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An Interaction Analysis of a Computer Science Co-Design Conversation on Cultural Relevance and its Implications for Design

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Abstract: This paper uses interaction analysis to examine an episode moment-by-moment of how a group of educators recognized and acknowledged that a specific design decision could be harmful for a historically marginalized population of students enrolled in the district. However, once a key change was made to be more culturally responsive and considerate, new and unexpected

pedagogical challenges appeared. This case serves to illustrate some of the unexpected tensions that can appear in real-time when unanticipated questions about cultural relevance are foregrounded during lesson and materials co-design. It also serves as a reminder that educational technologies are not “race” neutral.

Introduction

Culturally Responsive Teaching (Gay, 2000) is a pedagogical approach that focuses on demonstrating cultural awareness and sensitivity through curriculum and instruction. This orientation towards instruction advocates for learning spaces that validate students’ cultural knowledge and competencies, specifically through supporting the instructor's cultural knowledge base as they design and enact curriculum. One form that this might take is emphasizing existing and often undervalued knowledge assets that learners already have. Another form might be to encourage pride in identities and histories that have historically been dismissed or erased but are core parts of a young person’s lived experience. And still another form is to demonstrate sensitivity and awareness of how harm has been or can continue to be perpetuated through language, symbols, and actions and, most importantly, taking steps to avoid causing further harm. This article is an in-depth analysis of the latter and an examination of what that looks like interactionally in the context of computer science curricular planning and design, especially in a case where the need for this had not been anticipated by all parties in a co-design session but was appreciated by everyone at the end.

Literature Review: Cultural Relevance and Computing Education

We take as axiomatic that culture is omnipresent in learning and development (Rogoff, 2016; Nasir, 2004; Lee, 2008). Naturally, this includes efforts to teach and promote computer science, which can be an underappreciated observation. Participation in computer science has tended to have a demographic skew, especially toward male participation (Cheryan et al., 2015). Men, and particularly those of the dominant culture, have often been recognized as success cases in computing. This ignores the possibility that such success is related to the

learning and instruction of computer science already existing as culturally relevant for their backgrounds and experiences (Washington, 2020). Their particular orientation towards computer science, however, only reflects a limited set of possibilities.

Operating within a framework of culturally responsive pedagogies invites greater possibilities as it asks educators to consider whose perspectives are underrepresented and how one might adapt it to include more. Hammond (2014) defines culturally responsive instruction as the moves teachers make to scaffold instruction based on students' cultural knowledge as a means of building new learning. Hammond also describes degrees of attending to matters of cultural relevance, using the terms surface, shallow and deep. Surface culture attends to concepts that can be observed - such as clothing, music and holidays. Shallow culture speaks to the unspoken rules that govern the community, such as concepts of time and non-verbal communication. Lastly, deep culture speaks to the values and mores that undergird the values of the culture, such as ideas around spirituality, fairness and group identity. These different degrees manifest in learning spaces whether the actors are aware of them or not, and without intentional work, they can replicate the cultural values of those in positions of leadership. There are a variety of ways in which these different depths of culture have been engaged in computer science education programs that are intended to broaden participation beyond those traditionally involved.

One example has been in the area of electronic textiles (e-textiles) as used for pedagogical purposes (Buechley et al., 2013) and with attention to differential participation in computing along the axis of gender. E-textiles emphasize the intersection of computing with fabric craftwork. They have been subject to numerous educational designs and are identified as one way to shift from forms of participation in computing that are gendered as masculine because they are compatible with fiber-arts related crafting practices (such as quilting, weaving and knitting appear as examples elsewhere - see Keune, 2022; Lee & Vincent, 2019). Specific microcontrollers designed for e-textiles, such as the lilypad arduino, have been associated with greater uptake among women as measured by project contributions in online spaces (Buechley & Hill, 2010). Computer science curricula that are intentionally focused in creating more equitable participation in light of known inequities in access (Margolis et al., 2015), such

as Exploring Computer Science, have embraced this approach and expanded to include e-textiles based curricula (Fields et al., 2018). Studies by Madrigal et al (2020) and Bailey et al (2023) both explored programs that sought to increase CS engagement specifically with Black middle school girls. The former explored how an afterschool program could support CS interest and skills, while the latter was a summer program focused on cybersecurity and the Internet of Things.

In addition to gender, computing education can also be reimagined along ethnic and racial axes. Attending to these axes is a necessary step given the way that technology can reflect and reify dominant ideologies. For example, the work of Safiya Noble (2018) highlights this tension in her work exploring how Google's search algorithm resulted in hypersexualized images of Black girls' - representing historic stereotypes about Black women (Collins, 2000). With the awareness that computing and digital technologies are not racially "neutral" researchers and educators can take active steps to address problematic patterns of representation and participation in computing.

For example, online and physical spaces have been designed specifically to explicitly welcome and empower historically minoritized racialized groups. *Digital Divas* (Pinkard et al., 2017) and *COMPUGIRLS* (Scott et al., 2013), along with nonprofit organizations such as *Black Girls Code*, are all compelling examples that are intersectional and speak to both gender and race. Race and ethnicity can also be made an explicit part of computer science education by helping minoritized youth to recognize and critique inequitable social structures that tend to align with race and ethnicity. This approach can create opportunities for students to raise their critiques and develop counternarratives (Vakil, 2018).

Another way that race and ethnicity has been explored as providing distinct assets for computing, especially in US-based work, has been in the intentional linking of computing with heritage practices. For example, Searle and Kafai (2015) have embarked on work with indigenous communities in the United States to combine Native craftwork with computing. Similarly, Eglash and colleagues (2006) have sought to elevate ethno-computing by recognizing the rich computational reasoning that resides in cultural practices such as those

found in the elaborate cornrow patterns and beadwork used in African American hairstyles. These aforementioned projects provide aspirational models of what could be new culturally relevant and responsive designs for computer science learning environments and learning tools that do not exclusively center current dominant cultural perspectives. For this article, we examine cultural relevance for nondominant groups as it is manifested in co-design conversations. These are important moments to bring to computer science education researchers because it is even in these sorts of "back room" preparatory conversations and decisions that matters of whose culture is represented still emerge and do so in consequential ways. Often, the interactional focus of disconnects in cultural relevance are revealed in classroom interactions once students are already part of the lesson (e.g., Enyedy & Mukhopadhyay, 2007, Philip et al., 2016). This case documents things that happen prior to students being present - in the design and planning phase.

Theoretical framework

The interpretive and theoretical framework informing this paper is situated in what Philip et al., (2016) has called racial-ideological micro-contestations. Racial-ideological microcontestations (heretofore shortened to 'microcontestations') are interactional moments during which the learning of disciplinary content knowledge is an overarching concern, but issues of race are invoked by another due to equal concern. This results in multiple simultaneous stances present including those that are epistemic, affective, and moral. For example, we could imagine a biology classroom discussing the topic of disease, vaccine hesitancy, and public health initiatives. The underlying points may be that years of scientific research and experimentation provides adequate supporting evidence of vaccine effectiveness. The implication is that sharing this set of epistemic commitments makes that evidence sufficient by itself for convincing the public to get vaccinated. If a participant in the conversation were to comment that it is more complicated than just providing evidence given historical medical neglect and harm of racialized communities, fostering distrust and poor access. This observation serves as an invitation to acknowledge, respond to, and engage further on these points that a microcontestation episode would have likely begun. The series

of responses and eventual conclusion of that episode invite conversations about race and ideologies and are appropriately related to the science topic at hand. Microcontestations are noteworthy moments and have been accepted as an intellectual contribution for interaction analysis because it elevates a class of interactions where fluency on complex matters of race and matters of disciplinary content are simultaneously and prominently raised that must be navigated (Warren et al., 2020; van Es et al., 2022).

Our vaccination example is hypothetical, as microcontestations were first named in the context of a data literacy activity in a high school classroom that directly involved students of multiple racial identities and discussions of how data and their referents accord with racial dynamics related to geographies and media preferences (Phillip et al,, 2016). Specifically, in the source example, a high school class discussed a geographic data visualization and a conversation ensued about why there was a difference and how it was associated with a neighborhood that consisted heavily of one historically-marginalized racial group. At various times, students tried to provide explanatory stories around the data visualization on the basis of what they knew from their own racial membership and express solidarity. The teacher intervened and made attempts to redirect conversation to respond to some emergent tensions. In that source case, the lens of microcontestations revealed some missed opportunities that could have shifted the interactional dynamics between students and between teacher and student. By making issues of race and content prominent in interaction, this lens serves to spotlight some tensions and complexities that learning scientists must consider and respond to in the design of learning experiences. Through the presentation of two examples, one hypothetical and one already in the literature, we have sought to provide a sense of what microcontestations are and make the case that these are not rare and idiosyncratic events. Indeed, the example we provide below from our own data helps to further illustrate in yet another domain how microcontestations emerge and must seek resolution. In this paper we analyze how an issue of cultural relevance arose, was addressed, and mediated within a K-12 CS curriculum co-design session.

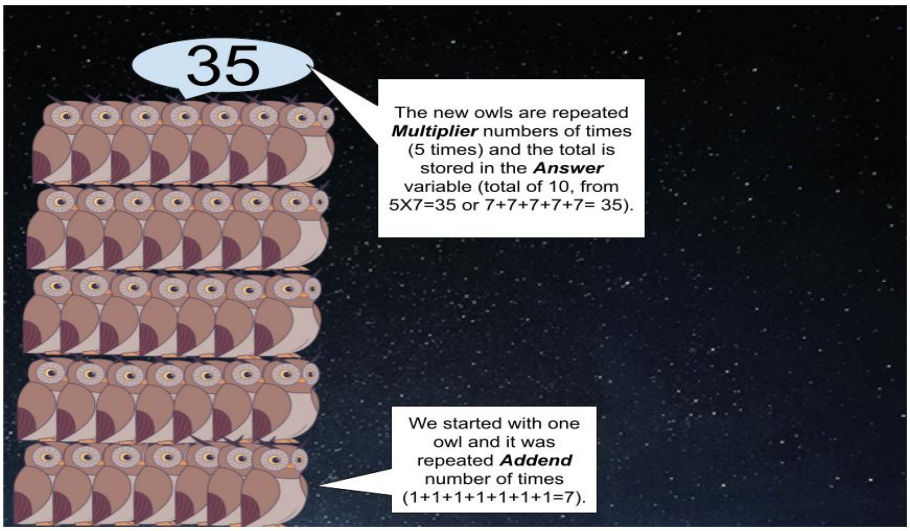
Methods and Data Sources

The Co-Design Research-Practice Partnership

The episode we share is part of a larger project that is a multi-year research-practice partnership in which a university-based team is working with a rural-serving school district to develop support for paraprofessional educators who are tasked with teaching computer science as part of their computer lab responsibilities. The computer lab specialists (their official title) had historically been responsible for overseeing instruction on matters like basic computer literacy, internet safety, keyboarding, and search. With the adoption of statewide computer science standards for K-12, districts throughout the state have explored a range of approaches to address those standards while recognizing that instructional time was already full and that budgets could not be expected to change to allow for new permanent full-time teaching staff to be hired.

As a partnership, this project is of the co-design variety (Penuel et al., 2007; Voogt et al., 2015). A tacit ideal of co-design is that the collaborative aspects of design work occur under the presumption of simultaneity and equal participation. Given that, joint sessions were done as periodic meetings with all parties present, sometimes via Zoom and sometimes in person depending on circumstances. A sequence had been developed and agreed upon in which the university and district participants would generate ideas for where there were the greatest content needs and/or other the existing constraints (schedules, pre-requisites, availability of technical resources). With this understanding, the university team would initiate the design process. For example, the topic of interest to this paper is exponents. The design team decided to address the exponents content with Scratch-based visualizations that showed the difference between repeated addition (multiplication) and repeated multiplication (exponential growth). Figure 1 shows the repeated addition visualization, and as the Scratch program is executed, the owls appear in five groups of seven, dynamically showing the repeated groups to represent 5x7=35.

Figure 1. Depiction of Scratch element in repeated addition



Scratch is a project of the Scratch Foundation,. It is available for free at https://scratch.mit.edu

Once this topic was identified, the university team worked separately, with the involvement of district personnel providing intermittent feedback on the creation of the materials and artifacts. Prior to the lesson's rollout, classroom teachers and computer lab specialists who were members of the design team taught the lessons to each other during the sessions and offered commentary or suggestions. This rehearsal allowed the educators time to provide feedback and shape the lesson before it was shared with the larger community.. It was during this role-play that the analyzed episode appeared.

Setting and Participants

The region where this project is set is, according to 2020 Census records, approximately 85% non-Hispanic White. Hispanic/Latinx individuals (White and non-White identifying) make up about 11% of the local population. Less than 2% is of Asian ancestry and all other Census-tracked racial groups were less than 1% each of the local population.

All of the district personnel and teachers on the co-design team from this region are White. The research team located within this region (7) was predominantly White, with two of four graduate research assistants present who were international students of South Asian origin. Two other researchers (from a different institution and region) were present as well for the observed design activity and are East Asian and Black.

All four authors of this paper were members of the research team at large, representing both institutions and identifying as Black (Author 1), East Asian (Author 2) and White (Authors

3 & 4).

Data Collection

The episode at the heart of this paper took place during a design meeting that involved district personnel, classroom teachers from multiple participating schools in the district, computer lab specialists from multiple schools, and researchers. The objective of this portion of the meeting was to rehearse the lesson and identify any adjustments that might need to be made in the month before teachers would give the lesson. There was no expectation that conversations related to cultural relevance would arise nor were the members of the research team aware of the specific potential cultural insensitivities prior to this meeting. The entire group of participants were split into two with one half congregating at one table and the other congregating at another. A stationary video camera was placed at one end but not controlled by a researcher. Given that, the angle and audio quality was not ideal – some speakers could only be seen from behind or leaned in and out of camera view - but the quality was sufficient for this analysis. At the table were multiple classroom teachers and computer lab specialists, one central district office employee, and members of the research team hailing from two universities. The focus of concern was that the choice of Sprite in the Scratch program, in this case an owl, could disrupt the learning for the Indigenous student population.

Interaction (Data) Analysis

In order to understand how the events unfolded, we adopted an Interaction analysis approach. Interaction analysis is a methodological approach that appeared early in the learning sciences literature (Jordan & Henderson, 1995). Basically, it leverages the availability of interactional records such as video and audio recordings and focuses on short time-scale moments (often on the scale of a few minutes). The aim of it was to understand social meanings as they were expressed and negotiated in real time. Because of the complexity of human interaction, the standard techniques for conducting interaction analysis as a form of inquiry involved reliance on various forms of transcription and multiple iterative group reviews of the original video footage. The validity of an interaction analysis is based on its reporting with transparency provided on the interactional episode, the interpretation, and the justifications for

those.

Consistent with that approach, we iteratively reviewed, transcribed, re-transcribed, and intensively discussed the episode and video footage in several ways (watching it without sound, watching it focusing on a single person, etc.) over a period of multiple months with multiple trained analysts to generate the interpretations offered below. During these review sessions with members of the university researchers, we also shared the audio transcript alongside the video for note-taking purposes to support the subsequent discussion. Lastly, we interviewed several members of the school personnel to gain their understanding of the conversation. Of note for this reporting, we are being intentionally vague about the individuals' specific roles within their schools, district, or universities to further reduce risk of reidentification.

Findings

We have divided our findings into three sequential scenes for ease of reading. The first scene is the initial moment we identify as a microcontestation – Daphne's first mention of the concern. The next scene analyzes how the concern is elevated and responded to by different participants. In the final scene we analyze the unexpected consequences of addressing Daphne's concern. Figure 1 (above) provides context for these sequential scenes, illustrating the approach of showing repeated addition/multiplication.

Identifying the concern

The episode took place as one of the school district team members, Lisa, was role-playing instruction using the Scratch lesson that had been developed to demonstrate repeated addition and repeated multiplication. She asked others at the table who were role-playing as students to open the pre-developed Scratch program (see Figure 1, above) and to begin making specific edits to explore multiplication and exponents. It was at this point when another school team member, Daphne, interjected. Her register and posture changed to indicate she was no longer role playing t but speaking as a colleague. Eleanor, seated at the far right end of the table, also worked in the school district, while Alex and Taylor, seated to Lisa's immediate left, were members of the university team.

1. Lisa: (reading from the script) And if you want, you can continue on with your pen and your owl for your sprite.
2. Daphne: (after shifting her posture so that she is leaning forward) You know the problem with the owls, is we have Navajo students, and owls in the Navajo
3. Eleanor: (at the far end of the table, responding with an elevated voice) yes-
4. Daphne: -are like really bad luck, and like, like it's intense, it's a like a big thing.
5. Lisa: (turns to the left where university team members are sitting, sighs) Did you hear that?
6. Taylor: (looking at Lisa) Yeah
7. Lisa: (to Daphne, hands raised, palms up): wait but you can't-
8. Daphne: -Like they freak out over it
9. Lisa: -you, can't (raises pitch and punctuates words with beat motions) you find something wrong with every kind of creature? (drops hands on desk)
10. Daphne: -Yeah
11. Lisa (laughs, looking left towards university team members): I don't know
12. Taylor: Oh, we probably should change that.
13. Daphne: It- it's a- It's just a really-
14. Lisa: Really?
15. Daphne: -it's a biggg thing

In this transaction, Daphne changed the focus of the interaction to be one of educators and designers, rather than that of role-playing and rehearsing. She noted immediately that the school district had an indigenous student population who were part of the Diné/Navajo nation. In line 2, Daphne stresses this is something for the group to be aware of, stating three times that for these times owls were "really bad luck", "it's intense", and "big thing". Only Eleanor, seated at the far end of the table, was familiar with this information and validated Daphne's contribution. This was a new idea to Lisa, as she turned to the university team members, asking if they had heard the comment - which could be her attempt to make sure this was noted for

later revision. However, after, she expressed an initial objection (line 7 and 9) to Daphne (“wait, but you can’t… can’t you find something wrong with every kind of [Sprite]”) while Daphne continued to stress the seriousness of the use of the owl sprite (lines 8, 13, and 15).

This was the first known instance in which race or ethnicity was invoked as a topic of discussion during the course of the day. Lisa’s initial response was surprise. Her early responses (lines 5 and 7) suggest that this might be something that need not be modified (“you can’t...”). She then added in a slightly higher linguistic register and an exaggerated voice suggesting that it would be possible to “find something wrong with every kind of creature”. This was not stated with markers of anger but more of disbelief or concern of how the group could proceed. The shift in register, accompanied by a slightly exaggerated slapping of hands on the desk, made this statement appear ambiguous regarding whether it was mock frustration for humor or an invitation for solidarity from others who might feel similarly. While it is possible to interpret this exchange in a way that positions Lisa as resistant to honoring the students’ values and beliefs, our analysis allowed for more interpretations. It is possible to understand Lisa’s response as her concern for whether it was even possible to find a neutral sprite. Alternatively, it is also possible that Lisa's frustration centered around the interruption of her rehearsal time shift to revision and away from role-playing. For Lisa, as well as many others in the room, these meetings served as a primary space to rehearse and receive feedback, which made the time a valuable commodity and the negotiation around sprite characters a point of lesser importance. Lastly, Lisa also could be responding to the work that would be required in finding a new sprite, work that might delay lesson implementation. Regardless of the interpretation, Daphne raising the owl's meaning and Lisa’s general questioning of the need to address it, reflects a moment of disagreement in which a resolution is needed.

We recognize this as a microcontestation wherein Daphne’s concerns around culturally relevant instructional choices intersect with the teaching of exponents. What was at odds here was whether the racial and cultural concerns that were raised and marked by Daphne were important enough to merit changes in the midst of rehearsing the lesson. There was a tension with respect to whether this was a reasonable concern, when Lisa's partially exaggerated

response and appeal to others serves as an entry for someone else to express their solidarity in thinking Daphne's concern might not necessarily not be a matter necessitating an actionable response. If sprite selection was indeed a problem for everyone, then it may seem like responding to this instance was prioritizing one cultural group's needs over another or prioritizing the experiences of one group over the work it would take to find a viable alternative. For members of the university team, however, this was seen as something that required immediate response and correction (Line 11). While not evident in the transcription, Taylor began looking for replacement Sprites.

Elevating the concern

Shortly after, Lisa sought clarification on the implications of what would need to happen next. The role play had been halted, and she leaned toward Daphne to ask the following before Daphne interrupted again.

16. Lisa: So, does that mean we have to-
17. Daphne: Yeah, no, like I had to- take um, I had one in my class this year that was Navajo. Um…[student name]
18. Lisa: Ohh (tilts head to the side, drops her hand from her face and bends her wrist) Ohh
19. Taylor: I guess one suggestion is that
20. Daphne: And then remember when I had-
21. Daphne: maybe you weren't here when I had [another student] and she was like Navajo. (Lisa looks at the script in front of her)
22. Taylor: What do you guys think of about a [alternative] sprite. What animal do you think would be good?
23. Eleanor: (turns to educator on her left) Because in their tradition owls are bad omens, and it's like a curse if I understand it correctly.
24. Daphne: (looking towards Eleanor and then back to computer): Yeah, it's - I don't know all the details on it, I just know it's like a big thing.

In line 17, Daphne then repeats her personal connection. She adds that she had a Diné/Navajo student in her “class this year”. Lisa seemed to recognize the name of the student and change tone with “Ohh” (line 18). At that moment, her arm that is upright then bends at the wrist as if any tension being held with the erect arm just dissipated, and Lisa tilted her head sideways in what could be interpreted as an expression of understanding and empathy.

Some side conversation also took place from a university team member who is trying to find another sprite to use (line 19 and 22). During this time, Daphne has some overlapping speech (line 20) and adds an additional connection when she names that she had “had [another student] and she was Navajo.” At this point, Lisa looks down and appears to accept this is a matter that can be addressed. At the other end of the table, Eleanor overheard this and turned to the educator sitting to her left to explain that “owls are bad omens”. Daphne, who was not being addressed but could hear Eleanor speak, turned and added that she did not know much about it. What she did know was that it was important (“a big thing”, line 24).

This portion of the exchange suggests that once a specific individual who could be harmed was identified (line 21), Lisa stopped raising questions about changing the sprite. This was a marked change from the earlier response to the caution that this was potentially problematic for a group of people. In fact, it is following this second personal connection that Taylor first suggests an alternative sprite, and Lisa immediately engages in searching for a viable substitution. This exchange also suggests that there is an understanding that they need to be sensitive, but the exact reason for *why* it was a sensitive matter was not widely shared nor understood. Eleanor seemed to know some, but no one knew immediately why it was potentially harmful. Later, Taylor, reading from a website, says, “when an owl appears it may be a warning that something terrible is about to happen."

While the group proceeded with the rehearsal, discussion of the owl resumed twenty minutes later with Eleanor responding to a comment about a number of edits needing to be made to the Scratch lesson. In response, Daphne reflects on her cultural understanding of owls, saying, “I've never really put owls in my classroom but, like - a lot of people do. It’s super common, Yeah, because to us- to me- they signal wisdom and knowledge, but to them it’s not.” Through this articulation, Daphne recognizes that this animal represents one thing

(wisdom) to one population and something else to another (threat). She even corrects herself in changing from “to us” (an assumed common understanding) to “to me,” perhaps recognizing in the moment that not everyone seated at the table has the same values and beliefs. Lisa wavered between looking at those talking, nodding her head in engagement and also reviewing the lesson plan.

Discovering unexpected ramifications

Initially, the group settled on the Gobo, a Scratch-created sprite that is yellow in color (see Figure 2). However, Lisa interrupted the role play session when she realized that in changing the sprite from an Owl to a Gobo, the larger dimensions of the Gobo posed an issue.

Figure 2. Depiction of the Owl and Gobo sprites
Note: the Owl Sprite is narrower than the Gobo Sprite

25. Lisa: So far on this sheet, if we go with this one, can we have it move 20 steps versus 10 steps because they're just kind of so close together. So, I just changed mine to 26 just to see what it would look like it

27. Taylor: The problem with that could be is they are going to change to a number to [inaudible]

28. Lisa: That’s right

29. Daphne: you could change it later, after, like for this particular one, you could do 20 and then

30. Lisa: But see I would do this then..I'd tell them [inaudible] it gets erased
31. Daphne: I get what you're saying

The concern that Lisa raised was that the Gobo sprite was wider. When it was stamped, the Gobo overlapped whereas ("they're just kind of so close together") when it was the owl, there was no occlusion on sprite stamps. Lisa suggested that the number of steps to move laterally should change from 10 to 20 so that there would be no overlaps when stamps were made. However, Taylor then observed that this was going to be a problem for later parts of the lesson. When there were larger values for the number of stamps, they would not fit on the stage in Scratch. Lisa (line 28) realizes what Taylor was saying would be a problem if this was a permanent change. Daphne suggested it be done temporarily, "you could change it later..." (line 29). However, Lisa expressed that this could be counter to what they intend for students as the change could be made for the one example, but then "it gets erased" so that they could complete the other examples. Daphne acknowledges that this is a problem (line 31). At this point, the contestation is over as it was agreed that a change in sprite was appropriate. However, this created the new tension of how the pedagogical strategy and Scratch program were designed to link the mathematical idea of exponents as repeated multiplication as demonstrated by Scratch code would be represented. While the change to the Gobo sprite responded to the need for cultural sensitivity, it ended up challenging the pedagogical and integration strategy as represented in the curriculum material being developed and tested.

Discussion

This microcontestation episode wherein Daphne's concern around culturally relevant instructional choices intersect with the teaching of exponents spotlights some moments of notice that learning scientist and research-practice partnerships involving design should consider for future work.

First, it is very possible that a lack of understanding and general assumptions that the tools were sufficiently appropriate factored into this. No members of the university team had been a priori aware of the significance of owls as a bad omen. Additionally, there was also little awareness of how many students of Diné/Navajo background attended the school that served

a predominantly White student body. Returning to the earlier assertion that all human activity is cultural in nature, the selection of the owl as a neutral sprite reflects dominant views in the United States about owls being symbols of wisdom. The owl's significance for the Diné could be understood to reflect Hammond's concept of deep culture - tied to values and spirituality, while at the same time, for many at the table, the owl represented a common school decoration for wisdom, an example of a type of surface culture. This difference in perception and significance is at the heart of the microcontestation. In Scratch, sprites such as the bat, snake, and shark are cartoonish without being encoded with features that would signal danger. Nor did the sprite catalog include figures such as a grim reaper that would be perceived as an omen of bad luck. In fact, while the default sprite in Scratch is a cat, it is a bright orange cat - not a black cat, an animal held as an omen of misfortune in the dominant United States culture. As demonstrated by Taylor's response, it is something that, once discovered, is a matter to be taken up immediately and seriously. However, why did this situation come about? Because this was in Scratch, a well-known tool for introducing computer programming, a blanket assumption seemed to have been that the tool was already vetted enough. The added responsibility to think about tools meant to increase issues of exclusion as having potential shortcomings was not in immediate awareness. The research community is still recognizing how educational technologies that are meant to be neutral or safe to use can still end up embodying mechanisms of exclusion (Litts et al., 2021; Martin, et al., 2010). It is a caution worth keeping in mind.

Second, this did not appear to be a concern that produced a uniform response across design team members. Daphne had seen this as a point of immediate concern whereas Lisa needed some more time to see how this was a pressing concern relevant to the students in their schools. We caution the reader to exercise restraint in how different actors are viewed in this episode. We firsthand have seen how Lisa is generous and helpful in a range of interactions within in this project. Her initial response was compelling not because it was her that had expressed it, but it is very likely the same one that large segments of people in the broader geographic region and nation would have - questioning the ability to prevent harm through any choice. This is not to be accepted as how we may wish things should be, but it is

how things are currently. If partnerships and collaboration are a priority for our work, we have the opportunity to recognize this and find productive ways forward. In this case, it appeared a key turning point was when Daphne connected the impact of the owl symbol with a specific student that both she and Lisa knew. Once it was a specific person for whom all were invested in educating and supporting, the seeming reluctance to make changes in the sprite eased. Her quick transition can be interpreted as a moment of learning (of which was an important aspect of these meetings). It is possible that Lisa's reaction could have been similar had the change related to learning about a new instructional strategy - shifting from wondering if it is necessary to understanding and appreciating the change. That this particular episode highlights a moment of cultural literacy speaks to the need for greater and community-specific professional development to examine these issues.

Third, while it was known as a cause for concern and should be acknowledged, the reasons for why it was a concern were not fully understood. Daphne could confidently assert that the owl was problematic, but Eleanor needed to introduce why it was problematic. This was a key learning moment for all to understand the owl's meaning to the Diné/Navajo. The question this raises is what level of knowledge we want educators to have that will support their awareness of cultural diversity, exclusion and potential harm. We are not equipped to know the long-term impact of this incident for the actors involved. We can assert that the sprite has been changed, but it is unknown how work around issues of culture and historically marginalized communities will be understood or centered. It could be possible that simply new behaviors are put in place to respond to immediate concerns, but the underlying matters and thoughts about race and racism that limit progress are not being addressed. Rather, they are just becoming harder to see in public in some settings.

Finally, there was an entanglement here that the mathematics and computing integration had with the owl. While the sprite selection may have seemed arbitrary and interchangeable, it turned out that its precise size on the screen supported specific uses in line with pedagogical intent. The owl was small enough to appear a certain number of times in the space given and help to illustrate repeating processes represented computationally. What the owl selection serves to illustrate here is that whether or not the harm or risks are known, the

infrastructure in which something as simple as a screen sprite is placed and which it supports quickly become intertwined. It is not simply a matter of cosmetic change in response to cultural concerns. Rather, it implicated many other changes that had to be made.

Thus, in a brief moment when a Scratch program was being built in service of a co-design to bring computer science into contact with other school content, a seemingly neutral owl was selected as a sprite to help realize a model of computation and mathematics. However, this interaction analysis revealed the implications for curriculum planning and design. First, it helped highlight the fact that educational technologies are not race (nor gender) neutral, and as such require additional scrutiny when incorporating. Second, it demonstrated the importance of community wide professional development as it pertains to culturally relevant instruction when implementing technology to ensure that harm is not inflicted on learners.

Implications

While the interaction resulted in a change to the specific lesson, we believe that there are larger implications for co-design work that this episode speaks to. Considering the desire for greater cultural sensitivity - within this group and within other co-design environments - this interaction analysis provides several key takeaways. First, in situations in which work is being designed for a diverse group, considerations must be given to who they are and the potential perspectives they might bring that are not part of the dominant culture. In the case with this paper, no members of the RPP were Diné, and it was only in this moment of rehearsal that the symbolism of the owl surfaced. This may be achieved in rehearsal spaces by different members of the team taking on additional perspectives. In a sense, when Daphne called out the issue with owls, she was considering her students' perspective. Second, when incorporating imagery or icons form and function, as well as meaning, must be considered. In this case, the owl met the specific form and function needed within the lesson on exponents, but the understanding of an owl as a harbinger of bad news did not align with the learning objectives. Drawing on the first point of understanding the audience, the selection of the icons (or sprites in this case) must meet more than the functional needs of the software. Finally, the practice of rehearsing co-designed lessons prior to their teaching is

crucial for ensuring that issues reflecting a cultural insensitivity are avoided. Because of this rehearsal, classroom instructors avoided inflicting harm upon their indigenous students (as well as a disruption in their learning). By engaging in the rehearsals, participants were able to provide feedback and immediately enact changes to the curriculum. This required both time (for feedback and revisions) and a strong sense of community in which one would feel safe and comfortable offering engaging in discussions around cultural awareness, which speaks to the importance of having multiple stakeholders present. .

Conclusions

These seemingly innocuous (to the parties whose perspectives are centered) decisions in a computer science learning experience can have important meanings. They require us to ask ourselves whether we are equipping all educators and researchers to be prepared to address issues of cultural sensitivity in support of equity of access. Also, "seemingly innocuous" changes can also have ripple effects – it seems as simple as 'just use a different sprite' but that affected other decisions in how the instruction was structured (which had to do with spacing for repeated addition or repeated multiplication). While this is a single case example, it provides a cautionary lesson for considering the multiple things requiring attention. It is also a demonstration of how commitments can get buried under other decisions such that this is more than cosmetic or superficial. The larger point is that we must be able to anticipate and address these before they become too embedded and other things "depend" on them, lest we harm students and also create additional work.

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