ABSTRACT:

As students in U.S. schools become increasingly linguistically and culturally diverse, teachers need to understand the language demands inherent in instruction and assessment, and they need to be prepared to design and modify instruction to meet the needs of students from linguistic and cultural backgrounds other than their own. As teacher preparation programs throughout the country grapple with how to prepare teachers to teach for linguistically and culturally diverse students, one statewide, high-stakes assessment of competencies for pre-service teachers, the Performance Assessment for California Teachers (PACT), has included prompts that ask candidates to focus specifically on English learners, academic language, and the language demands of mathematics instruction, and rubrics that evaluate their effectiveness in doing so. In this paper, we explore how 8 teacher candidates discussed the role of language in mathematics teaching and learning, especially related to English learners, on the PACT. We focus on mathematics, both because of the importance of the subject for English learners and others who have traditionally been underserved by U.S. schools, and because mathematics is often misunderstood to be a “language-free” endeavor. We document a variety of ways in which teacher candidates discussed the role of language in mathematics teaching and learning, the nature of academic language, and particular challenges in meeting needs of English learners. We argue that the PACT provided a potentially valuable venue for teachers to reflect on and articulate their developing understandings, and for teacher educators to evaluate those understandings. In our discussion, we highlight implications for teachers of Latino/a students, representing the largest group of English learners both in California and nationwide, and a group...
that has been traditionally underserved by U.S. educational institutions, particularly in mathematics instruction.

Acknowledgements

This research was supported by the National Science Foundation, grant number ESI-0424983. Any opinions, findings, and conclusions or recommendations expressed in this article are those of the authors and do not necessarily reflect the views of the National Science Foundation. We wish to thank Kendyll Stansbury, Ruth Chung, and Ray Pecheone for their assistance in the data collection for this paper. Rosanna Covarrubias, Martha Ramirez, and Esperanza Zamora assisted in preparing the data, and Rodrigo Gutierrez helped with the initial data analysis. Angela Thompson provided editorial assistance. Our work has benefited from productive conversations with Barbara Merino and our colleagues in the Center for the Mathematics Education of Latino/as (CEMELA).

Introduction

As U.S. schools become increasingly linguistically and culturally diverse, teacher educators, researchers, and policy analysts agree that increased attention must be paid to preparing teachers to meet the needs of students who come from families that do not speak English, especially those from groups that schools have historically failed to prepare academically (Gándara, P., Maxwell-Jolly, J., & Driscoll, A. (2005); Fillmore & Snow, 2005; Tellez & Waxman, 2006a; Christian, 2006). In an early call to improve teacher preparation for English learners (ELs), García (1990) lamented the lack of specialized knowledge among teachers responsible for educating these youngsters. In the nearly two decades since Garcia’s warning, despite productive efforts among individual teacher educators Tedick and Walker, 1995) and teacher education programs (e.g. Oliveira & Athanases, 2007; Stoddart, Pinal, Latzke, & Canaday, 2002), many teachers’ knowledge and skills remain largely inadequate to the task of educating EL’s effectively. A majority of teachers with EL’s in their classrooms have not had any special pre-service or in-service training in either second language development or pedagogical strategies for working with students learning English, and only a tiny fraction of teachers teaching EL’s have a university degree in Teaching English as a Second Language.
(TESOL) or bilingual education (Christian, 2006). In California, where our work is centered, over 40% (2.6 million) of all students come from homes where English is not the dominant language, and the state’s 1.6 million English learners, those according to the state not yet ready to do grade-level academic work in English, represent one in four of the entire state school-aged population (Rumberger, 2007). Yet over the past five years, only 57% of California teachers with a majority of English learners in their classrooms have received more than one in-service experience that focused on the needs of English learners (Gándara, Maxwell-Jolly, and Driscoll, 2005).

It is clear, therefore, that teachers need significantly improved preparation and support, both at the pre-service and in-service level, in order to offer quality and effective instruction for EL’s (Alexander, Heaviside, & Farris, 1998; Gándara, P., Maxwell-Jolly, J., & Driscoll, A. (2005); Tellez and Waxman (2006b). It follows that, in a policy context in which teacher education programs are increasingly influenced by high-stakes, minimal competency exams for their graduates, an important component of support and preparation of teacher for quality instruction for ELs would be for the developers of such assessments to take seriously issues of language development and support for English learners.

In this paper, we explore efforts by a consortium of teacher education programs throughout California to highlight teachers’ developing conceptions of academic language, the language demands of content-area instruction, and the needs of English learners as part of a pilot statewide comprehensive assessment of pre-service teachers’ knowledge and skills. Used in the teacher preparation programs at approximately 15 universities throughout California, the Performance Assessment of California Teachers (PACT) is an end-of-program performance assessment that is currently slated to be one option for meeting testing requirements for a state teaching credential
beginning with the 2008-2009 academic year (Pecheone & Chung, 2006).¹ For the PACT, teacher candidates spend several months preparing a “Teaching Event” that consist of a video-taped segment of a teacher candidate’s lesson and a wide variety of supporting documents (e.g., teacher plans, artifacts, student work samples, candidates’ reflections on each stage of the planning, instruction, and evaluation of the lesson). Candidates organize these multiple sources of data in the Teaching Events within the categories of planning, instruction, assessment, and reflection.

Explicit direction to address issues of academic language, language demands, and meeting the needs of English learners are included among the prompts that guide teacher candidates through all four sections of the PACT (planning, instruction, assessment, and reflection). In addition to rubrics assessing candidates work on each of the four sections are two separate “academic language” rubrics: “understanding language demands” and “supporting academic language development”. We will discuss these prompts and rubrics in more depth later in this paper.

While the PACT allows each teacher candidate the choice to focus on either language arts/literacy instruction or mathematics, our research focuses its attention on mathematics instruction. Schools have historically done a poor job of mathematics instruction for English learners and Latinos, resulting in persistent underachievement in mathematical performance. Urgent calls at the state and national levels have been made to address these disparities, particularly in relation to high stakes student assessments and increase graduation requirements. Furthermore, mathematics is a discipline often erroneously viewed by teachers as “language free.” In reality, as we will discuss below, language plays a complex and crucial role in

¹ The PACT assessments are based on previous holistic teacher evaluation programs such as the National Board for Professional Teaching Standards and the Interstate New Teacher Assessment and Support Consortium.

After describing in more detail the PACT and its approach to eliciting and assessing teachers’ reflections on the language, content learning, and the mathematics instruction of EL’s, we explore how eight elementary teacher candidates integrated these topics into their work on the PACT. The eight candidates, enrolled in different teacher education programs throughout the state, each chose mathematics as the focus on their Teaching Event and were student teaching in K-5 classrooms with at least 50% English learners. The majority of students in most of these preservice teachers’ classrooms were identified as Latino, and the predominant primary language of the English learners was Spanish (see Table 1). Based on a qualitative analysis of the entirety of each candidate’s written materials that comprised their Teaching Events, we discuss the range of ways in which the candidates integrated topics related to academic language, the relationships between language and mathematics, and instructional strategies designed to meet the needs of English learners. We found an analysis focusing only on academic language was insufficient to understand that variation of they way language interacted with instruction. In addition to the cases revealing the prevalence and complexity of vocabulary in teacher thinking about mathematics instruction, several themes emerged about the relationships of language and mathematics learning and teaching beyond vocabulary that shed additional insight including complexities related to teaching English learners and the role language plays in mathematics learning. Our findings highlight the broad areas of knowledge and skills related to teaching English learners that an assessment such as the PACT can elicit and assesses.²

² We should clarify at the outset that the purpose of our study was not to investigate the effectiveness of the PACT as a measurement instrument (issues in scoring validity, the quality of the rubrics, etc.), nor to evaluate how the teacher education programs that these teacher candidates were participating in went about preparing them for the needs of English learners. We do believe, however, that our study can inform efforts in both areas.
Related Research

Before describing the development of the PACT and the teachers’ responses, we briefly review several relevant areas of research. We begin by discussing research on how language is related in important and complex ways to mathematics, and why these complexities add additional demands on English learners’ mathematics education experiences. We then turn to research on preparing teachers for linguistic diversity in the classroom, especially mathematics classrooms. We conclude our literature review with a section on academic language, a topic of much interest currently in education and one that the PACT’s approach to English learners was centered around.

Language, Mathematics, and English Learners

Language plays a key and complex role in mathematics understanding and communication (Lampert and Cobb, 2003; Foreman (1996; 2003). Spanos et al (1988) describes the complex language demands of mathematics, including syntactic features (uses of comparatives such as greater than, less than), semantic features (technical vocabulary like “coefficient”; everyday words with specific math meanings such as square, power; and synonymous words such as plus, add, combine), and symbolic notation (e.g. $\Sigma$, $\pi$, $>$). Syntactic, semantic, and symbolic features, are therefore important components of the mathematical “register” – a set of meanings, words, and structures appropriate to the practice of mathematics (Kelly & Bazerman, 2003; Moschkovich, 2000; Pimm, 1987). It is important to note that understanding the linguistic demands of mathematics teaching and learning must not neglect the mathematics itself: As Barwell (2005) points out, “It is not enough . . . to analyse the language of mathematics or to import a general theory of language learning into mathematics teaching.
Mathematics educators are interested in how learning mathematics whilst learning the language of the mathematics classroom affects the mathematics that is learned (p. 147).” Campbell, Adams, Davis (2007) suggest an approach to thinking about language and the teaching of mathematics that considers “the importance of analyzing the relationships between language, life experiences, culture and instructional content (p. 19).”

The complexity of language and mathematics intensifies when a student must communicate her mathematical understanding in a second language. Research on mathematics, language, and Latino/a English learners/bilingual students has shown that English learners can demonstrate their understanding of mathematics if conceptions of language are broadened beyond focusing on vocabulary proficiency and the mathematical register (Moschkovich, 1999; 2002; 2007a;2007c). For example, Moschkovich’s research demonstrates that Latino/a bilingual math learners exhibit mathematics understanding in the forms of argumentation and conjecturing, even though they may not be able to express their understanding of mathematical relationships using specific mathematics vocabulary. She argues that if evidence of mathematical understanding only focuses on language as explicit vocabulary usage, then other forms of language and thus understanding may be missed. Students bring linguistic resources that help them make sense of the mathematics including those expressed in their first language as well as non-verbal communication through representations (e.g. gestures, pictures, graphs , and tables).

Successful mathematics teachers of English learners and Latino/a children understand the complexity of language and its role in mathematics learning. Effective teachers provide opportunities for students to hear and use language to negotiate linguistic and conceptual meaning (both in English and Spanish), give students the opportunities to use other resources
(other than English) to demonstrate their understanding, and help students learn specialized mathematics language or genre including comprehending and writing word problems (Gutierrez, 2003; Khisty, 1997; 1999; 2001; Khisty & Chaval, 2002; Celedon-Pattichis, 2003). These classrooms are language “rich,” illustrating strategic uses of language that transcends written and verbal English competencies while at the same time explicitly work to develop those language competencies to foster mathematical understanding and literacy. For example, Khisty’s research documents how an elementary teacher named Mrs. Martinez orchestrates rich mathematical discussions that demand oral explanation and meaning making. She consistently asks students probing and clarifying questions to not only assess learning, but to facilitate mathematical learning. The teacher also models explicit use of mathematical vocabulary to make mathematical meaning rather than memorize mathematical terms (Khisty, 1999).

These studies provide important examples of the way language and mathematics learning are connected in effective classrooms taught by veteran teachers for English learners. Yet, little is known about how these strategies are developed over time. More specifically, much remains to be learned about how pre-service teachers’ view these relationships and integrate their views about the relationship between language and mathematics into practice. Our study examines how beginning teachers, given their teacher preparation (i.e. coursework) and student-teaching experience think about this relationship and how that might be expressed in their lesson planning and pedagogical reflections.

**Preparing Teachers for Linguistic Diversity**

Fillmore and Snow (2005) suggest that adequate preparation for EL pre-service teacher education programs include courses on the educational applications of contrastive linguistics, first language acquisition, second language acquisition, and other areas of educational linguistics.
While it is easy to argue that teacher education should be made more comprehensive with the additional of distinct courses, some teacher educators (e.g. Tom, 1997) have argued that it is not realistic to add more courses to pre-service teacher education programs, especially given the legislative demands to shorten or even eliminate preservice programs (Levine, 2006). The course addition approach seems logical, but the research on teacher development suggests that adding content in teacher education, without the chance to practice in genuine teaching settings, rarely enhances pre-service teachers’ knowledge and skills (Knowles & Holt-Reynolds, 1991). Valdes, Bunch, Snow, and Lee (2005) call for an integrated approach, one that infuses a focus on language and linguistics throughout teacher education programs.

With regard to the preparation of teachers for linguistic diversity in mathematics classrooms specifically, Campbell, Adams, and Davis (2007) present an integrated framework in their mathematics methods courses consisting of four main components: academic content, mathematical and cognitive processes, mathematical and contextual language, and cultural/life experiences. They argue that teachers who pay close attention to these four components have a more “accurate representation of students’ knowledge and abilities (p. 20).” Their integrated framework highlights language in relationship to other instructional contexts (social, mathematical, cognitive, and cultural) that benefit mathematics learning of English learners. This model for pre-service mathematics methods courses exemplifies a new kind of mathematics teacher preparation needed to effectively teach mathematics to English learners, one that considers language and mathematics discretely as well as integrated with a complex web of multiple relationships. Aguirre (2006) proposes a similar framework but includes an explicit focus on social justice that asks pre-service teachers to critically examine the relationship of mathematics and language from a socio-cultural and political standpoint as they develop their
Building on work by Civil (2002; 2006), Freire (1993), Gutierrez (2003), Gutstein (2006), Khisty & Viego (1999) and Moschkovich (1999; 2002a), this framework addresses teacher knowledge related to language through the understanding of community knowledge and the linguistic resources embodied in the daily practices of a given community, as well as the language practices of school mathematics and mathematicians that supports mathematical communication and learning such as explanation, justification, and proof. Furthermore, it situates this integrated knowledge with respect to related contexts such as race, racism, immigration and social class to enhance teacher understanding of the political contexts of teaching and learning of mathematics with traditionally marginalized groups such as Latinos and English learners.

**Academic Language**

There is widespread agreement regarding the importance of academic language for the education of English learners, and for the need for teachers to focus on this area. For example, Montes (2002) shares the implementation and assessment of a targeted academic language approach that was found effective with English language learning students, including those who were at-risk of dropping out of the school, suggesting that improving and enhancing teachers’ instructional approaches were crucial to the success of program implementation. Far less consensus exists, either among language scholars or educators, as to the nature of academic language or the instructional approaches that might most effectively help students develop it (e.g. Bailey, 2007; Bunch, 2006; Garcia, 2002; Solomon & Rhodes, 1995; Valdés, 2004; Rolstad, in press). Solomon and Rhodes (1995), for example, in a survey of elementary teachers of English as a Second Language from around the United States, found that teachers varied widely in how they defined and described academic language. When asked what specific aspects of academic
language they focused on in their elementary school classrooms, teachers responded with a wide range of targets, including vocabulary; general grammatical features of English syntax; the organization of written texts; language functions such as comparing, contrasting, and categorizing; register variation (contrasting academic settings with social settings); and activities focusing on “higher cognitive thinking”. Some teachers focused on the local context, arguing that teachers themselves “decide the type of language needed to survive their classrooms,” while others emphasized the importance of the larger social and political context: “Academic language is the accumulation of language that has built up as the result of being schooled in a particular culture.” [pp. XX]

Many K-12 bilingual and EL educators have found the distinction between decontextualized, “cognitively academic language proficiency” (CALP) and less cognitively demanding “conversational” and “basic interpersonal communication skills” (BICS) (Cummins, 1984; 2000) a useful distinction. However, soon after Cummins published work on the BICS/CALPS distinction, researchers challenged its premise as ignoring the social context that all language use entails and for privileging a dominant middle class variety of language (see Rivera, 1984, MacSwan & Rolstad, 2003). Mindful of this and other critiques, Cummins later suggested that a continuum of cognitively demanding and contextually driven language activities better explained the distinction than did a dichotomy, pointing out that all language functions should be valued in educational programs. Even more recently, Cummins has put forth a new model of academic language that focuses on meaning and use (Cummins, 2000). In spite of his reorientation, many educators still use the BICS/CALPS distinction to describe their students’ language proficiency, and Cummins himself has vigorously defended the original distinction Cummins (2000).
Other approaches have focused more on the functions of language in academic settings. For example, Gee (2003) conceives of academic language as an often-unfamiliar “Discourse” that children are called upon to engage in, one that is not so much “decontextualized” as it is residing in a context to which many children have had no exposure. Likewise, Bartolomé (1998) argues against the “tendency to glorify and romanticize a particular type of academic language discourse that is inaccurately referred to in the literature as “de-contextualized” language (p. 4). According to Bartolomé, labeling academic language as “decontextualized” emphasizes its linguistic features but ignores the fact that “language production for meaningful communication cannot be achieved outside the cultural context that gives the produced language meaning in the first place” (p. 4). In other words, according to Bartolome, “all language is context bound in one manner or another” (p. 4). Bunch (2006) demonstrates how students’ “language of ideas” often varies from the “language of display” expected in school settings, yet how the former can be used to engage substantively with academic work in classroom settings.

Using systemic functional linguistics (SFL) originally developed by Halliday (1994), a number of researchers and educators have focused on how language is used in particular social contexts, and how those social contexts in turn influence the language used (Johns, 2002; Schleppegrell, 2004; Schleppegrell and Colombi, 2002). The emphasis in this approach, like others who focus on academic language as register variation, is on linguistic features. In applications of SFL in educational contexts, there is not one academic register, but rather different registers for each subject area such that, “developing knowledge and understanding in school subject areas and developing control of the linguistic resources that construct and communicate that knowledge and understanding are essentially the same thing (Unsworth, 2000).
As we will discuss later, it was in the context of these debates surrounding the nature of academic language that the PACT prompts and rubrics were developed. Ultimately, the PACT focused on teachers’ awareness of the role of language in the instructional and disciplinary contexts. Thus, teacher candidates were asked to explicitly address academic language in the context of content learning and instruction, for example in mathematics lessons, and the rubrics focused on the language demands of instruction and how students were faring in meeting those demands with their developing linguistic resources.³

The Performance Assessment for California Teachers (PACT)

History and Context

To our knowledge, the PACT represents the first preservice teacher evaluation effort to measure teachers’ knowledge and skills surrounding academic language and language demands as part of a potential licensure decision. Other classroom observation tools, such as the Communicative Orientation of Language Teaching, COLT (Spada & Lyster, 1997) focus on language teaching, but these instruments are designed for research. Echevarria and colleagues (2004) have developed the Sheltered Instruction Observation Model (SIOP), a model of content and language teaching, as well as observation tool designed to assess its implementation in the classroom. The SIOP, however, is not linked to a high-stakes assessment of preservice teachers. Neither the COLT nor the SIOP are explicit in aiming to assess the teachers knowledge and skills in addressing the language demands of the curriculum or of the academic language development of students.

The PACT developed in response to policy changes in teacher credentialing in California, and its focus on issues related to the teaching of English learners was a result of California’s

³ The first author of this paper (Bunch) was instrumental in the development of the two academic language rubrics for the PACT.
demographics. California has more ELLs than any other state (Kindler, 2002), and these students’ performance on standardized academic achievement tests remains stubbornly low (Jepsen & de Alth, 2005). These performance data, along with the virtual elimination of bilingual education as a consequence of Proposition 227 (see Gandara, 2000, for a review), has over the past decade encouraged a reconsideration of the state’s overall strategy for helping its large and growing ELL population meet challenging achievement benchmarks. When the political will in the late 1990’s emerged to redesign standards for initial teacher credentialing, pre-service teachers’ preparation for instructing ELLs rose to the top of the criteria under consideration. As a result, one of the 13 Teaching Performance Expectations (TPE) ultimately approved by the state board of education was directed solely to teaching of English learners. TPE 7 outlines the competencies teachers must gain in their preservice program, requiring that “Candidates for a Teaching Credential know and can apply theories, principles, and instructional practices for English Language Development leading to comprehensive literacy in English.” It is important to note that, while including this explicit focus on competencies needed by teachers for addressing the needs of English learners, all references to multicultural education were omitted in the final version of the standards (see Ahlquist, 2003, for an overview of these debates).

4 Generally, only about 40 percent of the state’s ELLs score at the basic or above proficiency levels on California’s statewide criterion-referenced test of language skills, compared with seventy-five percent of all English-only learners who meet these standards. We provide these data with the caveat that the statewide tests do not meet validity or reliability standards for language learners; they are, however, the only performance data the state collects.

5 (See http://www.ctc.ca.gov/notices/coded/030005/030005.html for an explanation of the standards and other information.)

6 Our own review of the TPEs reveals a prosaic list of competencies common to teachers across the country. Perhaps not what we expect for new teachers in California, where only 31.3% of the total K12 population is “White.” By many accounts, the development of the TPEs, like most curriculum standards, was politically charged from the start and grew increasingly so while it became clear that political forces were at work to diminish the multicultural and multilingual elements that many members of the committee desired (see Alquist [2003] for a review). The process leading to the nearly wholesale omissions of multicultural standards in the TPEs was similar to the ways that the state’s K12 social studies standards were rendered (Symcox, 2002).
Required knowledge of English Language Teaching (ELT) for all credential candidates represented a new mandate in California. Prior to the redesign of the standards, the state offered an “add-on” endorsements, known as the Cross-Cultural Language and Academic Development (CLAD), for teaching in classrooms with significant numbers of English learners; consequently, only teachers who worked with EL’s were required to take courses to be certified in ELT. The fact that ELD instructional knowledge was now mandatory for all credential earners—whether or not they intended to teach ELL—forced credentialing programs to reconsider their course scope and sequence and submit the plan to the state for approval.

As Pecheone and Chung (2006) point out, the new legislation also required the state to develop an individual assessment designed to measure a candidate’s ability to demonstrate the knowledge and skills required in the TPE. Known as the Teacher Performance Assessment (TPA), the state published a Request for Application to groups willing to develop the TPA, and the Educational Testing Service (ETS) quickly won the contract. However, the legislation also allowed for alternative versions of the TPA, as long as such assessments could prove that they were reliable and valid measures of the TPEs. Many in the teacher education community in California were concerned with the shortcomings of the test of teaching developed by ETS, believing that the ETS version would trivialize important contextual knowledge and develop a standardized examination which would demand that teacher candidates arrive a “correct answer.

In reaction to the state-sponsored-ETS TPA, a coalition of credentialing universities including Stanford University (lead institution on the project), all 8 University of California campuses that credential teachers, 3 California State University programs, and Mills College (a small private liberal arts school in Oakland with a strong tradition of teacher education) formed the Performance Assessment for California Teachers (PACT) group. The PACT group formed to
develop a version of the TPA with the intent of developing a more contextually sensitive and nuanced assessment of preservice teachers than the ETS version.

But concern over what tests can appropriately measure the TPE’s has been only half the story. The California State University System, the largest credential granting body in the state, lobbied to halt mandatory TPE assessment altogether after the legislation was passed. Questions about who would pay for the assessments and recourse for those students who fail were offered as justifications for delaying implementation. Therefore, during the time we conducted our research, the PACT was in pilot phase. The PACT has recently been approved by the California Commission on Teacher Credentialing (CCTC) as one of the acceptable TPE assessments that teacher candidates can use upon completion of their teacher preparation programs during the 2008-2009 academic year, although it remains to be seen whether or not the CCTC or state Legislature will be further delaying mandatory assessment on the TPEs altogether.

In developing an alternative to the ETS assessment, PACT faced the challenge common to all efforts to design an authentic tool to evaluate the work of preservice teachers, especially for the high stakes purpose of final licensure: meeting the dual criteria of authenticity and validity. Paper and pencil tests of pedagogical knowledge, for instance, rarely capture either the context nor the teacher thinking that informs instruction (Murnane, Singer, Willet, Kemple, & Olson, 1991). On the other hand, more authentic assessments, such as teaching portfolios, often fail to meet the high psychometric standards required for high stakes assessment (see Téllez, 1996, for a review). Indeed, modern methods for assessing and evaluating teaching often leave teachers and teacher educators nonplussed and unsatisfied. Lesson length observations combined with a checklist of desired behaviors, might be the most common strategy for evaluating teachers, but as Gitlin and Goldstein (1987) suggest, they can be inauthentic: “These abrupt observation visits
are initiated with little sense of the classroom's history and upon completion are not integrated into its ongoing history.” (p. 7).

With the shortcomings of traditional lesson length observations in mind, PACT sought to develop a contextualized process of evaluating preservice teachers that would span more than a single lesson, encourage reflection, and provide evaluators with a video to provide even greater context. While PACT was not originally guided by any one theoretical frame, we believe that the PACT assessment meets nearly all of the 15 mandates for preservice teaching evaluation laid out by Uhlenbeck, Verloop, & Beijaard, 2002. Uhlenbeck et al., in a review of beginning teacher evaluation, suggest any new model must be built from the recent research and theory on teacher development (e.g., teacher thinking) and informed by the importance of reliability and validity. Among the 15 requisite features are (a) both actions and cognitions should be assessed, (b) teachers should be assessed within the context of their work, (c) teaching should be comprehensively defined and include pre- and postactive phases of teaching, and (d) teachers should engage in deliberation and reasoning about their practice.

**PACT Teaching Events and Rubrics**

Focusing on a “Teaching Event” (TE) that consists of a videotaped segment of lesson along with a variety of supporting documentation and reflection, the PACT requires candidates to demonstrate knowledge in four primary areas: planning, instruction, assessment, and reflection. In addition to analyzing both whole class and the work of several individual students, one of whom must be an ELL or student facing linguistic challenges. Candidates must also submit a 10-20 minute video of a lesson that took place during the teaching segment they document in the Event. The teaching portion of the Teaching Event is completed in candidates’ student teaching site. Teaching Events have been developed in both elementary literacy and
mathematics as well as most secondary subjects. Elementary multiple subjects candidates have the choice to focus on literacy or mathematics. Cooperating teachers assist candidates in organizing lesson segments as well as with other administrative tasks, but the experienced teachers must allow each candidate to complete the teaching and reflection independently. The PACT Handbook contains prompts that help candidates construct their responses and guides candidates through the documentation they need to complete the event. (See the Appendix for sample prompts that relate directly to the teaching of ELL.)

Studies conducted on the PACT during its pilot phases suggests that the Teaching Events provide a valid and reliable way to assess preservice teachers’ knowledge and skill in teaching (Chung, 2005; Pecheone & Chung, 2006; Pecheone et al., 2007). Of particular note are the rubrics that allow independent evaluators to rate a candidate’s Teaching Events on a four-point scale. The primary rubrics of planning, instruction, assessment and reflection show strong inter-rater reliability, as well as strong construct validity.

Although the well-established rubrics covered general teaching skills, the PACT group needed to assess more than these four teaching elements. Motivated both by the need to assess the standard requiring knowledge of ELD (TPE 7) and the recent interest in the ways that academic language learning enhances content knowledge (Bunch, Abram, Lotan, & Valdes, 2001; Schleppegrell, Achugar, & Oteiza, 2004) the PACT group chose to create a rubric assessing teacher candidates’ knowledge of and teaching capacity for academic language (AL). In addition to a rubric specifically aimed at academic language, PACT developed an additional rubric measuring candidates’ ability to assess the language demands of instructional materials (Short & Echevarria, 2004). Unlike the planning, instruction, assessment and research rubrics, the Academic Language and Language Demands rubrics would be assessed across the entire
teaching event, instead of the matched sections of the other rubrics (e.g., the rubric for planning applies only to the planning section). We have included both the AL and LD rubrics in the Appendix. In total, eleven rubrics have been developed for the PACT: three addressing planning; two each for instruction, assessment, and reflection; and academic language and language demands (one rubric each). Each rubric is scored on a 1-4 scale, yielding a range of 11-44.

While the scoring system overall and the setting of a cut score for passing has been a chief effort of the PACT working group, and we are interested and involved in these efforts, in this paper we limit our discussion to the content of teacher candidates’ responses and not to the technical measurement issues.

The Academic Language and Language Demands rubrics are unique from the other PACT rubrics in that they are designed to assess teachers’ work across the entire Teaching Event. Throughout their discussion of each Teaching Event, candidates are required to respond to a number of prompts that provide them an opportunity to discuss English learners, the language demands of instruction and assessment, and academic language in particular. In fact, every section of the PACT includes prompts about language and language learners. These include prompts focusing specifically on academic language, language development, and language demands:

- How do key tasks in your plan build on each other to support student learning of the curriculum content and the development of academic language related to that content?
- When you consider content learning of your students and the development of their academic language, what do you think explains the learning or differences in learning that you observed during the learning segment?
Other prompts asked candidates to comment on supports for English learners and to reflect on a sample of student work from an English learner.

- Describe any language supports used to help your students (including English learners as well as other students struggling with language) understand the content/or academic language central to the lesson.
- From the three students whose work samples were selected, choose one English learner and other student . . .

As discussed earlier in this article, there is not widespread consensus regarding the nature of academic language. It is not surprising, therefore, that in designing the PACT rubrics there was much discussion and debate surrounding the most appropriate way to proceed. Academic Language is described in the ’05-'06 PACT candidate handbook as follows:

the language needed by students to do the work in schools. Academic language includes such things as specialized vocabulary, grammar and punctuation, conventional text structures within a field (e.g. essays, lab reports) and other language-related activities typical of classrooms (e.g. expressing disagreement, discussing an issue, asking for clarification). Academic language includes both productive and receptive modalities.

Appendix A presents the two rubrics that were used to score the AL sections of the TE’s.

Candidates were provided these rubrics in the candidate handbook.

In the remainder of this article, we explore what eight teacher candidates wrote about as part of their PACT Teaching Events.

The Study

In approaching our analysis of teacher candidates’ work on the PACT, we were guided by overarching research questions addressing teaching and teacher education developed by us
and our colleagues at the Center for the Mathematics Education of Latinas/os (CEMELA). Collectively, CEMELA researchers were investigating various aspects, in various contexts, of how pre- and in-service teachers consider language and culture in teaching mathematics to Latino students. The CEMELA-wide research questions relevant to our study include the following:

- How do teachers understand the role of language and the cultural resources of Latino students and parents in the learning of mathematics?
- How do teachers recognize and use these resources to adapt their mathematics instruction to meet the needs of students?

The PACT offered us a corpus of data that could help us understand pre-service teachers’ experiences and thinking about language and content-instruction, specifically mathematics. We were excited to explore the CEMELA research questions in the context of pre-service teacher development.

Data Collection and Sample Selection

We asked the PACT administrative office to send us a sample of Elementary Math Teaching Events from the years 2004-2005 and 2005-2006 academic years. The office had been collecting Teaching Events in all subject areas for five years, primarily for the purposes of benchmarking, revisions of rubrics, and the training of scorers. From a total of approximately 200 Elementary Math Teaching Events, we requested a sample representing a range of overall

---

7 CEMELA is a National Science Foundation funded Center for Learning and Teaching made up of four institutions: University of Arizona, University of California, Santa Cruz, University of Illinois, Chicago, and University of New Mexico. This interdisciplinary consortium made up experts in mathematics, mathematics education, language and culture focuses on the production and dissemination of research and practice of mathematics learning and teaching of mathematics with Latino/a students. CEMELA seeks to understand the interconnections of mathematics education with the unique language, social, and political issues impacting Latino communities and to help prepare the next generation of mathematics education researchers and practitioners with an integrated knowledge base aimed toward improving mathematics education for Latino children.
scores from preservice teachers, K-6. We requested Teaching Events from teacher preparation programs that differed from each other in terms of geographic location, demographic contexts served by graduates of the program, and theoretical and pedagogical approaches to preparing teachers for linguistic diversity. In order to ensure a range, we requested portfolios that included “high,” “medium,” and “low” scores on the academic language rubric. Owing to the confidential numbering of the data, we do not know their university affiliation. We expect that our initial sample included Teaching Events from approximately 10 sites, all in California, including campuses of the University of California, the California State University, and private universities. The most common program model for participating universities is a year-long master degree program that includes a teaching credential.

The initial sample provided to us by the PACT office included 36 Teaching Events. We narrowed this number down first by including in our study only Teaching Events from candidates whose classrooms were composed of at least 30% ELLs, leaving us with a total of 17 Teaching Events. From these, in order to be able to do a close analysis of the entirety of each event, we narrowed our sample to 8, choosing Teaching Events from candidates who taught in classrooms with the highest percentages of both Latino students and English language learners. Our final sample included Teaching Events conducted by candidates in at a variety of grade levels: one kindergarten, two first grade, two second grade, two third grade classrooms, and one fifth grade. Table 1 describes the demographic features of the classrooms, schools, and communities of the 8 teacher candidates, as well as the mathematics curriculum used in their classrooms and the focus on the learning segment they chose for their Teaching Event.

---

8 While the majority of the TE s we received were already in electronic text format (e.g., Microsoft Word), the remaining files came to us as paper copies only. We scanned these TE s, converting them into electronic versions. The teaching events varied in length, some exceeded 75 pages in length which made for additional data collection and analysis demands.
Data Analysis

We analyzed the data on three levels (Miles and Huberman, 1994). We began our analysis by looking specifically at teachers’ use of the term “academic language” (AL). While our interests went beyond the use of this term, the focus on teachers’ use of a concrete term provided us with an efficient place to begin our analysis. Also, “academic language” (AL) was the most predominate specific term used by the designers of the PACT to elicit candidates’ comments on language, both in the prompts and in the rubric (See Appendix X & Y). Finally, we were interested in how teachers used the term in order to contribute to a larger exploration of the use of the term (see the discussion on academic language above). For this first level of analysis, we conducted an electronic word search for “academic language,” highlighting every use of the term in each of the eight Teaching Events. We annotated each instance of the use of academic language with preliminary observations about the teachers’ use of the term. We next compiled charts for each Teaching Event that included each instance of use of the term, potential codes, and other observations and comments. For the first three Teaching Events analyzed, three different researchers independently conducted these academic language word search analyses and came together after each round to check our consistency and to discuss the emerging findings. After this initial process, we divided the remaining Teaching Events among the three researchers for the remaining word searches and analyses.

While reading several Teaching Events in their entirety both before and during the process of the academic language word search we found that, as predicted, teachers’ discussions of language issues related to mathematics learning and teaching were not limited to their use of the term academic language. Therefore, we conducted a second, more comprehensive analysis of the entire text of each of the 8 teaching events. We read each Teaching Event in its entirety,
instituting selective coding of the data, refining the previous academic language category, and identifying other emergent categories (Strauss, 1987). As we will describe in more detail below, the new categories that emerged from the data included the role of language in mathematical learning, language demands, the role of students’ native (non-English) languages, supports, challenges, and family/community connections. We produced theme summaries from the category codes for each teacher case. At least two researchers reviewed each case, meeting to discuss and resolve discrepancies in the coding.

For the third level of analysis, we conducted cross-case comparisons. Matrices and other displays were developed to further condense data and draw comparisons across the 8 teachers (Miles & Huberman, 1994).

While we took great care to ensure variability across specific criteria, our analysis is limited to teacher narrative. In addition, while the PACT does include video excerpts, the videos are only a very small sample of a pre-service teachers’ lesson segment and developing practice. We chose to focus our analysis on the teachers’ written descriptions to get a more comprehensive view of how they discussed language, math, and English learners. Finally, we should note that we did not systemically analyze the official score that each candidate received on the various PACT rubrics. As articulated above, our interest in this study was in documenting the range of ways that the PACT allows for teacher candidates to articulate language issues in relation to mathematics learning and instruction, rather than to address technical issues of test measurement.

Findings

We organize our findings as follows. First, because of the focus on academic language highlighted in the PACT prompts and rubric, we describe the results of the first phase of our study, in which we analyzed teacher candidates’ explicit use of the term academic language. As
we will discuss below, teachers ranged widely both in the extent to which they used the term and in how they appeared to understand the concept. Focusing on pre-service teachers’ use of academic language provides valuable insights into the ways in which performance assessments like the PACT can provide a forum for teachers to write about such issues, and for evaluators to assess their understandings. However, as we predicted, the candidates’ discussions of issues related to the linguistic and cultural resources of their students, and the relationship between these resources and the teaching and learning of mathematics, were not limited to use of the term academic language per se. Therefore, we follow our analysis of teachers’ use of the term academic language by describing the results of our in-depth analysis, in which we analyzed each candidates’ Teaching Event in its entirety and coded for themes related to the research questions articulated above. Ultimately, the PACT helped us get a glimpse of what pre-service teachers are thinking about language, math and teaching ELs. It also gave us insights and confirms different views of academic language, different views of the relationship language has to math, and the variety of strategies and challenges associated with taking language seriously in content (math) instruction.

**Academic Language**

The eight teacher candidates ranged widely in the extent to which they used the term *academic language* as well as in their apparent conception of the term. Three candidates (Angela, Elizabeth, and Fiona) did not use the term at all, even when responding to the prompts that asked them to address the concept in their responses. Holly used the term 6 times; Belinda, 8 times; and Grace, 13 times. Far surpassing any of the other candidates in terms of the number of times she used the term academic language was Christine, who used the term 37 times. The lack of any mention of the term by three of the eight candidates was surprising, given the emphasis on
academic language in both the prompts and rubric. It is important to note, however, that these three candidates did address issues of language in other ways in other parts of their Teaching Events, suggesting that the AL-related prompts may have stimulated reflection on language issues even if candidates did not use the term academic language.

It was evident from their other comments that these three candidates held widely different views concerning the role of language in mathematics. For example, Fiona explained her belief that the language demands of mathematics are minimal because “math deals with numbers.” Angela, on the other hand, while also avoiding the term academic language, used the AL prompts to comment on issues of language and English learners in varied and substantive ways. When prompted to write about aspects of language proficiency in conversational and academic language, Angela discussed the fact that language proficiency is not a “barrier” for some English learners, as they “are able to ask clarifying questions of vocabulary words being used.” For other English learners, according to Angela, language proficiency plays a “bigger role,” for example “when a student is unable to count beyond a certain number because they do not have the English vocabulary to count into the teen numbers.” When responding to a prompt asking how the learning tasks in the teacher candidates’ lesson plan build on each other to support content learning and academic language development related to the content, Angela discussed how her lesson on equality begins with an opportunity to assess student understanding through a discussion of “the definition of the equals sign”. According to Angela, “beginning with a math discussion helps to access student prior knowledge and to engage them early on what they already know,” and “[p]roviding a definition early on provides the students with something they can hold on to and carry with them throughout all of the lessons.” Reflecting on Angela’s responses, it is clear that even though she does not use the term academic language, she used the
PACT to comment on a wide variety of aspects of the relationship between language and the mathematics learning of her students, especially English learners.

Those candidates who did refer explicitly to academic language used the term in a variety of ways. We had expected the “conversational” vs. “academic” language distinction might dominate candidates’ discussions, given our perception of the influence of Cummins work among teacher educators, as well as the fact that while the rubrics did not refer to this distinction, one of the early prompts asked candidates to “consider aspects of English language proficiency in conversational and academic language.” To our surprise, only two of the eight candidates drew on a general distinction between “academic” and “conversational” language, and in neither case was the distinction discussed in depth. One of these candidates (Belinda), also distinguished between the use of oral academic language and written academic language. Neither of these candidates elaborated on the distinction nor linked them specifically to mathematics teaching and learning.

Taking a different approach, several candidates listed specific California English Language Development Standards in lesson plan templates calling for targeted academic language. While this approach is more consistent with the functional perspective toward academic language emphasized in the rubrics, the candidates using the ELD Standards did not elaborate on why they chose to do so.

Far more prevalent than either the academic/conversational distinction or the use of ELD standards, however, was candidates’ association of the term academic language with vocabulary. While we were aware of the dominance of the “academic language as vocabulary” approach among some teacher educators (e.g. Marzano), we were surprised by the dominance of this perspective in the PACT Teaching Events, given the fact that the two academic language rubrics
were designed in part to get candidates to move beyond a conception of academic language as vocabulary alone (for limitations of the academic language as vocabulary approach, see Bruna, Vann, & Escudero, 2007; Moschkovich (2002, 2007d). According to the rubric, in order for a candidate’s score on the “understanding language demands” portion of the rubric to merit a 3 or higher (with 1 being lowest and 4 being highest), the candidate needed to identify “language demands of the learning tasks and assessments that go beyond vocabulary to include specific text types or other language demands that are challenging for individual students or groups of students” (emphasis added).

Upon closer analysis of the candidate’s discussions of vocabulary, we found a wide variety of different ways in which candidates expressed the nature of the vocabulary demands of their lessons and the implications of those demands for the teaching and learning of mathematics, leading us to a more complex picture of the “academic language as vocabulary” stance than we began with. In fact, as we will explore in more depth below, it was through their discussion of vocabulary that some candidates’ offered compelling comments regarding the relationship between language and mathematics learning and teaching.

While candidates at times simply listed the words that they believed English learning students would not know, many of their discussions went well beyond such lists. Belinda’s comments on vocabulary in her Teaching Event demonstrate a range of perspectives. Taking a somewhat traditional stance on the need for students to know particular words in order to participate in her lesson on measurement, Belinda argues that “the academic language presented may be terms that the students have not heard before. By discussing these new words in detail as they are presented, I hope to guarantee that the students are not confused by the vocabulary” (p. 25). Belinda offers what might also be considered traditional vocabulary support strategies, such
as word walls, with each word translated into Spanish with an accompanying picture. Belinda also highlights the fact that some words have what she calls “double meanings . . . depending on the context” (p. 25). For example, regarding the word *foot*, Belinda states that she “will need to make it clear to students that this measurement does not hold the same meaning as a foot that is attached to our leg” (p. 25). Belinda’s discussion on vocabulary however, goes beyond what students do *not* know. She also emphasizes the need for teachers to start with students’ own experiences and ways of speaking and build upon those experiences in math lessons. This is evident as Belinda discusses the introduction to one lesson, on perimeters:

I asked them if we were to go outside and take a walk around the playground, how would I know how far they all walked? They told me that they would “add it all up,” which we renamed as calculating the perimeter (p. 29).

In this example, while Belinda is clearly interested in students’ understanding of the mathematical expression “calculating the perimeter,” she does not view students’ understanding of the phrase as a pre-requisite for understanding the *concept* of perimeter. On the contrary, it is clear that students already understand the concept of perimeter in their suggestion to “add it all up”; Belinda is simply modeling the mathematical terms for the concept.

Belinda also demonstrated the awareness that academic language is not simply about teaching students words that they might not be familiar with, but it is also about thinking about *how* words are most effectively used for particular mathematical purposes:

I found myself saying ‘smaller than,’ rather than ‘less than’. It is important that I model the use of the academic language so that the students will become familiar with all the terms and use them” (p. 47).
Another candidate, Christine, linked her vision of vocabulary as tools that can be used to facilitate particular mathematical procedures and understandings:

Each day students will be taught the necessary vocabulary and have a multitude of opportunities to learn the meaning behind the vocabulary, practice the vocabulary and learn how to apply the principles behind the vocabulary. . .

[more than, less than, and equal to] . . . This information is important for students to learn because not only is it providing the academic language for them to use when comparing in any context, it is also providing them with a deeper understanding of number relationships. (Emphases added.)

In this example, Christine discusses the “principles behind the vocabulary,” which she describes as important both for “comparing in any context” and for “a deeper understanding of number relationships.”

Beyond Academic Language

In addition to candidates’ discussions surrounding the nature of academic language and its implications for their teaching and their students’ learning, our more comprehensive analysis of the entirety of each Teaching Event revealed a wide variety of other ways in which the pre-service teachers addressed issues of relevance to teaching English learners. As mentioned earlier, we identified the following themes: the role of language in mathematical learning, language demands, the role of students’ native (non-English) languages, supports, challenges, and family/community connections. The categories are not mutually exclusive; at times we identified the same stretch of teacher comments as included two or more of the themes. An in-depth discussion of each of the themes is beyond the scope of this paper. However, the emergent themes suggest a variety and complexity in pre-service teacher thinking about language and
content instruction for English learners. To demonstrate the range of responses across each of these categories, we will focus on two: challenges and the role of language in mathematical learning.

Challenges

Candidates represented in different ways the nature of the challenges inherent in the teaching and learning of mathematics in linguistically diverse classrooms. Several of the candidates described the challenges as communication barriers presented by the language of instruction, such as vocabulary unfamiliar to students. For some, the discussion of language challenges was integrally related to a discussion of the mathematical concepts being addressed. For example, Grace integrated her discussion of language and mathematics concepts by distinguishing the challenges facing English learners and those facing all students. She argues that work samples from two of her students “accurately represent the rest of the class, in that they provide evidence of students’ common challenges, such as identifying the rule for the given function table and in particular the difficulty many of the English Language Learners face expressing their ideas in writing, especially when faced the unaccustomed task of writing about math concepts.”

Two candidates represented the challenges as residing in the students themselves, either due to their inherent limitations or their behavior. In her planning commentary, Fiona made her expectations of her students clear: “considering that I have students who are Beginner, Early Intermediate and Intermediate [EL’s], I can expect that my students will have problems completing the assignment and or rush through the assignment making simple errors” (p. 4). The assumption here is that the students’ predicted difficulties are not to be attributed to the
instructional context, but rather to the students’ deficiencies or carelessness. Later, in reflecting on her lesson, Fiona makes this point even more explicitly: “in my observations I noticed that students who scored low on their assignments were a result of their natural low skills, or they rushed through the assignment making simple mistakes” (p. 2, emphasis added). In the second example of a candidate attributing problems to the students themselves, Holly repeatedly highlighted her students “laziness” as the underlying issue. The following quotation is representative: “While this learning segment focused on division, it appears to be the laziness and lack of attention that has produced so many incorrect responses, as many did not show their work they were to in an effort to get the test off of their desks.”

Several candidates attributed some of the challenges to students’ parental or family support. Grace, for example, maintained that many parents speak only a little bit of English, “so it is imperative that I provide students with adequate understanding of directions and procedure, enabling them to practice the reinforcement activities independently” (p. 28)]. Other candidates’ responses highlight an explicit deficit perspective related to families and communities of their students, attributing students’ problems to the lack of linguistic and academic resources available in their households and communities.

In contrast, several teachers described the challenges as residing not in the students and their families, but rather in the instructional context. Denise, while also attributing some of her students’ mistakes to “carelessness,” also attributes the problem to her own classroom management: “I was so absorbed in working on problems on the overhead, that I forgot to monitor the students to make sure they were watching what I was doing or that they were on task.” Elizabeth, on the other hand, argued that attempting too many different “activities” in her lesson led to the fact that “at times students missed out on the time to work on more challenging
problems]” such as “larger Math problems” or “comprehension problems.” Therefore, the challenge as Elizabeth viewed it was not that something was wrong with the students, but rather that the lesson prevented students from having access to more time for more challenging work. Finally, while Grace identified parental English language limitations that needed to be considered to support her EL students, she also attributed the difficulties of some of her English learners to an instructional context that had not given them the opportunity to practice the skills they were being asked to perform: “Throughout the year, I have observed that my students have little opportunity to express math ideas in writing . . . The writing prompt asking them to explain their ideas is therefore an unaccustomed task . . . Word problems are generally more difficult for the majority of the class, but asking them to write about math added another layer of difficulty” (p. 53).

The challenges to instruction highlight the range of associations teacher candidates made upon reflection in trying to make sense of the difficulties they faced in the development and delivery of their mathematics lessons. While deficit views about students, families, and communities were prevalent, some teacher candidates also demonstrated critical reflection on the instructional context for which they had responsibility and could locate instructional strategies that may have also contributed to student difficulties apparent in the mathematics lessons.

**Role of language in mathematics learning**

The cross-case analysis of teacher responses also revealed variation in how candidates’ discussed the role of language in mathematics learning. Five of the eight teachers described the importance of this role in a variety of ways that linked language to facilitating mathematical understanding. For example, Grace reported in her narrative that accessing language was “necessary to mathematical understanding.” More specifically, she highlighted vocabulary
development as a key to mathematical understanding. Quoting from Grace’s PACT instruction planning commentary,

“Within the body of each lesson I have devoted a lot of attention to helping students access the language necessary to understanding the content. Step by step demonstrations are supported visually and verbally. With class discussion and guided practice students will have opportunity to observe, follow along, and apply the skills associated with the new academic vocabulary before they are asked to do independent work.” (p. 27 planning commentary – language demand prompt)

Here, Grace highlights the many instructional strategies she will use to support her students’ access to “the language necessary to understanding the content” consisting of developing “new academic vocabulary.” Similarly, Belinda described the importance of vocabulary development, while also asserting that emerging mastery of mathematics vocabulary does not eclipse mathematical understanding. For example, in a 2nd grade lesson on measurement, Belinda adjusted her instruction when she observed that, “none of the students had heard the word perimeter before, but they understood quickly what the word meant” (p. 49).

Beyond access and vocabulary development, teacher candidates highlighted mathematical communication, discussion, and discourse as a means for students to make meaning of the content and “challenge their mathematical thinking”. For example, Angela discussed the role of mathematical discussion on student thinking.

“Math discussion provides an opportunity for students to take risks in talking about their mathematical thinking or for students to be challenged in their thinking through the ideas and feedback of others. It also provides me with an opportunity to assess students’ prior knowledge and ways of thinking about mathematical concepts (p. #).”

Angela articulates the dual role math discussion plays in her instruction. The statement highlights the connection of language via mathematical discussion and its impact on
“challenging their [student] thinking” as well as providing the teacher with a way to assess that thinking that will inform her lesson planning.

Another vehicle of language in relation to mathematics learning described by a teacher focuses on the importance of mathematical communication of ideas both orally and in writing. Fiona clearly articulates this role in her assessment of one her English learners on a 5th grade lesson on functions.

“As a result of this segment I saw that student C had developed confidence with graphing procedures, but I need to continue helping him develop the habit of expressing math ideas in words and thus connect meaning, underlying concepts, with mechanical procedures. He was great at graphing the ordered pairs, but consistently had difficulty talking or writing about patterns, connecting the concepts with the symbols.” (p. 42, assessment commentary, prompt 5 evaluating 3 students’ work)

Here language plays a more extensive role in the meaning-making and expression of developing mathematical proficiency that includes conceptual understanding and procedural fluency of students. For Fiona, being able to express mathematical ideas in words (orally and in writing) is a “habit of mind” that needs nurturing to facilitate mathematical understanding.

While several teachers reported an important connection between language and mathematics, there was one teacher candidate in our sample that reported a limited connection between language and mathematics. As discussed above, Fiona defined mathematics as “focused on numbers” and therefore a content area devoid of language. She defined language development primarily as defined in terms of opportunities to read and write. In response to one prompt, Fiona indicated that since this was a mathematics lesson there would be little focus on language development outside of learning new vocabulary words. This proved to be an interesting stance in regards to assessing English learner performance. For example, the PACT asks teachers to evaluate a student performance by assessing student work. One of the samples
must be from an English learner if possible. In the case of this teacher’s assessment of one of her EL’s understanding, she reinforced the limited relationship between language and mathematics understanding.

“As a student, sample C is very observant and is able to complete any assignment that is modeled to them and does not deal with the English language. For example C is quick to pick up on math and science lessons because math deals with numbers and science lessons deal with a lot of pictures. The challenge for this student is the language barrier, however, he/she is beginning to pick up on language and is able to now use the correct mathematics vocabulary such as add and subtract (Assessment Commentary p.3 of 3).”

Fiona’s response highlights her perception of the limited role language plays outside of vocabulary development. Since mathematics “deals with numbers” she asserts that her English learner can “pick up” the mathematics learning. English is a “barrier” but does not prevent this student from performing well on this teacher’s lessons. Thus while vocabulary development is part of the language challenge of this student, mathematics understanding remains relatively unaffected.

Christine, on the other hand, attempts to unpack the subtle relationship between language and content in her kindergarten class:

Based on these observations I have found that students as learners of academic language can be very different from students as learners of academic content. In my class, which has a large range of both academic ability and language proficiency, it is very important for me to be aware of each level for each student. I think sometimes students who do not possess the academic language might be overlooked as not possessing the academic content. When teaching students who are learning in a second language I have found it key to focus on both aspects. It is important for students to acquire the language, it is important for students to acquire the content, and it is important that I am able to assess each separately.
Here Christine presents a nuanced view of the relationship of language and mathematics. As a teacher of second language learners, it is important for her to understand that language and mathematics have discrete and integrated roles and relationships in a child’s learning. From her perspective, she must attend to both these aspects (discrete and integrated) and be able to assess separately. In some ways this teacher evidences the development of an integrated knowledge that highlights the complexities and saliency of language and mathematics learning beyond vocabulary reminiscent instructional examples offered by Gutierrez (2003) and Khisty and Viego (1999).

It is clear that the PACT prompts enabled these teachers to articulate an explicit relationship between language and mathematics. The variety of responses offers an important look at the way teachers articulate this relationship, some reporting an expansive, important relationship that facilitates mathematics learning, while others report a limited relationship – each of which have informed their instruction and assessment descriptions, particularly in relation to teaching English learners.

**Conclusions and Implications**

In this paper, we have explored the development of a high-stakes minimal-competency test that attempted to take seriously the need for pre-service teachers to be prepared for working with linguistically and culturally diverse students. We have also explored the range of ways in which the PACT provided a forum for teacher candidates to discuss their conceptions of academic language, the language demands inherent in mathematics lessons, how they envision supporting students from a variety of linguistic backgrounds, and the relationship between language and mathematics teaching and learning. Our purpose was not to evaluate the
effectiveness of the PACT prompts or rubrics (although we have been involved in such efforts). Rather, it was to provide a “systematic snapshot,” demonstrating what is possible when teacher candidates are asked to take academic language and language demands seriously when talking about their teaching and their students’ mathematics learning. The role of language in the teaching and learning of mathematics is absent from nearly all other assessments of pre-service teachers’ competencies. While we make no claims in this paper about the efficacy of the PACT to determine which teachers ought to be allowed into the profession or not based on such an assessment, our research does suggest that integrating these foci in pre-service assessments may be productive, both to pre-service programs attempting to improve the preparation of teachers for mathematics and linguistic diversity, and for those who wish to know more about what new teachers bring with them to their first jobs. Our analysis also suggests that the PACT, aside from its primary purpose as a high stakes test of minimal competency, has potential value as a formative assessment that can help teachers address these issues, provided that the teacher education faculty with whom students are working have the necessary expertise to guide them (Costa, McPhail, Smith, & Brisk, 2005) Studying the PACT could also provide teacher preparation programs themselves with important information regarding their candidates’ understandings surrounding issues of language and mathematics.

Our results also suggest that prompting teacher candidates to consider issues related to academic language is potentially helpful for eliciting discussions about mathematics learning and teaching. However, we believe that it may be difficult to get teachers to avoid considering the term synonymous with “academic vocabulary,” even with explicit efforts to encourage teachers to move beyond vocabulary in their understanding of the term. Yet, as we have shown, not all discussions of “academic language as vocabulary” are created equal, and teachers reveal much
about their understanding of the relationship between language and mathematics teaching and learning as they discuss vocabulary.

As helpful as discussions surrounding academic language may be, our research also points to the importance of moving beyond academic language when discussing how best to educate English learners in mathematics classrooms. Indeed, as demonstrated by the number of themes other than academic language per se that emerged from our analysis of the Teaching Events in their entirety, important information about candidates’ perspectives on language, mathematics, and English learners would have been missed by focusing exclusively on the way that they used the term academic language itself. Our findings strongly suggest that the PACT offers a way to better understand how teachers’ knowledge about language and mathematics emerges in relation instruction and provides access points to further explore with beginning teachers the multiplicity and complexity of relationships among language and mathematics when addressing the content needs of English learners.

References


Table 1: Eight Teacher Candidates and Their Students, Classrooms, and Schools

[SOURCE: Teacher candidate’s self report data on PACT Teaching Event.]

<table>
<thead>
<tr>
<th>NAME</th>
<th>GRADE AND CLASSROOM CONTEXT</th>
<th>STUDENTS</th>
<th>LEARNING SEGMENT FOCUS AND CURRICULUM</th>
<th>SCHOOL AND COMMUNITY CONTEXT</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANGEL A</td>
<td>Classroom: K-1 class (Teaching Event focuses on</td>
<td>EL: 9/10 (90%)</td>
<td>Lesson Focus: Equality</td>
<td>School: Small charter school; 66% Latino, 32% African American, and 2% other. 83% of the students are on free or reduced lunch.</td>
</tr>
<tr>
<td>(P01)</td>
<td>mathematics lesson with 1st Grade students only)</td>
<td>Primary language is Spanish for all EL’s.</td>
<td>Curriculum: Mathematics curriculum consists of a variety of texts and activities that combine routine practice, review of basic concepts, and some exploratory activities that include work with manipulatives such as geoboards and pattern blocks.</td>
<td>Community: Large urban area. Neighboring community is largely Latino and African American; lower income. Most families speak Spanish at home.</td>
</tr>
<tr>
<td></td>
<td>All classroom instruction in English.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BELIND A</td>
<td>2ND Grade</td>
<td>Classroom:</td>
<td>Lesson Focus: Measurement/ Unit of measure; Relationship</td>
<td>School: K-5 public elementary school. Total of 526 students, of which 32% are English Language Learners. 48% of the students enrolled in this school receive a free or reduced lunch daily.</td>
</tr>
<tr>
<td>(P08)</td>
<td>EL: 15/20 (75%)</td>
<td>Primary language is Spanish for all EL’s.</td>
<td>between inch and foot; Centimeters; Perimeter</td>
<td>Community: Small seaside town in central California.</td>
</tr>
<tr>
<td></td>
<td>Exit Bilingual second grade class. Aim is to exit ELs before 4th grade. There is a range of early-intermediate to advanced levels based on CELDT scores for the ELs. “Sixteen students are eligible for Title I resources, three students are pulled out for resource”</td>
<td></td>
<td>Curriculum: Harcourt Math by Harcourt School Publishers, 2002. English Language Learners receive primary language instruction for language arts in Spanish with an additional ELD session three times per week.[CHECK ABOUT INFORMATION ON MATH INSTRUCTION]</td>
<td></td>
</tr>
<tr>
<td>CHRISTINE</td>
<td>Kindergarten</td>
<td>EL: 15/19 (78%)</td>
<td>Learning Segment Focus: Number Sense; Inequalities</td>
<td>School: Title I California Distinguished School, is in its sixth year of operation</td>
</tr>
<tr>
<td>(P09)</td>
<td>14 native Spanish speakers and 1</td>
<td></td>
<td>“There are two students”</td>
<td></td>
</tr>
</tbody>
</table>


| DENISE (P15) | 1ST GRADE (self contained) | EL: 14/19 (74%)  --- 45% Asian, 35% Hispanic, and 20% White | Learning Segment Focus: Counting Money  
Curriculum:  
First Grade Harcourt Math, 2002 |
|---|---|---|---|
| native speaker of Chinese  
3 beginning EL’s  
FARMS = 90% | with developing English skills, with whom I am working on number correspondence as well as number recognition and counting.”  
Curriculum:  
Math jobs are kits the students use to begin working on simple addition and subtraction problems. | as a K-6 elementary school. Enrollment is approximately 290 students plus twenty-four preschool students. Various programs for students and families.  
Community:  
“This school is located in a middle-to-upper class neighborhood with grocery stores and restaurants located near by. Although the neighborhood is full of houses with families, most of our students are bussed in from the further surrounding areas, which are low-income housing areas.” |

| Classroom:  
School:  
“The Elementary School, grades K-6, provides services for approximately 624 students with an ethnic population of: 45% Asian-American, 36% Hispanic/Latino, 16% White, 2% Filipino-American, and 9% African-American. Of these students, 62% are English Learners (EL). 74% of the students receive free/reduced price meals, and 14.1% are from families receiving CalWORKs services. The students attending this school have 15 primary languages.”  
Community:  
“This district serves an ethnically diverse population composed of 50% Hispanic, 27.5% Asian, 18.7 White not Hispanic, 1.2% African American and 1.1% Pacific Islander students.” |
| **Elizabet h (P20)** | **3rd Grade** | **EL:** 18/20 (98%)  
“The students have a low academic ability. The students’ majority are at basic level, or below basic for their reading and math skills.”  
“The students are many ELD students who are below basic level. Several students in the class have been put back a grade. There are many students in the class that have behavioral problems. Several of the boys have been suspended from school prior from being in this class.”  
“The students’ language skills are limited. Learning Segment Focus: Relating Multiplication to Division; Dividing by 2, 3, 4, 5  
Curriculum: California Mathematics, Scott Foresman 2001 “The students’ lessons are limited in time to fit into the teachers schedule in the day. Also the lesson is geared to the content standards.” | **School:**  
“poverty stricken school”  
“The school is very old and it has students from k-5 grade attending. The school has a library, as well as a computer lab. The students also are all on free lunch. The school is a reading first school and has many reading intervention programs to help student learning.”  
**Community:**  
“urban school district” |
| **Fiona (P21)** | **Grade 2** | **EL:** 10/20 (50%)  
“- 19 "Mexican-American," 1 European-American (95%)  
Beginner, early intermediate, and intermediate ELD levels.”  
Cooperating teacher is bilingual. Learning Segment Focus: Identify and count money  
PreK-6 elementary school.  
“Low social economic status elementary school. It is a Title One school.”  
“Many students in the school are related to one another, and they have a history at this school. They have many generations of relatives that have attended this school.”  
**Community:**  
“The surrounding area of the school is in poverty.”  
“Students come from the same area. Half of them reside in trailer homes within a two mile radius of the school. Many of them live in poverty. Most of their parents are no longer together. Some of them do not live with their parents but with their extended family.” |
| **Grace** (P24) | Grade 5  (self-contained) | EL: 21/27 (78%)  
--Beginning Intermediate to Advanced ELD levels  
--No native English speakers (6 FEP’s)  
--Overall class is 93% Latino  
--EL’s:  
--19 Spanish speakers  
--1 Tongan  
--1 Cambodian  
“...socioeconomic background of my students is largely low income. Most of my students are first generation children whose parents immigrated to the US from Mexico and Central America. Some of my students have only recently arrived themselves. About 90% of students qualify for free or reduced rate lunch program.” | Learning Segment Focus:  
Geometry and Coordinate Plane  
Curriculum:  
Math whole class instruction. | School:  
Year-round elementary school with focus on science and technology.  
Community:  
“The school community’s population in general has little material resources.” |
| **Holly** P27  
3rd Grade (self-contained) | EL: 12/20 (60%)  
[CHECK]  
“...languages that are spoken in this class are English, | Learning Segment Focus:  
Division by 6, 7, 8, 9, 10; reading and writing word problems; logic | School:  
“Low socio-economic status. Approximately 90% of the students at this elementary school qualify...
Spanish, Arabic, Korean, and Vietnamese. We have students born in Lebanon, Chile, and Mexico.”

“All of these students are classified as English Learners, even if they are deemed proficient in the language.”

[CHECK]

Curriculum: Harcourt Math, 3rd Grade, 2003, Harcourt suggestions for extending learning, and activities from Elementary and Middle School Mathematics, by Van de Walle.

“All of the lessons are taught in whole-class format.”

for free lunch, and about 60% also qualify for free breakfast.”

Community: “Many of these students do not have many resources beyond the school gates, which is to say that few have access to computers, or even television.”
EM10: How does the candidate describe student language development in relation to the language demands of the learning tasks and assessments?

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The description of the language demands of learning tasks and assessments is <strong>superficial.</strong></td>
<td>• Moving beyond obvious language errors, the candidate’s description of language demands <strong>focuses primarily on vocabulary</strong> that students may find challenging and indicates why.</td>
<td>• The candidate identifies language demands of the learning tasks and assessments that go beyond vocabulary to include specific text types or other language demands that are challenging for individual students or groups of students.</td>
<td>• The candidate identifies language demands of the learning tasks and assessments that go beyond vocabulary to include specific text types or other language demands that are challenging for individual students or groups of students.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The candidate discusses students’ language strengths as well as needs in relation to these language demands.</td>
<td></td>
</tr>
</tbody>
</table>

---

9 Text types can be oral (e.g., presentations of problem solutions, descriptions of mathematical reasoning, partner or group discussions) and/or written (e.g., diagrams, graphs, or charts; equations).

10 These other demands might include understanding a teacher’s oral presentation of information, responding to a question in class, listening to or reading directions, or sharing information orally with a partner.
relation to the language demands of the learning tasks and assessments. and **articulates**
**what makes those** particular text types or other demands **challenging** for particular individuals or groups of students.
### ACADEMIC LANGUAGE SUPPORTING ACADEMIC LANGUAGE DEVELOPMENT

**EM11:** How do the candidate’s planning, instruction, and assessment support academic language development?

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The candidate gives little support to students to meet the language demands of the learning tasks. OR • Language and/or content is oversimplified to the point of significantly limiting student access to the core content of the curriculum.</td>
<td>• The candidate attempts to use scaffolding or other support¹¹ to address identified gaps between students’ current language abilities and the language demands of the learning tasks and assessments. • These supports provide immediate access to content without providing opportunities for students to develop further language proficiency related to the demands of the learning tasks and assessments.</td>
<td>• The candidate’s use of scaffolding or other support provides access to core content while also providing explicit models, opportunities for practice, and feedback for students to develop further language proficiency related to the demands of the learning tasks and assessments.</td>
<td>• The candidate’s use of scaffolding or other support provides access to core content while also providing opportunities for students to develop further language proficiency related to the demands of the learning tasks and assessments. • The candidate articulates why the instructional strategies chosen are likely to support specific</td>
</tr>
</tbody>
</table>

¹¹ Such support might include one or more of the following: modeling of strategies for comprehending or constructing texts; explicit communication of the expected features of oral or written texts (e.g., using rubrics, models, and frames); use of strategies that provide visual representations of content while promoting literacy development (e.g., graphic organizers); vocabulary development techniques (context cues, categorization, analysis of word parts, etc.); opportunities to work together with students with different kinds of language and literacy skills, etc.
| further language proficiency. | aspects of students’ language development. |