subgroups disappeared (Cohen & Lotan, 1997).

Later research reinforced this key finding, showing that English learners benefit the most from talking in class but often get the fewest opportunities to speak (Ho, 2005). Equity of student voice also has connections to disciplinary disproportionality with research showing that the more opportunities teachers give students to respond, the fewer

classroom disruptions occur (Sutherland et al., 2003). Changing who gets opportunities to speak in our classrooms is an important goal to advance more equitable learning opportunities.heir world. We're excited to build on this emerging success going forward.

Building equitable talk

This rich history of research on student talk and equity guides our pedagogy in the Detroit district's Office of Science and has guided teacher professional learning over the past two years. Our professional learning emphasizes standards in practice, sets clear expectations of teachers and students, supports engaging instruction, and builds a reflective culture, with an eye toward equity.

Standards in practice: Teachers often tell us that written academic standards can be vague, subjective, intangible, and impractical. Our job is to help teachers put standards into practice. For example, the Michigan Science Standards, inspired by the Next Generation Science Standards, expect students to engage in authentic scientific work as they build fundamental science knowledge and connect to concepts across curricula. So we developed interactive, practice-oriented professional learning that helps teachers bring scientific discussion, thinking, and inquiry to life for all students.

We ask teachers to reflect on the standards: How will you know students are engaged in the kind of work that addresses the science standards? What is your evidence? Teachers want more students offering hypotheses for scientific phenomena, engaging in experiments, reasoning through problems, and exchanging ideas with each other — all of which show up in class as more student discourse.

Teachers then work collaboratively to create questions, prompts, and lesson plans that generate meaningful student discourse the next day. Teachers readily see standards in practice when their students are engaged in deep discussions and debates about science-based concepts, facts, and systems. A shift in practice from lecture to inquiry equitably supports our students of color.

Expectations: Setting expectations for student talk takes two forms here in Detroit: expectations of teachers from district and school leaders and expectations of students from teachers. We administrators try to set clear and consistent expectations for student talk as an instructional imperative among science teachers. We are constantly reviewing curricula, lesson plans, and instructional materials for alignment to this instructional imperative and to ensure that students from all backgrounds have opportunities to talk.

For example, we look to implement curricula that anchor lessons in inquiry about scientific phenomena, we review lesson plans with teachers to plan for student talk with open-ended, authentic questions, and we provide posters with student talk scaffolds for students to refer to during classroom discussions. In observations requested by teachers, we look for the teacher's essential questions for her particular lesson, her probing of student thinking, and her facilitation of student sense-making.

But more importantly, we know our teachers must have expectations that their students are capable of learning through discourse. This is critical for equitable outcomes among students of color, students with disabilities, and English learners. Teachers have to believe in the power, agency, and resiliency of their students as they puzzle through understanding with greater depths of knowledge, which is often captured by student discourse. In short, we want to help shift teacher mindsets from getting through content to understanding how students grow their skills and knowledge to become adept STEM thinkers.

Our professional learning experiences achieve this by expanding teachers' pedagogical content knowledge. Starting from what they already know about content, we challenge teachers to imagine ways they could learn more about their students' lived experiences to then find ways to connect content to students' lives in a way that establishes relevance. We zero in on teaching techniques such as asking questions and brief (three-minute) debates in which anyone can engage.

These discussion techniques activate prior knowledge and get students oriented toward thinking about the next steps the teacher will take with content. Using relevant research, we help teachers formulate questions and prompts that take students gradually and with scaffolding into more complex depths of knowledge. Teachers subsequently look at evidence from their teaching, often with the help of a coach, to explore the effects of their modified and new strategies.

Instruction: Of course, standards and expectations don't matter if they don't translate to instruction. We have to change how we teach if we want to change who learns in our classrooms. Therefore, we provide teachers with monthly virtual professional learning options on instructional themes of their choice.

Popular topics among our science educators have included "Questioning Technique — Essential Questions," "Relationships, Relevance, and Rigor in Science," and "Lesson Planning for Equitable Engagement." The goal is to give teachers choice and agency to address their own immediate learning needs in alignment with our district's standards.

Reflective culture: Perhaps most important, we seek to build a reflective culture of continuous improvement among our science teachers through the analysis of classroom data with a particular eye toward racial equity. Detroit science teachers are piloting TeachFX, an app for teachers that

automatically measures their teacher talk time compared to student talk time, questioning techniques, use of think time, equity of voice, lesson design, and more.

By using voice artificial intelligence to analyze discourse patterns and surface teaching insights from a teacher's class, the app can support teachers whenever they want feedback personalized to their own instruction and private to them. Administrators cannot access the data for evaluative purposes, so teachers can try new instructional strategies and reflect on objective data without fear of being punished.

This private and readily accessible source of data pairs well with more subjective and periodic forms of feedback that instructional leaders commonly provide. Teachers can triangulate data from TeachFX, student work, live coaching feedback, and summative assessments to calibrate their own instruction and learn from peer educators.

With teacher privacy protected, we can look across aggregated and anonymized data to visualize equity of voice, even in online classes — a great benefit during remote learning this past year. By anonymously analyzing discourse patterns by student group, grade level, and content area among volunteer teachers, we can see where we need to better support teachers to make science talk more equitable.

We've been pleased with the early results of our efforts. Over 300 teachers have used the TeachFX app or attended our professional learning workshops to examine their practice through the lens of student talk and equity of voice.

More talk, more action

Among the piloting TeachFX teachers, we saw a 45% increase in student talk in classrooms where over 90% of students are Black or Brown. That growth didn't come easily. In professional learning workshops, teachers described being shocked by their data at first, but then they decided to take a few more risks, redesign some of their lessons, rethink some of their questions, remember to use their "think time," and encourage every student to get involved in the discussion.

Teachers are giving high marks for the ways in which the sessions allow teachers to strengthen their teaching skills by reflecting on objective TeachFX data from their classrooms. Numerical ratings on a battery of satisfaction and learning questions average 9.0 or higher on a 10-point scale. Comments are equally positive. As one master teacher reacted after a professional learning session spent reflecting on her data, "The very first time I used TeachFX, I was amazed at the amount of time I was talking."

Reflecting after a questioning technique session, another teacher said, "I like the idea of building on questions from one to another to add depth to the classroom discussion and the engagement of the students." Teachers tell us they now have a better understanding of the science standards, and they're developing and sharing with each other the pedagogical content knowledge they need to deeply engage students in learning.

We still have much work yet to do and many challenges to overcome, especially while we work to help students' families struggling with basic needs exacerbated by the COVID-19 pandemic. Yet we all agree that high-quality public education — an education that elevates equity and student talk in the classroom — is a powerful vehicle to empower learners and change mindsets about what our students are capable of and how they can impact their world. We're excited to build on this emerging success going forward.

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