Examining Science Teachers' Conceptions of Student Interest as a Consideration in Designing Assessments

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Abstract

A key goal of science education articulated in *A Framework for K-12 Science Education* is to create opportunities for students to answer questions about the world that connect to their interests, experiences, and identities. Interest can be seen as a malleable relationship between a person and object (such a phenomenon students might study). In this paper, we analyzed data from a design study of an online course focused on preparing 11 secondary teachers to design three-dimensional tasks that align to the Next Generation Science Standards and that connect to students' interests. Our data sources were teachers' descriptions of their design decisions about what phenomena to use to anchor assessment, designed assessment tasks, and interviews with them about those decisions. We found that interest was an important consideration for assessment design, but they considered student interests in different ways. Some teachers shifted their views of what it meant to engage student interests in the context of assessment design over the course of their participation in professional learning. Most teachers made decisions about what they believed their students were interested in based on their knowledge of students or beliefs about their students' interests. In supporting teachers to design summative assessments that link to students' interest, it is critical to assume teachers bring a range of conceptions of interest, and to consider the feasibility and utility of task design tools from teachers' point of view.

Examining Teachers' Conceptions of Student Interest as a Consideration in Designing Assessments

According to *A Framework for K-12 Science Education* (National Research Council, 2012), a key goal of science education is that teachers regularly provide opportunities for students to systematically investigate issues and questions that relate to their interests. Interest is a malleable relationship between a person and an object of interest (such as a phenomenon) that is shaped by culture, context, and relationships (Azevedo, 2011; Hidi & Renninger, 2006). One motivation for connecting science instruction to students' interests in school is that it can help develop a "sustained attraction for science" and help students appreciate how science can be "pertinent to their daily lives" (p. 28). Another reason is that it can be a tool for promoting equity, to the extent that the interests of students from systematically marginalized underrepresented groups are prioritized (p. 28). A third reason is that cultivating interest is a potentially powerful strategy for broadening participation in STEM, since early interest in science is associated with pursuing advanced coursework in STEM in high school and beyond (Maltese & Tai, 2011; Tai et al., 2006).

While research on student interest in science is abundant (see, Potvin & Hasni, 2014, for a review), research on how teachers conceptualize and learn about students' interests suggests there are many ways teachers can do so. For example, it is not uncommon for teachers to elicit students' relevant interests and experiences when presenting science phenomena to students at the beginning of a unit or exploration of a topic (e.g., Cowie et al., 2010; Patro, 2008). Some teachers attempt to connect what students are learning with interests that teachers imagine students to hold about a topic as they present it (Hagenah & Thompson, 2021). In another study, students reported that their teachers actively shape their instruction around interests they've learned about through their relationships with students (Basu & Calabrese Barton, 2007). What is missing from this literature, though, is research on how teachers consider interest in the design and planning of instructional and assessment tasks.

Summative assessment design is an important opportunity for studying whether and how teachers conceptualize and consider their students' interests as they plan activities for the classroom. Teachers' classroom assessment practices affect students not only cognitively, but also affectively (Cowie et al., 2010). Further, there is evidence that when students feel a connection to phenomena presented in assessment tasks, their performance is enhanced (Taylor et al., 2016; Walkington, 2013). Finally, for assessment to help inform instruction and improve student learning, it is important to align theories of interest and motivation with classroom assessments (Shepard et al., 2018). Teachers' conceptualizations of what their own students' interests are, we conjecture, will influence how they consider interest in task design, ultimately shaping whether students' assessments are most connected to what students value, a key aspect of interest (Krapp & Prenzel, 2011). With the intention of supporting teachers engaged in designing assessments to connect to students' interests, we undertook a design-based research study of an online course for rural secondary science teachers. In the course, we introduced tools for teachers to use to elicit students' interests to inform the design of assessments. As part of the research on the course, we became aware of and curious about the different ways that teachers were conceptualizing interest and considering its role in the design of assessment tasks. In this study, we consider evidence from the assessments they designed for the course, rationales for their design choices, and interviews to answer two questions: *How did teachers conceptualize their students' interests? How did they consider student interest when designing a summative assessment task?*

Background: Key Characteristics of Next Generation Science Assessments

The consensus volume, *Developing Assessments for the Next Generation Science Standards* (National Research Council, 2014), articulated a number of major changes needed for assessment to align with new standards. These include the need for tasks to include multiple components that require students to make connected use of science and engineering practices together with disciplinary core ideas and crosscutting concepts. Such assessments would also need to reflect the learning progressions (NGSS; NGSS Lead States, 2013) as well as include tools for interpreting variable student responses so as to inform next steps in instruction.

Subsequent guidance from the field articulated the need for tasks to be anchored in phenomena or problems (Achieve, 2018; NextGen Science & EdReports, 2021). Here, phenomena refer to "observable events that occur in the universe and that we can use our science knowledge to explain or predict" (Achieve et al., 2017), while problems refer to concrete design challenges that students use science and engineering knowledge and engineering practices to address. That is, inferences about students' ability to *use* the three dimensions are expected to be based on their ability to do so while making sense of phenomena or problems they have not seen, but that are related to phenomena and problems they have studied (Penuel, Turner, et al., 2019).

It is not sufficient, though, for tasks to simply present phenomena or problems to students. The scenario used to describe the phenomena needs to *problematize* the phenomenon or problem, that is, make clear what is puzzling and what is "at stake" in making sense of the phenomenon or problem (Reiser, 2004). This is so for two reasons: it helps to motivate students' own efforts to answer the interrelated questions that follow, and it helps give coherence to the assessment task itself. This same strategy is used to establish coherence in instructional units (Reiser et al., 2021) and to motivate persistence in learning (Blumenfeld et al., 1991).

What is presented in the task—whether it is a qualitative description of a problem or phenomenon, or a set of data to analyze—needs to provide students with opportunities to use targeted elements of all three dimensions of science learning present in the standards: disciplinary core ideas, science and engineering practices, and crosscutting concepts (National Research Council, 2014; NextGen Science & EdReports, 2021). There are many phenomena that are potentially interesting and compelling to students and potentially useful for eliciting student understanding of targeted standards; however, not all tasks present students with the chance to use the three dimensions together to make sense of phenomena and problems (Penuel, Allen, et al., 2022). Thus, it can be challenging to find phenomena that are both compelling or interesting to students and that allow teachers, students, and others to gauge progress toward the three-dimensional learning goals of the standards.

The fact that NGSS assessments are intended to be interesting to students is itself a novel requirement for assessment design. This intent derives from the general importance of interest to persistence in learning (National Academies of Sciences Engineering and Medicine, 2018), as well as to the emphasis in the *Framework* on connecting what students study to their own interests, experiences, and identities (National Research Council, 2012, p. 28). What makes an assessment task potentially interesting to a student is, in principle, no different from what might make tasks interesting to students more broadly, features such as novelty, complexity, and incongruity (i.e., problematization) (Berlyne, 1970; Harackiewicz et al., 2016), as well as making clear how tasks might be relevant or useful to students (Hulleman & Harackiewicz, 2009). As we elaborate below, there are several potential approaches to discovering and eliciting interest from students. Each could potentially inform the design of assessment tasks organized around making sense of phenomena or problems that students find compelling and that are presented in a way that elicits or triggers student interest.

Descriptive studies of teachers' use and design of three-dimensional assessments pointed to challenges teachers have with working on their own or with colleagues to integrate practices and crosscutting concepts into assessments. Many teachers have remained focused on disciplinary core ideas, rather than fully integrating crosscutting concepts and practices (Moos, 2000). In teacher teams, when working with colleagues, teachers have incorporated tools from other disciplines or used the Claims, Evidence, and Reasoning (CER) framework, without shifting fully to three-dimensional assessments that require students to use the three dimensions to make sense of phenomena or problems (Friedrichsen & Barnett, 2018; McFadden et al., 2022).

By contrast, some studies of teacher professional learning have shown promise in supporting teachers to design three-dimensional assessments, including ones that connect to student interests. For example, Kang and Nation (2022) describe a co-design effort focused on supporting teachers in constructing coherent units, including summative assessments, in which design teams created "unconventional" forms of assessment, such as writing a letter to a loved one describing safety features of a car designed for them to protect them while driving (Kang et al., 2022). That project demonstrated the potential for supporting teachers in considering interest in developing assessments.

Our own study is intended to contribute to understandings of how teachers consider interest in the context of professional learning focused, in part, on the goal of making assessment tasks interesting to and for students. The current study explores how teachers went about designing assessments with interest in mind.

Conceptual Framework: Designing Assessments that Connect to Students' Interests

Our conceptual framework grounded in literature on different approaches to connecting *instruction* to students' interests, suggesting there is no single way to help make tasks interesting to students. We outline three broad strategies that educators, researchers, and curriculum developers have used to better connect to students' interests with instruction: 1) Eliciting students' interests, 2) connecting to local places and to lands and waters, and 3) developing deep and caring relationships with students.

Each of these approaches has their own affordances and potential challenges, but they share an aim to engage students deeply, support meaningful learning, and provide insights into students' understanding. As Penuel and Shepard (2016) argue, both instructional tasks and assessment tasks need to build on students' experiences and identities, to support meaningful engagement in disciplinary practices. In the same way that making an instructional task more relatable to students can increase engagement (Kang & Furtak, 2021), making assessment tasks more relatable to students, that is, by connecting them to their interests can potentially increase students' engagement with and performance on the assessment.

Eliciting Students' Interests

For several decades, scholars in science education and other disciplines have used techniques drawn from the funds of knowledge approach (Moll et al., 1992) to designing learning experiences that build bridges between students' everyday lives in their families and communities with disciplinary learning. Funds of knowledge refer to the bodies of knowledge and skills that have been historically accumulated and culturally developed that are essential for individual and household functioning and well-being (Vélez-lbáñez, 1988; Vélez-lbáñez & Greenberg, 1992). Teachers, in the fullest expression of this model of teaching, are first inquirers into students' families and communities, who are introduced to qualitative methods of study, including ethnographic observations, developing questionnaires, writing field notes, interviewing, and data management and analysis (González et al., 1993).

One strategy within the funds of knowledge is to use surveys to elicit sources of family and community expertise that could be relevant to teaching. As an example, one group of investigators created a funds of knowledge survey to give out to undergraduate engineering students. The purpose was to elicit their knowledge and experience in three domains relevant to engineering: tinkering, perspective taking, and helping mediate conflict between people with different points of view, with the intent of helping build students' connections to practices of engineers (Verdín et al., 2021). In another design study (Tzou & Bell, 2010), researchers guided teachers to elicit students' interest through the technique of photo-elicitation (Clark-Ibañez, 2004). In that study, students formulated questions to pursue in class after taking photos of ways their families stayed healthy. The teacher integrated students' questions into a kit-based science unit that had been chosen after ethnographic research revealed prevalent chronic health problems among students and their families in the school community, and so it was judged to be of great potential relevance. The study found that teachers could skillfully elicit student questions and use them in instruction, but they did not always align with disciplinary learning goals.

There have been calls to incorporate funds of knowledge into science assessment. For example, the National Research Council (2014) report, *Developing Assessments of the Next Generation Science Standards*, cited the photo-elicitation method used in Tzou and Bell (2010) as a potentially promising strategy for helping identify the diversity of students' interests and experiences in a classroom (p. 128). In addition, Bang (2019) has called for assessment task design to draw in knowledge students bring from families and communities. Fine and Furtak

(2020) have called for the use of a funds of knowledge approach to inform assessment task design. Their approach called for explicit attention to how culture is understood in task design, in which designers considered culture in “dynamic, living, and constantly evolving ways” (Fine & Furtak, 2020, p. 398). They further suggest the need for task design teams to use focus groups to identify meaningful phenomena for assessment task design. In Hawai’i, community level input into the design of tasks is a formal part of the assessment system, to promote cultural validity (Englert et al., 2022).

Connecting to Local Places and to Lands and Waters

Another strategy for promoting interest is to connect learning specifically to local areas that students know well. Place-based education emphasizes the need to ground teaching in local phenomena, where students can easily make personal connections between what they are studying and the people, nonhuman kinds, and natural and built environments they know through their direct experience (Gruenewald, 2003; Smith, 2007). A key assumption within place-based education in science is that grounding teaching in local phenomena activates students’ affective relationships to particular spaces, that is, their sense of place (Haywood, 2014; Semken & Freeman, 2008). Place-based education in science can also invite students to grapple with critical priorities in their communities, such as environmental racism and climate justice (Aikenhead et al., 2006; Eppley, 2017; Morales-Doyle, 2017; Segura et al., 2021; Zimmerman & Weible, 2017).

Indigenous educators have advocated for education focused on *lands* and *waters* that indexes places where Indigenous tribes assert sovereignty (e.g., Bang et al., 2012). Land-based pedagogies seek to sustain and repair relations between human communities and lands and waters, as well as with more-than-human relatives in such places (Calderon et al., 2021;

Corntassel & Hardbarger, 2019; Styles, 2019). Centering learning within lands and waters can help bring to the foreground young people's responsibilities, the impacts of prior decisions on the land, and the ethical need to anticipate consequences of present decisions (Learning in Places Collaborative, 2022). Land-based pedagogies necessarily invite a critical reckoning with colonial legacies of places and how those legacies are alive within current relationships and with views of what counts as knowledge (Bang et al., 2012). As such, they are more than simply about interest in the sense of a personal connection to a topic in science, such pedagogies invite a reimagining of relations between learners and the places and communities where they live, though they share with place-based pedagogies a concern for cultivating affective and ethical relationships to land.

Scholars have also explored how place- and land-based approaches can inform assessment design. For example, Armour and colleagues (2024) argue that assessment design should incorporate real-world applications and be student-centered, in that it invites students to suggest foci and approaches to assessment. Others have argued that prompts should activate students' past experiences of place, in order to increase student interest and motivate further learning (Clary & Wandersee, 2006). Advocates of assessments intended to be both place-based and to reflect Indigenous perspectives suggest the importance of collaborating with local elders and groups to identify topics of community importance for assessments (Ward et al., 2017). Land-based assessment, to ensure cultural validity, further needs to reflect ways of knowing, doing, and being of Indigenous peoples as valuable resources for sensemaking (Armour et al., 2024; Trumbull & Nelson-Barber, 2019).

Developing Deep and Caring Relationships with Students

There is a strong evidence base supporting the idea that deep and caring relationships between teachers and students are valuable for motivation, learning, and civic outcomes

(Schindel & Tolbert, 2017; Valenzuela, 1999; Wanders et al., 2020; Wentzel, 1997; Wubbels & Brekelmans, 2005) and for fostering interest in science (Singleton et al., 2024). Caring relationships that couple high expectations and supports to meet them, alongside an appreciation for the specific ways that discrimination and marginalization shape the lives of youth from systemically marginalized groups (e.g., Black students, LGBTQIA+ students), can help establish bonds that build students' commitment to their own learning and a sense of belonging (Antrop-González & De Jesús, 2006; DiNicolo et al., 2017). Enacting critical care in this way can also support teachers gain self-awareness and relate in more skillful ways to their students in ways that support students' identity development (Kumpulainen & Rajala, 2017; Trout, 2018).

To date, most work in assessment that focuses on building relationships with students seeks to develop an explicit understanding of students' experiences of classrooms, including their relationships with each other and with the teacher. For example, a study by Potvin (2021) used a modified form of a "cultural probe" (Gaver et al., 2004), a design technique for eliciting an inspirational, personal response from someone that reveals something about their preferences, with a group of teachers as part of cycle of teacher inquiry. The approach shifted teachers' practices and gave them a better understanding of students they did not know as well in their class. Penuel and colleagues (2024) have used brief "exit ticket" assessments to elicit student experience, including whether the day's lesson interested them and was important to their community. Notably, these approaches to assessment have not focused as we do in this study on the disciplinary substance of students' thinking.

The Current Study

The current study is a qualitative, descriptive study focused on teachers' ideas about the importance of interest in assessment task design and how they considered interest when developing tasks intended to elicit three-dimensional performance expectations of their own choosing from the NGSS. It is part of a design-based study (Design-Based Research Collective, 2003) of an online course designed to help teachers construct assessment tasks that reflect the vision of the *Framework for K-12 Science Education* (National Research Council, 2012) for teaching, learning, and assessment. The larger project is also undertaking an experimental study of the course to examine whether it can improve the quality of teachers' assessment tasks. This study of teachers' own reflections on their tasks and task design, derived from artifacts they provided in the research and interviews, was used to inform future iterations of the online course.

Design of the Online Course

The focus of this course was on helping secondary (grades 6-12) science teachers from rural areas to develop what we refer to here and elsewhere (Penuel, Turner, et al., 2019) as *transfer tasks.* Transfer tasks are multicomponent tasks to be administered at the end of a unit and that target performance expectation(s) that were focal in the unit. It is a test of students' ability to transfer knowledge (Bransford & Schwartz, 1999), in that they have to make sense of and answer questions about a new phenomenon or problem they have not yet seen using elements of the three dimensions from the performance expectation being assessed.

The initial version of the online course built from an earlier, briefer, face-to-face professional learning workshop (Penuel, Lo, et al., 2019), and it had five broad learning goals. First was to support teachers in "unpacking" or analyzing three-dimensional understandings of a focal standard or performance expectation (Krajcik et al., 2014). The second was on helping teachers understand what phenomena and problems are and how they can be used to provide coherence to assessment tasks. The third was to have them develop scenarios where a phenomenon or problem is presented in a way that will be interesting to them and productive for eliciting and demonstrated targeted understandings. The fourth was to develop assessments that prompt students' integrated use of the three-dimensions to explain phenomena. The fifth and final goal—which received somewhat less attention in this iteration of the course—was to support teachers in developing tasks that their students would find interesting.

The course was designed to be offered online via Zoom to ensure that participating teachers had access to the professional learning without the need to travel. Online tools were created to facilitate the sharing of resources. In total, participating teachers engaged in 25 hours of professional learning spread across three months. Each session was scheduled to be 2.5 hours, with select sessions lasting three hours due to the complexity of the work. Teachers were placed in small groups based on grade band and content area to allow them the ability to collaborate with colleagues with similar teaching assignments. Teachers received feedback on their work from their peers and a coach with expertise in the content area. Breakout rooms were used to facilitate small group discussions. To help teachers apply what they had learned to their classrooms, teachers focused their assessment work on a unit that they would be assessing at the beginning of the last month of the course. Sessions were scheduled to allow time for teachers to work and receive feedback on their work from a member of the research team. Teachers had a three-week window to administer their assessments to students and collect student work to reflect on their assessment work.

Early in the course, teachers administered to students a Student and Community Interest Inventory, which was intended to support their consideration of interest in the choice of phenomena or problem to anchor assessments. The student interest survey included several questions relating to students' experiences and interests learning science, as well as a question connected to local community issues: "What are two issues that members of your community are concerned about? For instance, students in California might be worried about wildfires." After receiving survey responses from their students, teachers analyzed responses in the class. Teachers were encouraged to draw on results from the survey in their assessment design.

Sample

A key focus of the project was to support rural teachers, whose access to sustained professional learning opportunities in science is often limited (Zinger et al., 2020). A total of 11 middle and high school science teachers from two rural districts in an Intermountain West state in the United States participated in the study. Of these, three were middle school teachers, and eight were high school teachers. They came from two high schools and two middle schools in mountainous rural communities where students' families worked primarily in service occupations serving vacationers. Among the high school teachers, two taught biology, two taught chemistry, one taught physics, one taught Earth science, two taught ecology or environmental science, and one taught botany/zoology and biotechnology. Of the middle school teachers, all taught integrated science. Table 1 summarizes key characteristics of teachers and their student populations.

Insert Table 1 about here

We received data from a total of 328 students in teachers' classes that we used to describe the backgrounds of students. Of those that provided information about their gender, 141 identified as girls, 163 as boys, and 5 as gender nonbinary or genderfluid. Among those that identified their race or ethnicity, 201 were white, 95 were Latine, seven were Asian or Asian American, five were Native American, and one was African American/Black. Six identified as bi- or multi-racial. A total of 213 students said they spoke primarily English at home, while 18 spoke primarily Spanish, and another 78 said they spoke both English and Spanish. Other languages spoken in the home were French (n = 8), German (n = 2), Vietnamese (n = 2), Japanese (n = 1), Russian (n = 1), Polish (n = 1), Hebrew (n = 1), and Zapotec (n = 1).

Measures

We drew on three different sources of data for the study: teacher-designed assessment tasks, an assessment submission form that explained their design decisions and rationale, and teacher interviews.

Teacher-designed assessments and assessment submission form. After completing the course, teachers were asked to submit a transfer task that they also gave to their students. The task submitted had to be created or modified outside of the course. Teachers submitted their post-assessments using an assessment submission form, in which they were asked questions about how they developed their assessment, including "When designing/modifying this assessment, how did you use what you know about your students to make it ENGAGING and RELEVANT for your students?" For this study, we analyzed both whether their designed assessment was anchored in a phenomenon that related to a student interest identified in their Student and Community Interest Inventory or some other interest they identified in their response to the question of how they considered interest in designing their assessment.

Teacher interviews. We conducted semi-structured interviews with each individual teacher after the online course was complete. In interviews, we followed a semi-structured protocol, where we asked teachers to expand on topics related to their experiences in the class, take-aways from the course, as well as opportunities and challenges they see in implementing the 5D course vision in practice. We recorded all interviews and created transcripts using Zoom.

Approach to Analysis

We conducted analyses first to characterize teachers' own perspective about whether their assessment had a phenomenon or not, and if so, whether the phenomenon was local or explicitly related to students' responses to the Student and Community Interest Inventory as interpreted by teachers. To determine whether their assessment was anchored in a phenomenon, two independent coders applied the definition developed by Achieve et al. (2017): "observable events that occur in the universe and that we can use our science knowledge to explain or predict." To further make a judgment as to whether the phenomenon chosen was related to students' responses to the Inventory, coders made a judgment based on teachers' actual descriptions, along with their response to the question about how they considered interest to code phenomena as related or not.

We next used a mix of theoretically driven and open coding of teachers' responses to the question about how they used what they knew about students to focus their assessment. The unit of analysis was the full response to the question. Theoretically driven codes pertained to whether teachers referenced data from formal methods for eliciting interest (e.g., the inventory or a survey they gave), referenced a focus on place or land, or referenced their knowledge of students. These relate directly to our conceptual framework. Open-ended codes developed from the data were three: claims that "everyone loves" a particular topic (or science in general), "assumed" and "don't mention interest." In the "assumed" responses, teachers mentioned interest but did not state why a certain phenomenon or topic might be of interest, or they stated their assumption that a certain topic would be of general interest. Slightly different from implicit assumption of student interest in a phenomenon, "everybody loves" responses involved explicit statements that a certain topic was of universal interest to all people or students. Lastly, "don't mention interest" responses made no connections between the phenomena and interest/did not mention student interest or provide a rationale why a topic might be of interest. One of the authors developed an initial version of the codebook, with input and feedback from the first, third, and fourth author and another study team member. They then did an initial independent coding of data; a second coder (the first author) then coded the data using the codebook. All coding differences were reconciled via discussion among the first four study authors.

With respect to interviews, we first identified all mentions of interest in the verbatim transcripts of interviews. We constructed a spreadsheet of all responses, where each row corresponded to a turn of talk (i.e., a response to an interviewer question) within the interview. Two coders (the second and third author) then identified a preliminary set of inductive codes for characterizing the responses related to the role interest played in their own attention, for students, and its relationship to local place. We conducted additional coding of interview data to focus on how teachers considered and learned or knew about student interests. Then, we constructed a data matrix by combining information from the data on the phenomenon chosen for their designed assessment, our coded rationale for their choice, and coded interview data, to help us see patterns across teachers in the data (a partial summary is shown in Table 2). From there, we decided to develop case descriptions of three teachers who represented divergent patterns with respect to their consideration of interest, and for whom there was rich interview data to understand their choices.

Findings

All the teachers reported some consideration of interest in their design of an assessment task, though two of the 11 teachers did not anchor their assessments in a phenomenon at all. Of those who did consider interest, as Table 2 below shows, the most common consideration was teachers' reported knowledge of their students (*n* = 5). The second most common consideration was "assumed" (*n* = 4), a category that emerged from analysis to characterize responses in which teachers articulated interest as a concern but did not say that it was based on actual knowledge of students or their interests. Of the other theoretically derived codes, only one teacher elicited interests directly using data from the course Student and Community Interest Inventory, and one used the idea that the topic was locally relevant was a consideration. The one teacher who did use data from the inventory noted the phenomenon they chose was related to what students said was interesting on their inventory. Otherwise, the remaining phenomena (n = 8) were unrelated to data on the inventory, and all the phenomena (n = 9) were nonlocal, that is, not specific to the place or lands where students attended school.

Insert Table 2 about here

Below, we elaborate on the conceptions and considerations related to interest in task design for three different teachers, Katie, Chris, and Evelyn. We chose these teachers because they represent different approaches to considering interest. Katie said that she valued a focus on interest and thought that local phenomena would be most interesting but chose a nonlocal phenomenon for her assessment. Chris said his ability to consider interest was constrained by his curriculum, and—and as interviews revealed—he was resistant to taking up the specific aspects of task design promoted in the course. Evelyn, by contrast was compelled to consider student interest, and she did so from the perspective of her reported knowledge of students and consideration of place in ways that were inspired by the course tools.

Katie

Katie is someone who held that what made something compelling in science was that it relied on authentic, local datasets; nonetheless, she chose a phenomenon for her genetics assessment that is common for this set of big ideas in science, a rare genetic disease. According to Katie, using a real data set “opens the door to research or studies that are being done in your local area.” By employing real datasets – something emphasized as a criterion for good assessments in the course, “you’ve hopefully got the interest piece also because it's real, it's authentic.” But the phenomenon she chose for her assessment did not include local datasets at all. In her assessment, she presented students a TED talk given by an adolescent suffering from progeria, a rare genetic condition that causes rapid aging in children and youth. Her rationale focused on the potential for the phenomenon to show the importance of resilience in the face of adversity, that is, how the adolescent “cope with the disease yet still have a happy life.” Notably, this ethical lesson was framed in terms of the teacher’s goals for what students would notice, rather than in terms of students’ own interests or concerns.

One reason why Katie did not turn to tools in the course like the Student and Community Interest Inventory to learn about her students’ interest was that she did not think her students were knowledgeable about their interests. She commented that asking students, “What are you interested in learning about?” was not “best way to approach” the problem of connecting teaching and assessment to students’ interests. Katie said that her students, when asked what they were interested in, often did not know. Katie trusted more the idea that a local phenomenon would interest her students:

> By making the learning relate to things that are happening currently or locally, I think that you can’t help but capture student interest and by creating lessons and assessments

> where the students are acting and thinking like a scientist, whether they know it or not, they're creating a level of identity as a person who knows how to do science.

Even though she did not use the Student and Community Interest Inventory to design the task, she did conduct an analysis of results from her class, and she said that the Inventory did provoke her thinking. However, it did so in a way that pushed her toward thinking that engaging students in using science and engineering practices to engage with local phenomena would be best for "engaging their interest in helping them create a sense of identity."

Chris

Chris illustrates a teacher who sees interest as important and a valuable part of his science teaching. Interest, he says in his interview, is a given in his instruction, "It's got to be there." This view is consistent with the justification for his phenomenon choice of a rollback car: "My students are interested in science, so I tried to use the demo of the rollback car as an interesting phenomenon which can then show their understanding of energy." Here, any phenomenon might have followed the statement, "My students are interested in science," so long as the phenomenon was a scientific one, but for him, his students' interest in science is a given, and the topic doesn't necessarily matter for garnering and sustaining students' interest.

Chris did appreciate two phenomena that were introduced in the course for how interesting they were to him. One was a time-lapse video showing an animal decomposing over several days on the side of a road, and a second featured data about a swallow population's adaptations to a new highway built through their habitat. He appreciated that these phenomena were "more than a cool hook" and could motivate learning through instruction or assessment. At the same time, Chris said that he prioritized creating a caring environment—that is, one that is "caring, loving, and good" in his own classroom over the goal of adjusting his curriculum and teaching to promote interest in science.

In fact, Chris saw his curriculum as a constraint limiting his ability to adjust his teaching to reflect student interests. In fact, he suggested that the materials themselves constrained the topics he could teach but were also inherently interesting to students:

> I love knowing what my students are interested in in the essence of, "It was kind of cool." My students, when they did this [survey, completed as part of the course], they were like, "We kind of like science." That was kind of nice to hear, but I'm still doing PEER physics [a widely used curriculum] and I'm not going to build my class around say an interest in space even if ten kids have it. For me, that's just not going to happen.

At the same time, he acknowledged a pull toward adjusting his teaching to focus on topics related to students' interests but says that it's not possible for him to do. He said,

> I would love to be that teacher that could pull that off. I can't do it. It's kind of like we got this, we're going to roll with this, I'll make it as good as possible, but if you're a kid who just love space, sorry, dude, you're here.

Chris did not elaborate on how he would "make it as good as possible," meaning interesting to students, in his response, though it's evident he sees it as his responsibility to do so within the constraints of the curriculum he's implementing. For him, the class did not help deepen his conception of interest: "I don't know if—no offense to the class—I don't think the class really made me think more about interest."

Evelyn

In contrast to Chris, Evelyn is someone whose ideas shifted through the course about interest. Initially, she admitted in her interview, "I didn't care about their [her students'] interests." By the conclusion of the course, however, there was consideration of interest evident her assessment submission form. Further, we characterized her consideration of students as based on her knowledge of students and their questions, and as connected to local phenomena. Her phenomenon focused on the uniqueness of Earth's habitability in comparison to other planets in the solar system. She chose that, because she had observed that students "had many questions about Venus and Mars while we were studying the atmosphere part of this unit." She commented, too, that she incorporated questions to elicit students' understanding of disciplinary ideas "based on phenomena they see locally."

Although she did not use the Student and Community Interest Inventory to select the phenomenon used in her assessment, it did lead to a shift in her thinking. She commented,

> But with that interest survey, it was just super cool…That interest survey was really enlightening to [inaudible] what they thought of science and how they, I guess didn't think they were a scientist at all. I appreciated [learning] that.

From this response, we inferred that Evelyn did in fact care that students identified with science but was surprised to find that they did not. Further, Evelyn said she had begun to use interest surveys in her class, in a "pared down fashion," as part of units she was teaching.

The online course also gave her a different way of thinking about science teaching, according to her interview. Her new vision for science teaching was that it should be more "holistic" and connected both to students' own questions and to things students care about:

> To me, it's more holistic way of teaching science, which is how it's supposed to be taught, not just in isolation and this little bit in class. But how do they see it in their terms and in their lives, and then how do I access that? Not just like, "Here's the content." But, here's why that matters in a bigger scheme and connect that to social studies and, "Hey,

> remember this from middle school, remember that storm we had a week ago." Or, back to questions that they had. And so, I guess it's not just content, it's not just skills. It's really making it important to them and what they care about.

Her response in this respect contrasted sharply with Chris' response, in that she did not take content as a given, but as something that should be adjusted to accommodate students' interests and experiences with science and disciplines over time.

By the end of the class, she was attending to students' questions more and beginning to tailor her teaching more to those questions. She commented:

> I really loved hearing things that they were questioning. Because then I could answer that later, I could come back to it and say, "Oh, Mars soil. Let's talk about that for..." And it allowed me to gear my instruction and even some of those phenomena towards their wondering statements.

As noted above, it was these questions that inspired her choice of phenomenon for the assessment task she designed for the course. In sum, Evelyn is someone whose consideration of interest shifted significantly in ways she attributed to encounters with a new kind of teaching and with opportunities to try out tools from the course.

Discussion

In this design study focused on how to support teachers in developing assessment tasks that embody the vision of *A Framework for K-12 Science Education* (National Research Council, 2012), we found that the majority of teachers' considerations of interest were based on their own assumptions about what all students were interested in or based on the idea that all students liked science. Of the theoretically identified approaches to connecting tasks to students' interests, the most common approach used was for teachers to base the choice of phenomenon or problem on their knowledge of students. The frequency with which both this approach and assumed knowledge of students was used is not surprising, given that these teachers are rural teachers who may have significant knowledge of their students (Hatch & Clark, 2021).

Despite presenting a tool and an experience of how to elicit students' interests using a survey to inform the design of their assessment tasks, only one teacher directly used survey data to inform task design. From our perspective as designers, this result was disappointing, but not entirely surprising. We know that it is difficult for any designer of instructional materials to hold and balance the goals of writing tasks to standards while also considering students' interests and concerns about issues in their communities. Addressing both these goals requires teachers apply both an understanding of the standards themselves (Krajcik et al., 2014) and their direct knowledge of students' interests and community priorities. Further, the challenges of shifting to engage students meaningfully in science and engineering practices through tasks may eclipse a focus on making connections between tasks and students' funds of knowledge (Carpenter et al., 2023). Teachers are largely left on their own to "connect the dots" among new three-dimensional goals for science learning, students' everyday lives, and teaching (Madkins & McKinney de Royston, 2019). Just as designers do, teachers need well-structured tools and practices to do so (Penuel, Allen, et al., 2022; Penuel, Reiser, et al., 2022), tools and practices that themselves often require iterative re-design before they can prove successful.

Each of the focal case study teachers was influenced by tools and practices introduced in the course, but not necessarily in the ways that we as designers intended. Notably, all three teachers mentioned the Student and Community Interest Inventory, but they oriented to it in different ways. Both Katie and Chris were provoked by the inventory's introduction in the course, but both rejected it as a tool. Katie believed asking about interests directly would be an ineffective means of eliciting students' interests, and while Chris did not challenge this aspect of the tool, he did not believe he could or should use the tool to adjust the content of his teaching. Evelyn used the tool, and even she did not use it to help select a phenomenon for her assessment; in fact, in the sample, only one teacher, Lisa, used the tool for this purpose, but she did not elaborate in her interviews as to why. Other activities did provoke change in teachers' conceptions of student interest. For Katie, it was the idea that tasks should use authentic data so that students got a feeling for what grappling with phenomena with real-world data might mean. And for Evelyn, the presentation of the vision of teaching and learning from the *Framework* gave her a more "holistic" vision of science teaching, as she put it, that gave more room for student questions.

It is tempting to interpret resistance to the tools from our point of view as designers, but an actor-oriented point of view (Lobato, 2012) can be more useful for informing iterative redesign of tools and practices. Although we could see Katie's judgment of her students' inability to articulate their interests as viewing her students from a deficit lens (Valencia, 2010), we choose to interpret her response as a failure of our tools to elicit interests in a way that could be useful for her and feasible for her to implement.

Conclusion

Interest is an important consideration in summative assessment task design, because assessments that connect to phenomena that are meaningful to students can sustain their engagement in extended tasks and potentially yield assessments *of* learning that also are assessments *for* learning. At the same time, we see that teachers need more than one kind of tool to reflect the wide variety of ways they conceptualized interest, particularly in relationship to place, land, and waters and to their desire to use what they know about their students to design tasks. Further, we need to identify tools that do not require significant amounts of time for teachers to use, such as simple prompts within assessments that invite students to make connections between phenomena in tasks and a related phenomenon that interest them. Teachers might even be encouraged to incorporate a brief writing task where students construct their own ideas about why what they study matters to them, a strategy that has been found to enhance secondary students' interest in science (Hulleman & Harackiewicz, 2009). These could be incorporated into an exit ticket type of an assessment that takes students only a few minutes to complete (see, e.g., Penuel et al., 2024). We caution that connecting assessment tasks to student interests and experiences is no straightforward matter, either for teachers or for people with professional expertise in developing assessments. Connecting to students' interests and experiences, moreover, is not a replacement for grappling explicitly with racism that systemically marginalizes students of color from science and engineering (Sheth, 2019). There may even be other aspects of assessment, such as grading, that are more consequential for equity (Feldman, 2018). It is critical to ask to what ends we are recruiting student interest, and into what kinds of practices. To that point, we might better invite students to what science and engineering could be, rather than what those fields are now (Penuel, 2020), and also to remember that interests of students change (DiGiacomo et al., 2018), and they can also be idiosyncratic (Azevedo, 2018). In short, as with any strategy for improving teaching and assessment, helping teachers build connections to student interest requires nuance, attention to what is practical, and a readiness to consider tradeoffs in any single approach.

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Table 1.

Characteristics of Teachers and Schools in the Study

Teacher	Yrs Teaching	Race	Gender	School	Student population of school
Bella	18	Latina	W	Meadowtree MS	378 students; 61% FRL; 59% Latinx, 38% white
Maria	28	white	W	Meadowtree HS	1038 students; 47% FRL; 57% Latinx, 39% white
Katie	5	white	W	Fountain HS	847 students; 18% FRL; 16% Latinx, 80% white
Lonnie	26	white	W	Iron Valley MS	354 students; 60%; 52% Latinx, 43% white
Darla	15	white	W	Meadowtree MS	378 students; 61% FRL; 59% Latinx, 38% white
Chris	17	white	M	Meadowtree HS	1038 students; 47% FRL; 57% Latinx, 39% white
Brooke	19	Not given	W	Big River HS	455 students; 45% FRL, 48% Latinx, 46% white
Fran	2	white	W	Fountainhead HS	847 students; 18% FRL; 16% Latinx, 80% white

Nancy	7	white	W	Fountainhead HS	847 students; 18% FRL; 16% Latinx, 80% white
Evelyn	13	white	W	Meadowtree HS	1038 students; 47% FRL; 57% Latinx, 39% white
Lisa	13	white	W	Fountainhead HS	847 students; 18% FRL; 16% Latinx, 80% white

Table 2

Teachers' Phenomena and Ways of Considering Interest in Assessment Task Design

Teacher	Phenomenon	Reasoning Related to Interest	Illustration of Reasoning
Bella	*What happens to matter when you make ice cream* Nonlocal Unrelated to inventory	Everyone loves	All students love food, specifically ice cream.
Maria	*The Blue Fugates* Nonlocal Unrelated to Inventory	Knowledge of Students	My kids like the strange the out of the normal the things that we don't experience up here in [place]. They like playing detective and piecing things together especially when it comes to genetics and the human condition.
Katie	*Rare genetic disorder as experienced by a teen* Nonlocal Unrelated to Inventory	Assumed	They learned about the disease progeria by watching a TED talk by an adolescent The TED Talk focused on his life as a high schooler and how he can cope with the disease yet still have a happy life.
Lonnie	*How fireworks get their colors* Nonlocal Unrelated to Inventory	Everyone Loves	The phenomenon was engaging to students because everyone loves fireworks.
Darla	None	Assumed	The students seemed very interested in trying to understand why a natural resource can have different properties then when combined with other natural resources.
Chris	*Demonstration of a rollback car where two wheels connected by pieces of wood and a rubber band between the wheels* Nonlocal Unrelated to Inventory	Everyone Loves	My students are interested in science, so I tried to use the demo of the rollback car as an interesting phenomenon which can then show their understanding of energy.
Brooke	*PKU results in people not being able to digest protein and developmental differences* Nonlocal	Assumed	interest in genetic diseases and mutations have been shown so I chose this topic for this reason

	Unrelated to Inventory		
Fran	*Explaining why Chile home to the largest earthquake and longest mountain range* Nonlocal Unrelated to Inventory	Knowledge of Students Assumed	I knew they wanted to learn about rocks in different places and since it was a real example of a location that most of my students had heard about, I figured it was engaging and relevant.
Nancy	None	Knowledge of Students	I knew that students were already engaged in the topic about ozone and environmental concerns so this provided an extension of that topic.
Evelyn	*Why Earth is habitable but other planets are not* Nonlocal Unrelated to Inventory	Knowledge of Students Connection to Place/Land	They also had many questions about Venus and Mars while we were studying the atmosphere part of this unit. The modeling fit in perfectly. The knowledge-based questions are based on phenomena they see locally.
Lisa	*Coral reef biodiversity loss* Nonlocal Related to Inventory	Knowledge of Students Data on Interest	The students were very interested in our work on coral bleaching, so I think they see that these events are important and impactful. Also, their interest surveys showed they found learning connections with climate change to be important to them.