Representing Percents and Personas: Designing Syncretic Curricula for Modeling and Statistical Reasoning

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Abstract: Syncretic literacy can link everyday and scientific concepts in student learning. In this paper we describe the design and implementation of a curricular unit in a bilingual middle school science class developed to help students link everyday conceptions, conceptions from math, science, and computer science, and their own broad linguistic repertoires to support syncretic literacy in modeling and statistics in a unit on post-Hurricane Maria outmigration from Puerto Rico. The unit invited students to use printed maps, physical objects, computer code, and simulations to explore concepts such as percentages and scientific models, framed by an approach from translanguaging pedagogy. Qualitative study showed that this approach supported students to engage productively in the tensions between scientific and everyday conceptions as described in Gutiérrez (2014), while using language resources from across communities and disciplines.

Purpose

Statistical reasoning and modeling, especially computer modeling, are cross cutting practices that can be brought to many domains. These practices are centered in different ways across school disciplines: as a specialized or applied form of mathematics in school math (Cobb & Moore, 1997; Gould, 2010), as a tool for hypothesizing, prediction, theory-building, and empirical argument in the sciences (Schwarz, et al., 2009), as a form of representation and reduction in history or social studies (Berson & Berson, 2007; Pagnotti & Russell, 2012), or as a tool for expression in language arts and composition (Bruce & Levin, 2003). However, central to all its uses, statistical modeling (and modeling practices in general) as it is presented to students, privileges 'real' numbers over local knowledge. When not in agreement with the statistical interpretation, students' experiences of disjuncture between their local knowledge and a statistical 'Truth' that numerical data is constructed to represent can materialize as tensions in classroom settings (Enyedy & Mukhopadhyay, 2007).

This study presents the implementation of a lesson designed to support modeling practices in which students, teachers, and researchers in a bilingual Spanish-English middle school science class created and grappled with physical and computational models of statistics representing post-Hurricane María outmigration from Puerto Rico. We analyze how students' sense-making and modeling practices drew on layered and intertwined literacies, paying particular attention to the resources that students recruited and deployed as they participated in the activity. Our design attempted to implement a syncretic approach (Gutiérrez, 2014) to support students in leveraging their translanguaging practices (García & Li Wei, 2014) for learning.

To begin to understand how such an approach can support learning, we were guided by the following questions: (1) What kinds of sense-making and modeling practices do students and teachers draw on as they participate in ongoing activity? (2) What kinds of understandings/knowledges/literacies are treated as valued resources in the process of building and making sense of models? We present two episodes of student model-building in order to highlight the generative possibilities of design to create space for multiple (sometimes disparate) modeling practices. We found that students used a range of resources across languages, disciplines, and communities to understand the complex phenomenon of migration, and to produce and understand models; leveraging their deepening understandings of ideas from one domain to support deepening understandings in others. These findings demonstrate the potential of syncretic approaches to design that enable students to co-construct ideas by leveraging resources from across disciplines, language practices, and communities.

Taking a syncretic approach

We acknowledge a core tension in fostering meaning-making with statistics and modeling in schools. On the one hand, secondary schools are both intellectually and administratively set up to discipline learning and academic practices (Siskin, 1991). For example, within the K-12 curricula in the United States, modeling practices are typically taught in science class, while statistics education resides in mathematics classrooms. One response to this structure is to conceive of learning in this domain as participation in and identities linked to multiple disciplinary communities of practice (Lave and Wenger, 1991; Gee, 2011), or participation as interlocutors in multiple disciplinary literacies, in which students may develop an assortment of distinct practices that they can take up as they move through multiple discourses and communities. On the other hand, as Gutiérrez (2014), drawing on Engeström (1999), reminds us, student learning is both "vertical" in the sense of being grounded in contexts or disciplines, and "horizontal" in the sense of integration of knowledge across contexts including the lived experiences outside of school. Although Gutiérrez primarily focuses on this as a tension between the 'scientific' and 'everyday' concepts, it may apply equally as a framing for concepts between disciplines, i.e., what we consider to be 'mathematically' scientific, 'science class' scientific, or 'social studies' scientific.

Pedagogical approaches such as project and inquiry-based learning (Barron et al., 1998; Hmelo-Silver, 2004), culturally sustaining pedagogy (Paris & Alim, 2017), and translanguaging pedagogy (García, Ibarra Johnson & Seltzer, 2017) invite teachers and students to dissolve borders between educator and learner, school disciplines, communities, and named languages - recognizing the assets of people and communities that have been traditionally marginalized, challenging hierarchies in education. These efforts acknowledge that meaningful and transformational learning experiences "bring together and reorganize different, contradictory and discrete cultural practices that are generally incompatible or in tension with one another" creating opportunities for the creation and exploration of what Gutiérrez calls "syncretic literacies" (Gutiérrez, 2014, p. 49). We take up the lens of "statistical meaning making as social practice" (Radke, Krishnamoorthy, & Ma, 2019) which describes meaning-making *about and with* statistics as emergent and co-constructed rather than a hierarchical or ordered processes. This focuses analyses on the interconnections and tensions that may emerge when students use their experiences and knowledges to reason about statistics and the social phenomena they represent (Enyedy & Mukhopadhyay, 2007). In our case, we are concerned with the ways in which the practices of statistics and modeling, including modes of inscription, and argumentation which are core ways of conceptualizing mathematical knowledge (Lehrer and Lesh, 2002), can be syncretic with respect to disciplinary and everyday conceptions.

Translanguaging theory (García & Li Wei, 2014; Otheguy, García & Reid, 2015) was developed to provide a framework for understanding how especially bilingual people leverage their full language repertoire in sensemaking, showing that students for instance may be strategic about using features from privileged language and a home language together to better achieve their learning and communication goals. Translanguaging pedagogy (García, Ibarra Johnson, & Seltzer, 2017) recognizes this capacity in students and attempts to foster learning by encouraging students to use their full repertoire of language and semiotic practices and literacies in class through a combination of a teaching stance, design features, and moment-to-moment teaching shifts. In this study, we recognize as translanguaging students' flexible use of linguistic resources and semiotic resources including images, objects and gestures, and computer-based representations (including modifications to pre-made computer simulations, and student– and teacher-generated computer code). In this way, we wed the concept of translanguaging with Gutiérrez's notion of syncretic literacies, and extend the syncretism not only to encompass the differing worldviews of 'everyday' and 'scientific' conceptions, but to also encompass the syncretism of bridging language practices no matter their different statures in school and society (e.g., varieties of English and Spanish), and of encountering different discipline-based understandings (math vs science vs social studies, and so on.)

Research setting and participants, data, and methods

Data comes from a research practice partnership (RPP) which brings teachers from three public middle schools in New York City together with university-based researchers to develop, implement, and study the integration of computer science concepts and practices into subject area curricula, in ways that support emergent bilingual students. In this paper we visit Lucy's (names of people and places are pseudonyms) seventh grade science classroom in a transitional bilingual program. A resident of the school's neighborhood and of a Dominican background (like most of her students), Lucy is a certified bilingual teacher in her 17th year teaching. Lucy, Sara, and Christopher co-designed a unit that investigated the long-term impacts of Hurricane María based on student interest in the topic. Lucy taught lessons in this unit weekly, from October to June. Given the fluid nature of the roles in an RPP (Bang & Vossoughi, 2016), researchers often co-taught/co-planned with teachers, and teachers often took on tasks that would be traditionally regarded as research, such as co-analysis and co-presenting at conferences. The lesson analyzed here was guest-taught by Sara, who was also a research assistant in Lucy's classroom. Sara is a bilingual, white, upper middle-class university-based researcher from outside of students' and teachers' school and community.

Data includes fieldnotes, audio recordings, photos of ongoing activity, and material artifacts including student work and the lesson slide presentation. Analytically, we focus on interactions in which physical and computational model-building is the driving activity. This honed our search and selection of episodes for analysis to those in which discussion is about either the development of students' physical migration models or sensemaking around the teacher's physical and computational models. Methods of multimodal and interaction analysis (Goodwin, 2010; Jordan & Henderson, 1995) were used to follow the unfolding nature of student and modeling practices and statistical sensemaking in talk and moment-to-moment interactions. Analysis focused on the resources (linguistic, physical, and conceptual) that students recruited and deployed in the process of participating in the activity.

Lesson design

In her first year in the RPP, Lucy developed a unit in which students used the multilingual Scratch programming environment (http://scratch.mit.edu) to create a computational model of the effects of Hurricane María, which had devastated Puerto Rico early that school year, addressing science curriculum standards for modeling in science. In her second year, Lucy expanded the unit to include more opportunities to interpret statistics. Students engaged in activities to learn about Hurricane Maria once a week. They shared their and their family members' experiences with storms, considered what kinds of data the public would want to know about storms, analyzed infographics of recent hurricanes, interviewed a Puerto Rican scientist via web conference, and read news articles to learn about the long-term effects. They also encountered the controversy over official death tolls of Hurricane María via articles and social media posts. As the unit transitioned to using the Scratch programming environment for modeling statistics in February, Lucy and Sara decided to have students analyze and unpack a few teacher-created Scratch projects as exemplars. Lucy, still new to teaching with Scratch, was hesitant to create and introduce students to a Scratch model. Sara offered to try it out first, an opportunity Lucy accepted. Sara, Christopher, and Lucy co-planned the lesson Sara would deliver. Importantly, the design sought to operationalize designers' philosophies about "syncretic" literacies by creating a context for students to participate in modeling practices across disciplines—science, math, computer science, and social studies, and to create space for students to contribute their own reasoning, which would be valued as productive towards learning and participation.

In the lesson, students would be asked to create a physical model of a statistic about out-migration from Puerto Rico after the hurricane, and then experience, describe, and analyze Sara's physical and Scratch models about the same statistic. The teacher would attempt to validate students' reasoning, but also acknowledge the tensions inherent in bringing disciplines and students' experiences together. The design also implemented principles from translanguaging pedagogy by providing students with opportunities to use manipulatives, oral language in any language, code, statistics and images in fluid and flexible ways. The stance, curricular design, and classroom moves were intended to elicit and encourage translanguaging across not only the students' linguistic repertoires, but their other semiotic repertoires as well. This echoes how Gutiérrez describes designing syncretic literacy learning as involving "intentional moves that 1) bring together and reorganize different, contradictory, and discrete cultural practices that are generally incompatible or in tension with one another; 2) preserve and foreground the tension between everyday and scientific practices; and 3) seek to maintain the value, history, and integrity of the everyday genre vis-à-vis the dominant form" (Gutiérrez, 2014, p. 49)

Designing physical migration models: Exploring student work

Sara began the lesson by sharing a slide of statistics students had identified from their reading of articles about the long-term impacts of Hurricane María during a conversation with Lucy the previous week. She then called up a slide zooming in on one of those statistics in particular, which translated to "After Hurricane María, 400,000 Puerto Ricans left the Island. Of those, 43% went to the state of Florida and 9% went to New York." She asked students to imagine they were going to teach a sibling or cousin about this statistic, and to, in pairs at their table clusters, use the provided manipulatives (e.g. small cubes) and a map of Puerto Rico and the US mainland with New York and Florida highlighted.

Rochy and Max: "Estos cuadritos significan uno cada uno, uno porciento" ["These little cubes mean one for one, one percent"]

Less than a minute after Sara introduces the task, Rochy calls her over to his desk where he sat with his partner, Max, asking "How do we have to do this?" Sara re-reads the instructions on the worksheet (written in Spanish). The following conversation is prompted by her question, "¿Qué puedes hacer con esto [points to handout] y con esto [points to the plastics cube manipulatives they have been given]?" (What can you do with this [points to handout] and this [points the plastic cube manipulatives they have been given]?)

[82] Rochy: Puede esto represent forty-one [pointing to one of the cubes]
Rochy: This could represent forty-one [pointing to one of the cubes]
[83] Max: Ponerlo en el color que van.

Max: Put it in the color where it goes

[84] Sara: Ok, ¿Cómo?

Sara: Ok, how?

[85] Rochy: Like, blue over there. No, déjalo like, like, put like like forty-three percent in in Flórida.

Rochy: Like, blue over there. No leave it, like, like put like forty-three percent in Florida.

((Places a blue cube on the image of Florida.))

[86] Sara: Ok. Put forty-three percent in Flórida. ¿Cómo representarías forty-three percent?

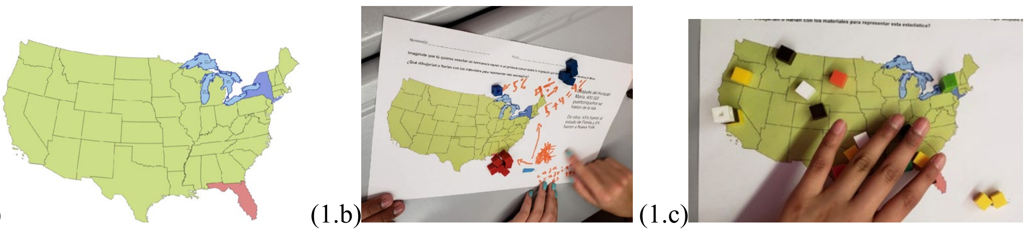
Sara: Ok. Put forty-three percent in Florida. How would you represent forty-three percent?

[87]. Rochy: Cuarenta y tres blue

Rochy: Forty-three blue.

When Sara restates the directions and motions to the materials in response to Rochy's question, he is pushed to make his own decision about what to "do" with the materials. Immediately, Rochy began actively working with the statistic, and verbally translanguaging to reason about how to represent it with the materials [82]. It is notable that Rochy's statement is the first time the word "represent" is used, as Sara had previously used "enseñar" ("to show" or "to teach"), and a classmate had used "mostrar" ("to show"). This language offering is taken up by Sara as a valuable linguistic resource for the task at hand. As they continue to model together, Rochy and Max discuss what a cube represents [82, 87], and where to place cubes on the map [83, 85]. Rochy's use of the word percent is the first time the language of "percent" and the use of the physical materials are brought together. Sara probes for further explanation about how blue cubes might be used to represent forty-three percent, taking up Rochy's word choice as "representar" here and in the episodes to follow. It is at this point that Rochy suggests, "forty-three blue," [87] and in that decision he has both planned how to model the migration of 43% of Puerto Rican migrants to Florida and defined each cube as representative of one percent.

Taking up this episode for an analysis of statistical modeling practices, we understand these excerpts to be an example of what Lehrer and Lesh (2003) described as, "interacting systems of inscription and notation as students grapple with potential correspondences between the world and the emerging mathematical description," (p. 384). As the boys work to build their model, they are simultaneously developing a material notational system in which they use cube units to represent 1%. Rochy mentions that they should "put" forty-three percent "in" Florida [85]. His modeling practices center around getting the physical manipulatives to represent visually the number 43. In other words, with each cube holding a value of 1%, his interest is in making sure they add up to a total of 43. What is amplified (Latour, 1999) is cardinality - that is, that 43% is equivalent to a set of 43 one percent units. In turn, what gets reduced (Latour, 1999) in his modeling practice and choices about how and what to represent is that the statistic 43% is already a representation, of people. They continue to work for about eight more minutes until Sara asks them to share their model with classmates Fabiana and Naomi. In what follows we learn they have added a new kind of cube (blue with a divot on top) to their representation.



(1.a) (1.b) (1.c)

Figure 1. (1.a) Worksheet given to students and the representations of (1.b) Rochy and Max (1.c) Katy.

[184] Fabiana: Mira, explícame, ¿qué significa esta (inaudible)?

Fabiana: Look, explain to me, what does that (inaudible) mean? ((pointing to the blue cube labeled 5% at the top of his model, see Figure 1.b))

[185] Rochy: Cinco porc[iento

Rochy: Five per[cent-

[186] Fabiana: [Ah, y ¿por qué colocas cuatro porciento si aquí es nueve?

Fabiana: [Oh, and why did you put four percent, if here it's nine?

[187] Rochy: Claro. Porque, estos cuadritos significan uno cada uno, uno porciento. Uno sumas un cuatro porciento y este significa cinco ((pointing to the cube labeled 5%)), tu lo sumas y hay nueve porciento.

Rochy: Of course, because these little cubes mean one for each one, one percent. You add one up to four percent and this means five ((pointing to the cube labeled 5%)), you add it up and it's nine percent.

When Fabiana asks Rochy to explain his model [184], she refers specifically to the cube labeled 5%. This blue cube had a divot on the top, making it slightly different from the other blue cubes he and Max had previously counted as 1%. It is notable that Fabiana, in both her questions [184 and 186], is focused on making sense of both Rochy's inscription tool (the cube) and his notation (5%) in relation to the statistic given (9%). In his answers [185 and 187] Rochy attends first to the inscription [185] and then to the notation in relation to the inscriptional tool [187]. To do the latter, he draws on this property of the manipulative as a resource to help him model a new unit of 5%, explaining that if this "special" cube represents 5%, and each smooth blue cube represents 1%, then together, they sum to 9%. Now we see that Rochy and Max's notational system has expanded to include two tools (the blue cube of 1%, and the divot cube of 5%), complicating the visual representation and producing a need for new written notation (5% and 4% in orange in Figure 1.b). What is amplified in their modeling remains the cardinality - that is, that 43% is equivalent to a set of 43 one's units, and 9 is the sum of a 5 unit and 4 one's units. In turn, what gets reduced in his modeling practice and choices about how and what to represent is that the statistics are a representation of people.

Katy's model of people migrating: "Más van a Florida" ["More go to Florida"]

This second excerpt also comes from the initial student pair work after the teacher launch. Just moments after the initial conversation with Rochy and Max but before Rochy talks with Fabiana, Sara stops at the table where Katy is working alone. When Sara approaches, the cubes are already on the map (See Figure 1.c) Sara opens her inquiry about Katy's model by asking "¿Qué vemos aquí?' ("What do we see here?"), and Katy responds "Personas" ("people"). Unlike Rochy and Max who used only blue cubes to represent percentages (1% and 5%), Katy has chosen to use the multicolored cubes to represent people [132]. Through further questioning, it is revealed that the placement of the cubes represents migration of people from Puerto Rico, but unlike Rochy and Max who placed cubes only in the states listed in the prompt, Katy has cubes strewn across the entire map. After a short verbal description that the people represented by the blocks are migrating, Sara asks how to interpret the model.

[137] Sara: ¿Cómo puedes representar que están migrando? Porque yo veo gente en todos lados.
Sara: How can you represent that they are migrating? Because I see people all over.

[138] Katy: Porque hay más personas (en esta parte) ((gestures to an area of the map))
Katy: Because there are more people (in this part) ((gestures to an area of the map))

[139] Sara: OK

[140] Katy: y menos personas en ((gestures to an area of the map))
Katy: And less people in ((gestures to an area of the map))

[141] Sara: Ah, puedes tener más en una parte y menos en otra. ¿Dónde van a haber más? ¿En dónde?
(5 seconds silence) ¿Dónde tienes que poner muchos?
Sara: Ah, you can have more in one part and less in another. Where will there be more? Where?
(5 seconds silence) Where do you have to put a lot?

[142] (3 seconds silence) ((Katy moves some cubes to Florida. See Figure 4))

[143] Sara: Ah, estoy viendo que estás arrastrandolos a, a Florida. ¿Por qué?
Sara: (3) Ah, I'm seeing you are moving them to Florida. Why?

[144] Katy: Por qué (mas van a Florida)
Katy: Because more are going to Florida

Throughout the exchange, Katy never refers to the cubes directly in her talk, nor does she explicitly represent specific quantities or percentages; instead she describes the model in terms of the people and their migration patterns. This is different than Rochy and Max who talked specifically about the cubes as physical objects and what the cubes represent (percentages). Additionally, unlike Rochy and Max who work to represent the precise statistic given in the prompt (both in their talk and in the model itself), Katy uses "mas" and "menos" [138 and 140], approximating the number of people who immigrated to different parts of the United States. Katy's model foregrounds the social phenomena over the statistic, though her use of terms like "más" and "menos" suggest the statistics played a role in where she placed the cubes. In this way, Katy's modeling reduces precision, but amplifies people's experiences and the 'everyday conception' in Gutiérrez's formulation.

Both Rochy and Max's representation of "percents" and Katy's representation of "people" illustrate the innovative ways that students make sense of materials to create models. Together, the two episodes surface a key tension between "the world and emerging mathematical descriptions" embedded in modeling-eliciting exercises of this sort (Lehrer & Lesh, 2003, p. 384). While models may attempt to capture social realities (e.g. migration of people), they often rely on intermediate quantitative data (here statistics) to do so. The students' choices about which of these ideas to prioritize highlight that statistical sense-making is not a hierarchical construction in which students first reason about a statistic and then reason with said statistics in relation to social phenomena (Radke, Krishnamoorthy, & Ma, 2019). Rather, Rochy, Max, and Katy are simultaneously making sense with and about both the statistics embedded in the prompt and the underlying social phenomenon in order to produce a physical model of migration. We argue that during these interactions, understandings about three core aspects are being co-constructed: the social phenomena that drive migration, the statistics that represent the migration, and the student models in production.

During a class discussion that followed this activity, Sara asked students what differences they noticed between how groups constructed their models. One student, Eddy, noticed a contrast similar to the one we highlighted above, that some groups chose to represent the exact numerical values of the statistics, whereas in some groups' models, including his own, "no importaba el número. Nosotros nos pusimos las fichas aquí, pusimos muchos aquí y poco aqui" ("The number didn't matter. We put the chips here, we put a lot here, and a few here"). Katy also pointed out that some groups indicated movement by drawing arrows, while others did not. Conversations like these both surface and validate students' different ways of translanguaging and sense-making about statistics and social phenomena. The understanding of both percentages as a numeric concept and what *migration* percentages represent (people moving) developed syncretically both as an understanding of number and as an understanding of the everyday notion of more and less people migrating.

Discussing and unpacking teacher models

Students' choices about what to model foreshadow key themes in the conversations that students and teachers in this classroom had later. In the course of the next activities, in which the teacher introduces a physical and computational model, as students' attention is drawn to one or another of these ideas (social, statistical, or modeling), they are also reckoning with, and potentially deepening and developing their notions of the others.

The first, a physical modelling of the process of migration, involved rolling a 10-sided die, then moving cubes representing people into cups placed on the printed map near and labelled as Florida, and other locations. Conversations followed in which students negotiated why the cubes placed in cups did not exactly match the 43% migration rate, incorporating real-world explanations of why people choose different destinations with discussions of probability and of the way in which the algorithm was constructed (if dice roll was 1, 2, 3, or 4, send the cube to Florida, otherwise, send to the 'other' cup). Later, Sara shares a Scratch model on the smart board which displays a map of the US mainland and Puerto Rico. When the user clicks the green flag "go" button, a new clipart icon of a person with a suitcase is generated every half second and "migrates" from Puerto Rico. The Scratch code randomly assigns each "migrant" a number from 0-100, sending those who receive less than 43 to Florida, and the rest to a random location on the screen. Sara asks students to describe what they see. Noticings include one student pointing out that "everybody is going to different places," and Rochy's that they are "dividiéndose" ("dividing themselves up"). Students also notice that the counter keeping track of migrants to places other than Florida is higher than the Florida counter. Sara asks students why that might be. As with the physical dice, students provide reasons rooted in the social phenomena. In the class discussion, the teacher reminds students of the 43% statistic which leads one student to notice that the other locations are 100% - 43%, which the teacher uses to reorient students towards how the percentages imply more people going to other locations. This then links the discussion back to social reasons people might migrate to one place or another. Finally, students examine the Scratch code, noticing how the "pick random" block is responsible for assigning migrants to different locations. In short, the episodes following involve more explanation of the 'scientific' and 'everyday' concepts of the statistics in a syncretic fashion, grounded in the teacher's models.

Discussion

This curricular unit was explicitly designed to allow students to use a variety of meaning-making tools to engage with concepts in statistics. Beginning with the selection of Hurricane Maria as a context, and continuing with opportunities for students to bring their own home language and initial understandings to bear, the unit was based on the idea that students needed to be able to draw upon resources from their out-of-school experience and their home language and culture. However, the team was equally interested in bringing the perspectives valued in school to bear, in particular, notions of modeling and data interpretation from science curricular frameworks, and notions of statistics from math, and notions of computational thinking from computer science. We used the three tenets of translanguaging pedagogy to support students using their full linguistic repertoire throughout: maintaining a stance that students' home language practices and culture were valued and welcome; designing classroom activities to share ideas in multiple semiotic formats and in open-ended ways that did not limit the literacies students could engage (e.g., supporting drawing, physical manipulation, ad hoc representational schemes in addition to more typical school sanctioned equations or written work); and bringing in-the-moment teaching moves to bear to support students in leveraging different language resources. The tenets of translanguaging pedagogy were also applied to computational representations as a form of languaging: representing algorithms and computation both in 'unplugged' offline activities as well as in Scratch; taking a stance that students could express computational concepts in language, in code, or through physical manipulatives; and providing in-the-moment teaching moves to validate students' use of multiple ways of exploring these concepts. By taking this expansive approach to translanguaging, the unit was able to engage the concept of percentage and statistics in a syncretic way, in which students were able to think about statistics not only mathematically, but also in terms of human stories of migration, or in terms of less quantitative formulations like "less" and "more". When Rochy can see both the individual migrant icons 'dividing' themselves into destinations, or when the class can connect the larger number of students migrating to places outside Florida as related to the "100% - 43%" math expression written on the board, they are translanguaging and engaging in syncretism, meshing everyday and scientific notions of percentages. In this way we have used the framing of translanguaging pedagogy to support syncretic literacies as envisioned by Gutiérrez.

Conclusion

In this paper, we have shown how a syncretically-designed unit that values and makes use of students' dynamic linguistic and representational repertoires, can support the development and use of linguistic and other meaning representations ranging from maps and cubes to computer code and models. While translanguaging pedagogy has been developed in large part to help legitimize use of non-dominant named language practices in schools, this pedagogical stance can also help us reach towards different forms of syncretism in learning. Akin to Gutiérrez's original conception, we can see how these students were moving towards linking the 'horizontal' and 'vertical' forms of learning in terms of the everyday conceptions around migration and natural disasters, as well as conceptions of models and statistics. In addition, we see how opening the design to a view of disciplinary perspectives as syncretic and co-constitutive allows us to push beyond the traditional formulation of statistics as a specialty within mathematics as well as modeling and data interpretation as a privileged epistemology in science. This shift creates the possibility for sense-making practices that value and make use of multiple personal knowledges and understandings about both content and social experience. Computation (more specifically, digital multimedia, and multilingual Scratch code blocks) in our project has served as a touchstone for a type of non-linguistic semiotic resource for translanguaging, but as this unit shows, other resources, ranging from toy blocks, to maps, to dice can be engaged as semiotic resources for syncretism and translanguaging. We recognize that our use of syncretic literacies and translanguaging theory extends beyond the narrowest conception of each. However, what unifies these two theories and our approach is an appreciation that inclusive meaning-making encourages learners to cross disciplinary boundaries, the boundaries of named languages, and the home/school divide to make sense of phenomena (such as the outmigration from Puerto Rico after Hurricane Maria).

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