WIDA

Making Science Multilingual: An Interdisciplinary Program and its Evolution

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WIDA

> *The authors are grateful to Rita MacDonald and David Crowther for their generous support of the research that led to this report.*

WIDA Research

WIDA advances academic language development and academic achievement for children and youth who are linguistically diverse through high quality standards, assessments, research, and professional learning for educators.

The overarching goal of research at WIDA is to promote educational equity and academic achievement for linguistically and culturally diverse students.

To achieve this goal, we work in partnership with districts, states, and national experts to conduct research focused on understanding and explaining the educational experiences and outcomes of language learners. Through our research, we also aim to inform the decision-making needs of educators and policymakers who serve these children and youth.

The WIDA research team is housed within the Wisconsin Center for Education Research (WCER). Located at the highly ranked School of Education at the University of Wisconsin–Madison, WCER is one of the first and most productive education research centers in the world.

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Introduction

This report discusses the establishment and early development of a collaborative, interdisciplinary program titled Making Science Multilingual (MSM). The program is part of a broader affiliation between two organizations: WIDA and the National Science Teaching Association (NSTA). The purpose of the program is to promote high-quality science instruction for multilingual students. A distinguishing feature of the program is that it involves the long-term collaboration between language and science educators. The main objective of the collaboration is to help support "equitable three-dimensional science instruction and learning where language is seamlessly contextualized and integrated for success for all students from all language backgrounds" (MacDonald et al., 2020, p. 2).

The MSM program addresses four "critical aspects" of equitable science instruction for multilingual youth: (a) the development of science identities in students, (b) students' equitable engagement in all instructional activities, (c) students' language development through this engagement in disciplinary learning, and (d) formative assessment practices that integrate science reasoning and effective language use (MacDonald et al., 2020).

MSM is made possible through an affiliation between WIDA and NSTA, which was formalized in 2019. (Discussions about an affiliation between the two organizations had begun in 2016.) The program has two co-leads: Rita MacDonald (WIDA) and Dr. David Crowther (University of Nevada, Reno). Rita MacDonald is an associate researcher and language expert at WIDA with extensive experience in the development of instructional resources for science, technology, engineering, and mathematics (STEM) teachers of multilingual students. David Crowther is a science teacher educator with both

a national and international reputation who has a longstanding professional interest in the science education of multilingual youth. He was the president of NSTA in 2017-2018.

The purpose of this report is to inform WIDA decision-making about future professional affiliations. The report encompasses the first year of the MSM program, which includes its formation and the conceptual development of its goals and pedagogical approach. The report addresses the rationale for the program, milestones it accomplished, resources it required, relationships it fostered, questions it tackled, and challenges it faced.

The report is based on a range of data collected for research purposes. These data include summaries of recorded regular meetings between the two co-leads, notes from face-to-face meetings between the co-leads, documents related to administrative processes and reporting (such as mission and vision statements, steering committee meeting notes, and an end-of-year report), as well as interviews with the co-leads. The report's two authors collected and analyzed the data, but were otherwise not directly involved in program activities.

Program Rationale

The formation of the MSM program was necessary for both WIDA and NSTA to meet the commitments outlined in their missions. NSTA aims to promote the science learning of all students, including those who are multilingual. WIDA strives to advance the learning of multilingual children and youth in content-area classrooms. A shared goal of both organizations, therefore, is the development of high-quality educator resources that support the equitable engagement of multilingual students in science. The development of such resources is at the heart of the MSM vision. In addition, the

affiliation as a whole and MSM in particular enable both organizations to make resources available to distinct, but often overlapping stakeholder groups: science educators and teachers of multilingual youth.

Improving the science education of multilingual youth is a priority for NSTA because of persistent evidence that multilingual students have limited access to rigorous science instruction. Multilingual students are underrepresented in STEM fields in college and in the workforce, at a time when the demand for workers and professionals in STEM fields is unmet and expanding (National Academies of Sciences, 2018). A key reason for this underrepresentation is a persistent opportunity gap in STEM education for multilingual youth: multilingual students are often excluded from participating in science instruction and have limited access to STEM courses (National Academies of Sciences, 2018). Awareness of this opportunity gap and an urgent need for high-quality resources to support the teaching of multilingual youth (voiced, for instance, at the 2019 National Congress on Science Education by affiliate members and presidents) motivated NSTA to seek a partnership with WIDA.

WIDA is well-placed to collaborate with NSTA. Its staff includes experts in language development who have knowledge of science education. WIDA has a history of developing resources that specifically target STEM teachers of multilingual learners (see the *Doing and Talking Math and Science* project funded by the National Science Foundation, http://stem4els.wceruw.org). Most importantly, WIDA counts content-area teachers of multilingual children and youth among its key stakeholders.

Despite its commitment to supporting the content-area learning of multilingual students, WIDA has been unable to meet the needs of general education teachers on its

own. Its standards are used primarily by language educators, and language educators are the largest group of teachers who participate in its professional development offerings or access its website. A partnership with NSTA offers WIDA the invaluable opportunity to collaborate with experts in the teaching and learning of science. This collaboration can help ensure that any resources that get developed reflect robust science instruction and address science teaching in ways that science educators recognize.

The MSM program enables the collaboration between content-area and language experts over time. Such a long-term collaboration is indispensable for the design of high-quality resources that support content-area teachers in meeting the needs of multilingual children and youth (Lee, 2019). Collaboration over time among educators with different sets of expertise is essential because the main issue they need to tackle – robust content and language integration – is highly complex. Both language and science educators need to embark on a journey to understand each other's perspectives, priorities, and practices. It is this joint journey that the MSM program makes possible.

Program Foundations

The continuous existence of the MSM program depends on two main factors: the support for the program by both organizations involved (NSTA and WIDA), and a productive working relationship between the two co-leads. In its first year, the MSM program received essential support from both WIDA and NSTA. The structure and circumstances of the two organizations are different, and these differences shaped the nature and amount of resources that each organization was able to contribute to the program.

For several years before the program was established, WIDA benefitted from consistent leadership and a stable financial position. These factors enabled WIDA to support the program not only by allocating considerable staff time but also by providing compensation to external experts. WIDA supported Rita MacDonald in dedicating half of her professional time to the program. It also supported the involvement of other WIDA staff (see the section on the science team). In addition to that, WIDA provided financial support for the program-related work of David Crowther, and paid honoraria to external experts who became involved in the development of program resources.

NSTA also took substantial steps to support its collaboration with other organizations in general and the work of MSM in particular. It changed its affiliate structure and created a new affiliate category, Affiliate C, which would apply to organizations like WIDA. NSTA approved the involvement in MSM activities of two of its staff members, Wendy Binder and Tricia Shelton, and also provided substantial financial support to David Crowther for conference travel and development work related to MSM. The financial commitments by both organizations made the work on the program possible and signaled a shared commitment to its mission and products.

The other key factor that made the existence of MSM possible was the productive relationship between its two co-leads. Collaboration is a complex affair in general, and collaboration across disciplines is even more so. There were certain key qualities that the co-leads shared and which enabled them to sustain a productive working relationship over time. The first such quality was the joint commitment to the equitable education of multilingual youth. David Crowther and Rita MacDonald share a passion for increasing the opportunities available to multilingual youth to participate fully in the disciplinary

practices of science and engage with science concepts and ideas. This shared passion created a feeling of trust and laid a strong foundation for all other discussions. It was also a source of inspiration that motivated the co-leads to do the work related to the program.

Second, Rita MacDonald and David Crowther are both life-long learners. Interdisciplinary collaboration brings together divergent ways of thinking and talking about instruction. Often the only way forward is mutual learning about the values and priorities of the other discipline. Both co-leads approached their collaboration with a sense of respect for the other's expertise and an awareness of the limitations of their own knowledge. This openness and respect made it possible for the co-leads to engage in shared meaning-making, and allowed them to learn from each other, as well as collaboratively design resources in which they both felt invested.

Third, David Crowther and Rita MacDonald were able to commit to the collaboration over the long-term. They knew that the work of the program would not be done quickly and were willing to dedicate the time necessary to see it through over several years. Without institutional support and productive interpersonal relationships, the program could not exist.

Key Milestones

Signing the Affiliation Agreement
The first major milestone in the MSM program's evolution was the signing of a formal affiliation agreement between NSTA and WIDA (see Timeline below). This event took place in mid-April 2019. With the agreement in place, WIDA joined NSTA as an Affiliate C at the 2019 National Congress on Science Education and was welcomed by other affiliate representatives and presidents.

Figure 1. *Timeline*
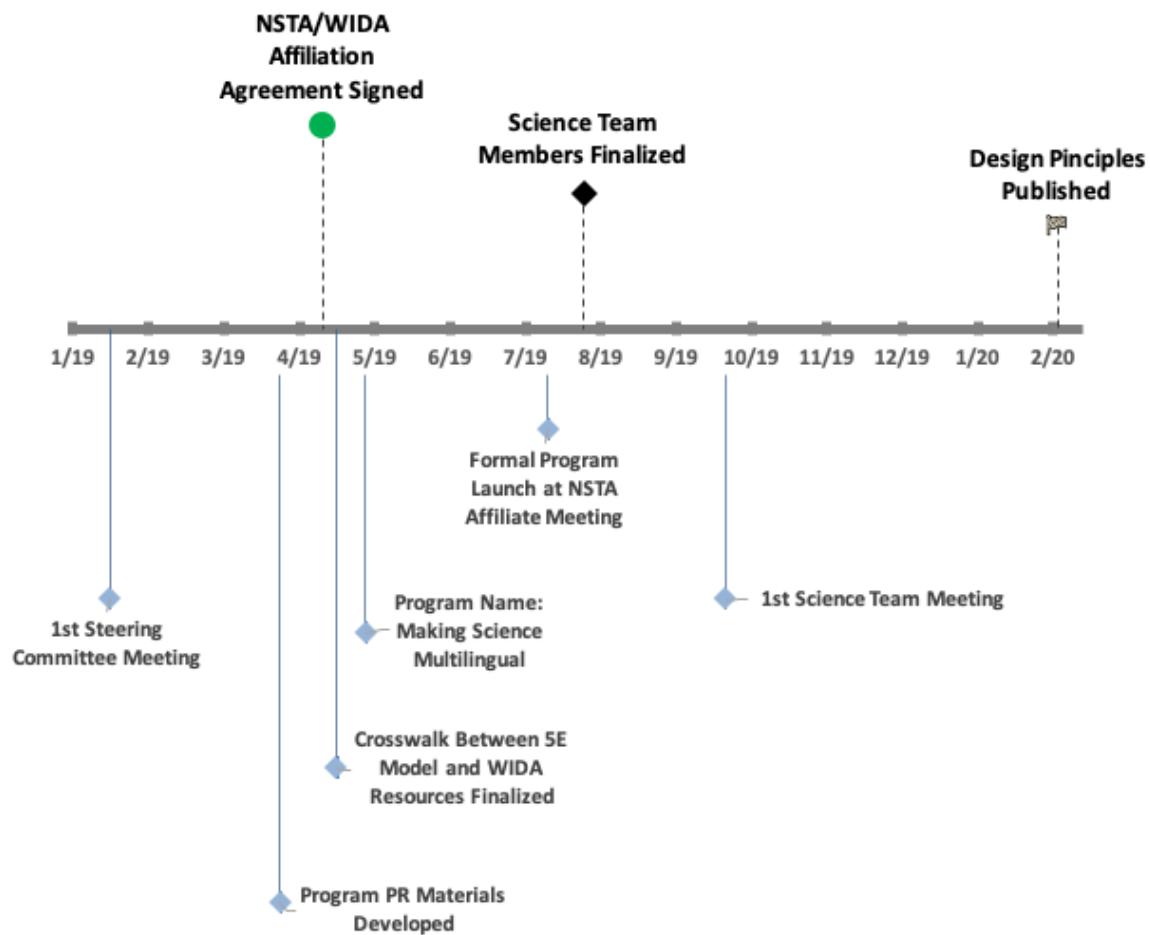
The signing of a formal affiliation agreement enabled the activities of the program. One phrase from the affiliation agreement in particular, "to encourage cooperative meetings, projects, and initiatives," enabled formal collaboration around the development of resources related to science teaching for multilingual learners. The formal affiliation made it possible for both organizations to financially support the activities of the program. The formal agreement also opened up access for the co-leads to marketing and legal resources at WIDA. The official launch of the program required the design of a logo and banner, as well as a PowerPoint template, a flyer, and other

materials. From a legal standpoint, the co-leads needed support in resolving complex questions related to the intellectual property of jointly produced resources.

The signing of the affiliation agreement expanded the organizational activities in which the co-leads could participate. For instance, Rita MacDonald and David Crowther co-presented at NSTA national and regional conferences. The collaborative work on the presentations offered recurrent opportunities for the co-leads to deepen their shared understanding of how to foster content and language integration in science classrooms. In addition, the signing of the affiliation agreement enabled Rita MacDonald to participate in NSTA activities. She received a three-year appointment to the NSTA standing committee on multicultural education and diversity—an opportunity not available to most affiliate representatives. She also took part in formal NSTA gatherings (such as in-person and virtual meetings of the National Congress on Science Education and NSTA affiliates) and online forums where she answered questions related to the education of multilingual students from the NSTA board, council, and other affiliate members. The NSTA gatherings provided a venue where MSM could be launched for an audience of science educators.

Forming the Science Team

A second key milestone in the program's development was the formation of a science team. The co-leads were committed to involving other staff from WIDA and NSTA in the activities of the program for two main reasons: (a) their own expertise was insufficient for the accomplishment of the program's mission, and (b) the involvement of other staff would increase the ownership of and commitment to the program. To develop robust resources for science teachers of multilingual students, the co-leads needed access

to a wide range of expertise. They needed the collaboration of colleagues who had experience designing and facilitating professional learning for science as well as language teachers. The co-leads sought partners whose work focused on equitable science instruction for minoritized students. The program required technical expertise related to designing teacher resources for an online environment. The development of resources by two organizations also depends on the active involvement of representatives from both. The presence on the team of current WIDA and NSTA staff was a way to guarantee this involvement. The existence of the science team strengthened the commitment of NSTA and WIDA to the program and ensured that the program represented inter-organizational collaboration rather than the work of two people. The team enabled the co-leads to act as facilitators and distribute both sensemaking and decision-making.

The expansion of the science team beyond the two co-leads happened in stages. First, two WIDA staff members joined the team in April 2019 (Jennifer Wilfrid and Troy Dassler), both of whom have expertise in science instruction for multilingual students. Three months later, the science team members were finalized and included: an instructional designer at WIDA (Justine Chien), two staff members from NSTA who develop and lead professional learning (Wendy Binder and Tricia Shelton), and a faculty member from the University of Colorado-Boulder with expertise in equitable science education (Melissa Braaten).

The science team met eight times between September 2019 and January 2020. Two of the meetings took place face-to-face during NSTA conferences, and the others were virtual. In this short amount of time, the team:

- discussed issues related to the science education of multilingual students,

- reviewed major frameworks and position statements by national organizations in science education and language education,

- designed a set of pedagogical principles intended to guide future action and resource development (discussed in greater detail below), and

- reviewed existing WIDA and NSTA resources and professional development offerings to identify products that the program may want to develop.

Crafting the Design Principles for Engaging Multilingual Learners in Three-Dimensional Science

The third milestone in the MSM program's first year was the publication of the Design Principles for Engaging Multilingual Learners in Three-Dimensional Science in February 2020 (MacDonald et al., 2020). Although the principles were designed by the science team, we discuss them separately here because of the important ways in which they contributed to the program's evolution.

The principles represent a set of ground rules for the development of resources that support equitable science instruction for multilingual youth. They summarize the foundational beliefs and positions about science instruction of the members of the science team, and are intended to anchor the future development of educator resources by this group. As the principles were being developed, contributions of time and effort by some key WIDA and NSTA staff members were curtailed significantly due to changes in workload and responsibilities. The co-leads needed to make adjustments to the work schedule (e.g., by holding brief meetings at NSTA conferences) and to the scope of the first deliverable (e.g., a fully developed set of pedagogical principles could not be crafted, and a draft outlining their broad direction was submitted in its place for approval by

NSTA and WIDA). A final draft of the principles was published as a WCER Working Paper in the first months of 2020.

The principles shaped the program in a number of notable ways. For example, the principles

- broadened the vision of the program from producing resources for educators to also providing a foundation for others to use to develop such resources;

- integrated a focus on equitable instruction with the emphasis on content and language integration; and

- were intended to serve a wide audience.

The key milestones described in this section explain how the MSM program was able to work successfully towards accomplishing its mission.

Supporting Structures

This section describes two different types of structures that made the existence of the MSM program possible: (a) structures that ensured organizational support for the project; and (b) structures that the co-leads put in place to facilitate the collaboration between them.

Structures for Organizational Support

The existence of the MSM program depended on continued support from both WIDA and NSTA. To sustain this support, the co-leads put in place structures that were specific to each organization. At WIDA, the co-leads formed a steering committee, which included members of WIDA leadership (i.e., heads of different WIDA departments) and met once every few months, for a total of five meetings during the first year of the program. The purpose of the steering committee was to provide guidance on the scope of

the program and its deliverables, and ensure that the program activities and products had the necessary support across WIDA departments. The steering committee provided input on the nature of the program (e.g., whether it should be a project within a department or an independent program), its mission and vision, and major deliverables. The committee helped ensure that the program went through all the necessary internal approval processes, even as these processes were still being designed and MSM often served as a test-case for the types of issues that the approval processes needed to address. Most importantly, the steering committee approved the involvement of staff from different departments to support the activities of the program (such as professional learning, marketing, and finance).

The co-leads established a different infrastructure to sustain NSTA's commitment to the MSM program by facilitating meetings between the leaders of NSTA and WIDA. The meetings took place every few months. The majority of the meetings were virtual, though some also took place in person during NSTA conferences. Key participants in the meetings were the NSTA executive director and WIDA director. The meetings paved the way for the signing of the affiliation agreement between WIDA and NSTA. They also helped the co-leads identify NSTA staff that could support key activities of the program, such as the distribution of co-developed resources and the formation of the science team. The meetings created opportunities for members of the two organizations to become familiar with the ways in which each functioned, and to reach a common understanding about the roles and responsibilities of the two organizations in supporting MSM.

Structures for Collaboration

Another type of infrastructure was as essential to the program's existence, as organizational support entailed regular opportunities for the co-leads to collaborate. These opportunities included both virtual and in-person meetings. We discuss the importance of each type of infrastructure below.

The co-leads held virtual meetings on a regular basis: between one and four times a month. These meetings gave the co-leads an opportunity to update each other on activities related to the program, discuss emerging issues, and make decisions about upcoming activities (such as conference presentations and a book proposal). Having a regular communication channel (in addition to email) made it possible for David Crowther and Rita MacDonald to truly lead the program collaboratively.

Virtual conversations are essential but insufficient for interdisciplinary collaboration. The co-leads realized that they needed opportunities to work together in person in order to accomplish challenging conceptual work. During the first year of the program, the co-leads met face-to-face four times for two to three days. The co-leads needed extended periods of time when they could distance themselves from the numerous demands on their time in their everyday professional lives. During the in-person meetings, the co-leads engaged in conceptual thinking by themselves or with members of the science team. The conceptual work involved science and language integration more broadly, and more specifically the development of models that bridge language resources developed at WIDA with pedagogical approaches familiar to science teachers. The in-person meetings created much needed opportunities for in-depth, collaborative meaning-making. The meetings thus enabled the co-leads to expand their knowledge of each

other's fields. This expanded knowledge in turn supported their virtual interactions and informed the resources they developed collaboratively.

Central Questions

In this section, we describe the central questions that the program co-leads needed to resolve during the first year of MSM's existence. Our analysis suggests that the central questions remained the same for the duration of the study.

The questions that emerged as central to the continued existence of the program fall within four types:

- Establishing the program and managing the WIDA/NSTA relationship

- Determining roles and responsibilities

- Exploring the integration of content and language

- Preparing conference presentations

As a new program, MSM was established gradually. The questions the co-leads needed to resolve and the actions they had to take to ensure its continued existence evolved over time, but the focus on keeping the program running remained present throughout the first year. In the initial months, the co-leads tackled questions related to the name of the program and its purpose, timelines, and marketing strategies. Issues related to the rationale for the program and its deliverables were relevant throughout the first year.

One of the core issues that the co-leads discussed with the greatest frequency was the relationship between WIDA and NSTA. The relationship was central to the program's existence, but it was also taxing to manage. The two organizations had vastly different structures and processes. Most importantly, they had dissimilar financial and leadership

histories. A strong commitment to the program by WIDA leadership was in evidence from the moment MSM was established, while the extent of NSTA's commitment was evolving and often unclear. The issues that the co-leads needed to navigate on a recurrent basis included the following, among others: the reciprocity in each organization's commitment to the program, the meaning of the term *partnership*, the capacity of each organization to engage in product development, and solutions to issues of marketing and intellectual property.

A second type of question central to the program's existence concerned the roles and responsibilities of those involved in it. This question encompassed discussions about the science team, as well as more general conversations about the allocation of resources. The co-leads began planning the creation of a science team early in the life of the program. Such an interdisciplinary development team did not yet exist either at NSTA or at WIDA. Creating the team meant that the co-leads needed to determine its purpose, rationale, activities, and deliverables. They had to clarify to each other and the team itself what the science team members were expected to contribute. The co-leads also had to plan and prepare for the meetings of the science team, and navigate tensions that emerged among team members with dissimilar experiences and priorities. In addition to managing issues related to the science team, the co-leads had to address more general questions related to resource allocation; such as what products to prioritize, who would do what work, and how they could best use their own time and effort—as well as the time and effort of other WIDA staff.

The third type of question that the co-leads discussed had to do with the relationship between content and language. The integration of science and language learning was at

the core of the program, and the co-leads needed recurrent opportunities to build understanding of one another's areas of expertise (science education and language teaching) and create a shared approach. The co-leads explored conceptual questions related to science and language integration, such as how to connect pedagogical models in science (5E and claim-evidence-reasoning) to language resources that WIDA was developing (the Framework for Equitable Instruction) and what the role of language specialists could be in planning, teaching, and assessment in science. The co-leads also engaged in more practical discussions about how this emerging shared view of content and language integration would be reflected in different program deliverables.

The final set of questions that were key to the activities of the MSM program during the first year were related to the preparation of conference presentations. The affiliation between NSTA and WIDA meant that there were slots for MSM presentations by the two co-leads; both at NSTA's five annual conferences (national and regional) and the WIDA conference. The discussions about conference presentations centered on the focus, content, and flow of these presentations, and the content of specific slides. Conference presentations offered the co-leads an important source of feedback on MSM resources and energized them through the overwhelmingly positive reception of the materials they shared with attendees.

Interdisciplinary Collaboration and Roles

One of the distinguishing features of the MSM program is the context for interdisciplinary collaboration that it created. Here we explore what roles the co-leads took as they worked together, and how those roles evolved over time; especially as MSM

sits at the intersection of two different organizations (WIDA and NSTA) and two different fields of study (science education and language learning).

Each co-lead had insider knowledge of one of these organizations and one of the fields of study. As time went on and the co-leads built shared understanding, they began to contribute ideas related to each other's fields of expertise. This illustrates the deepening understanding of the two co-leads about the interdependent nature of content and language learning, and what a robust integration of the two may look like in practice.

Organization insider. The success of the program depended on contacts within and inside knowledge of the two organizations involved in the partnership. Rita Macdonald, as a WIDA staff member, was the WIDA insider. She had direct access to WIDA leadership through the program's steering committee. She also had knowledge of internal WIDA structures (e.g., departments and their functions), processes (e.g., procedures for securing resources), and actors (e.g., key decision-makers). David Crowther, as a past president of NSTA, had insider knowledge of NSTA structures, processes, and actors, as well as a direct connection to the current NSTA president. The institutional knowledge and personal connections of the two co-leads enabled them to advocate for the program at both organizations, secure the resources the program needed to realize its mission, align the mission of the program with the mission of WIDA and NSTA, and keep the program present in the minds of WIDA and NSTA leaders.

Subject-matter expert. Another way in which the roles of the two co-leads were complementary had to do with their subject-matter expertise. Rita Macdonald's professional expertise positioned her as the language expert, while David Crowther's career in science education positioned him as the expert on science instruction. While the

co-leads never departed from these roles during the first year of the collaboration, their sustained work together enabled them to build understanding in each other's fields, ask critical questions to refine each other's thinking, and provide feedback on each other's ideas. The knowledge about science and language learning that became shared among the co-leads influenced the resources they developed and facilitated the robust integration of science and language. An illustration of this robust integration was that in their presentations, language was not showcased as one strategy among many for making science activities accessible to multilingual youth or as an afterthought to already planned science activities. Instead, opportunities for equitable student participation and language development were foundational to the design of the science activities themselves.

Project manager. A role that was key to the success of MSM was that of the project manager. The program was housed at WIDA but did not have a project manager assigned to it. Rita Macdonald, therefore, had to take on the role of managing the project she was co-leading. She carried out a wide range of actions that needed to be performed to establish and facilitate the work of the program. For example, she familiarized herself with the processes for program approval, kept track of action items, scheduled interdepartmental meetings at WIDA, created timelines, drafted budgets, and secured financial support for members of the science team. David Crowther provided input on those actions and often supported their realization by contacting NSTA, developing a budget for his own expenses, recommending NSTA staff for the science team, and shepherding the writing of some of the program's deliverables. Managing the project placed a great burden on Rita Macdonald in terms of time and the development of new areas of expertise (we discuss this issue further below).

Barriers

In this section, we discuss barriers to the MSM program's effective functioning. These barriers fall into different categories as indicated by the bolded headings below.

Shifting timelines. There were two main reasons why the timelines for the MSM deliverables shifted in the course of the first year: The delay in the release of the WIDA English language development (ELD) Standards, and the pace of decision-making at NSTA.

A few months after the MSM program was established, it became clear that the timeline for its deliverables would need to be adjusted based on delays in the release of the WIDA ELD Standards, and by extension the WIDA Framework for Equitable Instruction (FEI) on which the MSM deliverables were based. The delay in the release of the FEI gave rise to uncertainty about which components of the framework would be stable and which might change. Beginning in May 2019, the co-leads redirected their efforts to producing foundational documents related to science and language integration, and they decided to hold off the development of educator resources until the second year of the program; when the content of the FEI would be finalized.

A second factor that pushed back initial timelines for the development of MSM program deliverables had to do with the pace of decisions at NSTA. Negotiations with NSTA about its financial commitment to the program took place over months, which constrained the ability of MSM program members to dedicate time and effort to the program. The staff members most directly impacted by the pace of decisions at NSTA were David Crowther and NSTA staff who would become members of the science team.

Limited staff availability. From its inception, the MSM program was expected to produce resources for science educators. Many of these resources (such as e-modules focused on science and language integration) are effort-intensive and require the involvement of developers beyond the co-leads. NSTA did not have the capacity to dedicate staff time to the development of educator resources related to MSM, so this development needed to take place at WIDA. Unfortunately, there was no immediate availability of WIDA staff to engage in such development on behalf of MSM, which pushed the timeline for the design of educator resources beyond the first year of the program.

Burden of multiple roles. Both co-leads contended with multiple roles during the first year of the program, which contributed to exhaustion and limited the amount of time and effort they were able to dedicate to work related to content development. From the beginning of the MSM program's existence, Rita MacDonald became by necessity its project manager. The role was taxing because of the time-consuming nature of project management and the new learning it required. This learning encompassed a wide range of topics, including promotional materials, budget plans, communication plans between WIDA and NSTA, intellectual property, technological requirements for online resources, and others. Partly in recognition of the great burden that the multiple roles created, WIDA assigned MSM a project manager in the second year of the program.

David Crowther also assumed multiple roles while serving as a program co-lead. One role that significantly impacted the time he could devote to program-related activities was his involvement in a research project in the 2019-2020 academic year. This

project encompassed professional learning as well as research, and the research-related activities proved to be more extensive than originally anticipated. The project informed the design of MSM deliverables (such as the science-specific resources in the FEI) and professional learning opportunities that the co-leads facilitated, but it was not part of MSM. Our data analysis suggests that the project was most time-consuming for David Crowther in the fall of 2019.

Activities Beyond Year 1

Although this report focuses on the first year of the MSM program, we also include a brief overview of the activities that define the second year of the program's existence. The second year (which was still in progress at the time of this report's publication), focuses on the co-development, prototyping, and piloting of learning opportunities and resources for administrators and science teachers of multilingual learners. The actors responsible for this co-development are the program co-leads and the science team. The co-development was made possible by the signing of cross-organizational non-disclosure agreements by WIDA and NSTA.

The program's relationship to WIDA continues to evolve. MSM was assigned a project manager in the spring of 2020. In addition, MSM is helping WIDA reflect on and put in place internal decision-making processes that are better suited to the unique and evolving needs of programs like MSM.

Lessons Learned

In this section, we offer a number of insights about productive interorganizational and interdisciplinary collaboration that emerged from the data analysis:

1. Relationships are at the center of collaboration but take time to establish and considerable effort to sustain.

    a. WIDA and NSTA began exploring a possible affiliation three years before the MSM program was established. Even after the program came into existence, the signing of the affiliation agreement required intensive in-person and virtual communication between the leaders and staff of the two organizations.

    b. The program would not have survived without the robust collegial relationship between its co-leads. This relationship preceded the establishment of the MSM program.

2. Interorganizational collaboration can be sustainable over time even if the roles of the two organizations are not identical.

    a. The structure and circumstances of the two organizations shaped the nature and amount of resources that each organization was able to contribute to the program.

    b. The program is housed at WIDA, but former and current NSTA staff are part of the MSM leadership and science team.

3. Robust interorganizational collaboration requires a range of supporting structures: structures that ensure that the program receives continuous support from both organizations, and structures that foster the collaboration among the co-leads and the members of the science team.

4. Collaboration across the disciplines calls for the long-term involvement by experts from different fields and distributed leadership.

a. The science team was instrumental in crafting the design principles.

b. The science team continues to be at the center of the development and prototyping of learning opportunities and resources for science educators in Year 2 of the program.

5. Leading a program like MSM involves navigating multiple roles and questions of great complexity (such as legal questions related to intellectual property, budget-related questions related to funding program activities, and project management questions related to internal approval of the program, logic maps, and so on).

Conclusion

This report discusses the establishment and evolution of the Making Science Multilingual program: a collaborative program involving WIDA and NSTA. MSM is a unique program that brings together subject matter experts from different disciplines with the aim of producing resources for science teachers of multilingual learners. The program is significant because, to the best of our knowledge, such interdisciplinary and inter-organizational collaborations are rare. However, these collaborations are essential for the development of resources that speak to general education teachers, reflect discipline-specific pedagogical principles, and support the equitable engagement of multilingual learners.

During the first year of its existence, the MSM program had tangible effects on both WIDA and NSTA. First, it advanced their missions to support the disciplinary learning of multilingual students by producing a set of design principles that can guide the development of resources for teachers of multilingual students (see the Key Milestones section). Second, the program informed the thinking of staff at both

organizations. At WIDA, the program shaped the development of the WIDA Framework for Equitable Instruction. At NSTA, the program's co-leads facilitated the introduction of several motions that emphasized the need for NSTA to support the learning of *all* students. The co-leads supported professional learning developers at NSTA in answering questions they were receiving about the integration of science and language teaching. The collaborative design of the design principles undoubtedly facilitated learning about equitable science instruction for multilingual youth by WIDA, as well as NSTA staff involved in the project.

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