Mind, Culture, and Activity

Re-Mediating Second Language Acquisition: A Sociocultural Perspective for Language Development

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This article provides a cultural-historical (CHAT) analysis of the practices used by an effective teacher of Latino/a children previously classified as "underachieving" and "beginning/novice" English Language Learners. Although the teacher would not describe her practices in strict CHAT, or sociocultural theory (SCT) terms, our analysis shows that teaching practices in this classroom are better understood using a SCT model rather than more prevalent second language acquisition (SLA) models that dominate the field of bilingual/English as a Second Language education. We describe the fundamental limitations of SLA assumptions about learners vis-à-vis a SCT perspective and use classroom and case study data to illustrate how a CHAT perspective illuminates this teacher's practices. From a CHAT perspective, teaching and learning are socially reorganized around the mediation of dynamic learner identities and include shifts in expert–novice status, dialogic interactions, and the use of innovative mediational tools (e.g., keystrokes on a calculator) to promote academic writing and oral communication. The mediational reorganization described in the classroom opened up access to students who might have been dismissed by a SLA model as "incapable" of engaging in such tasks. We draw on classroom-level data (i.e., standardized scores in reading and math) as well as the work of selected focal students to illustrate our case.

INTRODUCTION

The continued rise of English language learners (ELLs; mostly Latinos/as), combined with the decline of bilingual education services/training nationwide, has created a crisis for in-service

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teachers who lack training in the learning and teaching of ELLs. For decades, second language acquisition (SLA) models of language learning have dominated the fields of English as a Second Language and bilingual education, with most of the focus being on the individual learner traits and universal trajectories of development rather than the social organization of learning and situated, differentiated models of development. Recent results from the National Assessment of Educational Progress reveal that the majority of ELL test takers scored far below non-ELLs in mathematics and reading and that the gap only widened from elementary grades to 8th grade (Fry, 2007). The issue of the schooling failure of ELLs largely affects Latinos/as as they are the largest group of ELLs (73%) (U.S. Department of Education, 2000).

SLA perspectives have generally lead to reductive views of what counts as language proficiency. Sociocultural theory (SCT) scholars over the years have increasingly called for the need to move beyond reductive views of language. Mathematics educators have argued for more integrated and specialized approaches to language and content taking into account content specific ways of meaning making (Moschkovich, 2002). Mathematics learning has been framed in terms of language socialization, discourse processes, and situated activity. This body of work has served to reconceptualize mathematics learning as a cultural practice. This article builds upon this work by focusing attention on second language development situated within a mathematical context. Our analysis focuses on how ELLs develop their "second language" through mathematics and not mathematics development per se, recognizing that the two are inseparable. Our article is intended to serve as a tool for rethinking and "re-mediating"[1] SLA approaches to language development, and we have chosen a mathematical context to reinforce our premise that second language development occurs within activity systems where language is a fundamental mediational tool for goal-directed actions and learning.

We argue that SCT provides a more robust perspective on second language development than SLA models. We support our argument by presenting evidence drawn from the instruction of a teacher, Ms. Martinez, in a working-class school, who has a record of having Latino/a ELL students be successful by qualitative and standardized measures. Ms. Martinez's instructional practices and how she organizes learning is a model of the transformative possibilities of working in economically disadvantaged schools with large populations of Latino/a ELLs. Overall, through her instruction, she creates an activity system that repositions students as agents of knowledge construction who collectively move toward a common goal using multiple mediational and semiotic tools. Through this activity system, her students not only develop mathematically but also appropriate complex writing practices in English.

The teaching practice of Ms. Martinez has been informed by math educators who emphasize dialogic principles of learning and instruction; in particular, the *keystrokes* medium of communication used by the students was appropriated from professional development sessions with a SCT orientation. We later present how she describes her approach to learning and instruction. We frame our conceptual argument with two focal students from Ms. Martinez's 5th-grade classroom. We selected these two students as they were in the lowest quartile at the beginning of the year and often dismissed by other teachers' for their lack of ability, yet they showed dramatic shifts in verbal participation, academic writing, and mathematical problem solving. In the next section,

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[1]The term "re-mediation" has previously been used by others working from a cultural-historical perspective to reframe dominant paradigms and approaches to literacy and learning (e.g., Gutierrez et al., 2009).

we contextualize the fundamental conceptual issues, when comparing SCT with SLA, and the unique insights of SCT, especially for struggling ELLs.

COMPARING SCT WITH SLA

Overview: The Problem of "Mixing Metaphors"

The Bilingual Education Amendment of 1974 stated that in addition to studying English, subject matter should be taught in the student's primary language with the objective of transitioning ELLs into mainstream classrooms. This ushered in an era of content-based approaches and sheltered instruction guided for the most part by psycholinguistic approaches to language learning (Cummins & Swain, 1986). During the same period, American academics and educators were introduced to the writings of Vygotsky (1978). Each perspective offers contrasting views of the role and function of language, learning, and the learner. In this article we argue that the differences are not trivial but have profound implications for how we organize learning in ELL contexts.

For the most part, the bilingual model that was adopted in much of the United States was a limited model in that English was still the target of instruction and a student's primary language (L1) was simply a means to English acquisition. In fact, in much of the ESL/Bilingual teacher education programs throughout the country Krashen's (1980) *Natural Approach* and Cummins's (2000) *CUP/BICS/CALP* models are the orienting frameworks for the required coursework on second language learning. Both models draw on nativist assumptions of linguistic processes including the *language acquisition device* whereby the mind is genetically predisposed to acquire *not* learn grammatical structures (the emphasis being on phonology, morphology, and syntax). Krashen's approach extends nativist principles governing first language acquisition to SLA. Cummins presented a more integrated theory of mind whereby languages are not self-contained, separated entities in the mind. This model helped distinguish between context embedded languages and decontextualized academic languages. This body of work has made valuable contributions in challenging prescriptive grammatical approaches to language instruction in ESL contexts. More recently, Cummins (2000) and others working from an SLA perspective have emphasized the social and interactive character of language development.

Given the emphasis on using language in authentic communicative situations, there has also been a tendency for those in the fields of bilingual and ESL education to merge SCT with SLA models and mix metaphors when talking about language and learning. This is particularly evidenced when talking about the *zone of proximal development* (ZPD) as something equivalent to Krashen's *i+1* theory of comprehensible input. Here we juxtapose the two definitions side by side (Table 1).

In comparing the two definitions there are fundamental distinctions. First, although Vygotsky emphasized the significance of signs, symbols, and language as preeminent mediational tools, ZPD has nothing to do with language per se but rather problem solving and interaction, whereas in *i+1*, language comprehension is the goal and the acquisition of linguistic structures happen as a result. Second, ZPDs emerge through interaction with more capable others with self-regulation as the developmental objective. In contrast, *i+1* is entirely situated within the individual's mind and development follows a predetermined natural order. In contrast, ZPDs do not emerge

TABLE 1
Zone of Proximal Development versus Comprehensible Input

Zone of Proximal Development	Comprehensible Input
"The distance between the actual development level as determined by independent problem solving and level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (Vygotsky, 1978, p. 86).	"We move from i, our current level to $i+1$, the next level along the natural order, by understanding input containing $i+1$" (Krashen, 1985, p. 2).

deterministically; rather they are the result of participants engaged in joint problem solving activity. Lantolf and Thorne (2007) stated,

> The fundamental problem is that the ZPD focuses on the nature of the concrete dialogic relationship between expert and novice and its goal of moving the novice toward greater self-regulation through the new language, while Krashen's concept focuses on language and the language acquisition device which is assumed to be the same for all learners with very little room for differential development. (p. 210).

In addition to *comprehensible* input, another prominent feature of SLA is the *affective filter hypothesis*, which assumes that a filter exists that affects the potential to acquire language. If a learner is in a high-stress situation, then the affective filter will block language acquisition. Therefore, instructors need to be careful not to stress out learners with overly complex meaning making tasks and continuously provide positive reinforcement as to not obstruct the language acquisition process. Another example of this "metaphor mixing" can be found in the following excerpt from a teaching methods text when discussing how a teacher should create "a challenging but non threatening atmosphere" for ELLs, which combines Krashen's notion of the *affective filter* with Vygotsky's ZPD: "The teacher creates a 'zone of proximal development,' which means that the teacher provides the amount of assistance the students need until they are able to function independently. A challenging atmosphere is balanced by a positive affective climate" (Echevarria & Graves, 1998, p. 165).

The previous statement fundamentally diverges from SCT in two respects: (a) The concept of assistance and (b) the need for a positive affective climate. Vygotsky's conception of assistance or *other mediation* must be understood in the context of how human mental functions develop across the lifespan as a result of mediation; thus, it is more complex than simply the "amount of assistance," which is probably more analogous to traditional notions of scaffolding. Assistance within SCT should be understood in terms of the shifts in quality of mediation between expert and novice not necessarily the amount. Another important point in relation to development is that people's status as experts and novices is situated within particular activities and the potential to shift in and out of those roles is to be expected depending on how the context changes. For example, a person may struggle with language they ordinarily have achieved self-regulation with when asked to make a public presentation.

In contrast to the SLA conception of affect and its role in learning, Vygotsky believed that children learn scientific concepts out of a "tension" between their everyday notions and adult concepts. This process is often filled with tension, struggle, and sometimes frustration as learners use

available mediational tools in pursuit of concrete ends, all of which would be inhibiting language acquisition according to traditional SLA models. Sometimes, ZPDs can be contentious "third" spaces, filled with struggle and difficulty as human beings move toward greater self-regulation as well as intersubjectivity. One of the major premises of SLA is that language acquisition is fostered by a lowered affective filter (i.e., low stress). From an SCT point of view, the construction of knowledge, growth, and development is borne out of active engagement between the learner, the goals, and more competent others. This has significant implications for how teachers organize learning for ELLs and the nature of the tasks they use to engender development. Using an SLA model, a teacher would be conscientious about not making a problem too difficult as to raise the affective filter and perhaps be beyond the acceptable $i+1$ range of comprehensible input, which is impossible to know. Furthermore, Krashen argued that comprehensible input must be "slightly ahead" of the current comprehension level, which puts instructors in the precarious position of trying to determine what exactly is "slightly ahead" assuming all learners traverse the exact same developmental sequence. This is quite problematic in terms of assessment because the unit of analysis is individual mental processes; on the other hand, using a SCT approach, instructors should focus on the nature of the mediation and how that shifts with respect to the problem solving task. Therefore, problems in and of themselves are not inherently difficult provided the mediational tools are accessible to the learner. This is particularly relevant in bilingual and ESL contexts where there is a tendency to implement reductive, "low stress" literacy practices in language arts and mathematics. A focus on the individual learner coupled with the undifferentiated learning trajectory rather than the nature of the mediational tools often leads to instructors having a deficit view of learners and consequently having lower expectations of what students can accomplish.

Language, Learning, and the Learner: Comparing SCT with SLA

In examining how Ms. Martinez effectively organizes learning for her ELL students, we argue that she creates a dialogic learning community and her practices are best understood when viewed with principles of SCT. We also point out some of the limitations of SLA and psycholinguistic models as exemplified by Krashen and Cummins. Our focus is on three dimensions: (a) How language itself is conceptualized, (b) the role of language in learning and development, and finally (c) how learners are positioned within the classroom community. Using Engeström's activity triangle we show how Ms. Martinez organizes learning toward the concrete end of creating a dialogic classroom discourse community, followed by a vignette of a typical problem-solving activity.

So far we have discussed some of the key areas in which SCT and SLA diverge, but the most salient difference, and perhaps least discussed, is how SCT and SLA differ with respect to how each conceptualizes the nature and function of language and its role in human development. One of the most prevalent themes in SLA work is the term "target language" (Krashen, 1989), and when learners come in contact with the target language it becomes input for the language acquisition device, deriving the phonological, syntactic, and morphological properties of the target language. Thus, language is treated as an isolated cognitive process independent of other developmental milestones and pathways. In this framework language is an end onto itself, or in SCT terms an "object" rather than a means, and SLA research in general is not concerned with how language impacts broader developmental issues. One manifestation of this view is how SLA has impacted how we think about vocabulary development where "target words" become the focal

point of instructional activities. This leads to an overt focus on fixed definitions rather than the meaning-making process. Of course, meaningful messages are central to SLA, but it is more a function of what a learner does intrapersonally as opposed to what takes place interpersonally. In the semiotic field of the classroom, this perspective on word definitions manifests itself as word walls, sight words to be processed, or in mathematics education, an overt focus on technical math terms. Pedagogically speaking, because the role of a teacher is to provide "input" and the learner is assumed to automatically sort out the information, it is assumed that through repeated exposure eventually the learner will acquire the competence necessary to use the words. In terms of assessment, this also leads to an inordinate reliance on oral performance; thus, teachers presumably know learners have acquired the information when they produce the target vocabulary.

More recently, some researchers working from an SLA perspective have sought to emphasize the interactive and social dimensions of language acquisition by focusing on communicative situations, interaction through "cooperative learning" and the development of "interlanguage" as a key scaffold for language development. For example, McCafferty, Jacobs, and Iddings (2006) have made the following claim:

> In relation to cooperative learning, Krashen and Terrell argued that despite the fact that in interaction learners may hear incorrect forms of the L2 from each other, student production should nonetheless be used as one part of the curriculum for their methodology. (p. 18)

Furthermore, they added that *interlanguage* (intermediate forms of the L2) ought to be encouraged because learners can make meaning and be exposed to examples of *i+1*.

Cummins (2000) sought to clarify some of the misconceptions surrounding his model by emphasizing that instruction should be cognitively challenging, academic content should be integrated, and the importance of developing critical awareness about language functions (p. 98). Furthermore, he argued that CALP should not be understood as an isolated attribute of learners, but rather as "one of a number of individual learner attributes that are determined by societal influences and which interact with educational treatment factors in affecting academic progress" (Cummins & Swain, 1986, p. 31). He went on to state that this is "essentially a Vygotskian perspective on language and academic development" (p. 92).

For Vygotsky and those working from an SCT position, language is a means to concrete ends and language serves as a mediational tool for solving problems. Language (signs, symbols, etc.) is deeply intertwined with the concept of *mediation* which in contrast to SLA's "acquisition" metaphor positions language as an external tool rather than an internal organ of the mind, that is co-constructed through interaction with the world toward situated goals. Although language is a significant tool in the developmental process, it still is part of a broader developmental trajectory whereby concrete goals are the ends and language is one of the means. Thus, the fundamental question for organizing learning is not "what language is to be learned or acquired?" but rather "what tools are needed to reach a goal (i.e. solve a problem)?" In terms of assessment, it is not the linguistic performance of words that marks development, but rather how the nature of the mediation shifts in relation to the goal of the activity.

In contrasting SCT with SLA there are clear distinctions in terms of how we perceive the learner. From an SLA perspective, the learner is cast as a passive recipient of knowledge following a linear, undifferentiated, natural developmental path, whereas SCT presents a learner who is an active agent engaged in situated meaning making. The central developmental assumption for psycholinguistic models is that learners proceed from the simple to the complex, from BICS to CALP. As a result there is a heavy emphasis on "simplified" speech (e.g., Krashen, 1980) in early

stages of development, and there is a notion that the readiness to engage in linguistically complex tasks emerges from biology and time rather than the quality of the mediation. This directly leads to an underestimation of what learners can accomplish and how instructors construct learner identities with respect to particular subject domains. In the language acquisition process, writing would not be something that is incorporated at early stages of development because it would be considered "too advanced." This prevalent assumption in SLA approaches stems from the view that infants learn language through oversimplification and clarification practices embraced by primary caregivers, and as a result language instructors of adults should adopt a similar approach in accordance with *i+1* discussed earlier because SLA is very similar to first language acquisition.

In Ms. Martinez's classroom, the evidence suggests that the intuitive progression from BICS to CALP is a fallacy and would serve to undermine the development of ELLs. We discuss this in detail later when we talk about Mauricio, a student who doesn't exhibit the characteristics of BICS and struggles with oral performance yet writes at a level that would be considered cognitively advanced. In this regards, SCT conceptualizes learning not as a linear process of moving from the basics to the advanced or from simple words to more complex ones but rather as a shift in the object/action to meaning ratio. For Vygotsky, the use of any word to signal an object in a decontextualized manner or similarly a set of actions (without them being present) represented an advanced developmental milestone. This transformation represents a degree of abstraction that is the byproduct of situated, meaning-making activity. He gives the example of a child who transforms a stick and the act of riding it to mean riding a horse and thus the stick comes to represent a real horse. This is precisely the point were the "ratio is inverted and meaning predominates, giving meaning/object" (Vygotsky, 1978, p. 98). Actions and objects are never truly separated from the meaning, especially in terms of mental perception, even though it might appear that way when one examines the linguistic performance of words and arbitrarily isolates the definition of words. Children arrive at meanings and "definitions" through the transformation of situated actions/objects. Thus, the teaching of definitions in the absence of situated frames is contrary to the principles of human development espoused by SCT.

CONTEXT

Our focal classroom is part of a transitional bilingual program in a predominantly Latino/a urban school with nearly half the population classified as ELL. Ms. Martinez has been teaching for over 20 years. Every year, her 5th-grade classroom is made up of students whose primary language is Spanish, many who are relatively recent arrivals to the United States, and some who are designated as part of special education. The language of instruction is generally English, but Spanish is used to clarify meanings, build connections or when students help each other.

Ms. Martinez on Learning and Instruction

As stated earlier, Ms. Martinez does not talk about her learning in formal SCT terms; nevertheless, through professional development and later a master's program in teacher education, she has become familiar with SCT-based ideas like *funds of knowledge*, the centrality of communication and interaction in cognitive development, and the need to focus on cross-disciplinary problem solving rather than treat each subject as a discrete discipline. In general, her classroom was

filled with written and verbal academic conversations between students and teacher, where students regularly encountered new words and expressions in the context of meaning making, had opportunities to share them, and ultimately appropriated them. Ms. Martinez did not reduce the curriculum's level of complexity, especially its language, even though the students were mostly ELLs. Instead, she created an environment in which students experienced and used language in the context of joint activity and problem solving. When asked why she used sophisticated language with her ELLs, she replied, "When are they going to learn it? How are they going to learn it? They encounter those words in books. I'm angry with the notion that students are not competent to learn." Ms. Martinez clearly was aware of taking an integrated approach that was cross-disciplinary, stating, "There is reading going on [in math class], there is geography going on, there is social studies going on." When asked to reflect upon how she organizes learning for her students, Ms. Martinez states key elements of the kind of classroom community she wishes to foster. For example, she firmly believes in the centrality of language in cognitive development, and she views writing as particularly important. "Writing helps them learn mathematics . . . writing makes children be more thoughtful. . . . Writing is the vehicle for cementing ideas and the language of mathematics." She also believes in making writing and interaction part of the regular, cultural practice of the class. "Consistency is important. . . . If I expect something from my students, I don't say I expect it one day and let it go for two, three days. It's everyday"—hence, the idea of the classroom as a *community of practice*. She is also very adamant about creating a collective culture that emphasizes process over the correctness of outcomes. "I tell them [the students] the reason why we're in school is because we are learning and if we make a mistake that's great. Let's put it up on the board so that we could figure out how we could fix it." Finally, one of her main goals is to foster metacognition. "There is a lot of analysis they have to do. They have to think about their own thinking."

Achievement as Measured by Standardized Scores

In general, Ms. Martinez has a history of her ELL students making significant gains on standardized tests, which are given in English for students in 5th grade. The gains are even more significant when we consider the gains of the students who entered her class with the lowest reading scores. However, it would be difficult to discern which students are which from the way learning is organized in her classes. The following table (Table 2), shows how the students in her class compare with other 5th-grade classrooms at her school and through out the district as measured by the Iowa Test of Basic Skills. We have also disaggregated the data by reading scores to further illustrate the substantial gains made by the more novice ELLs in her class. Furthermore, we present the scores for our two focal students, Violeta and Mary.

The data show that Ms. Martinez's class compares favorably to the other classrooms within her school and the district overall in terms of improvement in math and reading over the course of an academic year. Of particular interest to us were the struggling ELLs in her class as measured by the lowest reading scores on the Iowa Test of Basic Skills at the end of the fourth grade. The eight students who entered Ms. Martinez's classroom with the lowest reading scores showed an average gain of two grade levels, which is nearly double of what is expected and double the gains made by the other students. Our observations of Ms. Martinez's classroom have shown how these students benefit from the way she organizes learning and the types of mediation available to them. We

TABLE 2
Growth in One Year Measured by Median Grade Equivalent

Comparison Groups	End of 4th Math	End of 5th Math	End of 4th Reading	End of 5th Reading
Ms. Martinez's class[a]	4.3	**6.1 (+1.8)**	3.9	5.2 (+1.3)
Third grade or below in reading[b]			3.1	**5.0 (+1.9)**
Fourth grade or above in reading[c]			4.3	5.3 (+1.0)
Violeta	4.7	**7.0 (+2.3)**	2.9	**5.0 (+2.1)**
Mary	4.0	**6.1 (+2.1)**	3.1	**6.2 (+3.1)**
Other fifth graders in Ms. Martinez's school[d]	4.6	5.8 (+1.2)	N/A	
District[e]	4.6	5.6 (+1.0)		

Bolded numbers = Greatest gains during acadamic year.
[a]$N = 22$. [b]$N = 8$. [c]$N = 14$. [d]$N = 56$. [e]$N = 23,479$.

have chosen to illustrate our argument with work from two of the most "novice" students, Violeta (gain of 2.1 grade equivalent in Reading, 2.3 in Math) and Mary (gain of 3.1 grade equivalent in Reading, 2.1 in Math). These students began the year with two of the lowest reading scores in fourth grade (with only one student scoring lower), but showed the greatest gains.

Overall, Ms. Martinez's students accomplished a great deal in a short amount of time as evidenced by their performance, as indicated by the bold text in Table 2. We offer these data to support our argument that with the reorganization of classrooms with Latino/a ELLs into one that emphasizes an activity system with a variety of mediational tools, second language learners can gain significantly. In the following sections, we provide discourse analysis of vignettes that illustrate how learning was socially organized in Ms. Martinez's classroom. The ice cream and $\frac{3}{4}$ circle problems are examples of complex problems that are well beyond the expectations of the standard curriculum, yet students are systematically repositioned to develop writing, speaking, and higher order problem solving. Our selection of these problems is rather arbitrary as we could have picked from a number of "complex" problems that were part of the regular routine of Ms. Martinez's classroom; nonetheless, we wanted to make sure that whatever examples we chose to illustrate our larger argument had discourse segments and writing samples that featured our focal students.

The Ice-Cream Problem

Unlike most 5th-grade mathematics classrooms, in this class the students have studied geometry and measurement all year long. They have not been taught typical algorithms, or procedures and formulas, used in geometry but have learned key properties of shapes and their relation to each other in order to derive more concrete approaches to problem solving. From the beginning of the school year, students have used a calculator as a regular part of every mathematics lesson. Furthermore, joint problem solving and public explanations of solution strategies are part of the norm in this classroom for doing mathematics. On this day, Ms. Martinez begins by drawing on the chalkboard a figure (Figure 1) that she calls two-dimensional ice-cream cone. She asks the class to find the area of the "ice-cream cone." At first, the figure has no dimensions, but Ms. Martinez offers to give the students the "altitude" and the "radius" for the triangle components
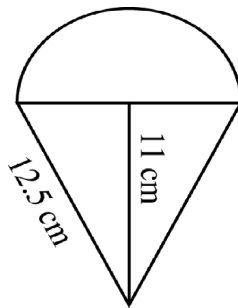
FIGURE 1   The ice-cream problem.

of the figure. A brief negotiation between Ms. Martinez and the students ensues, with the students asking to have the problem be a "bit" more difficult. Ms. Martinez acquiesces and offers them the "hypotenuse" instead of the radius. During this very brief class discussion, no numbers were said. This seemingly small act reinforces our assertion that Ms. Martinez is more concerned with socializing children to mathematical discourse through language rather than focusing on discrete mathematical procedures. In this case, her speaking conceptually and engaging her students to communicate likewise, mediates speaking mathematically in English, and thinking mathematically. When the teacher and students reach agreement about the conditions of the problem, numbers are added to the drawing and the students quickly begin to work on solving the problem, which by most standards is very complex (Figure 1).

From Individual Acquisition to Collective Activity

Although Ms. Martinez has proven to be an effective teacher as measured with standardized measures, in this section we aim to show how we can apply SCT to understand how she organizes learning using an episode of the ice-cream problem. Figure 2 shows how Ms. Martinez's class can be viewed as an activity system, with the ice-cream problem as an example, and the mediational means through which she fosters a dialogic classroom characterized by more egalitarian discourse structures, an emphasis on problem solving not problem answering, and the use of multiple modalities to develop student thinking. When viewed as an activity system, we are able to analyze the relationships and contradictions between the various elements. We can consider how the subjects achieve objects through tools, how the rules shape the interactions, and how the division of labor shapes the actors. Beliefs about learning and discourse strategies are mediational tools as well. Bidirectional arrows highlight the fluidity between the various elements and show that the subjects are also shaped by the tools, the rules are shaped by the interactions, and the division of labor is not static as roles are expected to shift. Thus, in contrast to SLA, where learners are viewed individually, SCT situates the learner within an activity system. With a higher order, complex problem framing the interactions, the outcome of such practices is a dialogic learning community characterized by a more responsive and open relationship between mathematics discourse and *all* its users. It is an environment whereby the discursive rules of participation reposition students as experts and active agents of knowledge construction. It also
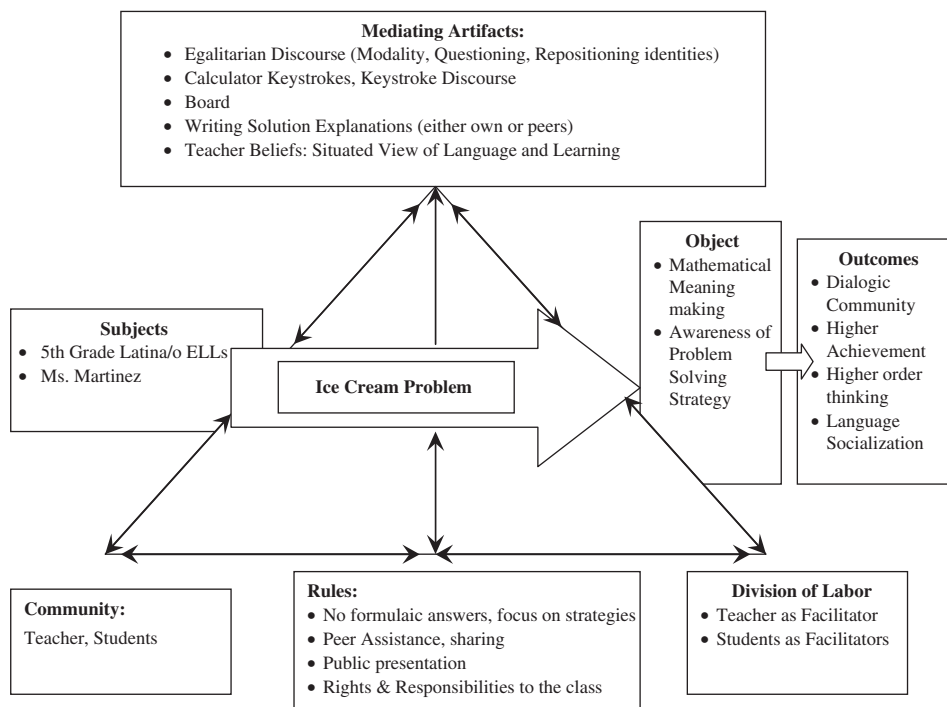
FIGURE 2 The ice-cream activity. *Note.* From *Perspectives on Activity Theory* (p. 31) edited by Y. Engeström, R. Miettinen, and R. Punamaki, 1999, Cambridge, England: Cambridge University Press. Copyright © 1999 by Cambridge University Press. Adapted with permission.

fosters a social space where participants share power, authority vis-à-vis sense making and the teacher consciously relinquishes control sometimes found in many ESL/bilingual classrooms. Students are expected to solve problems and write solution explanations ordinarily considered to be developmentally inappropriate. We believe this arrangement has significant implications for the development of all students, but especially the struggling students (at or below 3rd-grade level on Iowa Test of Basic Skills). The focus on higher order and abstract thinking mediates the appropriation of mathematical and academic registers at a stage that might seem premature given SLA's more linear understanding of language development.

Establishing Participation Rules and Dialogic Discourse Norms

Given that activity systems are goal directed and rule governed, our work with Ms. Martinez clearly reveals an explicit strategy for all community members to appropriate rules of participation that would lead to the desired outcome of the activity system: A dialogic community geared to solve the problem(s). Classroom community members co-construct these rules through specific types of discourse moves. First, when students orient to Ms. Martinez as an expert of the

content, it is her practice to redirect them to their peers or back to themselves, thus making them authorities of knowledge making. Second, she accomplishes this goal via a questioning posture in order to mediate the norms of interaction within the activities. Throughout the ice-cream problem activity she establishes the interdependence of the community members (e.g., lines 1–5 next). These lines show the stance Ms. Martinez has assumed for herself in relation to the problem and the students: To be a facilitator of problem solving rather than an epistemic authority of mathematical and linguistic content. As we see in line 1, Ms. Martinez orients students to peers or "team members" and puts the onus for the task back on the students. In this very brief turn Ms. Martinez twice poses questions to the students which reaffirms the importance of working with peers: "What would you do?" (lines 4 and 5). Even after a couple of students claim to have "got it" (lines 6 and 7), she redirects them to the other members of their team emphasizing the collective ethos she aims to promote:

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01.   Ms. M: You compare with your team members and if they agree, well
02.          then maybe you should talk about it with them. Ok? You know
03.          how to do that, alright? What if you did not know
04.          that, you knew that one but you didn't know that one? What
05.          would you do? The inverse operation is right. Yes you can.
06.      S: I got it teacher.
07.      S: Yes, I got it.
08.   Ms. M: Do they all have it in your team?
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A third normative expectation is to publicly present their thinking. This happens in multiple ways and in stages: First in their small groups and through their writing, then by going to the board, or speaking to the whole class from their positions. A fourth important rule governing public presentations is that other students are expected to initiate explanations and commentaries on the strategy and, if need be, point out gaps in the strategy being presented; thus, students are not waiting for permission from Ms. Martinez to speak. In presenting their thinking publicly, students are keenly aware that they will be scrutinized; however, this occurs as part of the collective problem solving. Furthermore, students can present their thoughts with whatever language is at their disposal, including talking "keystrokes," a critical mediational tool that we illustrate in the next section. In addition, students can openly challenge, clarify, and correct claims within the public space of the classroom—even those originating from the teacher. Thus, these actions create a truly dialogic and egalitarian discourse structure that is simultaneously contentious in pursuit of making sense and solving the problem. Unlike most classrooms where ELLs sit in silence, listen to the teacher, and speak in a scripted manner, these rules of participation serve as part of the regulatory practices that engender a dialogic community of practice rich in students' language use.

Mediational Tools: Repositioning Epistemic Identities

One of the key mediational strategies Ms. Martinez invokes is the deliberate repositioning of learners as epistemic agents and content experts responsible to the collective for learning through peer mediation. One of the ways in which Ms. Martinez positions students to engage in dialogic inquiry is through their ability to challenge their peers as well as herself; the following lines (lines 36–42) taken from the ice-cream episode illustrate this point where Ms. Martinez uptakes a student challenge to her claim in lines 37 and 38:

36.   S2: Find the missing length.
37.   T: She **fo::**und the missing length.
38.   Ss: No!
39.   T: She didn't?
40.   Ss: Yeah.
41.   S1: Oh yeah.
42.   S2: Yeah, she found (.)

This sequence exemplifies the symmetrical and egalitarian social space that frames the interactions between teacher and students. Another important way in which Ms. Martinez accomplishes this space is by adopting a posture of uncertainty in her own modality while students assume a posture of certainty. For example, after Mary has written the first part of her strategy for solving the problem using "keystroke" symbols, Violeta, another student, approaches the board to build upon what Mary has already written. Violeta is prompted by Ms. Martinez to use a different color in order to distinguish her contribution from Mary's, and Violeta is asked, "So right now in the window, what do we have in the window right now, Violeta?" The window is referring to the screen on the calculator, and although the question is addressed to Violeta, other students chime in, "the radius," and Ms. Martinez uptakes their response, "We got the radius," once again indexing the collective orientation of the class. Ms. Martinez then repositions herself as a novice learner with respect to Violeta's strategy when she says, "I don't know what you're gonna do," and as Violeta begins to write her strategy on the board, Ms. Martinez becomes a narrator of Violeta's work when she says, "She's putting the radius in the memory." It is evident here that the calculator as a mediating artifact is playing a crucial role in how Ms. Martinez and the students communicate both orally and in writing about how they are solving the problem. Students confirm their approval of the strategy with overlapping "**Oh::: Yeah!**" and in response Ms. Martinez strategically positions herself once again as a novice learner and asks, "I wonder why?" (line 70). She regularly vocalizes such "wonderments," which serves to opens the floor to student conjectures about what is happening (lines 71–73):

70.   Ms. M: I wonder why?
71.   S1: [She's gonna find the area of the quarter circles
72.   S2: [But then why the semi-circle.
73.   S3: [How is she going to memorize each step? [Referring to why Violeta should use the
                calculator's memory]

As students are discussing and making attempts to figure out the various aspects of Violeta's strategy, Ms. Martinez prompts the class to explain what Violeta is doing, "Alright so:: what is Violeta doing here?" and the students offer various perspectives on what she is doing usually synchronizing their talk in relation to one another, in other words each student in essence completing the thought of the other, (lines 74–76):

74.   S1: Finding the area of the uh:::
75.   S2: [Finding the area of the quarter circles
76.   S3: [Quarter circles
77.   Ms. M: There is no quarter circle
78.   Ss: No the semi-circle
79.   Ms. M: The **semi-**circle↑. She (.5)
80.   S: [forgot a keystroke

When Ms. Martinez disagrees with their claim (line 77), other students take the floor to offer a better explanation for what is being done (line 78). So Ms. Martinez remains true to how she positions herself as a novice observer within the discourse frame of the activity, which is to refrain from providing quick answers and thus allow students to fully engage in the task at hand as experts (lines 77). Throughout this activity, it is always a student who evaluates the correctness of a step and moves the strategy forward. In fact, when students offer the more accurate description, that of a "semi-circle" (line 78), and Ms. Martinez begins to exclaim "semi-circle" (line 79), another student interjects to complete the explanation of the apparent error, which was then articulated in terms of keystrokes (line 80). Ms. Martinez continues her surprised tone in line 81 and redirects the question to Violeta to explain what she did. But as we see in lines 84 to 86, other students begin to explain what led to the error using the term "EXCHANGE," referring to a calculator function:

81.   T: **Whoa (.) whoa::** wait a se:cond
82.   Ss: [**No:::**
83.   T: Violeta, tell her what she did.
84.   S: Exchange first, exchange first because you're, summing the area
85.   to the radius.
86.   S2: Yeah::

At this point, Ms. Martinez prompts Violeta to revisit her strategy and listen to Mauricio. Although Mauricio struggles with oral English (i.e., Cummins's notion of BICS), he offers a correction to Violeta's strategy (line 86). It is important to note that a student like Mauricio who struggles with oral proficiency, from an SLA perspective, would not be positioned to talk to the class. However, it is easy to understand why Ms. Martinez continues to position Mauricio as an expert because of what he is able to display in his writing (to be discussed later). Once again using the metaphors of keystrokes and their functions to talk about the problem, Ms. Martinez positions Mauricio as the expert instead of herself (lines 87–92):

87.   T: Violeta, step, step back and look at your keystrokes and then
88.   listen to Mauricio again.

This time Mauricio stands up and assumes the floor as he provides his reasoning as to why Violeta needs to "Exchange first cause you are summing the area to the radius," coupled with a confirmation from another student (lines 90–92):

89.   M: Go ahead [Standing Up]
90.   Exchange first cause you're
91.   summing the area to the radius.
92.   S: Yeah. [delay as Violeta looks at the board]

Violeta struggles to understand Mauricio's correction of her error as Ms. Martinez once again re-mediates and poses a question to her (line 93), which opens the floor once again for peer mediation. Finally another student goes to the board to show Violeta:

93.   Ms. M: Don't you see it?
94.   S1: You're summing the area to the length, to this little line [referring to the radius that is
91.   highlighted with colored chalk]
95.   S2: Oh! Can I go show her?
96.   Ms. M: So fix, just fix it. Yeah go show her.

This opens up the floor (lines 97–106) for four students to mediate Violeta's work until (line 105) Violeta realizes where she made her mistake. This sequence really typifies the discourse arrangement within the activity and is a good example of peer mediation that has been fostered in this classroom through the activity system organized by the teacher.

97.   S1: You are summing this (points to the board) to
98.   this radius.
99.   S2: And you don't need that.
100.   S1: And you don't need that? [Gesturing to the board]
101.   S2: She just wants the area.
102.   S1: You put sum, exchange. Put exchange
103.   and then sum.
104.   S2: No.
105.   S3: [No, you don't put sum
106.   S4: [You don't put sum
107.   V: Oh. Okay, I got it.

Mediational Tools: Talking Keystrokes

As we discussed earlier, from a SCT point of view, learning is the transformation of the object/action to meaning ratio. This is where we believe the writing and talking with "keystrokes" functions as a critical mediational tool. The students in Ms. Martinez's class have developed a more concrete way of talking about abstract mathematical practices to solve the ice-cream problem as well as other problems. The previous discourse segment illustrates how the participants appropriate a keystroke discourse to negotiate the ice-cream problem: More broadly, this may apply to other complex problems typically found in algebra and geometry domains that utilize more symbolic forms of communication and where the formal mathematics register is the target of instruction. The keystroke discourse mediates thinking in the small groups, presentations, and most significantly their writing. In the following section we show how our focal students have developed writing through solving the $\frac{3}{4}$ Circle problem.

The $\frac{3}{4}$ Circle Problem: Developing Writing and Formalized Thinking through Keystrokes

As stated earlier, Violeta was one the most struggling students at the beginning of the school year both in terms of reading and mathematics. In the case of Violeta, we can see transformation in terms of her ability to express her thinking through writing. Figure 3 shows a writing sample from Violeta from the beginning of the school year.

Later in the year, the students are given the $\frac{3}{4}$ Circle problem, a challenging problem where the goal is to find the perimeter given that the area of the $\frac{3}{4}$ circle is 100 cm^2. This is a problem that Ms. Martinez genuinely didn't know how to solve. Violeta explains her thinking through writing using *keystrokes* (Figure 4) and presents her techniques in front of the class, and her peers write about her thinking. The contrast in her work is evident in terms of sentence structure, organization, and logical reasoning. She clearly explains the steps she took to solve the problem using keystrokes and illustrations as needed. Her writing is organized, using complete sentences, title, and proper formatting. She exhibits logical sequence of steps as evidenced by transition
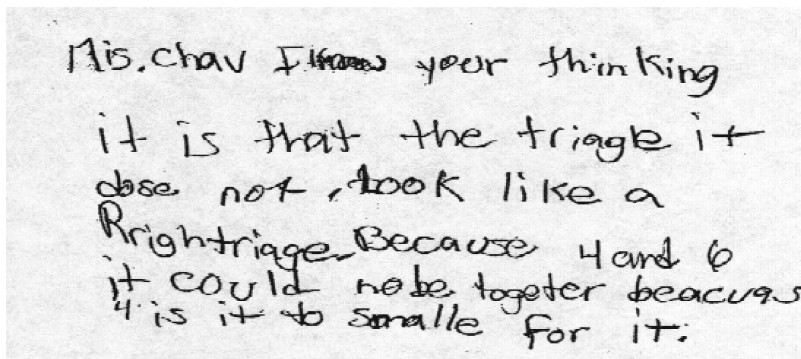
FIGURE 3   Violeta's writing early in the year.

words like *next* and *then*. She uses a personalized style as evidenced with the use of personal pronouns and appears to be very proud that she "got it" and provides a positive self-evaluation of her presentation before the class.

Mauricio and Mary also respond to Violeta's work, thus creating multiple opportunities for reflection, writing, and metacognition. Mauricio, who we mentioned earlier, is a novice when it comes to oral linguistic performance, but his writing (Figure 5) shows how he can display sophisticated symbolic reasoning with the keystroke symbols serving as the "vocabulary" for displaying his thinking. In addition to oral presentations of their thinking, the students are expected to write the keystrokes used to solve the problem and to write an explanation of the solution; the solution can be their own or someone else's. From the previous discourse segment and Violeta's problem solution, Mauricio chooses to describe Violeta's strategy and displays a level of clarity that was not evident while he was orally trying to engage her in the public space of the classroom. Many of the formal mathematical register terms, especially the ones relating to functional relations like "divide," "π," "square root," and "sum" are displayed using the keystroke symbols (Figure 5) and he is able to talk about other aspects of the geometric aspects using language he has an affinity for (i.e., "curvy part"). The writing is characterized by formal organization, complete sentences, and a detailed presentation of the steps taken. The article is organized using a typical writing template: Title, introductory, body, and concluding paragraphs. He uses transition words like *next*, *now*, and *then* to move through the logical sequence of steps taken. More important, he moves beyond the procedural steps and offers an explanation for the purpose of Violeta's action beginning with, "She stored it because . . ." as well as conjecture for future steps: ". . . later on she would have to add it with the curvy part." The practice of writing about other students' thinking simultaneously develops academic writing and metacognitive abilities. In this example, Mauricio mixes the genre of narrative with the emerging genre of keystrokes as a symbolic language. He follows up his narrative description of what Violeta has done with an elegant, simplified keystroke statement. This mixing of multiple genres of communication is also demonstrated in how he represents the number 4 in both simple numeric notation as well as keystroke notation.

Another example of a student reacting to Violeta's work comes from Mary, who was also one of the low-performing students at the beginning of the year (Figure 6). Mary illustrates the steps Violeta takes with graphic illustrations of the keystrokes. Furthermore, she uses a more summative

Going Around in
Circle

I did a challeng poblem and I got it. I went in front of the class to explain it. This is how I solved it. I am going to excplain how to find the perimeter of three quare circles. First I took $|100|+|3|$ to find the area of a quarer circle. Next I multiplied by $|4|$ to get the area of a whole circle. After this I divided by $|\pi|$ to get area of a square build on the radius. Then I took the $|\sqrt{x}|$ to get thei radius or side length of the sq. built on the radius. Next, I multiplied by $|2|$ to get the diameter. Then I $|Sto|$ because that is the two straight lines. After this I multiplied by $|\pi|$ to get the circumference of a circle. I divided by $|4|$ to get the curve of a quare circle. Next I multiplied by $|3|$ to get the three Curvy parts of a 3/4

Circle. So then I $|sum|$ to the memory. I $|exc|$ to get the perimeter of the three quarter circle. I think I did well in how I excplained it.
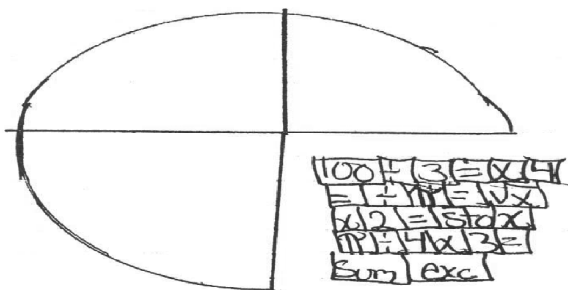
FIGURE 4 Violeta's writing of the $\frac{3}{4}$ Circle.

and evaluative style as opposed to the descriptive style adopted by Mauricio. Her introduction of the problem reflects a more personalized and socially situated style, one that highlights her personal identity within the larger classroom community. Her personalized style is indexed by the use of personal pronouns such as "me" and Violeta's proper name. She begins, "Let me tell
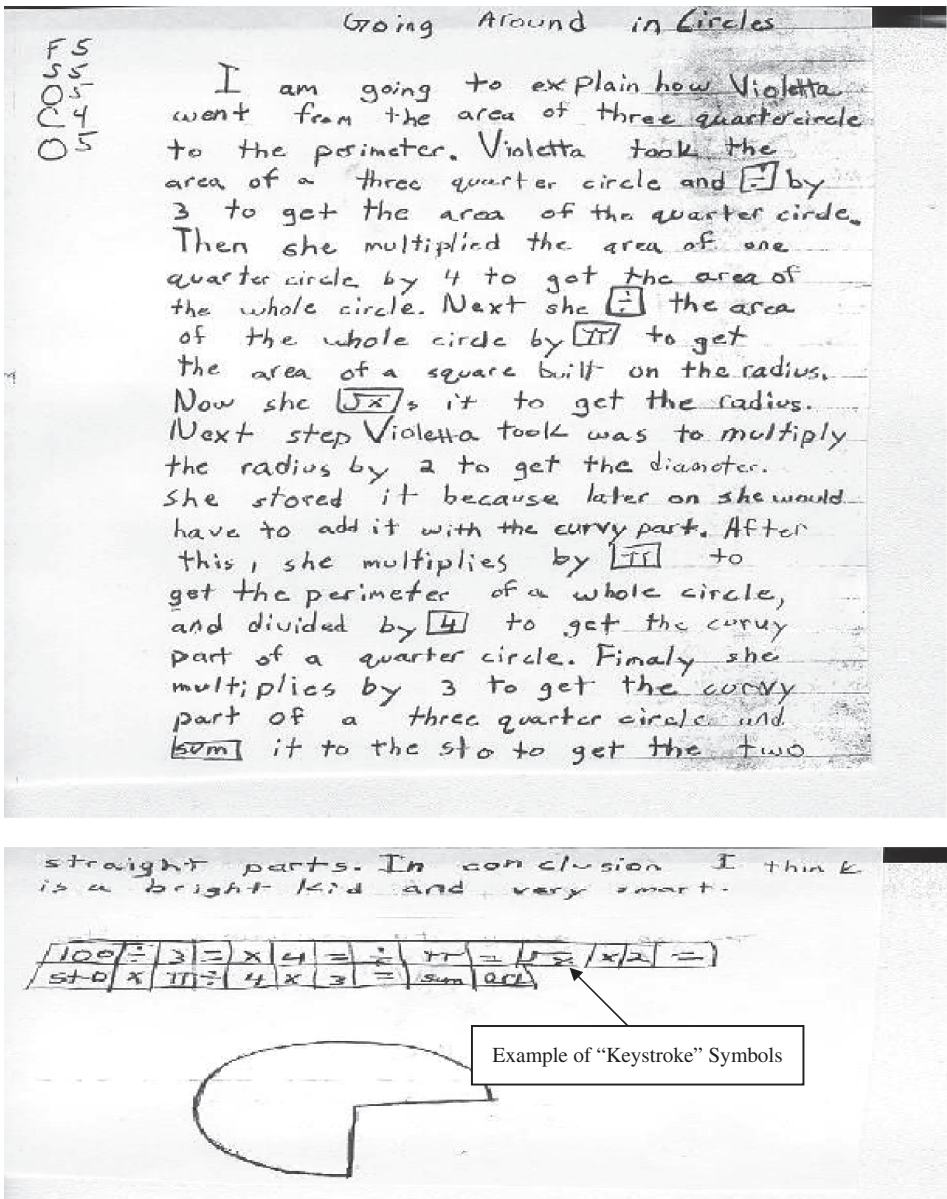
FIGURE 5   Mauricio's writing about Violeta's strategy.

you how a girl named Violeta, who is in my classroom, explained to 206." Mary's writing is an example of how students can reflect on each other's thinking while also adapting their own voice. Ms. Martinez has oriented the students toward a culture of writing that is more focused on thinking and understanding rather than form.
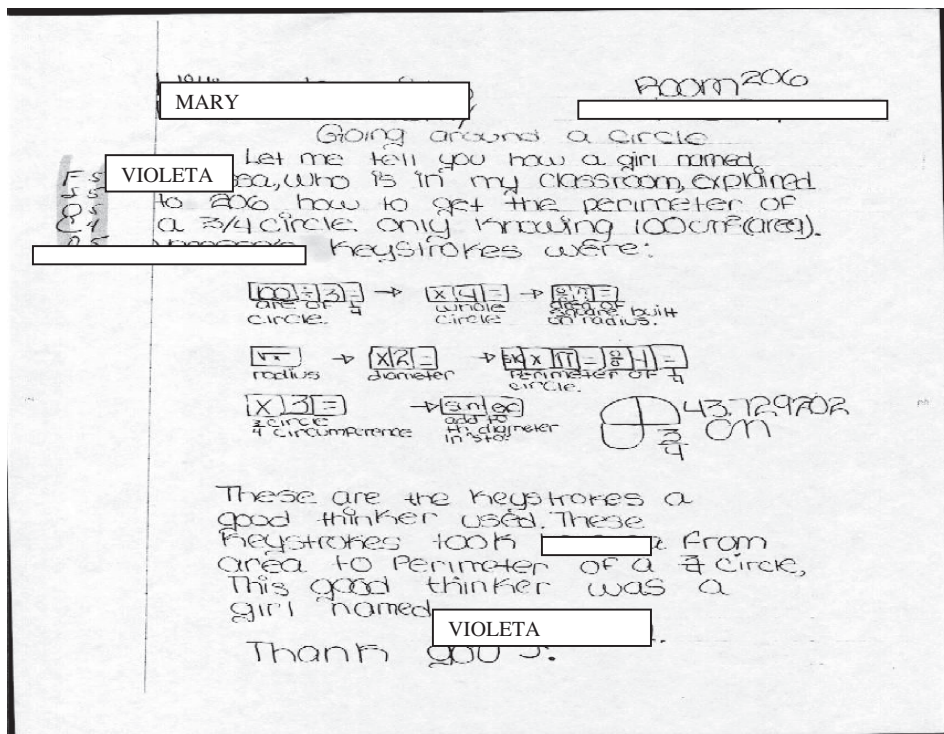
FIGURE 6 Mary's writing about Violeta's thinking.

Even though the keystrokes discourse serves as a concrete mediational tool leading to more abstract modes of representation, Ms. Martinez is cognizant about moving toward more abstracted "formal" registers that are borne out of situated learning. The following snippet from earlier in the ice-cream problem shows how one student references Mary's strategy as "the Pythagorean theorem backwards" (the student's term for "inverse operations"), and Ms. Martinez uptakes this contribution and expands upon the student's thinking (lines 56–67) and at the same time draws connections to previous experiences with the concept (lines 66–67).

50.   Ms. M: She has twelve and a half to the second power, subtract
51.   eleven to the second power equals square root. When she,
52.   why did she subtract, she built a square on the hypotenuse
53.   and then she built the square on the altitude, but she
54.   subtracted one from the other, why?
55.   S: Because she's using Pythagorean theorem backwards
56.   Ms. M: [What's
57.   Pythagorean theorem forwards? [Giggling]
58.   S1: Getting the hypotenuse.
59.   Ms. M: If you are working backwards
60.   S: [Because she is trying to get the,
61.   the radius

62. Ms. M: She's trying to get the radius. Does that give you the radius
63.   or does it give you the diameter?
64.   Ss: The radius.
65. Ms. M: The radius. So now you know the radius. Hector does that bring
66.   back something you learned?

This interchange illustrates sophisticated levels of conceptual understanding expressed in very comprehensible language by students functioning in their weaker second language. In line 55, a student creates a phrase that appropriately describes the idea of "inverse," and in line 60 a student captures in words the objective of the steps being presented by someone else. Furthermore, at no time during this snippet or during the entire class discussion of the problem solution were numbers used to discuss formulas or procedures; it was all at the conceptual level.

DISCUSSION AND IMPLICATIONS

In this article, we have sought to illustrate how a SCT lens can provide key insights into second language learning, especially with regard to the social organization of learning, activity, and the quality of the mediation. Although the focal students presented in this article showed significant improvements over the course of a typical academic year, their classroom activities were not organized in a typical manner. Drawing on an SCT framework helped us better understand the most salient features of effective practice in Ms. Martinez's classroom, namely, problem-oriented activities, multiple mediational tools, and an emphasis on discourse and interaction. In Ms. Martinez's classroom, participation was purposefully organized to mediate participation from all the students, especially the focal students presented here, who were among the most struggling students in her class. Traditional models of SLA focus on individual learner traits rather than the context of development. Ms. Martinez's practice shows what is possible for struggling ELLs when instruction and learning are based on the social context of development rather than the apparent deficits of learners as measured by standardized tests. Over the course of the year, the focal students strengthened their academic writing, higher order problem solving, and oral proficiency, but not necessarily in a predictable, linear developmental manner as predicted by the Krashen and Cummins models. In each of the cases presented here, development in writing did not necessarily follow everyday, oral proficiency (i.e., BICS). Finally, the SCT model of language development redefines language as a mediational tool for learning rather than the object of learning and instruction. This is a powerful and fundamental departure from SLA models of language development. Ms. Martinez's practice is organized to focus on problem solving, peer assistance, contested dialogue, and the centrality of writing to exchanging ideas. Language, per se, is not the target of the activities even though it permeates the activities in the classroom through multiple modalities. Ms. Martinez reorganizes learning by explicitly shifting the norms of participation, dialogue, and repositioning epistemic identities, and the use of various forms of communication including abstract symbolizing (i.e., calculator keystrokes, writing mathematical explanations). An SCT perspective has significant implications for instruction and teacher development. First, it shifts the focus from teaching language using discrete strategies vis-à-vis individual learners to what contexts can be created to develop more abstract thinking through writing and interaction. Second, in contrast to SLA perspectives, where learning is largely passive, SCT views the learner

as an active agent in their language use and development. This shifts the responsibility for learning on students within structured activities designed by the teacher that calls for quality mediation in the form of more expert others and artifacts. It was part of the classroom practice to engage in challenging geometric problems that were well above traditional 5th-grade curriculum, let alone a curriculum designed for ELLs. Third, it is important to deliberately position novice students as experts and mediate their development through multiple modalities. Finally, we return to some fundamental assumptions about ELLs, especially Latinos/as. All the aspects of second language development offered here rest on a core assumption, which is that Latino/a ELL students are capable of such advanced work, of self-agency, of working collectively—in conjunction and with the guidance of a teacher who positions them accordingly.

REFERENCES

Cummins, J. (2000). *Language, power, and pedagogy: Bilingual children in the crossfire*. New York, NY: Multilingual Matters.

Cummins, J., & Swain, M. (1986). *Bilingualism in education: Aspects of theory, research, and practice*. London, England: Longman.

Echevarria, J., & Graves, A. (1998). *Sheltered content instruction: Teaching English-language learners with diverse abilities*. Boston, MA: Allyn and Bacon.

Engeström, Y. (1999). Activity theory and individual social transformation. In Y. Engeström, R. Miettinen, & R. Punamaki (Eds.), *Perspectives on activity theory* (pp. 19–38). Cambridge, England: Cambridge University Press.

Fry, R. (2007). *How far behind in math and reading are English language learners?* Washington, DC: Pew Hispanic Center.

Gutiérrez, K. D., Morales, P. D., & Martinez, D. (2009). Re-mediating literacy: Culture difference, and learning for students from non-dominant communities. *Review of Research in Education, 33*, 212–245.

Krashen, S. (1980). The practical and theoretical significance of simple codes in second language acquisition and learning. In R. Scarcella & S. Krashen (Eds.), *Research in second language acquisition* (pp. 7–18). Rowley, MA: Newbury House.

Krashen, S. (1985). *The input hypothesis: Issues and implications*. London, England: Longman.

Krashen, S. (1989). We acquire vocabulary and spelling by reading: Additional evidence for the input hypothesis. *Modern Language Journal*, *73*, 440–464.

Lantolf, J., & Thorne, S. (2007). Sociocultural theory and second language acquisition. In. B. van Patten & J. Williams (Eds.), *Explaining second language acquisition* (pp. 201–224). Cambridge, England: Cambridge University Press.

McCafferty, S. G., Jacobs, G., & Iddings, D. (Eds.). (2006). *Cooperative learning and second language teaching*. Cambridge, England: Cambridge University Press.

Moschkovich, J. N. (2002). A situated and sociocultural perspective on bilingual mathematics learners. *Mathematical Thinking and Learning*, *4*, 189–212.

U.S. Department of Education. (2000). *Helping Hispanic students reach high academic standards*. Washington, DC: Author.

Vygotsky, L. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.