

“It’s so frustrating!” Understanding Design Dilemmas in Co-Design through Curricular Values

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Abstract: Co-design is an increasingly common process for curriculum development in science education, where teachers and researchers work together to create curricula, drawing on mutual knowledge and expertise. In efforts to understand this process, I looked at design dilemmas that occurred during design meetings and categorized the ideas that emerged in terms of underlying curricular values. I characterize these emerging curricular values and identify ways in which participants work to achieve and balance them.

Introduction

In the last decade, there has been a strong movement to transform science teaching and learning in the United States to be more student-centered, equitable, and meaningful (NRC, 2012). Curricular materials are an important step in achieving these goals—both to provide tools for teachers to use that reflect these reforms, and to help them develop the practices needed to use these tools (NRC, 2015). Curricula developed through cooperative design by teachers and researchers are an important strategy that brings together different kinds of expertise needed to achieve curricula that reflect target reforms and are tailored to the realities of classrooms (Penuel et al., 2022; Reiser et al., 2000). A co-design approach can also provide opportunities for teacher professional development of pedagogical and subject matter knowledge (e.g., Peel et al., 2020), and support teachers’ agency (e.g., Severance et al., 2016).

Yet, developing designs for classroom learning involves balancing different priorities that need to be addressed (Penuel et al., 2022). Furthermore, tensions can arise between teachers and researchers working together due to their differing agendas (Couso, 2016). I aim to understand how these design intricacies unfold by examining (a) the curricular values that emerged regularly throughout the design process in one curricular co-design context and (b) how they were balanced in conversation during team meetings.

Project overview and methods

I take an in-depth look at the work of one design team of 3 teachers, 3 researchers, and a district science curriculum specialist who developed a Next Generation Science Standards (NGSS)-designed pilot high school physics wave unit during 25 90-minute weekly Zoom meetings across 7 months. The development work was part of the OpenSciEd project, a collaboration between inquiry Hub at University of Colorado Boulder, Biological Sciences Curriculum Study, Denver Public Schools, and Northwestern University. OpenSciEd is an ongoing partnership which strives in part to lead the development of research-based NGSS-designed classroom materials made available to the public.

All meetings throughout the creation of the unit were recorded and transcribed. I fulfilled the role of a participant-observer in the setting, diving more intimately into the design work to be better familiarized with it. I watched the recordings of meetings and identified *design dilemmas*—times when team members were at a crossroads in the curriculum or were faced with problems that had multiple possible directions. Within these design dilemmas I characterized the *curricular values*—criteria that were used to make design decisions—that were evident in specific utterances. I also identified *tensions*—moments when curricular values were at odds with each other.

Results and discussion

Table 1 presents the range of curricular values I identified, along with indicator questions that operationalize the values being offered. I found that co-designers’ utterances fell into seven different categories of curricular values: *coherence*, *coherence from the students’ perspective*, *student engagement*, *equity focused science education*, *alignment with the standards*, *scientific accuracy*, and *teacher’s pedagogical approach* (see Table 1). These curricular values were sometime stated independently from other values; for example, “I’m looking for more fun things to do here” was a concern for the need to reach the value of *student engagement*. More often values were stated as aligned toward achieving a certain goal or at odds with each other. For example, during a deliberation on how to incorporate energy into the lesson, Matt, a teacher participant, stated “There might be a tension between how we are thinking about energy for this application [as a model in which fields carry energy] (*coherence from the students’ perspective*) and how we are thinking about energy in our whole course (*coherence*) and in the NGSS [as systems carrying energy] (*alignment with the standards*).” Based on preceding utterances, it is evident that the first “we” used here positioned Matt in

“student hat”—as if he was a student experiencing the lesson. The value he was naming was *coherence from the students’ perspective* which he portrayed as in tension with 2 other values: the coherence of the “whole course” (*coherence*) and “the NGSS” (*alignment with the standards*). For Matt, the “whole course” and “the NGSS” were aligned toward the same goal. Therefore, the underlying values were not in opposition with each other, but both conflicted with the value of *coherence from the students’ perspective*. This led to a segment of utterances in which the team deliberated over how to proceed with the lesson using curricular values as criteria for their proposed directions.

Table 1

Curricular values that were found during design team meetings, the indicator questions used to operationalize the values, the definition of each curricular value, and examples of identified corresponding utterances.

Curricular Values	Indicator Question	Definition	Examples of Utterances during meetings
Coherence	How do we—designers—understand this curriculum?	The layout of the lesson and unit makes sense and is logically organized to the design team.	“Alright, so let’s see if I understand this correctly. I’m reading it as a little bit of a contradiction within the same paragraph, that we’re going to think of it as a photon.”
Coherence from the students’ perspective	Will this make sense to students?	Designers develop a path that is motivated by anticipated student questions and interests.	“...if I’m a kid, I’d be like ‘teacher I want something that compares all those’. And then, bam, here is the spectrum.”
Student Engagement	Is this fun and exciting?	Students are excited about and engaged with the lesson or unit.	“I can see that excitement there.” “I’m looking for more fun things to do here.”
Equity focused education	Is this equitable?	Being mindful of the ways in which science education is culturally and socially responsive and meaningful. Making curricula for all students.	“The history that we know around most of these experiments are white guys from Europe and um that can be really problematic when students are going through the curriculum and every single example looks exactly the same.”
Alignment with Standards	What do the standards tell us to do?	The Performance Expectations and Disciplinary Core Ideas outlined in the NGSS are incorporated.	“Do you think that we might get pushback from other people on the fact that it’s high school and we’re not using terminology from the NGSS?”
Scientific Accuracy	Are we doing good science? What does physics say?	The science present in the lesson and unit needs to be precise and correct.	“Yeah, it’s not really accurate to call all particles molecules, but I think you can call all molecules particles. So then let’s just use the word ‘particle.’”
Teachers’ Pedagogical approach	How does this approach to the task reflect our pedagogical commitments?	Ideas expressed by a participant of the design team from teaching experience.	“I am always for never using vocabulary...I just, I hate voca... I don’t know, it gives me like PTSD to like pre-teach vocabulary. I just, I don’t like it.”

This work introduces *curricular values* as useful metrics or evaluation criteria in design work. This study highlights that it is possible to identify these values systematically, and that these values are at the core of design dilemmas. Theoretically, this work deepens the understanding of deliberations within design dilemmas and helps to discern what stakeholders bring into the co-design space. Further understanding underlying curricular values and relationships between them can inform models of how to support co-design as a vehicle for implementing reforms.

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