

## Re-imagining science education research toward a language for science perspective

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**Abstract:** With a decade passing since the release of the *Next Generation Science Standards* (NGSS), it is timely to reflect and consider the extent to which the promise of science teaching and learning that values and centers learners' varied epistemologies for scientific sensemaking has been realized. We argue that this potential, in part, lies in the hands of our science education research community becoming aware and intentional with how we situate learners' language-related resources and practices in our work. Hoping to achieve a more inclusive and expansive future where science is for and by all — re-imagining what is possible in science education — we propose science education research move toward a *language for science* perspective. When taking up this perspective, researchers center the diverse ways that learners adopt and draw upon wide-ranging language resources and practices to explore phenomena, engage in scientific sensemaking, and express evolving understandings about our natural world. In this commentary, we describe how we conceptualize a *language for science* perspective and why we believe such a perspective is critical for carrying out transformative equity-oriented research. We also illustrate one way that this perspective might be taken up, specifically in the context of science education

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research that integrates translanguaging theory and pedagogy to explore multilingual learners' scientific sensemaking experiences. Though our commentary is framed within the context of realizing reform-oriented science teaching and learning in the United States, the argument we make is central to the discipline of science and thus is relevant for science education research conducted across the globe.

**Keywords:** language · equity · scientific sensemaking · translanguaging

## **Re-imagining science education research toward a language for science perspective**

Tied to every wave of educational reform is hope; a hope that we can transform learning environments for the better. Fueled by such hope and grounded in synthesized recommendations brought about by decades of research (NRC 2012), the *Next Generation Science Standards* (NGSS; NGSS Lead States 2013) represent the latest science education reform in the United States (US). The *NGSS* encapsulates a vision of science teaching and learning in which learners are positioned by the classroom community as doers of science who actively collaborate with peers to generate and communicate explanations and models of natural phenomena (Miller, Manz, Russ, Stroupe and Berland 2018). When learners from historically minoritized communities are supported and encouraged to engage in this type of sensemaking work (Odden and Russ 2019) in ways that are authentic and meaningful to them, this vision has the potential to create more equitable science learning spaces (Warren, Vossoughi, Rosebery, Bang and Taylor 2020). However, realizing this potential requires the desettling of dominant ideologies and pedagogies that privilege certain ways of doing and communicating science in schools (i.e., those of white, Western, English-speaking, upper middle-class individuals; Bang, Warren, Rosebery and Medin 2012). This is especially important for learners from minoritized language backgrounds whose experiences with rich and meaningful science learning have been limited due to narrow views of language impacting what is recognized and valued in science education (Takeuchi, Kayumova, de Araujo and Madkins 2022). In particular, such narrow views have influenced *what* and *whose* language-related resources and practices count as generative for science learning experiences (González-Howard, Andersen, Méndez Pérez and Suárez 2023).

Like previous reforms, the *NGSS* provides another opportunity to imagine a different, more equitable, future for science education in the US (Lee and Stephens 2020). However, with a decade of nascent research and work across educational domains, including curriculum development and teacher preparation, we will fall short of "changing the game" (Gutiérrez 2009) and transforming unjust systemic structures if we do not explicitly and critically problematize how we *define*, *use* and *value* language in science learning environments (González-Howard and Suárez 2021). It is of utmost importance to grapple with notions of language in the context of science education research because the use of language is inseparable from how we teach, learn and engage with the discipline (Suárez 2020). Additionally, whether intentional or not, researchers' language conceptualizations are consequential to their research. Thus, the potential for realizing more equitable science teaching and learning through the *NGSS* (Bang, Brown, Calabrese Barton, Rosebery and Warren 2017), in part, lies in the hands of our science education research community becoming aware and intentional with how we situate learners' language-related resources and practices in our work (González-Howard, Andersen, Méndez Pérez and Suárez 2023). As such, hoping to achieve a more inclusive and expansive future where science is for and by all — re-imagining what is possible in science education — we propose that science education research move toward a *language for science* perspective. Such a perspective privileges the diverse language-related resources and practices (García and Wei 2014) that learners might adopt and draw upon to productively engage in meaningful knowledge construction work (Miller, Manz, Russ, Stroupe and Berland 2018).

### **A language for science perspective**

What does *language for science* mean, and what implications does such an idea hold? Learners mobilize various language-related resources and practices to productively generate scientific knowledge and to communicate scientific ideas (Andersen, Méndez Pérez and González-Howard 2022). Thus, a *language for science* perspective centers the different ways that individuals use wide-ranging language-related resources and practices to explore phenomena, to engage in sensemaking, and to express evolving understandings about our natural world. These rich and rigorous resources and practices have been well documented in research (Warren, Ballenger, Ogonowski, Rosebery and Hudicourt-Barnes 2001), but are eclipsed by dominant perspectives of language that are deeply rooted in intersecting social and political forces intended to marginalize and oppress, including (but not limited to) race, colonialism, and gender (Takeuchi, Kayumova, de Araujo and Madkins 2022). Examples of such dominant perspectives include English-only pedagogies, and instruction focused on helping learners develop more “appropriate” or “academic” language-related resources and practices (Flores and Rosa 2015). A *language for science* perspective forefronts the complex and dynamic relationship between language and scientific sensemaking (Odden and Russ 2019), where language is inseparable from sensemaking (Maxwell-Reid 2020) and works in service of (i.e., *for*) sensemaking (Lee and Stephens 2020). Further, viewing language through a *language for science* perspective enables the educational community to emphasize how scientific sensemaking transcends spaces, resources, practices and epistemological approaches (Warren, Vossoughi, Rosebery, Bang and Taylor 2020). Western science, for example, represents only one way of knowing about the world and therefore, any associated language resources and practices only represent one way of communicating and engaging in scientific sensemaking (Bang, Warren, Rosebery and Medin 2012). Thus, there is no one prescriptive way to use language for science — said differently, there is no one “language of

science.” As such, when science education research aligns with a *language for science* perspective, researchers examine if or how learners are supported in expanding upon and developing a myriad of language resources and practices to flexibly draw upon and mobilize for sensemaking purposes that matter to each learner.

To illustrate one possible way that researchers might take up a *language for science* perspective, we turn to research on science education with multilingual learners, specifically, research that integrates translanguaging theory and pedagogy (Karlsson, Nygård Larsson and Jakobsson 2020). Building on decades of work from sociolinguistics and bi/multilingual education, translanguaging captures the ways in which multilingual individuals fluidly draw upon and mobilize their full language repertoires (i.e., linguistic and multimodal communicative resources) for meaning making, without regard to any socially or politically constructed boundaries (Otheguy, García and Reid 2015). A disciplinary perspective on translanguaging (Pierson and Grapin 2021) encourages an expansive view of what “counts” when it comes to learners’ linguistic and multimodal repertoires for scientific sensemaking. For instance, learners might mobilize a combination of linguistic resources such as writing and talking across named languages (e.g., Arabic, Mandarin, Spanish) and/or multimodal resources like gestures, graphical displays of data, and models, to make meaning and communicate ideas (Suárez 2020). In recent years, emerging critical scholars in science education have begun integrating translanguaging in their research to study and illustrate the rich ways that multilingual learners use their full language repertoires to partake in science and engineering practices (Pierson, Clark and Brady 2021), engage in classroom interactions (Siry, Wilmes, te Heesen, Sportelli and Heinericy 2022) and demonstrate learning (Fine and Furtak 2020). By taking up a *language for science* perspective in their research, these scholars have made clear the importance of noticing and

valuing multilingual learners' use of linguistic and multimodal resources and practices as generative for learning and doing science, and of not viewing particular language-related resources or practices as supplemental, scaffolds or alternative forms of engagement and expression (Grapin, 2019). Moreover, this research has demonstrated how translanguaging theory and pedagogy is both critical of the language systems that dominate school spaces and holds the power to be transformational for multilingual learners' science learning experiences (Pérez, González-Howard and Suárez 2022).

Although the examples that we unpack above lie in research focused on multilingual learners and translanguaging (an area with which we have personal and professional experiences; Andersen, Méndez Pérez and González-Howard 2022), there is also much to learn from scholars in other areas of science education research that carry out work aligned with a *language for science* perspective. For instance, scholarship focused on Indigenous ways of knowing (Ojalehto, Medin, Horton, Garcia and Kays 2015), and work examining the intersections of race, culture and language (Brown 2006) have shed light on the brilliant, heterogeneous language-related resources and practices taken up by learners from minoritized language backgrounds when they generate knowledge and communicate ideas about natural phenomena. Therefore, we also encourage the research community to seek bridges between these areas of scholarship - to learn from each other and to continue to critically reflect and imagine new possibilities for science education research that sheds light on the varied ways learners use language-related resources and practices for scientific sensemaking.

### **A timely moment for reflection and re-imagining in science education research**

With a decade passing since the release of the *Next Generation Science Standards* (NGSS Lead States 2013), it is timely to reflect and consider the extent to which the promise of science teaching and learning that values and centers students' varied epistemologies for scientific sensemaking (Russ 2014) has been realized. In this piece we elevate language and the ways that our perspectives and ideologies around language (Lemmi, Brown, Wild, Zummo and Sedlacek 2019) influence how we as a science education research community examine, work with, support, and subsequently impact, science learning spaces. In particular, language perspectives and ideologies manifest in our research questions, how we position participants in our work (especially those from minoritized language backgrounds), the data we collect and how we analyze it, the ways we present findings, and the conclusions and implications that we draw (González-Howard, Andersen, Méndez Pérez and Suárez 2023). We argue that if we in the science education research community do not problematize and change our ideologies and practices associated with language, we will perpetuate inequities by continuing to privilege the use of certain language-related resources and practices for doing science, making meaning and expressing learning (González-Howard and Suárez 2021)

To conclude, we turn to a quote from Bryan Brown, which captures the essence of our argument: "When we fail to respect the cultural diversity that people bring to the conversations, we fail to understand the intelligence of those who have incredible ideas simply because they are using language that we do not associate with brilliance" (2019, p. 86). Building on this idea and working toward what could be possible and more equitable in science education, we urge our fellow science education researchers to shift their notions of language and how language relates to science, and to adopt a *language for science* perspective in their work. Doing so will help us notice, elevate, and celebrate all the brilliant ways learners use language to make sense of our

natural world and to communicate science ideas (Grapin, Pierson, González-Howard, Ryo, Fine, and Vogel 2023). This shift in mindset and practice will enable us to explore new disciplinary possibilities (Warren, Vossoughi, Rosebery, Bang and Taylor 2020) while also helping us to re-imagine and realize a more equitable future in science education (Bang, Brown, Calabrese Barton, Rosebery and Warren 2017).

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