



Customization of Curriculum Materials as a Site for Identifying and Taking Action on Shared Problems of Practice

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Abstract: Science learning reforms require shifting epistemic and power structures so students and teachers build knowledge together within the context of meaningful questions and problems. Curricular customization allows teachers to preserve these reform-oriented goals while adapting for their specific contexts and students. This paper presents three cases from professional learning communities (PLCs) who followed the same curriculum customization model, but with different equity goals: supporting bi/multilingual learners' ownership of learning, increasing the relevance of curriculum for students, and encouraging more student voices and multiple perspectives. Together, these cases highlight how the collaborative customization model facilitated productive tensions that lead to teacher learning.

Introduction: Customization of curriculum as a site for teacher learning

Current reforms to make science learning more meaningful and equitable for learners entail shifting the epistemic and power structures in the classroom so that teachers and students work together to build knowledge in the context of meaningful questions and problems (Sevian et al., 2018). Yet these shifts in science teaching are challenging for many teachers (Windschitl & Stroupe, 2017). Curriculum materials that illustrate these approaches can support teachers in enacting them in their own classroom, reflecting on their instruction and learning from that work (Harris et al., 2015). However, curriculum enactment is not prescriptive, but rather a “participatory relationship” between the teacher, curriculum materials, students and context (Remillard, 2005). Teachers need to customize curriculum to preserve the goals of the reform while adapting tasks and activity structures to meet the needs and leverage the resources of their students (McNeill et al., 2018). The commitment to eliciting and building on students' ideas and engaging students in knowledge-building practices means that teachers' work with students must be sensitive to the ideas and arguments that emerge in their classroom.

Customization of curriculum materials is a potential site to support teacher learning as teachers make sense of teaching reforms and their implementation through concrete examples of activity design, tools, and guidance for interaction with students. We view the customization process as a version of a plan, do, study, act cycle (Bryk et al., 2011). Our model consists of cycles with four stages: (1) (Re)establish an equity goal with student data; (2) Analyze curricular materials to plan customization; (3) Enact and collect student data; and (4) Reflect on the equity goal and enactment. In this paper, we focus on three cases of teachers engaged in this customization model in the context of professional learning communities (PLCs), educators who meet regularly to engage in collaborative work to improve their classroom practice. This type of PLC work can result in shifts in teachers' instruction, such as creating more equitable and collaborative classrooms in which students engage in epistemic practices (Shim & Thompson, 2022). In our model, the equity goal was central to the PLC work. A shared goal around a common problem of practice can be essential for teacher learning that impacts classroom practice (Horn & Little, 2010). Next we present findings from three different PLCs each engaged in this customization process, but focused on different equity goals.

Case 1: Supporting bi/multilingual learners' ownership of learning

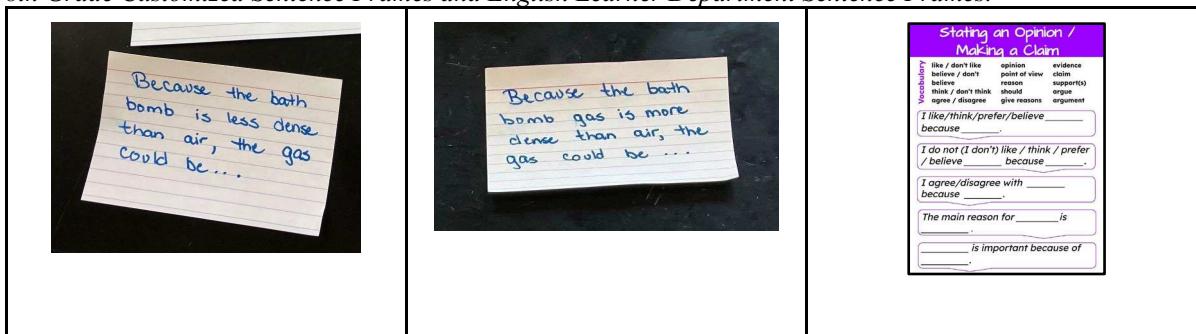
We collaborated with seven middle school science teachers (grades 6-8), for seven 2-hour meetings over four months, focused on developing a linguistically inclusive classroom to support their emergent multilingual learners (EMLs) ownership of learning. The teachers' equity goal stemmed from a recent wave of (im)migration of Spanish and Portuguese-speaking EMLs with varying levels of English proficiency and textures of formal classroom experiences. Conceptually, we focused on examining and expanding language use in science by (1) problematizing monolingual language ideologies towards a “languaging ideology” (Garcia & Wei, 2015) and

(2) problematizing academic language use towards a language of ideas (Bunch & Martin, 2020). One tension teachers discussed centered on customizing curriculum for accessibility of directions versus for students' sensemaking. This tension focused on maintaining students as "experts" and knowledge users while also providing clarity and appropriate scaffolding for students to participate in sensemaking tasks.

In our second PLC meeting, this tension emerged when teachers discussed supporting students in developing their arguments from evidence, a language-intensive practice. The PLC discussed using sentence frames and how the teachers' English Learner Department's (ELD) frames felt inauthentic to the disciplinary task (Figure 1, right). In contrast, the 8th-grade teachers created their own sentence frames, contextualized in the anchoring phenomenon, that asked students to evaluate arguments. The teachers' customization provided "true or false" statements that students had to evaluate using the evidence from a flammability and density lab. Students were grouped with home language peers and encouraged to use gestures for communicating ideas. For true statements, students then had to complete the sentence frame using data from their investigations (Figure 1, left & center). The 8th-grade teachers' customized sentence frames supported students in constructing and evaluating arguments because they were in service of the disciplinary practice and focused on EMLs collaboratively evaluating the parts of an argument with evidence. The 8th-grade teachers saw their customization as successful because of how EMLs actively discussed with their peers and also wrote out their arguments using relevant evidence. Although the 8th-grade teachers felt successful, they recognized the multiple levels of scaffolding their customization offered, which led them to wonder "How do we make this harder?"

Figure 1

8th Grade Customized Sentence Frames and English Learner Department Sentence Frames.



As teachers worked on negotiating this tension, we saw an interplay of pedagogical (accessibility of the task and design of learning), cultural (EMLs' linguistic practices), and conceptual (what counts as knowledge and who is considered knowledgeable) dimensions (Braaten & Sheth, 2016). The tension served as a context for teachers to investigate their pedagogical reasoning concerning broader calls for equity and justice in science education, particularly for EMLs. Specifically, we saw teachers not only expanding what counted as language use for sensemaking (e.g., home languages, using gestures, using physical objects) but also repurposing instructional strategies (e.g., sentence frames) to be more contextualized and to (re)position EMLs as epistemic agents within sensemaking instructional tasks.

Case 2: Increasing the relevance of the curriculum for students

Our second case concerns another PLC with ten teachers from 6th-8th grade. The PLC identified their equity goal as increasing the curricular relevance for students based on their analyses of student survey data concerning their perceptions of classroom experiences. The data revealed that students, especially those from minoritized communities, did not feel that their ideas always mattered in class. To attempt to address this issue, the teachers decided to work on enhancing the curriculum's relevance, which they reasoned would support these students in seeing their ideas and experiences as being more connected to what their class worked on (Aikenhead, 2006). The teachers met in bi-weekly 90-minute meetings for one school semester and worked in three grade-level teams, each working on the upcoming unit. Although approaching the customization differently from each other, all the teachers' work centered around capitalizing on students' own ideas and experiences to provide a context to explore the target scientific ideas. In trying to achieve their customization goal, the teachers grappled with a tension between integrating students' ideas and lived experiences into the curriculum while maintaining the curriculum's plan for investigations designed to address questions emerging from the unit's anchor.

In this PLC, several teachers used the related phenomena that students brought up from their own experiences to provide contexts for students' science work to augment or replace one or more of the unit's



investigations. For example, the sixth grade team was concerned that a unit on thermal energy was designed with too many of the unit's investigations solely in the context of the anchoring phenomenon of an iced drink in a regular cup warming up more quickly than an iced drink in a "fancy" (insulated) cup. One teacher, Cathy (pseudonym), found out that a group of her students were curious about a related phenomenon of how blankets keep people warm. Therefore, she modified one lesson designed to investigate cup features that keep liquid warm by providing students with options to either conduct the original cups investigation or investigate blanket features that keep people warm. In reflection, Cathy felt that by allowing students to investigate blanket features they had an opportunity to investigate a phenomenon they had identified and were interested in. The customization might help them feel that their ideas mattered and it also might help fatigue with the original context. However, in tension with this goal was the struggle that emerged in maintaining the coherence of the curricular sequence after this substitution, since later activities directly related back to the cups. Cathy appreciated that her students were able to work on a phenomenon that they had suggested: "It'll be interesting to see that survey that the kids got earlier in the year about like, do, your ideas matter. ... Maybe it's worth all the chaos, because they feel like their ideas matter." Meanwhile, she was concerned that students might need extra steps to connect the blankets back to the anchoring phenomenon. She wondered if it was too early in the unit for her to replace the original investigation, and instead could bring it in after the cups – "Now that we know this information, let's talk about the blankets, and how would this help us explain it or understand it more."

While PLC teachers saw both advantages and problems with their customizations, the work of exploring how to follow students' ideas while drawing on the curriculum resources to build the target science provided rich opportunities for teachers' learning. Teachers had the opportunity to experiment with strategies for connecting the science more directly to students' own experiences, see this strategy's potential, and begin to appreciate some of the considerations to attend to in order to pursue it. In addition, attempting to navigate these customizations with the unit's existing supports for coherent building of ideas connected to students' questions helped some teachers better understand how the curriculum is designed to support students' sense of coherence. For example, Cathy referred to appreciating more deeply "the way that [curriculum] storylines work... like it surfaces, the kids come up with that next idea... And so I think this really showed me how sticking to that part of the storyline really helps." These initial experiences of teachers in this PLC reveal the potential of the customization PLC context to help teachers grapple with the nuances of the pedagogical goals in productive ways, helping teachers elaborate their thinking about achieving both curricular and equity goals.

Case 3: Encouraging more student voices and multiple perspectives.

In our third case, we collaborated with a group of teachers in grades 6th-8th approximately bi-weekly for two hours each time over four months. The teachers identified the equity goal of encouraging more student voices and perspectives while making sense of phenomena. This equity goal was informed by student survey data which highlighted that while students felt the teachers valued their ideas, they did not feel that their student peers were valuing or respecting their ideas. Consequently, the teachers customized the curriculum to support more discussion and opportunities for students to share. Teachers reasoned that by providing students with more opportunities to develop and share ideas they would begin to see value in others' perspectives. By centering their customization work on more students having a voice, teachers made changes that encouraged and prioritized students sharing ideas and talking to each other. However, in making these changes to increase student participation, a tension emerged as the teachers realized that those customizations did not necessarily support increasing multiple student perspectives. During a post-PLC interview, Ms. Gomez said, "the very first thing I did was sentence starters. Every student must say this sentence starter and go with it. And that strategy crashed and burned immediately. It was the first thing I did, and it just did not work. And it was because I was just trying to get them to speak..."

Ms. Gomez attributed this failure to focusing solely on participation in their customizations. By providing sentence starters to every student, Ms. Gomez felt, "It was really stopping their ability from expanding beyond the sentence starter." This productive failure led to the teachers' future customizations prioritizing students' perspectives and sharing ideas. Grappling with this tension, the teachers created customizations to position students as sources of knowledge (or experts) from which other students could benefit. In a post-PLC interview, Ms. Gomez conceptualizes this tension when she stated:

I say this a lot, understanding the difference between the voice and sharing the perspective was also a light bulb for me too. Realizing that I'm trying to get them [students] to not only speak, but to share their opinions, share their perspectives, and show that we really value what they're saying. ...realize that it's not just about them speaking, it's about them sharing what they're really thinking and knowing that it's valuable.

This refined conceptualization of the equity goal makes a clear distinction between voice and perspectives. This distinction led to future customizations repositioning students from passive participants to valued members of the classroom community, where students' ideas and opinions are prioritized. For example, in a future lesson comparing different types of sugars (natural and synthetic) Ms. Gomez positioned students as experts in different sugars before having students share their thoughts and ideas with others. In wrestling between student participation to multiple perspectives, Ms. Gomez turned this tension into a productive moment that helped her gain greater clarity into the types of customizations she enacted moving from customizing for participation to customizing for surfacing more student ideas. This tension pushed her to refine the customizations to better address the equity goal of encouraging more students' voices and multiple perspectives.

Conclusion

Engaging in authentic and challenging problems of practice in PLCs that leverage teachers' classroom experiences can support teacher learning and changes in classroom instruction (Shim & Thompson, 2022). In each PLC case, the work started with a shared problem of practice that informed the equity goal. Teachers identified areas where customization could better support their students' equitable sensemaking and then engaged in the customization cycle of exploring and negotiating design solutions for these goals. Tensions emerged as teachers worked to negotiate multiple goals and constraints in their designs, as well as during enactment when teachers found that the customization fell short of addressing the equity goal. Uncovering and grappling with these tensions can become productive sites for teacher learning, by challenging existing understandings and supporting teachers to envision alternative, nuanced and equity-oriented futures for instruction (Rainio & Hofmann, 2021).

References

Aikenhead, G. S. (2006). *Science education for everyday life: Evidence-based practice*. New York: TC Press.

Braaten, M. & Sheth, M. (2016). Tensions teaching science for equity: Lessons learned from the case of Ms. Dawson. *Science Education*, 101(1), 134-164.

Bryk, A. S., Gomez, L. M., & Grunow, A. (2011). Getting ideas into action: Building networked improvement communities in education. In M. T. Hallinan (Ed.), *Frontiers in sociology of education* (pp. 127-162). Dordrecht: Springer Netherlands.

Bunch, G. C., & Martin, D. (2020). From "academic language" to the "language of ideas": A disciplinary perspective on using language in K-12 settings. *Language and Education*, 1-18.

García, O., & Wei, L. (2015). Translanguaging, bilingualism, and bilingual education. In W. E. Wright, S. Boun, & O. García (Eds.), *The Handbook of Bilingual and Multilingual Education* (pp. 223-240). Wiley.

Harris, C. J., Penuel, W. R., D'angelo, C. M., DeBarger, A. H., Gallagher, L. P., Kennedy, C. A., Cheng, B. , H. & Krajcik, J. S. (2015). Impact of project-based curriculum materials on student learning in science: Results of a randomized controlled trial. *Journal of Research in Science Teaching*, 52(10), 1362-1385.

Horn, I. S., & Little, J. W. (2010). Attending to problems of practice: Routines and resources for professional learning in teachers' workplace interactions. *American Educational Research Journal*, 47(1), 181-217.

McNeill, K.L., Marco-Bujosa, L. M., González-Howard, M., Loper, S. (2018). Teachers' enactments of curriculum: Fidelity to procedure versus fidelity to goal for scientific argumentation. *International Journal of Science Education*, 40(12), 1455-1475.

Rainio, A. P. & Hofmann, R. (2021). Teacher professional dialogues during a school intervention: From stabilization to possibility discourse through reflective noticing. *Journal of the Learning Sciences*, 30(4-5), 707-746.

Remillard, J. T. (2005). Examining key concepts in research on teachers' use of mathematics curricula. *Review of Educational Research*, 75(2), 211-246.

Sevian, H., Dori, Y. J., & Parchmann, I. (2018). How does STEM context-based learning work: What we know and what we still do not know. *International Journal of Science Education*, 40(10), 1095-1107.

Shim, S-Y & Thompson J. (2022). Four years of collaboration in a professional learning community: Shifting toward supporting students' epistemic practices. *Science Education*, 106(3), 674-705.

Windschitl, M. & Stroupe, D. (2017). The three-story challenge: Implications for the Next Generation Science Standards for teacher preparation. *Journal of Teacher Education*, 68(3), 251-261.

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