"Los Programadores Debieron Pensarse Como Dos Veces": Exploring the Intersections of Language, Power, and Technology with Bi/Multilingual Students

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Critical computing approaches to K-12 computer science education aim to promote justice in computing and the wider world. Despite being intertwined with inequitable power dynamics in computing, issues of linguistic (in)justice have received less attention in critical computing. In this article, I draw on theoretical ideas from sociolinguistics and critical computing to analyze qualitative data collected in computing and technology-integrated language and humanities classes serving emergent bi/multilingual middle school students. Conversations about language, technology, and power were close at hand in focal classrooms, and surfaced in moments when students acted as users and critics of, and tinkerers with, digital tools. Students exercised agency in relation to both technology and language—using their budding understandings of language to question digital tools, and their engagements with tools to challenge traditional language ideologies. I build on past scholarship and the findings of this analysis to argue for the development of *critical translingual computing education*—an approach that would engage especially language-minoritized students in critical computing to build on and affirm their language practices and promote linguistic justice in computer science education, fields, and tools.

CCS Concepts: • **Social and professional topics** → **K-12 education**; **Computing literacy;**

Additional Key Words and Phrases: Bilingual students, critical computing education, equity, K-12 education, translanguaging

ACM Reference format:
Sara Vogel. 2021. "Los Programadores Debieron Pensarse Como Dos Veces": Exploring the Intersections of Language, Power, and Technology with Bi/Multilingual Students. *ACM Trans. Comput. Educ.* 21, 4, Article 28 (August 2021), 26 pages.
https://doi.org/10.1145/3447379

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1 INTRODUCTION

Critical and justice-centered computing approaches to **Computer Science (CS)** education are gaining traction in U.S. K-12 contexts [43, 74, 85]. These approaches are guided by the idea that issues of equity in CS fields and education cannot be solved by simply "broadening participation" to include traditionally marginalized groups: there is a role for computing education to play in

This work was sponsored by the National Science Foundation under NSF grants CNS-1738645 and DRL-1837446. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the NSF.
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1946-6226/2021/08-ART28 $15.00
https://doi.org/10.1145/3447379

addressing the political economy and social structures that have contributed to those inequities [45]. These projects incorporate social and sociotechnical critique and action into computing curricula that often builds upon diverse participants' cultures—their experiences, communities, and identities.

A key dimension of computing and cultural relevance that has received less attention in critical and justice-oriented computing education is language and linguistic (in)justice. Educational projects certainly engage and empower linguistically diverse youth (e.g., [71]), but rarely make the intersections of language and technology the explicit focus of critique and social action. And yet there is plenty to critique and transform in this realm. Technologies and sociotechnical spaces that process and generate language often index and perpetuate traditional hierarchies in society [22, 63, 64, 79, 92].

Language and discourse are also used by gatekeepers in CS education, fields, and industry to reinforce traditional hierarchies [59]. This is part of the reason students who use, or may be perceived to use, language differently from a dominant standard English—for example, Black, Latinx, and Indigenous or Native students, immigrant students, students with dis/abilities, and bi/multilingual learners who may be learning English—have been traditionally marginalized in CS education, and in schooling in general. Educational linguists use the term *language-minoritized* to describe how students are positioned when schools and other institutions act under the assumption that language diversity is a problem to solve [68], and call for linguistic justice in education. And yet it is well documented that language-minoritized students who society has erroneously labeled as "deficient" users of language in fact engage in dexterous and creative practice with language and critical metacommentary [69, 90] about language and power [26, 30, 77]. Liberatory educational possibilities emerge when educators center these students' critical observations about language [25, 77] and advocate for linguistic justice [5].

In this article, I share results of an analysis that sought to understand how and when issues of language and power surfaced in middle school bi/multilingual learners' engagements with and commentary about technology and computing. By answering this question, I hope to provide a foundation for the development of *critical translingual computing education*—an approach that would build on critical language [3, 5, 78] and computing [49, 75, 85] pedagogical approaches to explicitly engage students at the intersection of language, technology, and power to promote linguistic and other forms of justice. This approach would support students to develop positive identities as communicators; to interrogate dominant language ideologies and stereotypes as they surface in technology and society; and to promote ethical use, processing, and generating of language in technology.

To conduct this inquiry, I analyzed empirical data from a broader qualitative classroom case study [87] that followed sixth graders as they used digital tools and participated in computing activities integrated into their **English as-a-new-language (ENL)**, bilingual language arts, and social studies courses. In particular, I selected moments from classroom observations, interviews, and focus groups that implicated deeper social issues linking power, language, and technology, such as the excerpt of my interview with Andy, quoted in the title of this article. There, Andy exhorted programmers to think twice before they create software for students available only in English.

My data collection and analysis was guided by translanguaging theory [33], a concept from sociolinguistics and bilingual education that recognizes how especially minoritized language users' sense-making and communication practices go beyond dominant standard named language categories. This theory helped me notice and document how students used language in the course of CS activities. I also viewed students as potential participants in "critical translingual" discourse [78], "inquiry into language and its links to power and identity" [77, p. 148], and in "hacker literacies"

[72], "the critical 'rewriting'of sociotechnical spaces and tools" [73, p. 21]. Those lenses helped me elicit and take students'metacommentary and critical activity around language and technology seriously.

In my analysis of students'comments and interactions around computers and software, I found that issues of language politics surfaced in moments when students acted as (1) users of digital tools, (2) critics of digital tools, and (3) tinkerers with digital tools—meaning, in moments when students interacted with tools as designed, in moments when students offered up explicit critiques about particular technologies, and in moments when their creative interactions with technology suggested alternative designs and uses for digital tools. Students exercised agency in relation to both technology and language—using their budding understandings of language to question tools, and their engagements with tools to challenge language ideologies.

Focal students grappled with the intersections of language, technology, and power across several activities and roles, a point that suggests these topics are close to the surface in classrooms serving emergent bi/multilingual learners. For this, a critical translingual computing approach offers up a rich and relevant area for pedagogical development and study. Exploring such topics might benefit all students, but language-minoritized students—primed to think about language and power given how they and their language practices are positioned in society—might especially connect with this approach. I make this argument not in the spirit of simply "broadening participation" into a field that has contributed to these students'marginalization, but to support students'engagement with critical computational literacies in ways that build on and affirm their language practices and identities, promote their empowerment, and lead to linguistically just and ethical CS fields and tools. My analysis additionally offers pedagogical clues and considerations for critical computing and language/literacy educators working in multilingual classrooms.

2 LITERATURE REVIEW

The review component of this article defines and provides context for critical computing education, also called *critical computational literacies*. It also considers the role of language and power within computing fields and CS education—ideas that might be incorporated into critical computing education.

2.1 Critical Computing Education

As the CS for All movement has gained momentum, it has been critiqued from a number of angles. Some take issue with the out-sized influence of the tech industry in CS education [38, 85], which has obscured the roles that technologies and industry have had in perpetuating injustices of many kinds—or to quote technology and society scholar Ruha Benjamin, in creating "a vast array of distortions and dangers" [6]. Police agencies have used computing tools to surveil and detain undocumented immigrants with the cooperation of the largest technology companies [21]. Search engines have perpetuated damaging stereotypes of Black girls and women [60], and tech start-ups and giants have restructured the labor market toward more precarity [15]. The carbon footprint of the industry has ballooned [36]. As Ko et al. contend, "many of us in the computing discipline, while happy to celebrate computing as a tool for social change, ignore its role in these injustices, and in some cases, dismiss the idea that computing is anything but a value-neutral tool independent from society" [45, p. 31]. There are increased calls for CS education to reckon with the ways that computational systems are intertwined with social power systems, and, as learning scientist Sepehr Vakil put it, to equip youth to "critically analyze the affordances and constraints of technological advancement, as well as the moral imagination and technical skill to create with compassion and ethical integrity" [86, p. 33].

Critical and justice-centered computing approaches [85]—including ethical CS [44], critical computational thinking [43], and critical computational literacies [49]—offer an alternative. Often rooted in Freirian pedagogies [27], these approaches encourage learners to use computing concepts and practices to resist oppression and promote justice in social and sociotechnical spaces. Goals of critical and justice-centered computing education include supporting diverse groups of students to offer counter-narratives to dominant ideologies [49], exercise agency despite oppressive schooling arrangements [71], and advocate for social justice movements and action [83, 84]. Others are fueled by recent attention to issues of algorithmic injustice and the ways technologies code racial inequity [6, 10, 60], and support students and educators to be critical about technology itself [16, 75]. Some approaches do both.

Given these projects' orientations toward justice and social transformation, students often embody identities traditionally marginalized in society and in CS education—Black and Latinx young people, girls and women, youth with dis/abilities, and low income youth. In their work with these populations, many critical computing education projects take up principles of culturally relevant and sustaining pedagogy to engage students and their intersectional identities and communities [35, 46, 47, 62, 70, 76]. Linguistically diverse students participate in critical computing projects, but the intersections of language and technology are not generally an explicit focus of teaching, learning, or activism in these spaces.

2.2 Language and Power in Computing and Computing Education

For the educators, scholars, and activists who take up critical stances in computing and computing education, the intersections of language and technology would be ripe for exploration. First, dominant computing communities and the technologies created within them could benefit from social justice intervention around issues of language. Leading technologies can index problematic and pervasive language ideologies—often intertwined with problematic racial and gender ideologies. Recent scholarship has highlighted the gender and racial biases of the training data used in machine translation [64, 92] and in the processing of language for mental health diagnosis [79]. Studies have documented how designers' choices around the tones of voice, accents, and dictionaries used by digital assistants like Amazon Echo reproduce racialized and gendered power relations [63, 93], and the complex politics of localization/translation of sociotechnical spaces [22].

Language and language ideologies [67] are also intertwined with the oppressive systems in society—such as racism, sexism, classicism, and ableism—that drive inequity in communities of tool creators and designers. Few programming languages use keywords and include support documentation in languages other than English [55] leading to disparities in who learns to code worldwide. The exclusive nature of the CS "clubhouse" [53] is in part maintained through language and discourse [34, 59]: there are conventions around the communicative repertoire [69] of programmers—how they are expected to look, talk, and dress, and the programming languages they are expected to know.

Language is also intertwined with inequitable power dynamics in computing education. When CS is offered as part of the school day, it is necessarily embedded in systems that evaluate and police the language use of racialized and minoritized students who use language differently from the dominant "standard" form of English used by dominant, white, college-educated groups. Those systems include testing and accountability regimes that have literally erased bilingual education from federal and local education guidance and policy [28] and which measure emergent bilinguals against monolingual English standards in invalid ways [50, 56]. In part to satisfy those requirements, schools may program students to receive targeted "pull out" English intervention services during courses viewed as "enrichment," such as CS, deepening issues of inequitable access. Schools might also make assumptions that emergent bi/multilingual students must learn English before

they can engage with complex content [11], potentially contributing to lowered expectations for these students in computing [52]. When computing is offered to language-minoritized students, it is not often taught in culturally relevant [76] ways that build on students' language practices or ways of knowing.

Although language contributes to the equity challenges in CS fields and educations, language may also be part of the solution. Linguistically diverse, language-minoritized students are often already engaging in metacommentary—or commenting about language and communication [69]—and critical thinking about language [26, 30, 77, 90]. Critiquing software for how it indexes particular language ideologies, and reimagining and recreating software based on those critiques, might offer another way for students to engage in critical computational literacies—activities that might support students' own language and identity development, as well as lead to more transformative computing practice. Before designing and implementing this kind of curriculum, however, it is necessary to understand how and when issues of language and power already surface in emergent bi/multilingual students' engagements with technology and computing.

3 ANALYTICAL LENSES FROM CRITICAL COMPUTING, BILINGUAL EDUCATION, AND SOCIOLINGUISTICS

To help me understand how issues of language and politics surfaced in emergent bi/multilinguals' interactions with technology during and around school-based computing activities, I drew on lenses from both critical computing and sociolinguistics.

The first lens is the concept of *hacker literacies* [72]. Hacker literacies refer to practices people engage in "to resist, reconfigure, and/or reformulate the sociotechnical digital spaces and tools that mediate social, cultural, and political participation" [72, p. 2]. These literacies build on critical media literacy [9], such as questioning the nature and biases of broadcast media, to consider how people might become empowered to critique and transform digital tools and participatory media culture [41] like social media, gaming platforms, and crowd-sourced encyclopedias. By viewing students' practices through this lens, I can consider how students critically engaged with not just the messages communicated through digital tools and media, but with the architecture of the code and interfaces producing those technologies.

The second lens is *translanguaging theory*. Translanguaging refers to how people orchestrate linguistic, semiotic, and social resources from a unified repertoire to fluidly and flexibly make meaning and communicate. This theory highlights how people's language practices "go beyond" and indeed defy the standard named language categories (e.g., "English," "Spanish") traditionally privileged in society, a perspective that seeks to dismantle those language categories [33]. All people translanguage, but the translanguaging of bi/multilinguals and language-minoritized people is especially marked and stigmatized in society given legacies of colonialism and racism [61]. Translanguaging theory has been applied by scholars in many ways [40], including to explain and describe the fluid language practices of bilingual people across settings (e.g., [17, 31, 48, 54]). In CS education contexts, emergent bi/multilingual students were found to flexibly orchestrate a range of linguistic, semiotic, embodied, and technological resources to talk about code, to make sense while programming, and to communicate their understandings, values, identities, and stories in and around computational models and digital animation projects [4, 65, 87, 88]. Students were also found to translanguage to support and mentor peers in CS education after school programs [13]. Translanguaging also refers to a pedagogical approach that encourages teachers to value and build upon students' diverse language practices to promote teaching, learning, and critical thinking about language [29]. In this analysis, I use translanguaging theory to help me notice the creative and emerging language and social practices that students brought to and constructed in

focal CS-integrated classrooms [24]—including language practices that might be marginalized and labeled "non-standard" in traditional classrooms.

The third lens is a *critical translingual approach* [78]. Language-minoritized students' critical metacommentary regarding language and power is well documented [3, 5, 30, 90]. Building on translanguaging pedagogy, the critical translingual approach calls upon teachers and educational researchers to notice and build on those practices to promote drawing connections between language, power, and identity [25, 77]. Given its translanguaging orientation, the critical translingual approach aims to dismantle oppressive language categories. It combines these notions more explicitly with work in critical language awareness, or exploring how language has reinforced power hierarchies, and how especially language-minoritized people might use language and take action to resist and dismantle those hierarchies [3]. These ideas have also been applied in recently developed pedagogies that aim to combat anti-Black linguistic racism [5]. The critical translingual approach also promotes critical reflection about raciolinguistic ideologies—how "white listening subjects" perceive deviance in the speech of racialized people no matter the form that communication takes [26, p. 150]. My analysis applies the critical translingual lens not as a pedagogy, but to help me notice moments when students participated in critical metacommentary about language and power.

These three lenses combined helped me analyze how and when language-minoritized students grappled with issues related to power, language, and technology.

4 CONTEXT

The data I analyzed for this study was collected as part of a broader qualitative classroom case study [23, 87] embedded within Participating in Literacies and Computer Science (PiLa-CS), a research-practice partnership [14] project that I have supported as a researcher since 2017. The project brings New York City teachers of emergent bi/multilingual middle school students together with university-based researchers to integrate CS and programming with the Scratch environment into content area classes. Teacher and researcher co-designers of curricula are driven by a translanguaging pedagogical approach [29], which means that as students designed, programmed, and debugged their CS projects, we invited them to use all of their linguistic, semiotic, and technological resources to communicate and learn, and to make strategic choices about language to consider purpose and audience [87]. We aim to view students as agentive participants in computational literacies—a concept we define as mobilizing a range of linguistic, social, and technological resources and practices to participate in conversations about, with, and through code and computing (see [87, 89]).

The case study was conducted with two classes of students at STEM Academy,[1] a school in a predominantly Latinx neighborhood of the city which served sixth to eighth grade students. I selected this school because teachers involved in our RPP from that school served a diverse group of emergent bi/multilinguals across two different program models: a Spanish/English dual language program that supported students to learn in both languages, and an ENL program that supported English practice in small differentiated "pull out" groups. In the year the study was conducted, the school's population was 84% Hispanic (Latinx) students (the majority of those from the Dominican Republic or with heritage there), 9% Black non-Hispanic, 3% Asian, and 4% white non-Hispanic students.[2] Fifty-one percent were classified by the NYCDOE as Multilingual Learners/English language learners, and 36% had an individualized educational plan for a special

[1]The name of the school, students, and teachers are all pseudonyms.

[2]Often students from the Middle East are designated "white" in New York City schools—there were few, if any, Western or Eastern European descended students at the school.

learning need. Ninety-eight percent of students qualified for free and reduced lunch, a proxy for living at or under the federal poverty line [2].

I followed Ms. Torres' sixth-grade Spanish/English bilingual social studies and language arts class, which served between 12 and 17 students as the year progressed, and Ms. Kors' mixed-grades ENL pull-out group, which served between 6 and 8 students. Conversations with teachers revealed that the majority of the students in the bilingual program arrived within 3 years from countries in the Caribbean, Central and South America, or were U.S.-born Latinx, whereas those in the ENL class typically arrived within 2 years from East and West Africa and the Middle East. Students in the bilingual program used English and Spanish daily, and those in the ENL class used languages including Amharic, Arabic, English, Fula, French, Tigrinya, and Wolof. All had varying experiences with language, literacy, technology, and schooling. Ms. Torres and Ms. Kors were both native New Yorkers, Latinas and Spanish/English bilinguals with heritage in the Dominican Republic who had been teaching for 3 and 10 years, respectively.

Researchers' identities matter in all research projects—particularly in projects like this one, where we hope to build long-term, trusting relationships with participants across power differentials around race, age, gender, class, position, and language, and to highlight the salience of those factors in educational practice. I am a white, Jewish, upper middle class university-based researcher, and a New York native. I grew up using English at home and learned Spanish in school and work contexts in the United States and Latin America. Given this positionality, I had to recognize my own tendencies to embody a "white listening ear" [26] and attune my ears to the ways that students used language. To build trust and help students feel comfortable sharing with me, I drew on my experiences forging relationships with students as a bilingual teacher and after school program educator. I was also assisted in data collection by co-researchers Dr. Laura Ascenzi-Moreno, a Colombian-Italian Latinx, native New Yorker and bilingual teacher-educator; Dr. Christopher Hoadley, a white male education technology professor from the Midwest who could use French with some students; and Marcos Ynoa, a male, Dominican-heritage native New Yorker, graduate student research assistant, and former ENL teacher who also used Spanish and English with students.

5 METHODS

The research questions for the broader case study focused around students' translanguaging and sense-making practices as they participated in computational literacies. For this, I used an approach from applied linguistics called *moment analysis* [90], which challenges the notion that linguists should look solely for evidence of pre-conceived patterns, instead encouraging the consideration of participants' critical and creative language-in-use and their metacommentary about their practices during translanguaging moments—the unit of analysis. In line with this approach, I conducted classroom participant observations, formal interviews, and focus groups to document students' practices and ideas during conversations they had about, with, and through code and computing [87]. Students' critical computing engagements were not on my radar initially, but as I collected and analyzed the data, I flagged several instances where students directly critiqued technologies, as well as moments when their metacommentary and interactions implicated deeper social issues linking power, language, and technology. These noticings prompted me to consider how and when issues of language and power surfaced in emergent bi/multilingual sixth graders' engagements with, and commentary around, technology and computing in this analysis. More details about data collection and analysis follow.

5.1 Data Collection

I collected data across a number of settings and in multiple ways to capture both language in use and students' commentary about language and technology.

Along with researcher colleagues, I conducted 51 class period length observations across the two focal classrooms from October to June of a school year—nearly every CS-integrated lesson conducted by Ms. Torres, the bilingual teacher, and about two-thirds of ENL teacher Ms. Kors' CS-integrated lessons. Prompted by students' comments about their interactions with a personalized learning software called *iReady* during a designated "technology" period, I also observed a session of that class (see Section 5.3). I audio-recorded and transcribed these observations, and took field notes focusing on the form and content of students' and teachers' language, technology, and communication practices. I also took photographs of students' screens, classroom artifacts, and student work.

I also conducted beginning-of-the-year introductory interviews with 11 students about their prior experiences with language, literacy, and technology. I gave Spanish/English bilingual students the option of hearing the questions in English, Spanish, or both languages, and encouraged them to talk using whatever language they wished. Questions were adapted from a protocol by Brooks [8]. Some sample questions are included in Appendix A.

To narrow my gaze during complex, dynamic classroom interactions and to establish relationships that would lead to richer exchanges, I used the introductory interviews to help me select five focal students to follow during classroom observations, four of whom (Álvaro, Andy, John, and Mariposa) will be introduced in greater depth in the findings sections. John was in the ENL program, whereas the other three were in the Spanish-English Dual Language Bilingual program. I selected these students because they represented a range of backgrounds across gender, race, age at arrival to the United States, and country of origin, as well as language, literacy, and technology practices. As a participant-observer, I conducted informal check-ins with focal students during and after activities, typically asking them to describe their language/communication choices, actions, and intentions as they used and created with the Scratch software. I took notes about and, when possible, audio-recorded these check-ins. Given that my unit of analysis was the translanguaging moment and not the individual student' experience, I did not shy away from documenting and analyzing interactions involving students who were not "focal."

With researcher colleagues, I also conducted four focus groups with all focal students plus six additional students. These were audio-recorded and conducted in English and Spanish. Researchers prompted students to reflect on their identities and interests, their attitudes about language and bilingualism, how they and others use and perceive language at school, and the language(s) they used while programming in Scratch. Drawing on an artifact-based interview protocol adapted from Brennan and Resnick [7], we also asked students to share what they created in Scratch with us and each other. See Appendix B for sample focus group questions. With help from researcher colleagues, I transcribed focus groups and interviews—see transcription conventions in Appendix C. All Spanish-English translations that appear in the text are my own.

5.2 Data Analysis

Data included field notes, student work samples, and photographs of screens and classroom artifacts, as well as observation, interview, and focus group transcriptions. In line with the broader case study's goals to consider students' translanguaging during conversations about, with, and through computing, I conducted three post-collection reviews of the whole corpus. I began by memoing my initial noticings and themes, looking for examples of translanguaging and engagement with computational literacies. Then, I used qualitative coding software to help me identify more specific characteristics of students' computational and digital literacy practices, the topics of their conversations and metacommentary, and the diverse language practices students used as they engaged in those conversations (see Appendix D for some example characteristic "tags"). Inspired by moment analysis' focus "away from frequency and regularity oriented, pattern-seeking

approaches to a focus on spontaneous, impromptu, and momentary actions and performances of the individual" [90, p. 1224], my goal was not to "code" the data into separate categories and look for patterns as is the goal of most traditional coding schemes [57]. Instead, I aimed to tag the data so I could look for moments where tags overlapped and thus would feature students orchestrating a range of translanguaging features to creatively and critically engage in computational literacies. These moments varied in length from several minute-long interactions in classrooms to seconds-long comments spoken during focus groups or interviews.

For this particular analysis, I was guided by the more specific research question: How and when did issues of language and power surface in middle school bi/multilingual learners' engagements with and commentary about technology and computing? For this, I selected moments that were tagged with conversation topics relevant to this intersection such as "language and identity," "language and race," "evaluations or attitudes about language," "evaluations or attitudes about technology," and practices such as "language exploration through or with tech." I then analyzed those moments by reviewing my memos and tags, considering the ongoing activity contexts for these moments and the roles students were playing within them. I also viewed moments through the lens of the concepts in my theoretical framework by looking for examples of practices that "resist[ed], reconfigure[d], and/or reformulate[d] the sociotechnical digital spaces" [72, p. 2] and questioned traditional linguistic hierarchies to participate in critical translingual discourse [78]. I triangulated observational data with data from interviews and focus groups, and triangulated text-based transcription with images and student work to further warrant interpretations.

6 FINDINGS

Before diving into the examples, I would like to share some ethnographic details as context. I documented several instances of students in the focal classrooms expressing curiosity about and interest in language—a trend consistent with other studies conducted with bi/multilingual students (e.g., [3, 5, 30, 90]). Students in the ENL class often asked their classmates to say or translate words into their home languages so they could hear how words sounded in an unfamiliar language. Students in the bilingual classes argued with teachers about using the language of the day and debated about the best words to use to refer to everyday items. They played with language and accents, making jokes that hinged on *doble sentido* (phrases with multiple meanings) and on translanguaging itself. When asked in a focus group about the particular words and gestures he used—many of them common in the neighborhoods where he lived in New York and Santo Domingo, Dominican Republic—one student, Álvaro, explained, "esto nos representa, maestra" ("those represent us, teacher"). Sometimes students' curiosities surfaced stereotypes or otherwise sensitive issues connecting language, race, ethnicity, and power.

Students brought this interest in language to their engagements with technologies in ways that suggest implications for critical computing education. I present three examples illustrating how issues of language and power surfaced in students' engagements as (1) users of digital tools, (2) critics of digital tools, and (3) tinkerers with digital tools. The first example highlights the political dimensions of language indexed in one student's use of the drop-down menu of language choices for the interface of the Scratch programming environment. The second example highlights how issues regarding language, race, and power cropped up in students' critiques of an educational software used at their school to promote practice of math and literacy skills. The third example highlights the issues of language and power implicated in students' creative experiments with the text-to-speech code blocks in the Scratch environment. In each example, I explore how students' budding questions and views about language, technology, and power were evidenced in the data, and use ideas from sociolinguistics and critical computing to provide deeper context.

6.1 "...Everybody Speak English": Language Politics Surfacing in Students' Engagements as Technology Users

In the Scratch environment, users can choose which of more than 60 languages they would like to use to view the code keywords and interface [1]. Exercising their translanguaging pedagogical lenses, teachers modeled toggling between interface languages and encouraged students to employ this resource as needed. The example shown in the box follows one student, John, a sixth grader who had arrived from East Africa the previous school year, as he discussed his language choices as a user of this feature of Scratch. His comments evidence his grappling with questions about the value of "his language" in and beyond CS education contexts, and surface issues related to language hierarchies and dominant language ideologies in the United States. John's questions and views stemmed from his experiences as a multilingual person living in the United States and East Africa, and his experiences creating projects in the CS classroom.

John expressed complex attitudes about language, identity, and place during interviews, focus groups, and classroom interactions. He connected speaking Tigrinya (what he called "his language") to Eritrea, (what he called "his country"), and commonly spoke Tigrinya with his family. John also learned to read, write, and speak Amharic when he lived and went to school in Ethiopia before moving to the United States. He was also familiar with some Arabic words and phrases, was not shy to practice English with teachers and peers, and was enthusiastic about creating and sharing digital stories with images and code. When, during our focus group, we asked John how important it was to him to be bilingual, he brought up ongoing conflicts between groups in Eritrea and Ethiopia, adding:

> *John*: I think it's *((being bilingual))* a good thing and bad thing. Because like I said before, I came from Ethiopia, from Eritrea to Ethiopia then before, like before, they were in peace? Like uh, if I went to Ethiopia then I speak my language, they'll be like, they'll hurt me, like they will they will hurt me like that? But like, if I, like, and like it's a good thing that you can talk with them. *(Focus Group, 5/31)*

John noted here that being bilingual can enable communication with more people, but can also have negative consequences, because language can be used to mark tribe, sect, religion, and where someone is from, potentially putting one in danger during conflicts [80].

John similarly expressed ambivalent sentiments about being bilingual with respect to coding and programming. A moment later in the focus group, we asked John "How important is it to be bilingual when you are programming?" He replied:

> *John*: Uh that's uh, it's a good thing. Because uh, you got, if someone like if someone do not speak uh like - if someone, you speak uh, like uh, your language and you do not speak English, you can just change it, the language. Or like, you can, if he doesn't know the language and he speak, or he don't speak English, you can change the language. *(Focus Group, 5/31)*

Although John may be externalizing his own experiences to some extent, in this excerpt, he uses the word "someone" and the pronouns "you" and "he,"[3] evidencing his view that toggling between interface languages can be useful to accommodate peers programming alongside him. About a minute after sharing the ways in which bilingualism could be of benefit to him while programming, John spontaneously posed a question to the group which revealed he was still grappling with related issues:

[3]John's use of the pronoun "he" here does not necessarily mean he thinks only boys and men are learners of computing.

> *John*: I have a question about the thing—Is it a good thing to only speak English? Or uh, like or another country like language because like if you speak English like, people know like what kind of language you speak. But if you speak like my language, people—people doesn't know like my language more popular. Is that a good thing only to learn English that way people could speak to you like and they don't—they know that English is like all people know that—English is like American—uh like they speak American people? And pe—uh like, is it only—is it good thing to just learn American? *(Focus Group, 5/31)*

Here, John's statement "English is like American" and question "is it a good thing to just learn American" evidence his grappling with the notion that in the United States, English equals American, and the best thing might be to only speak English. He suggested that when you speak English, "people know like what kind of language you speak," whereas his own language is an unknown quantity that is not that popular. His ideas here are consistent with a comment John had made 2 months earlier during his in-class presentation of his Scratch digital story, when Chris Hoadley and I asked John if he'd ever considered changing the language of the Scratch interface to Amharic (Tigrinya was not an available choice). John said, "...No one speak my language, that's why I choose English. Like everybody speak English" (Observation, 3/15). Even if Scratch made Amharic visible on its drop-down menu, John remarked that since he is the only one at school who uses "his language," that it is not useful to him when he creates computer programs at school.

John's comments and questions relating to selecting a language for Scratch revealed tensions he was wrestling with as a multilingual student proud of his language practices and embedded in a multilingual world, who nevertheless perceived the outsized power of English in his new environment. His question alluded to the dominant language ideology in the United States, which constructs monolingualism as the norm [51, 91] and English as a "code of power" [20]. This ideology has historically driven harmful assimilationist educational policy for language-minoritized groups [32]. At the same time, John's comment that he would toggle the Scratch interface to accommodate a peer indexed a "two-way street" communicative ethic—a more translingual orientation toward language that values meaning-making over use of a particular standard [12, p. 43]. John likely did not settle his questions by the end of the focus group, but we did ask other student participants to weigh in, and a few highlighted the benefits of bilingualism in their responses.

Conversations like those between John, his classmates, teacher, and researchers about the language of programming interfaces, and the politics around selecting one or another, are not generally included in the scope and sequence of critical computing projects, let alone traditional CS education. And yet, emergent bi/multilinguals are navigating their bilingual identities and grappling with what their language practices signify to others in the CS classroom, and in broader society. Issues of language politics figured into the everyday decisions John made as a user of Scratch in the computing classroom.

6.2 "[iReady] it's Racist": Language Politics Surfacing in Students' Engagements as Technology Critics

The next set of examples highlights how issues of language and power surfaced in students' engagements as critics of a personalized learning software called *iReady*. Students were scheduled to use this tool one to two periods per week in the computer lab at STEM Academy. It presented students with multiple choice and short answer math and English language arts questions in oral and written English, and was meant to be adaptive in nature. Teachers asked students to engage in iReady independently and to wear headphones at all times. Students critiqued iReady for being available in English only, and constraining their engagement, expression, and comprehension,

with one student perceiving iReady as discriminating against bi/multilinguals. These critiques evidenced students' budding views on and attitudes toward technology, race, and language.

The first critique highlighted sixth grader Andy's view that iReady limited their creativity and expression.[4] Andy, who had arrived to the United States the previous school year from the Dominican Republic, shared their critique spontaneously during our first one-on-one interview, explaining that the topic of my research (CS and bilingual students) would be important to look into because while they had experiences using Scratch and other software, and knew about "otros horizontes de la computación" (other horizons of computing), many of their classmates would come to associate computing with taking tests on iReady. I asked them to elaborate, and to compare iReady to Scratch, a software they said they had enjoyed:

Andy: Es que iReady es solo—es solo como—imaginemos esto. Imaginemos que estamos en una habitación. Y hay dos maestros. Uno de lectura, y uno de matemáticas. Es lo único que hay. Lectura, matemática. No hay nada más. No puedes ver nada más, no hay forma de expandirse, solo lectura y matemática. Ahora, Scratch. Scratch, tú puedes liberar tu imaginación, poner todo lo que quieras, no hay cosas incorrectas... Por lo cual, ves la gran diferencia de que en Scratch tú puedes expandir tu mente... *(Interview, 11/30)*	*Andy*: It's that iReady is just—it's just like—Imagine this: imagine that we are in a room. And there are two teachers. A reading one and a math one. It's the only thing there is. Reading, math. There is nothing else. You can't see anything else, there is no way to expand yourself. Only reading and math. Now, Scratch. In Scratch, you can liberate/free your imagination, put in anything you want, there is no wrong thing... For that, you see the big difference that in Scratch, you can expand your mind...

Here, Andy equated iReady to a room empty except for a math and a literacy teacher, with few possibilities for "expanding oneself," as contrasted with Scratch, where, they argued, one could more freely exercise one's imagination. Drawing on their experiences creating and sharing animation projects created with Scratch and other apps, Andy critiqued iReady for limiting imaginative and expressive possibilities for its users.

Andy's worry about classmates who may not have had as much experience with creative computing as they did picked up on a particular phenomena at the intersection of language and power: the narrowing of curriculum that can happen when schools and school systems, perceiving emergent bi/multilingual students as "English Language Learners" in need of remediation turn to software and technology. Personalized learning systems and the ways they are implemented in schools exercise deficit perspectives as they evaluate and drill learners against grade-level standards that do not take into account the ways they translanguage to express themselves and learn. Students are told they read at kindergarten, first, and second grade levels, and are given decontextualized passages to read and problems to solve to help them "grow." Andy perceived iReady's narrowing effect and resisted it through their critique.

Students also critiqued the software for the way it communicated with them. iReady was not capable of processing students' oral language, gestures, or other semiotic elements of their communication beyond inputs with the keyboard and mouse. Álvaro voiced frustration with one of the key expressive modalities iReady employed—repetitive directions communicated through auditory input. In observing students using the iReady software, I also noted that sometimes

[4] Andy used they/them pronouns.

the system did not provide written directions for tasks, leaving students with only images on the screen and auditory input in English as clues for what to do. For some emergent bilinguals, this could be more challenging to process. I also noticed that when students attempted to translanguage orally with peers to clarify directions, teachers perceived off-task behavior and told them to work quietly and independently.

Students also critiqued iReady for being available to them in English only, an observation I corroborated during two visits to the iReady classroom.[5] Although I did not complete a thorough review of iReady's curriculum and policies, I learned that the English-only nature of the iReady tool was by design. Claudia Salinas, vice president of English learning at Curriculum Associates, the company that produces iReady, was quoted in the online publication EdSurge in 2017, stating: "For students whose first language isn't strong, translations are really not going to help them...The research shows the kids coming [to the United States] are the most educated and the least educated ever...If you have students coming in with strong first language, I'm all for translation. But if not, you need to figure out how to build English with little to anchor from." [18] This idea evidences deficit-based assumptions about the language and literacy of the learners that use their products—assumptions that students' critiques interrogated.

In one interview, Andy critiqued iReady's English-only interface directly:

Andy: ...deberían pensar un poquito mejor en lo de que solo sea en inglés... Es que el, las computadoras vienen con un traductor equipado y traducen cada página en la que tú vas. Y cómo eso está la mayoría [de iReady] hecho en animación, la página no se permite traducir, por lo cual no vas a poder em, entender casi nada de lo que te dice. Y también, como dije, es como que, los programadores debieron pensarse como dos veces antes de decir vamos a publicar eso... Es como que, fuera de los Estados Unidos hay más personas que le gusta allí aprender otros idiomas... no solo deberían poner, que no solo uno aprende inglés, que también uno puede aprender otros lenguajes, porque así uno expande eh, los lenguajes y nunca es malo aprender, tener dos o tres idiomas que más. *(Interview, 2/28)*	*Andy*: ...they should think a little bit better about how it's only in English... It's that the, the computers come equipped with a translator and they translate every page that you go to. And since the majority of *((iReady))* is made in animation, the page doesn't let you translate, for that, you're not going to be able to, um, understand almost anything that it tells you. And also, as I said, it's that the programmers should think like twice before they say, let's publish this... It's like, outside of the United States there are more people who would like to learn other languages... They shouldn't just have that, that one isn't just learning English, but that also, one can learn other languages, because that way, one can expand um, their languages, and it is never bad to learn, to have two or three languages or more.

In these comments, Andy drew on their experiences as an emergent bilingual person negotiating content in a new language to critique iReady for being incompatible with the browser-based translation work-arounds they tried to enact, which limited possibilities for them and their classmates to translanguage and sense-make around English elements. In sharing that the program provided support in and for English learning, but not for learning other languages, Andy's comments also highlighted their own positive attitude toward multilingualism as contrasted with the

[5]I also placed a call to the company that produces the iReady software, Curriculum Associates. A technical support agent confirmed only the iReady math diagnostic test was available in Spanish.

English monolingual ideology underlying iReady and its implementation at their school. Andy also critiqued iReady's programmers directly for releasing the English-only product. They may have drawn on their experiences as a programmer/animator to make this critique: interviews with them throughout the CS-integrated unit evidenced they had put much thought into ensuring the language used in their digital project and its accompanying instructions connected to their intended audience [87]. Andy's comments here not only voiced their opinion of the iReady software's linguistic constraints, but, in line with hacker literacies, exhibited their attempt to reformulate the tool with browser-based translation strategies and indeed, to transform iReady by offering suggestions for the programmers who created it.

In one case, notions about race and racism also figured into students' language-based critiques of iReady. During a focus group, sixth grader Mariposa—who had arrived to the United States from the Dominican Republic 2 years prior to this school year—called iReady's inability to be translated "racist," saying, "And the other problem for me is that, I think it's racist because it doesn't have two languages, it only have one. So it's much difficult for kids that doesn't know English" (Focus Group, 6/14). Recent studies have documented instances of language-minoritized students perceiving and experiencing linguistic racism [26, 30, 77, 90]. This example suggests that students can additionally perceive and experience technologies as agents of racism based on the language(s) they employ (or do not employ). Although Mariposa's teachers had not explicitly discussed issues of biased algorithms or racism in technology with her class, her critique anticipates these ideas.

When bi/multilingual students engaged with digital tools as critics, they mobilized their budding understandings of language, race, and power to argue that education technology discriminated against bi/multilinguals and narrowed these users' ability to express themselves and comprehend. Students also suggested ways of changing the tool to ameliorate these issues.

6.3 "keloke": Emergent Opportunities for Language Exploration with Code and Computers

Toward the end of the school year, teachers engaged their emergent bi/multilingual students in using the "text-to-speech" code blocks in Scratch, which enable creators to program sprites (characters and other assets in their animations) to speak aloud using robotic-sounding computer voices. Scratch creators can type the text they would like their sprite to "speak" into a code block, use other blocks to change the pitch and language library for these voices, and then sequence these blocks into their projects. Issues relating to linguistic hierarchies and identity surfaced during two moments in Ms. Torres' bilingual class as students experimented with text-to-speech code blocks as tinkerers. These moments provided opportunities for creative play with language that challenged traditional linguistic boundaries and hierarchies and revealed some of the connections students had formulated between language, gender, racial, and national identity.

The first moment began shortly after Ms. Torres showed students a video tutorial about the text-to-speech blocks in Scratch. She expected students to integrate these blocks into a dialogue-based animation about the journeys to school of students around the world as part of a CS-integrated social studies project. During the workshop time that followed, students experimented with these code blocks excitedly. For several minutes, Álvaro and a few other students repeatedly triggered codes to prompt their sprites to say, as Álvaro spelled it, "keloke" (¿Qué lo qué? or What's up?)—a common informal greeting in his neighborhood in New York and in Santo Domingo, Dominican Republic, where he had lived until the previous school year. During our focus group, Álvaro explained this phrase represented him and where he came from, evidencing how he drew connections between language and identity (Figure 1).

Students' creative tinkering with the text-to-speech blocks brought their voices into technology in a novel way. Technologies that use the human voice—like Amazon's Alexa and Apple's

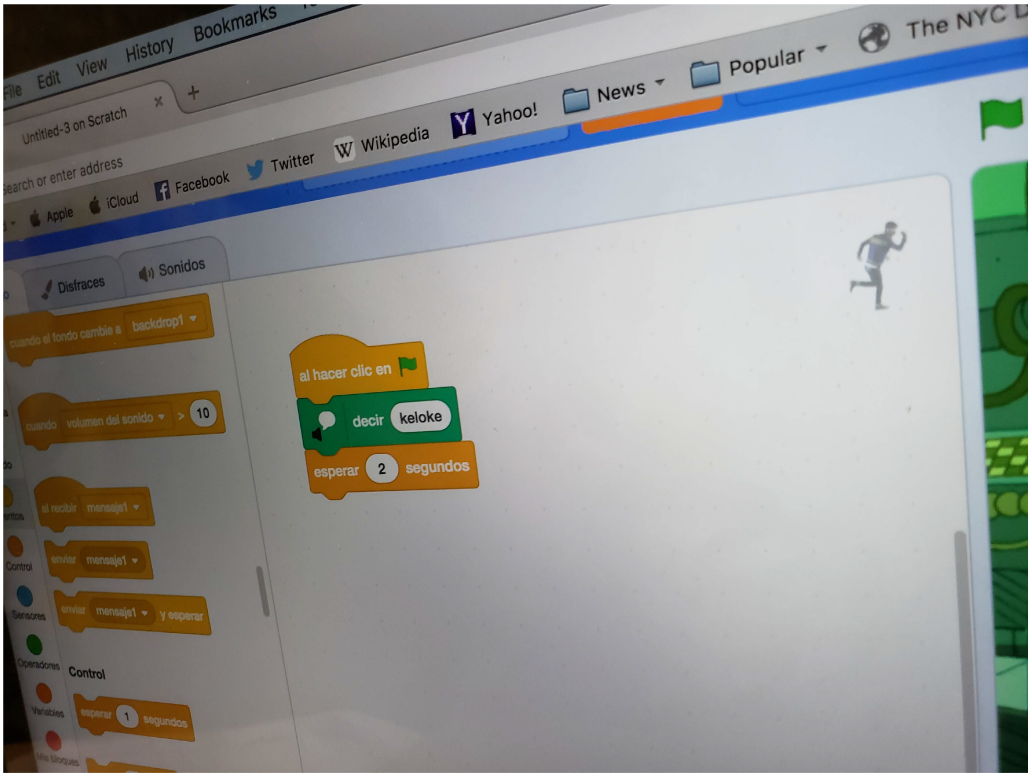

Fig. 1. Álvaro's Laptop Screen, Including Text-to-Speech Code Blocks With "keloke" Written in the Text Box.

Siri—take a fairly traditional and structuralist approach to language. Even as users can select from a few different pitches and accents, this technology still relies on standardized language, and libraries and dictionaries that do not reflect the dynamism of especially language-minoritized people's speech. As students in Ms. Torres' class typed phrases like "keloke" into the text-to-speech code blocks in Scratch, they were playing with and reinventing voice-based technologies in their own image. This type of language exploration was afforded by the Scratch tool's design. Although this connection was not made explicitly by students or educators, one effect of making robots say phrases students personally identified with—of making robots literally translanguage—was to provide alternatives to text-to-speech tools on the market, and to challenge linguistic hierarchies perpetuated by those tools.

After the first few times triggering robot voices, students who were using the interface in English noticed something about the computer voices. Sixth-grader Ivan, who spent his first 5 years in the Dominican Republic before moving to the United States, mimicked the robot voice's pronunciation of the text, repeating "kAY lOH kAY" with his own voice (I spell this phonetically as Ivan said it) as other students laughed. Something similar had happened earlier in the class period when Álvaro used the text-to-speech code blocks for the first time. Álvaro used the word *americanita* in reference to the voice. This female-gendered diminutive adjective might be translated as "U.S. American," but I have also heard this term used by students to signal white as well.

In this example, Álvaro ascribed a race, nationality, and gender to the technology's production, evidencing connections he had made between the computer's voice (pronunciation, pitch) and identity. Additionally, students' play with the language output of the text-to-speech code

challenged Spanish/English linguistic boundaries and hierarchies. In a schooling and societal context where white listening subjects perceive the speech of Spanish-speaking language-minoritized people as inappropriate or deviant [26], students tinkered with text-to-speech functionality to joke with a voice that spoke Spanish like an "americanita." This moment brings to mind Rosa's work on "inverted Spanglish" [66]—language practices used among U.S. Latinx young people that "invert both pronunciation patterns associated with Spanish lexical items and the ethnolinguistic identities associated with these linguistic forms" (p. 74). Inverted Spanglish is often playfully deployed, and produces "U.S. Latina/o ethnolinguistic identities that signal intimate familiarity with both English and Spanish" (p. 74). Such practices can parody whiteness and signal the linguistic dexterity of U.S. Latinx. Rosa argues the effect and meaning of these practices are complex and deeply contextual, presenting "neither a straightforward critique of hegemonic whiteness and monolingual English dominance nor a straightforward embrace of these hegemonies" (p. 77).

As a key side note, I had an interaction with Ivan after this moment that did not encourage deeper reflection or dialogue about these interactions. In fact, in our conversation, I referred to the computer voice as an "issue" and asked Ivan how he would "fix it"—potentially implying that the phonology of the robot created pronunciation that was a problem. I reflected later about why I might not have engaged students in a more open-ended, reflective way. My positionality as a white, American, Spanish-speaking woman likely made me sensitive to hearing students describe voices as "americanita." In my exchange with Ivan, I attempted to quickly move on from the topic even though students continued to play with and talk about the text-to-speech voices. There was potentially more to discuss with students regarding identity, accents, technology, and power.

In these two moments, students' practices as tinkerers of a digital tool highlighted the connections students made between language and identity, and challenged traditional linguistic hierarchies and boundaries.

7 DISCUSSION AND SIGNIFICANCE

The preceding examples demonstrate just how close at hand topics at the intersection of language, technology, and power are in computing classrooms serving emergent bi/multilinguals. As a user of Scratch, John mulled over the pros and cons of the "change language" feature, a moment that indexes broader issues around how language-minoritized students navigate bi/multilingual identities in English-dominant U.S. contexts. As critics of the iReady software, students expressed that the tool constrained their expression and comprehension, they questioned the tool's narrow monolingual interface, and even called out the software as racist, critiques that highlight the monolingual language ideology underlying the tool and its implementation at their school. Álvaro and Ivan's playful acts as tinkerers with text-to-speech technology suggested alternatives to the dominant voices and libraries used in voice assistant technology while also challenging traditional linguistic hierarchies. Students' budding attitudes about language and power came through in these moments (e.g., John's ambivalence about bilingualism, Andy's valuing of multilingualism, and Álvaro's connections between accent and identity).

There are potentially many reasons issues of language and power cropped up in and around students' engagements with technology. Students' experiences living and languaging across different countries and regions, and moving between the differing linguistic environments of school, home, and community, may have primed them to notice how language practices gain and lose status and become associated with different identities. John's commentary and Mariposa and Andy's critiques of iReady allude to experiences with linguistic discrimination and environments that do not recognize their communicative strengths.

Although the teacher-moves that supported students' sense-making in these moments were not an explicit focus of this analysis, the translanguaging stance exercised by teachers and researchers

may have also contributed to opening up space for students to share their views on language, technology, and power. During our focus groups, researchers made space for students to reflect on their language practices and experiences with specific tools. This strategy might have helped bring students' critiques and curiosities about language, technology, and power to the surface even if students did not always arrive at settled answers to their questions. Teachers additionally encouraged students to experiment with changing the language of the Scratch interface and provided open time for experimentation with text-to-speech Scratch blocks—experiences that piqued students' curiosity and provided them with opportunities to make and justify their decisions about the language in and of their technologies.

In any case, as emergent bi/multilingual sixth graders used, critiqued, and tinkered with digital tools, they exercised agency in relation to technology and language. They mobilized critical and expansive notions about language to suggest alternatives for technology, and through their creative engagements with digital tools, questioned and challenged traditional linguistic hierarchies. Students participated in hacker literacies [72] and critical translingual discourse [78] simultaneously.

Given how close to the surface these topics proved to be in focal classrooms, I argue that exploring issues of language, technology, and power might offer a rich and relevant context for computing education with language-minoritized students. I make this argument with three key commitments and potential pitfalls in mind. First, the goal of such a pedagogy must go beyond simply "broadening participation" in CS. Computing education, tools, and fields have marginalized and oppressed emergent bi/multilingual students and their communities—especially those with non-dominant identities around race, gender, immigration status, class, and ability. To truly promote equity in the field, CS pedagogies must reckon with and address those truths [45]. In line with the broader goals of critical computing, CS education curriculum exploring the intersections of language, technology, and power would seek to rethink technology from abolitionist [6], ethical [44], and social justice standpoints [85]. In line with critical language awareness and critical translingual approaches, conversations about language, power, and technology in CS education curriculum would promote linguistic justice [5]. These CS pedagogies would seek students' and their communities' empowerment vis a vis language and technology—not simply their participation in fields that continue to marginalize them.

Second, in line with culturally relevant and sustaining approaches to CS education, curriculum must be responsive to and build upon students' translanguaging practices and funds of knowledge [58]. This means considering students' "repertoires of practice" [37] when designing learning environments, and avoiding making assumptions that the intersections of language, power, and technology are necessarily of interest to students from given racial, ethnic, or language backgrounds. Computing teachers, especially those who are not trained in TESOL or bilingual education, may need professional development on concepts such as translanguaging pedagogy [29], which can be enacted by teachers whether or not they speak the languages of their students.

Third, educators must be prepared to grapple with the challenge of engaging students at this intersection. Although students engaged issues of language, power, and technology without much prompting from educators or researchers, when adults probed students' thinking or opened up space for students to discuss these issues—as in the focus groups—students shared deeper reflections and ideas. Alternatively, when adults ignored the ways these issues bubbled up—as I did in the last example—students missed opportunities to develop positive identities as multilinguals, to exercise agency in relation to technology, and to probe the assumptions underlying dominant language ideologies and stereotypes. Instead of brushing past moments that implicate language, power, and technology—or worse, policing and standardizing the ways students use language around and engage with tools, as in the iReady classroom—educators might anticipate and build on these moments. This necessitates educators committed to developing their own racial literacy

[81] in both technology and education contexts. This would entail developing intellectual understandings about structural racism, the emotional intelligence needed to "resolve racially stressful situations," and a commitment to reduce harms to communities of color [19].

Critical translingual computing might be a topic uniquely suited for classrooms serving bi/multilingual classrooms, but all students might benefit from opportunities to engage at the intersection of language, technology, and power. What could it look like to take students' engagements with language, technology, and power seriously in the CS classroom? Building on critical translingual and critical computing approaches, what would a critical translingual computing education entail? Such a pedagogy could support students to develop positive identities as communicators; to interrogate dominant language ideologies and stereotypes as they surface in technology and society; and to promote ethical use, processing, and generating of language in technology. Drawing on this analysis, educators might engage students across the multiple roles they play in interactions with and around technology—as users, critics, and tinkerers. In the following, I offer some potential directions for educators and curriculum designers to explore organized along the three roles identified in my analysis. I expand the last category, "tinkerer," to include how educators might additionally support students in their roles as creators of digital tools. These roles should be viewed as interconnected rather than mutually exclusive.

When educators expect students to engage as *users* of digital tools, they might recall Andy and Mariposa's blistering critiques of iReady and carefully vet tools for their languaging, sense-making, and expressive possibilities. To do so, teachers should consider how the range of students in their classes will experience tools given their abilities, language and communication repertoires, and prior experiences with technology. Educators—even those who do not speak the languages of their students—might model translanguaging strategies students can use to sense-make around tools, such as toggling the language of a tool's interface, searching for multilingual documentation for a programming language, and consulting word walls, peers, and other supportive materials [39]. Educators might also encourage students to explain the communicative choices they make with tools around language of interface.

Teachers might also expect and make space for students to provide their feedback as *critics* of ed tech and other software. Building on the findings of this study, educators might guide students to uncover the assumptions underlying the design of linguistic elements in technologies like iReady—drawing connections to issues of race and linguistic hierarchies along the way. Teachers might also encourage students to notice when and how technical and sociotechnical systems constrain or devalue their own communication and expression. Armed with their critiques, students can propose or enact tool redesigns to ensure technologies reflect the way they and their communities use language.

When students are engaged as *tinkerers* and *creators*, educators might prompt students to justify the choices they make about the codes, text, images, video, and other modalities they employ, and help students explore the implications of those choices for linguistically diverse populations. Students might explore, for instance, how technologies that incorporate voice handle issues of pitch, accent, vocabulary, and pronunciation, and discuss how different computer voices are perceived in society and why: How do computer voices get "socialized" with genders and races? [93]. Do these accents sound like theirs or those of people in their communities? Why or why not? As creators and tinkerers, students might then experiment with the "text-to-speech" function of Scratch, considering issues of accessibility, stereotyping, and representation as they justify why and when to select particular languages and pitches for the text-to-speech voices.

Explicitly exploring issues of language, technology, and power with emergent bi/multilingual students would likely be new for most CS, language arts, TESOL, and bilingual teachers. At the same time, there may already be space in these disciplines for this kind of critical thinking at

the K-12 level. Discussing issues such as the linguistic biases of tools and technologies offers up a way for educators to discuss the impacts of computing—a core CS education practice as noted in documents like the K-12 CS Framework [42] and the CSTA standards [82]. As argued by Flores [25], the critical thinking employed by language minoritized students when they negotiate meaning across socially constructed language boundaries is aligned with the expectations of the English Language Arts Common Core State Standards that "are not demanding mastery over academic language, but are rather calling for students to be language architects who are able to manipulate language for specific purposes" (p. 25). A critical translingual computing approach is not just potentially relevant to students, but feasible even in current curricular frameworks.

At the same time as there are many practice-based implications for this work, more research is needed to understand the experiences of linguistically diverse students vis a vis conversations about language, technology, and power. What issues surface in contexts where students are more explicitly creating technology and digital artifacts? How would students with disabilities use, critique, and tinker with or create software and tools? What about students who identify as speakers of Black language [5]? Additionally, our project, although focused on supporting and building on students' translanguaging and cultural practices, did not specifically aim to promote critical computing. How might language play a role in the conversations students have in projects designed as critical computing learning environments? There are many avenues for future research on these topics.

8 CONCLUSION

Critical computing projects aim to support young people in using technology to promote justice across a host of contexts and issues, They encourage students to consider justice and ethics as guiding principles as they use, analyze, and create technology. Despite the key roles that language and language politics play in the development and use of digital tools, and in the gatekeeping of technology communities and education, the intersection of language, technology, and power has not been an explicit focus in critical computing.

In this article, I presented an analysis of data collected in a qualitative classroom case study in middle school ENL and bilingual computing-integrated classrooms to explore how and when such issues already surface among emergent bi/multilingual students—a population that has been language-minoritized in U.S. schooling and society. I was guided by concepts from sociolinguistics (translanguaging [33] and the critical translingual approach [78]) as well as from critical computing (hacker literacies [72]), and found that issues of language, technology, and power were close at hand, bubbling up in moments when students acted as users and critics of digital tools and tinkerers with them. Students' interactions and metacommentary evidenced how they exercised agency in relation to technology and language—using their budding understandings of language to question tools, and their engagements with tools to challenge language ideologies. Educators should take the conversations students are having at these intersections seriously by developing critical translingual computing approaches. Educators might promote students' deeper reflection in these areas to support them in developing positive linguistic identities, creating more linguistically just tools, and questioning the assumptions underlying dominant language ideologies. With the right supports, students have the potential to transform computing across domains, benefiting themselves and their communities.

APPENDICES

A INTERVIEW SAMPLE QUESTIONS

In the following are some of the questions I asked students during one-on-one interviews at the start of the school year.

Questions about Language:

- Which languages are spoken in your home? Which languages do you use with the adults in your home? The young people? With people outside of your home?
- When and how did you learn your languages?
- What languages do you and your classmates use in school? When do you and your classmates use your different languages?
- Can you tell me about a time in your life when it was important to know English/know Spanish/be bilingual?
- How important is it to you to learn English? To learn more Spanish? To be bilingual?

Questions about Literacies and Technology:

- What was school like in the country where you lived? How was it similar/different to this school?
- Do you like to read outside of school? What languages do you use to read?
- Do you like to watch TV or videos on the internet? What languages do you use for watching TV or videos?
- Do you use any technology or electronics? What kinds? Where do you use technology? What do you like to do with technology? Where/how did you learn to use technology?
- Have you ever made something on your phone or computer that you shared with someone else? What did you make? With whom did you share it?
- When do you use the interface in English or another language? Why?
- Everyone's learning different things about Scratch in this class. What are you learning?

B INTRODUCTORY ONE-ON-ONE INTERVIEW SAMPLE QUESTIONS

In the following are some of the questions asked during focus groups with students at the end of the school year.

On Identity and Language:

- Paper and markers were provided, and students were asked to "draw their many selves." Then, students shared their drawings to introduce themselves to the group.
- Teach me some words from your family, community, country, or even from YouTube or music that I wouldn't know.
- Do you consider yourself a bilingual person? Why or why not? What does it mean to you to be a bilingual person?

On Language and Programming:

- How important is it to you to be a bilingual person when you are programming?
- Do you know how to translate Scratch into another language? How? Were there times you used Scratch in English? Were there times you used it in another language? Why?
- How do you decide what language or languages to use while you are working with partners (Pair programming)? Giving feedback or comments? When you share your work with classmates in the room?

On iReady:

- Sometimes you use iReady in the tech lab. What do you do there? What do you think about it?
- You also use Scratch. What do you see as the differences between the two computer programs?

Artifact-Based Interview Questions (inspired by and adapted from Brennan and Resnick [7]):

- Describe how you built your project.
- Describe why you chose the sprites and scripts that you chose.
- Why did you decide to write the text in the introduction and text in your project using the language you did?
- Did you look at any other projects or code on Scratch? Did they make you think in a new way about your projects? How?
- Did any bugs come up while you were working on this project? How did you fix them?
- Who do you want to see this project? Who is your audience?
- What would you change or add to this project if you had more time? Why?
- What did you enjoy/not enjoy about doing this project?

C TRANSCRIPTION CONVENTIONS USED IN THIS TEXT

- ((italicized in double parentheses)) Indicate transcribers' comments, usually from field notes
- (Single parentheses around talk) Indicate a problematic hearing
- Ellipsis ... indicates omitted speech
- (Observation/Focus Group MM/DD) ¬— Indicates the type of data and the month and date of the school year when it was captured

D TAGS USED TO TRACK MOMENTS DURING ANALYSIS

In the following is a selection of the tags I used to characterize the content of moments as captured in classroom observation, focus group, and interview transcripts, during analysis.

Computational/Digital Literacy Practices:

- Computational thinking practices from Brennan and Resnick [7]: Testing and debugging, experimenting and iterating, reusing and remixing
- Tinkering and play
- Troubleshooting
- Talking to/with computers
- Exploring language through use of technology (e.g., machine translation or other language-generating/processing tools)

Conversation Topics Co-occurring with Computing Activities:

- Evaluation or attitude about technology
- Evaluation or attitude about language
- Language, bilingualism and identity

Linguistic and Semiotic Resources Orchestrated in Translanguaging:

- Gesture and body position relative to others and computers
- Whispering/self-talk
- Scratch code blocks
- Different varieties of oral/written language, slang/community-specific words
- Images
- Invented spellings
- Role-play/rehearsal

ACKNOWLEDGMENTS

Thank you to the TOCE reviewers and editors whose feedback helped me strengthen the article. Also to Laura Ascenzi-Moreno, Chris Hoadley, Ofelia García, Kate Menken, and Jasmine Ma for

their ongoing support, and to our "best" writing group: Tatyana Kleyn, Maite Sánchez, and Laura Scheiber. Marcos Ynoa and Sarah Radke helped conduct observations and focus groups as well as transcription. Special thanks to all teachers, students, and administrators at PiLa-CS partner schools.

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Received July 2020; revised March 2021; accepted June 2021

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