Science curriculum gets a boost from teacher leaders

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A high-quality curriculum is vital for students to meet academic standards, and educators need professional learning to implement the materials effectively and align their instructional practices accordingly (Chu et al., 2022; Short & Hirsh, 2020). However, the growing movement for curriculum-based professional learning often overlooks an important resource for implementation: teacher leaders.

Unlike administrators, teacher leaders continue in the classroom while also demonstrating, facilitating, or building capacity among their peers. This positions them well to lead the implementation of new curricula. Unfortunately, many teachers do not see themselves as leaders, nor do

their supervisors or the general public (Bybee, 2023).

Recognizing that teacher leaders play an essential role in curriculum adoption and implementation, the Chicago Public Schools Department of STEM (Science, Technology, Engineering, and Math) partnered with Loyola University Chicago's Center for Science and Math Education to create a system of professional learning designed to advance teachers' practice while also explicitly enhancing their leadership capacity.

A cornerstone of this effort was the science master teacher leader cohort, a group of science teachers in the district who worked collaboratively with the Center for Science and Math Education and with each other. With support from the Bill & Melinda Gates Foundation, the group built a program that addressed common gaps in the field by defining teacher leadership, attending to issues of diversity and equity, and detailing leadership preparation components (Wenner & Campbell, 2017). That effort is paying off in improved instructional strategies and teachers' leadership development.

ESTABLISHING CRITERIA, NAVIGATING CONSTRAINTS

The district sought to recruit experienced science teachers to participate in 25 hours of professional learning yearly, with the plan that teachers would participate in the cohort for multiple years and new teachers could be recruited to account for attrition.

We invited teachers to apply to the master teacher leader cohort if they had demonstrated expertise in instruction aligned to the Next Generation Science Standards (NGSS), knowledge about Amplify Science (the K-8 science curriculum chosen by the district's science leaders and teachers), or leadership potential.

The targeted outcome goals for the cohort were:

1. Develop a community that shares and reflects on the key components of high-quality science instruction;
2. Engage in collaborative learning cycles of planning, implementing, and reflecting on instructional strategies; and
3. Reflect and share progress toward personal leadership learning goals.

In the years 2018-22, many factors put constraints on these goals, including COVID-19 school closures, hybrid learning, and systemic educational inequities. Set against these significant challenges, the project's ambitious scope required modification over time.

DEVELOPING A PROTOTYPE: 2019-20

In November 2019, 30 K-8 science teachers met to kick off the master teacher leader cohort and engage in collaborative professional learning. Amidst the adoption of Amplify Science, the teachers were excited to develop high-leverage instructional strategies for implementing the new curriculum.

To share and reflect on best practices, these teachers engaged in small-group collaborative plan-do-study-act (PDSA) learning cycles around a chosen focus area: student discourse, writing in science, or formative assessment. Giving teachers choice provided an individualized system of learning that was aligned with the Learning Designs standard of Standards for Professional Learning (Learning Forward, 2022). The teachers also attended an additional 24 hours of Amplify-specific professional learning outside of the leadership cohort to ensure curriculum expertise and a shared understanding of the key components of an NGSS-aligned classroom.

Leadership development in the first year of implementation focused on preparing teachers to facilitate curriculum-specific professional learning. Teachers analyzed case studies from *Teacher Leadership in Mathematics and Science: Casebook and Facilitator's Guide* (Miller et. al., 2000) and developed leadership skills to prepare for these roles.

When the schools suddenly faced the COVID-19 pandemic in March 2020, the cohort pivoted to learning cycles centered on the challenges of remote learning. This would come to define the next year of the program.

ADAPTING TO NEW CONSTRAINTS: 2020-21

The pandemic not only disrupted learning but unearthed barriers and disparities that minoritized communities have long faced in our education system. National discussions of educational reform for equity, the social and political climate of the nation, and hybrid learning all profoundly impacted students' and teachers' mental health.

In this context, the importance of being responsive to educators' immediate needs was apparent. Therefore, our goal was to sustain science teaching excellence focused on high-leverage instructional practices in a hybrid setting and, at the same time, attend to teacher and student social-emotional well-being.

All master teacher leader cohort participants collaborated virtually around instructional practices and formative assessment as well as one of three differentiated pathways for continuous learning. New members participated in Deepening NGSS Implementation. Returning members selected either Amplify Professional Learning Facilitation, which focused on building capacity to disseminate best practices districtwide by studying principles of adult learning and developing leadership skills, or School and District Leadership, which focused on building leadership skills.

The PDSA small-group work continued. Problems of practice included communicating scientific ideas, connecting content to the real world, developing student scientific identity, and evaluating student

discourse. Whole- and small-group work allowed for reflection on best practices for NGSS-aligned instruction.

Throughout, the cohort adapted to the constraints of virtual professional learning. Teachers shared celebrations and challenges of hybrid teaching, concentrating on meaningful ways to assess student progress.

REFINING THE DESIGN: 2021-22

As the project progressed, participant feedback revealed successes and opportunities to refine the professional learning design. Learning cycles aligned with Standards for Professional Learning (Learning Forward, 2022) were a key component to building capacity for science teaching excellence. But while we had successfully developed a network of teachers implementing high-leverage instructional practices, we realized we needed to strengthen the leadership development portion of the program.

We restructured our support into inside the classroom and outside the classroom learning strands, each with its own unique set of goals. We introduced learning cycle action plans as an inside the classroom activity to lend structure to the PDSA process, outlined in the table on p. 35. As the name implies, this shared document gave groups the means to plan collaboratively for implementation throughout the learning cycle.

To support the learning cycle action plans, we introduced a pineapple chart protocol as a tool for making teachers' practice public (Barnes & Gonzales, 2015). The pineapple chart is a system that allows teachers to invite one another into their classrooms for informal observation.

In our iteration of this protocol, volunteers prepared a brief presentation of a specific strategy that increased student engagement in the science and engineering practices, such as facilitation moves to leverage student-to-student discussion. This addition developed teacher expertise as science educators while also allowing a safe space for participants to practice leadership skills by sharing and receiving feedback from other adult learners.

Through differentiated activities outside the classroom, participants strengthened their leadership skills and developed personalized leadership goals. Goals included becoming professional learning facilitators, school leaders, Amplify Science curriculum experts, school or district advocates for science, and thought partners with colleagues at the Chicago Public Schools Department of STEM. Participants showcased their individualized goals, artifacts, and reflections from this learning strand in a leadership portfolio.

TESTING THE PROGRAM: 2022-23

Equitable science teaching became a priority in the most recent iteration of the master teacher leader cohort. Participants had established a foundation and were gaining traction with high-leverage instructional practices, and they were now positioned to tackle the equity issues that became obvious in 2020.

With support from new Chicago Public Schools instructional frameworks, we created opportunities for teachers to unpack their identities, examine biases and privilege, and reflect on how these factors impact interactions with students and peers (Brown, 2019). Activities included conversations about the wheel of power and privilege (adapted by Sylvia Duckworth, n.d.), equity within instructional practices, and how an individual's positionality intersects with social identity and impact (Jacobson & Mustafa, 2019).

We continued with leadership development and pedagogical learning, refining and differentiating the learning activities to help educators navigate career development and strengthen their teaching practice. We also led immersive learning experiences, showcasing phenomenon-driven instruction, storyline sequencing, and strategies for equity and identity.

Andy DeVivo, 4th-grade science specialist, Chicago Public Schools.

A PARTICIPANT'S PERSPECTIVE

"Teaching can be an isolating experience with few moments of collaboration, but as a member of (the master teacher leader cohort), I was part of a community of like-minded individuals who inspired me to continue to improve my practice so that my students had a more rich and transformational learning experience in science."

— Andy DeVivo, a member of the first master teacher leader cohort in 2018. At that time, he was a 4th-grade math and science teacher. He continued to participate in the cohort until 2022, when he joined the Chicago Public Schools Department of STEM as the 4th-grade science specialist. He now serves as one of the facilitators of the master teacher leader cohort.

MASTER TEACHER LEADER COHORT LEARNING CYCLE ACTION PLANS		
November–January	**February–March**	**April–May**
Learn and plan	**Do** **Study**	**Act and share**
• Build community. • Ensure shared understanding of our purpose. • Identify the question(s) we aim to answer. • Research and share best practices for effective instruction in the focus area.	• Begin integration of new practices into instruction. • Share and discuss data about what worked, what didn't, and how we know. • Discuss and identify trends, successes, needs, and priorities. • Refine our question(s) and plans.	• Reflect on practices and content implemented. • Create a plan of action to continue the work.

We included a video reflection component, in line with the Learning Designs standard of Standards for Professional Learning, to make learning "engaging, self-directed, and rewarding" and to help "build educators' feelings of self-efficacy" (Learning Forward, 2022). Teachers videoed instruction related to their goals, reflected on their footage, and used these reflections to guide group conversations.

IMPACT

About 70 teachers from 56 Chicago Public Schools have participated in the master teacher leader cohort program, and their participation is paying off in the following ways.

Cohort teachers are science instructional experts in the district.

We surveyed cohort participants at the start and end of each school year and compared findings with Chicago Public Schools science teachers participating in other professional learning from Loyola University Center for Science and Math Education. According to these survey results, cohort participants reported less instructional time engaging in direct instruction compared to other science teachers, suggesting increased use of NGSS-aligned instructional strategies. They also reported greater confidence in their ability to implement NGSS-aligned instruction in the classroom than comparison teachers.

Artifacts created by participants support these findings. Cohort participants have developed formative assessment tools, scientific writing tasks and rubrics, resources for leveraging student-to-student discussion, and a number of equity and inclusion practices for the science classroom. The pineapple chart protocol initiated the development of a library of NGSS high-leverage strategies with the Amplify Science curriculum that can be used for future districtwide dissemination of best practices.

Cohort teachers have advanced their careers within the district.

Four former cohort members have been hired as science specialists in the Chicago Public Schools Department of STEM. At the school level, cohort members are serving on instructional leadership teams, leading science-focused grade-level meetings, hosting community science nights, forming science committees, and developing and facilitating science professional learning. At the district level, there is a growing group of teacher leaders who develop and co-facilitate districtwide science professional learning and moderate an online community for district science teachers.

Cohort teachers set the example for equity within their classrooms and across the district.

Participating teachers are incorporating student identity into their delivery of the curriculum and their assessment practices. They facilitate conversations at the school and district levels to put equity practices at the forefront of science teaching.

IMPROVING THE DESIGN: 2023-24 AND BEYOND

The master teacher leader cohort's impact on science teaching in the district is just beginning. The next steps include a plan for sustainability and replicability. In 2023-24, the cohort is being redesigned as a two-year Master Teacher Leader Academy that continues and expands strategies for equitable, NGSS-aligned instruction and leadership capacity. Activities from the last four years that have proven to align

2023-25 GOALS AND ACTIVITIES		
Year	**Program goal**	**Key activities**
1	Collaborate around key components of a three-dimensional NGSS classroom.	• Small group collaboration around learning cycles and shared problems of practice. • Pineapple chart presentations. • Classroom video self-reflections. • Reflections on identity, power, privilege, and positionality. • Monthly individualized instructional coaching.
2	Make progress toward personal leadership learning goals.	• Leadership case study analyses. • Pineapple chart presentations. • Leadership self-assessment. • Individual leadership goal-setting. • Leadership stories and portfolios.

with Standards for Professional Learning (Learning Forward, 2022) will shape the scope and sequence.

The 2023-25 goals and activities are outlined in the table above. Academy participants will facilitate districtwide professional learning, curate a video library of NGSS-aligned instructional strategies, and open their classrooms for peer observation. Impact measurements will expand to include interviews with cohort members, strategic analysis of participant feedback, and data from coaches' classroom visits.

The future looks bright for the master teacher leader cohort, and every year presents a new opportunity to further refine this model for science teacher leadership development. We are also confident that this model is replicable beyond the discipline of science and can be an exemplar for other districts looking to develop a teacher leadership program.

Research shows that leadership is second only to classroom instruction in school-based factors influencing student success (Grissom et al., 2021; Leithwood et al., 2004). Combining great teaching and great leadership can be key to improving outcomes across content areas.

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