# An Activity Theory Perspective on Academic Language Use by ELLs in a High School Math Classroom

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## Dedication

For Ms. Grant and her students

**Abstract**

Public reports of large-scale mathematics assessment data indicate that English language learners (ELLs), on average, are typically performing well below their fluent English speaking peers, and often well below grade-level expectations (Abedi, 2002, 2004; Abedi & Lord, 2001; Janzen, 2008; Secada, 1996). Current federal legislation requires that schools and teachers find ways to increase the math achievement of all students and help struggling students reach grade-level learning expectations. One way that general education math teachers can support ELLs in the mainstream mathematics classroom is to focus on their academic language development to a greater degree.

This interpretive case study of one sheltered high school pre-algebra classroom adds to the small, but growing, research base on students' academic language use in math instruction. It relies on Activity Theory (e.g., Engestrom, 1999, 2001), and conceptual frameworks associated with the analysis of learners' second language complexity, accuracy and fluency (CAF) (e.g., Ellis & Barkhuizen, 2005), and academic English proficiency (Scarcella, 2003) to examine the real-time language use by ELLs and how that language use was influenced by the classroom context.

Data analyses suggest that a number of elements in the classroom activity system shaped the expectations for, and opportunity to use, academic language. These elements included: (a) Classroom rules that reinforced the limited role of students in instructional activities; (b) the constantly fluctuating classroom community with a few members who could create a distraction from math learning; (c) the division of labor between the teacher and students that was weighted more toward the teacher, and; (d) the presence of several potential mediating artifacts (e.g., a language-reduced, conceptually-based curriculum, a consistent opening instructional routine, teacher language, collaborative student language) that could support, or detract from, the desired outcome of academic language production.

CAF analyses of four African focal students' language production highlight the lack of complex, academic language use by students in this particular classroom. Students' utterances were typically short, were often less than a complete phrase, used common everyday vocabulary, largely did not include math terms, and incorporated few

of the relevant language functions (e.g., explaining, justifying a solution, comparing/contrasting) emphasized by the curriculum and the teacher.

There were three key tensions in the activity system that minimized academic language expectations and opportunities for students to use such language. The first tension was between the departmental policy providing remedial instruction and the state and federal mandate for grade level instruction. Students were quite aware that the instruction they received was well below grade level and that they might not pass state assessments or be allowed to graduate. A second tension was the teacher's struggle to balance the teaching of math and the teaching of language. She had been trained primarily as a math teacher and had difficulty seeing the language of her discipline. The third tension was between adult and students' preferences for instructional approaches and activities. Some elements of best practice that the teacher implemented were resisted by the students, and some aspects of what the students thought of as good instruction were resisted by the teacher. Instead of creating a positive change in the activity system, as some tensions can do if they are addressed, these three unresolved tensions created a barrier to academic language production, and to the teaching and learning of math content as well.

ELLs' lack of access to grade-level content and the associated academic language constitutes a lack of opportunity to learn that schools must urgently address if all students are to succeed academically. This study provides critical evidence that educational leaders, in particular, need to do more to ensure that content teachers who do the difficult work of integrating academic language and content instruction are provided with clearly defined language learning goals, and that they are well-trained and fully supported in the classroom.

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# CHAPTER 1: INTRODUCTION

## Background and Rationale

Public reports of large-scale mathematics assessment data indicate that the group of English language learners (ELLs), on average, are typically performing well below their fluent English speaking peers, and often well below grade-level expectations (Abedi, 2002, 2004; Abedi & Lord, 2001; Janzen, 2008; Secada, 1996).[1] While some individual ELLs do achieve at higher levels, lower levels of group achievement are not unexpected for students who are learning academic content in a language in which they are not yet proficient. However, current federal legislation requires that schools and teachers find ways to increase the math achievement of all students and help struggling students reach grade-level learning expectations.

One way that general education math teachers can support ELLs in the mainstream mathematics classroom is to focus on their academic language development to a greater degree. Some educators and policymakers may believe that math is a relatively "language free" subject that is less challenging for ELLs because students are mostly working with numbers (Janzen, 2008). In keeping with that philosophy, ELLs have often been mainstreamed into mathematics classes first in the belief that teachers simply needed to help students learn a few new vocabulary words. However, researchers in both mathematics and English as a second language or bilingual instruction have documented that there is a close connection between complex language skills and higher level thinking in mathematics (Chamot & O'Malley, 1994; Janzen, 2008; National Council of Teachers of Mathematics [NCTM], 2009; Schleppegrell, 2007; Secada, 1996). To reach grade-level math standards, ELLs must be able to use English as a means of understanding and mastering the content (Chamot & O'Malley, 1994). Mastering the content includes learning to communicate mathematical meanings (NCTM, 2009). Learning to communicate solutions to problems strengthens and organizes students' mathematical thinking (NCTM, 2009). Without opportunities to communicate

[1] According to Kieffer (2008), these patterns may have as much to do with students' socio-economic status as with their developing English skills. He argues that in national longitudinal studies, ELLs receiving free or reduced-price lunch at school, an indicator of low-income background, tend to score similarly to fluent English speakers from low-income backgrounds on achievement measures.

mathematical understandings in a social setting, ELLs' content knowledge and skills suffer.

Nearly one hundred years ago, the Russian researcher Lev Vygotsky (1978, 1997) argued that language and thought develop together, and that students learn to think and talk about a subject by being exposed to the way that experts in that topic think and talk. Experts, or tools that can perform the role of an expert (e.g., textbooks, computers), use language to mediate students' understanding of what they are learning. In turn, students internalize the language to which they are exposed and use it as a tool to guide their own learning. An emphasis on the sociocultural nature of learning, in general, and learning mathematics in particular, fits well with the definition of academic language proficiency proposed by Scarcella (2003). Scarcella contends that while each school subject has its own unique academic language because of the differences in content, there are core underlying elements across content areas that must be taught. These elements include a combination of linguistic, cognitive and sociocultural/psychological components. She argues that ELLs must be explicitly taught academic language at school because they most likely are not exposed to academic English in their community or their home. Without exposure to other people using academic English in social settings, ELLs' have limited opportunity to learn the grade-level content transmitted through academic English in the classroom.

In the past, content teachers relied on English as a Second Language or bilingual education teachers to prepare students, broadly, to use academic language. Direct language instruction was not typically a part of content teaching provided in mainstream classrooms. Over time it has become increasingly clear that ELLs' language learning needs do not stop when they enter the mainstream content classroom. They need to learn academic language specific to the discipline, and the best way to learn that language is in the context of the content classroom. The textbook and the teacher use a particular vocabulary and way of presenting ideas, students are required to comprehend a variety of sources of input (i.e. computer programs, textbooks, teacher lectures, peer speech), as well as to explain and justify their own mathematical thinking. These types of skills and knowledge cannot be assumed to develop naturally, they must be deliberately taught (Scarcella, 2003). ESL teachers may support classroom math teachers in some way, but math teachers bear the greatest responsibility for developing content-specific language skills.

Where do mathematics teachers turn for more information on just what kind of specific academic language ELLs are exposed to, and are expected to learn, in the mathematics classroom? There is a well-established body of literature on mathematical discourse and fluent English speakers (e.g., Bowers, Cobb & McClain, 2000; Cobb, 2004; Cobb, Yackel, & Wood, 1992; Cobb, Wood, Yackel & McNeal, 1992; Kieran, 2001; McClain & Cobb, 2001; O'Conner, 1998; Van Oers, 2001; Williams & Baxter, 1996; Yackel, Cobb & Wood, 1991; Zack & Graves, 2001). However, there are a limited number of research studies that explicitly focus on ELLs in the math classroom (Janzen, 2008). Many of the studies that do exist present ELLs' skills and abilities in a negative light by focusing only on the comprehension barriers students face in the classroom (Moschkovich, 1996, 2007). Few of the available studies address academic language. The available research primarily centers on the role of the teacher's language in delivering classroom instruction (Adler, 1997, 1998, 2001; Setati & Adler, 2000), or how ELLs' native language acts as a resource in mathematics classrooms (e.g., Adler, 1997, 1998; Cohen, 1994; Moschkovich, 1996, 2007; Setati, Adler, Reed, & Bapoo, 2002). There are few studies that focus on the students and their process of acquiring and using the academic language they need to be successful in math instruction.

## Significance of the Problem

This study adds to the small, but growing research base on ELLs' production of academic language in the math classroom. Federal legislation requires state departments of education to assess ELLs' English proficiency and content knowledge each year. At the present time, states use a variety of English proficiency assessments based on different conceptualizations of academic language (Abedi, 2007; Wolf, Kao, Griffin, Herman, Bachman, Chang, & Farnsworth, 2008) and may change tests relatively frequently (Cook, Linquanti, Chinen, & Jung, 2012). The inconsistency and lack of clarity in state definitions filters down to the classroom, where content teachers may receive a list of state-developed English language standards, but little state-level guidance on how to address the standards in content instruction (Duguay, 2012). The variations in assessing academic language and the lack of guidance on teaching it in mainstream classrooms occur, in part, because there is no comprehensive, uniform definition of academic language that crosses content areas in the research literature (Abedi, 2007; Anstrom, Dicerbo, Butler, Kaz, Millet & Rivera, 2010; Valdes, 2004, Wolf et al., 2008). As a result, there may be wide variations in how mainstream teachers think of, and address, language instruction in their disciplines (Achugar, Schleppegrell & Oteiza, 2007; Duguay, 2012; Richardson Bruna, Vann & Perales Escudero, 2007).

Given the fragmented nature of the existing research base, and the potential differences in how teachers teach, and state departments of education assess, English proficiency, there is an urgent need for a unified body of research that describes specific features of academic language and leads to a comprehensive definition (Abedi, 2007; Wolf et al., 2008).

This study investigates the academic language to which students are exposed in a high school math class, the elements of the classroom and student characteristics that support, or prevent, ELLs' acquisition and internalization of that academic language, and the ways in which students use academic language to develop and communicate mathematical understanding. By examining authentic language use during instruction, the study is uniquely positioned to emphasize what ELLs can do in mathematics, in spite of limited proficiency in English, as well as areas where content teachers can give increased language support.

## Theoretical Framework

Studies of second language acquisition in naturalistic settings are intricate in nature, and as a result they tend to draw on concepts and research methodologies from a variety of related fields (Ellis, 1994; Ellis & Barkhuizen, 2005). This study relies primarily on Activity Theory (an off shoot of sociocultural theory) to relate features of academic language to the classroom context (Engestrom, 1987). To do so, it draws upon the concept of Complexity, Accuracy and Fluency (CAF) from Second Language Acquisition Theory (Ellis & Barkhuizen, 2005) to describe learner language production. Activity Theory and CAF are described below along with their contribution to the study. Associated data analysis techniques are also noted.

**Cultural-Historical Activity Theory.** Cultural-Historical Activity Theory (Engestrom, 1987), which developed out of sociocultural theory (Vygotsky, 1978, 1997), provides a way to look at how a student interacts within the social environment of a specific math classroom, and environmental factors that either support (mediate) or detract from ELLs' internalization and use of the math language they are exposed to in that classroom. Activity Theory suggests that the way the complex activity is realized for an individual learner is determined by the context of the activity, the individual's motivations and goals, and the history of sociocultural interactions between participants in a particular setting (Lantolf & Thorne, 2006; Roebuck, 2000; Yamagata-Lynch, 2010). Activity Theory allows for the learner to take a central role in making language meaningful and determining outcomes of activities. Students in the same math classroom may choose to interact differently with elements of their environment, thus, may perform a common activity in different ways.

Activity Theory does not have any prescribed data collection or analysis techniques associated with it. For this study, techniques from Mediated Discourse Analysis (MDA), (Meyer, 2001; Norris & Jones, 2005; Scollon, 2001a, 2001b), an activity-focused form of Critical Discourse Analysis that complements Activity Theory, have been used to analyze transcribed language from the classroom. MDA provides a way to highlight elements of the classroom context that play a role in mediating or detracting from students' use of academic language.

Activity theorists often represent the elements of a classroom activity system with a triangular model that typically has several nodes at the corners and the mid-point of each side (see Figure 2.1 *in Chapter 2)*. These nodes are related to specific social and cultural elements that affect learning (e.g., student, tools/artifacts, rules, classroom community, and division of work). Double-ended arrows illustrate the interrelationship of these contextual components with each other and their influence on the immediate object of activity and the long-term goal of learning math. Examining the complex, qualitative data collected for this study through the lens of an activity triangle illuminates the complex relationships between individual students, their social and cultural environment, academic language proficiency and these students' mathematical content learning outcomes.

**Complexity, Accuracy and Fluency (CAF).** According to Ellis (1994) the primary goal of second language acquisition studies, such as this one, is to describe the student's competence in the new language (i.e., their underlying knowledge). However, because there is no direct way of studying this underlying knowledge, researchers need to infer competence from analysis of student reports on language use or directly from the student's language production. For this study, linguistic analysis techniques taken from Ellis & Barkhuizen (2005) are used to analyze the student's L2 CAF. These aspects of language proficiency are typically associated with an academic register (Echevarria, Vogt, & Short, 2010; Scarcella, 2003; Tarone & Swierzbin, 2009; Zwiers, 2008). The analytical techniques used have been developed by SLA researchers who rely upon cognitive views of the ways that learners mentally respond to L2 input and the knowledge systems they construct as a result of the input (Ellis, 1994).

Combining Activity Theory and CAF, and key concepts related to data analysis, allows this study to do several things. First, it provides a rich, theoretically-based description of ELLs' natural academic language use in the context of the everyday social setting of a high school math classroom in which students from varying language backgrounds and with varying degrees of English proficiency interact. This type of classroom setting is a reality for many secondary math teachers, which ensures the applicability of the work. Second, a combination of theoretical frameworks allows a more in-depth focus on specific aspects of the classroom context that mediate or detract from ELLs' academic language learning. The mediators of academic language proficiency may be things that educators can influence the most. Generating practical solutions in the classroom is important to me because of my background in applied research. Finally, this approach allows me to highlight the linguistic skills and abilities ELLs possess as mathematical learners, rather than the obstacles to learning that are typical focuses in the research literature. Viewing ELLs positively, rather than negatively, is a philosophical commitment I believe to be extremely important for educators who want to find ways to increase students' academic achievement levels. Looking only at the challenges ELLs face can make the barriers seem insurmountable and conveys to the students that they are less capable of learning than others.

**Research Questions**

The data resulting from this study address the following questions:

1. *In what ways is the mathematical communication of ELLs shaped by the classroom context in which it is embedded?*
    a. How do classroom structures (e.g., grouping arrangements, resources available, grading policies, rules) influence a classroom of ELLs' academic language use?
    b. How do ELLs participate in shared language routines or practices that have developed in this class?
    c. How do people and artifacts in the classroom mediate, or inhibit, ELLs' academic language use?

Research Question 1, which is broadly focused, has the most direct link to Activity Theory because it focuses on characteristics of the overall classroom context that may affect students' academic language use. MDA techniques are used to examine the mediators of, and detractors from, academic language use.

2. *What do focal ELLs do with mathematical/academic English in the classroom?*
    a. How does the academic language produced by individual students during instruction vary in its complexity, accuracy and fluency (CAF)?

Research Question 2 relies on SLA theories (e.g., Ellis & Barkhuizen, 2005) to describe the academic language that four focal ELLs produce and their overall proficiency; specifically their CAF. There are multiple ways to define complexity. In this study, complexity refers to the linguistic difficulty of speech that a learner produces (e.g., degree of nominalization, use of dependent clauses, and use of complex language functions). The term accuracy refers to the amount of error in a L2 learner's speech,[2] and fluency is the smoothness and flow of language.

**Overview of the Study**

In Chapter 1 I have presented an argument for why a research study of actual ELL student language use in the math content classroom is an important addition to the field. This study fills a void in the literature because it focuses on natural student language use

[2] By themselves, accuracy measures may be problematic because they presuppose an "error-free" standard of language to which learner language can be compared and a clearly identifiable deviation from that standard. For more on the difficulties in identifying accuracy errors, see Chapter 2.

during instruction and describes what students are able, and not able, to do given the unique contextual factors that exist in a specific classroom.

In Chapter 2 I explore relevant literature about academic language proficiency in the standards-based math classroom. First, I review the definition of academic language that has informed this study (Scarcella, 2003) and compare it to the view of academic language incorporated in accountability testing requirements that affect instruction. Next, I describe the interrelated SLA concepts of complexity, accuracy and fluency (CAF) that I use to measure students' academic language production. I then explain how the three generations of Activity Theory, evolving from Vygotsky's Sociocultural Theory (SCT), illuminate the relationship between the social and cultural dimensions of the math classroom and students' academic language production. Finally, I describe two important studies of academic language learning that are based on other social and culturally-informed theories of learning, but which have particular relevance for this study.

In Chapter 3 I accomplish several goals. First, I give a broad overview of research instruments. The reader is referred to the appendices for copies of the instruments. Second, I provide an explanation of how data analysis techniques associated with Mediated Discourse Analysis, an analytical technique compatible with Activity Theory, help to determine elements of the classroom environment that support or detract from the students' development of academic English. Third, I explain the analytical techniques for examining learner language specifically relating to CAF. These techniques are taken from SLA research literature. Fourth, I give a detailed description of the research setting and participants.

Chapters 4 and 5 contain the research findings for the two primary research questions. In Chapter 4 I present an analysis of the first research question, based on Activity Theory. I describe in-depth the key contextual factors that emerge as important influences on academic language use, and include supporting evidence from field notes, classroom transcripts, and student and teacher interviews. In Chapter 5 I provide data in support of the second research question using CAF analyses based on SLA theory. Profiles of each focal student contain an analysis of the oral language that he or she produced during instructional activities, as well as information on the student's background and views of mathematics. Excerpts from the student's language use illustrate the findings about their language development.

In Chapter 6 I synthesize the findings of Chapters 4 and 5. I relate the observed patterns of academic language production to tensions occurring between elements of the classroom activity system and to tensions between the classroom activity system and external forces such as school or district policies and state testing requirements. These tensions shape the type of academic language that students are expected to produce and their opportunities to produce it.

Finally, in Chapter 7 I summarize the key findings and connect them to what is already known. The chapter includes recommendations for ways that sheltered content teachers, and the second language teachers who work with them, can support academic language production during math instruction. Recommendations for future research are also provided.

# CHAPTER 2: REVIEW OF THE LITERATURE

Three key areas of inquiry provide the foundation for this multi-faceted study of social and cultural influences on academic language learning in a math classroom. These areas are: (a) academic language conceptualizations, (b) complexity, accuracy, and fluency (CAF) analyses of second language (L2) production, and; (c) Activity Theory. This review describes key concepts and research in each of these areas and gives literature-based considerations and recommendations that can be applied to this dissertation. In addition, the chapter concludes with a description of two additional socioculturally-informed studies of academic language learning which are not based on Activity Theory. These two studies provide examples of how a researcher can study the relationship between an individual learner, the classroom community, and academic language production.

## Conceptualizations of Academic Language

There are many definitions of academic language, ranging from a broad perspective labeling any language used in school as "academic language", to descriptions of specific linguistic features associated with language use in a particular content area. One of the important features of this particular study is that the definition of academic language that I ascribed to as the researcher, and which informed the design of the study, was not the same definition as that imposed on schools by the current accountability movement. This section reviews the literature that has informed my own view of academic language, and discusses how my view compares with the school-accountability-based view of academic language. The resulting discussion helps to illuminate the ways in which the lack of a universal definition of academic language makes it challenging for researchers and teachers to design improvements to English proficiency instruction.

**Researcher's definition.** Academic language researcher and author Jeff Zwiers has broadly defined academic language as "The set of words, grammar, and organizational strategies used to describe complex ideas, higher-order thinking processes, and abstract concepts" (Zwiers, 2008, p. 20). Robin Scarcella (2003), a professor, teacher trainer, and former bilingual educator, wrote a paper on Academic English for K-12 students that has informed my personal views on academic language, and that has influenced Jeff Zwiers' work as well. She states:

> Academic English is a variety or register of English used in professional books and characterized by specific linguistic features associated with academic disciplines …Academic English includes many diverse sub-registers associated with different disciplines such as science, economics, and mathematics…It is not possible to 'do' science, 'do' economics, or 'do' mathematics with only ordinary language…One must 'do' discipline-specific work with academic and discipline-specific language. (p. 9)

Scarcella (2003) acknowledges that the distinctions between academic and everyday language can be blurred at times, and that some elements of language are shared between both varieties. However, she argues that there are some clear differences between the two kinds of language, such as an increased use of certain complex language functions (e.g., argumentation, persuasion, and hypothesizing) in academic language. Other characteristics of language in an academic setting include greater decontextualization of information, increased cognitive demands, greater reliance on the reading and writing modalities, and an increased need for mastery of advanced grammar and vocabulary for effective communication (Scarcella, 2003).

In her paper, Scarcella (2003, p. 29) describes a theory of academic language that incorporates the following components of proficiency: linguistic (e.g., phonology, lexicon, grammar, sociolinguistics, and discourse features), cognitive (e.g., background knowledge, higher order thinking skills, cognitive strategies, metalinguistic strategies), and sociocultural/psychological (e.g., standards of language use, beliefs, attitudes, motivation, interests, practices). In Scarcella's (2003) viewpoint, a student could master the linguistic and cognitive dimensions of academic language, and still struggle to communicate effectively in an academic setting if the sociocultural dimension is not also mastered. She bases this part of her theory on the work of Vygotsky (1962, 1978), which suggests that appropriate academic language develops through participating in the social practices of a community of learners who use language to accomplish learning goals.

A unique part of Scarcella's (2003) theory of academic language is that it includes both cognitive and sociocultural perspectives on language acquisition. However, Scarcella admits that her global theory is intended as a starting point for further discussion and research on specific features of academic language that students should learn at different levels. Researchers planning to use her theory as the basis for a study must still determine which language features to examine and how to measure each one of them.

While researchers studying language learning bring their own theories to a study, it is important to acknowledge that the study participants sometimes have a different viewpoint that is equally relevant to that research context. Educators working in the U. S. K-12 public education system are teaching ELLs in the context of a federally mandated accountability system that influences how English language proficiency is defined, and measured, in schools. The next section contains a review of accountability requirements regarding English proficiency, and some state-level issues in assessing proficiency that can have direct consequences for schools.

**School definitions of Academic English proficiency.** In 2001, Congress reauthorized the Elementary and Secondary Education Act (ESEA) with amendments that strengthened the educational accountability portions of the law. Educators and researchers commonly refer to the reauthorization as the No Child Left Behind Act, or NCLB. Two particular sections of NCLB have relevance for ELLs and are described here because of their connection to language proficiency.

First, Title I requires that states create expected content learning outcomes, or content standards, in reading, math and science for students at each grade level (The No Child Left Behind Act [NCLB], 2001a; U. S. Department of Education, 2012). After developing content standards, states need to develop annual assessments based on them so that they can measure students' attainment of the standards. Students must be tested in grades 3 through 8, as well as once in high school (NCLB, 2001a; U. S. Department of Education, 2012).

NCLB requires State Education Agencies to set increasingly larger targets for the number and percent of students overall, and in specific student groups (including ELLs), who reach the state-determined level of "proficient" on the content assessments each year (NCLB, 2001a). If a state or district meets its targets it is said to be making "adequate yearly progress" or AYP. Performance gaps between groups of students should be addressed through instructional programming and curricular changes (Francis & Rivera, 2007). In the original NCLB legislation all groups of students, including ELLs, were expected to become proficient in the grade-level content by the year 2013-14.[3] Since that time, states have been given the opportunity to have some flexibility in when the AYP requirements need to be met, but the expectation that all students will achieve content proficiency remains in place (ESEA, 2012).

Second, to continue to receive funding for English language development programs, states and districts must meet additional accountability requirements that are found in Title III of NCLB (Boyle, Taylor, Hurlburt & Soga, 2010; NCLB, 2001b). Title III contains separate provisions for English language instruction, but it directly links these provisions to student achievement on content tests mandated by Title I (Boyle, Taylor, Hurlburt & Soga, 2010; NCLB, 2001b). Title III requires states to develop a set of English proficiency standards for students in English language development programs. These standards must address skills in the modalities of listening, speaking, reading and writing English. The English proficiency standards must also relate to the grade-level content expectations contained in content standards (NCLB, 2001b; U. S. Department of Education, 2012). For example, listening standards should address academic listening skills needed for reading, math and science instruction. Thus, Title III frames language proficiency in terms of the Academic English skills ELLs need in order to be successful in learning the grade-level academic content.

Again, similar to Title I, states must administer an annual statewide assessment of English proficiency to ELLs (NCLB, 2001b). The test must measure student attainment of the English proficiency standards. States must also develop annual goals, this time called Annual Measurable Achievement Objectives, or AMAOs, to document students' language acquisition progress in three key areas (NCLB, 2001b). AMAO 1

[3] One recent estimate of national ELL performance on content assessments in reading and mathematics (Center for Education Policy, 2010) concluded that while, in most states, ELLs generally are making progress in increasing their content proficiency, the percentage of ELLs actually reaching proficiency in a state is typically quite low. In many states there is a large gap of 30 percentage points or higher between the percentage of ELLs and the percentage of non-ELLs achieving proficiency. Exact figures are difficult to determine because states set different content proficiency levels, and they determine which students enter or exit ELL status through a variety of means (Abedi, 2008). Furthermore, the highest achieving ELLs are typically exited from ELL status and replaced by incoming students with lower skills, thus making cross-sectional comparisons of ELLs over time difficult because the population is always in flux (Center for Education Policy, 2010).

documents the number of ELLs making progress in learning English in a given year. States are expected to set increasing AMAO 1 targets to show continuous improvement in English instruction over time (Cook, Boals & Santos, 2007; NCLB, 2001b). They are allowed to operationalize progress as they choose (Cook, Linquanti, Chinen, & Jung, 2012). Most states have defined progress as moving up one proficiency level on the composite English proficiency test score that represents student achievement across the four language domains (Cook et al., 2012). AMAO 2 addresses the number and percentage of ELLs attaining proficiency in English each year (NCLB, 2001b). Again, states have the flexibility to define English proficiency as they choose and wide variations in definitions have been noted (Cook et al., 2012). AMAO 3 addresses the number and percentage of ELLs meeting AYP targets on standards-based content assessments (NCLB, 2001b). The assumption underlying AMAO 3 is that students need a certain level of language proficiency to master the content standards. A lack of content mastery would potentially indicate a need for more language instruction. By linking language learning and content achievement, NCLB shifts the priorities of educators away from teaching language first, before teaching content, as had been traditionally done (Cook et al., 2007). Instead, the emphasis is now on teaching academic language and content at the same time.

Data showing both states' and districts' performance on the three AMAOs must be reported to the U. S. Department of Education each year. In the original legislation there were penalties for states and districts that do not meet their own AMAO targets in multiple successive years (NCLB, 2001b). For districts, these penalties include a modification of language programming as well as curriculum and instruction. Penalties may also include a reevaluation of the need for continued Title III funding and replacement of staff (NCLB, 2001b); U. S. Department of Education, 2012). Current possibilities for flexibility in meeting the AYP targets affect the part of the AMAOs that references content proficiency. However, the other AMAOs relating to English proficiency have not been affected by new flexibility provisions.

Even though NCLB was passed in 2001, English proficiency standards were not mandatory for states until 2007-08 (Boyle et al., 2010; NCLB 2001b). Since that time, the standards, and the related AMAOs that states establish, have been in a continual state of change (Cook et al., 2012). One reason for the constant change is that State Education Agencies have struggled to operationally define academic language, and to create English proficiency standards that are specific enough to be assessed in each of the language modalities and content areas (Abedi, 2004, 2007; Cook et al., 2012, General Accounting Office [GAO], 2006). A 2006-07 review of selected English language proficiency standards and assessments (Wolf, Kao, Griffin, Herman, Bachman, Chang, & Farnsworth, 2008) found that academic language tends to be defined in terms of tasks students needed to complete using language (e.g., reading a newspaper, determining main ideas in a piece of fiction, interpreting a chart or diagram, and understanding idioms or figurative speech). The researchers found that few state documents actually listed specific features of academic language that students needed to learn. As a result, because test developers typically develop the assessment tasks using state standards, these companies have been given significant responsibility to operationalize the features of academic language on which to assess students (e.g., Bauman, Boals, Cranky, Gottlieb, & Kenyon, 2007; Lara, Ferrara, Calliope, Sewell, Winter, Kopriva, Bunch, & Joldersma, 2007; Mathews, 2007; Rebarber, Rybinski, Hauck, Scarcella, Buteux, Wang, Mills & Cho, 2007).

Each state has its own definition of academic language that informs the development of English proficiency standards and assessments.[4] While some states do belong to assessment consortia that create shared standards and assessments, there appears to be no uniform definition of academic language across all states (Abedi, 2007; Wolf et al., 2008). A lack of consistency in defining academic language is also reflected in the research literature, where the absence of a common underlying framework to describe it has led researchers to study a variety of different aspects of the academic register (Abedi, 2007; Anstrom et al., 2010; Wolf et al., 2008). For example, peer-reviewed research and professional literature has addressed the following features of academic language:

- discourse practices (e.g. Freeman & Freeman, 2009; Solomon & Rhodes, 1995);

[4] Porter and Vega (2007) identified approximately 29 different assessments in use nationwide in 2006-07. Some states used multiple assessments to measure different aspects of English proficiency.

- extended conversation practices (e.g., Zwiers, 2009);
- grammar and syntax (e.g., Butler, Bailey, Stevens, Huang, & Lord, 2004; Dutro & Moran, 2003; Schleppegrell, Achugar & Oteiza, 2004; Schleppegrell, 2009, 2007, 2001; Zwiers, 2008);
- higher order thinking skills (e.g., Chamot & O'Malley, 1994; Scarcella, 2003);
- interaction patterns (Cazden, 2001);
- language functions (e.g., Chamot, 1996; Dalton-Puffer, 2007; Dutro & Moran, 2003; Kidd, 1996; Zwiers, 2008);
- language learning strategies (e.g., Chamot, 1996; Chamot & O'Malley, 1987; Echevarria, Short & Powers, 2006; Echevarria, Vogt, & Short, 2010; Oxford, 1990; Zwiers, 2007, 2005);
- length of acquisition time (e.g., Collier, 1987, 1989);
- literacy (e.g., Gibbons, 2009; Zwiers, 2010);
- outcomes (e.g., Slama, 2011);
- participation in academic activities through language use (e.g., Gibbons, 2002; Moschkovich, 2011; Walqui, 2010);
- metalanguage (e.g., Schleppegrell, 2013);
- registers (e.g., Cummins, 1980);
- teacher talk as a mediator (e.g., Gibbons, 2003; Zwiers, 2008);
- vocabulary (e.g., August, Artzi, & Mazrum, 2010; Beck, McKeown, & Kucan, 2002; Butler et al., 2004; Carlo, August, McLaughlin, Snow, Lippman, Lively, & White, 2012; Dutro & Moran, 2003; Echevarria et al., 2010; Kiefer & Lesaux, 2010; Zwiers, 2008).

To complicate matters, academic disciplines often vary in their conceptualization of academic language (Valdes, 2004). These conceptualizations influence the way instruction is provided. For example, elementary teachers may link academic language to the school setting, considering any language used for instruction as well as language used on the playground or in the lunchroom to be academic language (Anstrom et al., 2010). In contrast, the National Council of Teachers of Mathematics (NCTM, 2009) has published a statement that the major emphases of high school mathematics should be reasoning and sense-making, indirectly identifying academic language use as language functions used to communicate mathematical ideas. As another example, English and composition teachers may tend to think of academic language from a multiple literacies perspective which emphasizes that there is no one right way to use language in the classroom because standards for language use vary widely (Scarcella, 2003). In this viewpoint, teachers accept all styles of student language without mandating a particular style. The assumption is that students can talk or write about literature with whatever language style they choose.

Given the need to monitor and assess students' language development, educators, state department of education staff, and test developers have an urgent need for a unified body of research that describes specific features of academic language and leads to a comprehensive definition (Abedi, 2007; Wolf et al., 2008). More research is also needed to document the amount of time ELLs with varying types of characteristics take to gain Academic English proficiency in the current system of simultaneous content and language instruction (Francis & Rivera, 2007). Past research in this area has tended to describe students' acquisition of language under typical instructional conditions which may have prioritized language instruction before content instruction (e.g., Thomas & Collier, 2002). In recent years, according to Wolf et al. (2008), and Francis and Rivera (2007), there has been a movement by some researchers (e.g., Bailey, 2007; Bailey, Butler, Stevens, & Lord, 2007; Butler, Lord, Stevens, Borrego, & Bailey, 2004; Scarcella, 2003; Schleppegrell, 2001) to develop an integrated, multifaceted academic language framework. However, the extent to which a new perspective on academic language has been applied to state English proficiency standards and assessments is unknown.

**Lessons learned.** It is clear from the small body of Title III accountability articles reviewed that schools relying on Title III funding to support English language development programs need to document year-to-year changes in specific features of a student's academic language. However, because of a lack of clarity on which language features to measure and how to measure them, as well as differences in academic language conceptualizations across disciplines, there may be a great deal of variability at the district and classroom levels in how educators understand academic language.

A concrete and comprehensive way to measure and describe academic language production was needed for the purposes of this dissertation. The second language acquisition (SLA) concepts of L2 complexity, accuracy, and fluency (also referred to as CAF; see Ellis & Barkhuizen, 2005), suggested important aspects of language to examine, and ways to operationalize them. A discussion of the related literature describing CAF and its strengths and weaknesses follows.

**Complexity, Accuracy, and Fluency (CAF) Analyses of Language Production**

This section of the chapter will review the interdependent constructs of complexity, accuracy, and fluency (CAF) that have been applied to the systematic study of learner language in the field of SLA to describe general language proficiency and performance (Housen, Kuiken & Veders, 2012). Specifically, it will focus on how CAF has been applied to L2 oral language production studies.

CAF is not a theory of learner language. Rather, it provides researchers with a way to capture features of an individual's L2 production. A description of CAF variations can show how these features change, or do not change, over time in relationship to external factors such as instructional methodology, tasks, grouping structures, student personality, and student attitudes (Housen et al., 2012; Larsen-Freeman, 2009; Norris & Ortega, 2009; Palotti, 2009). The underlying assumption is that a proficient L2 speaker can perform language tasks fluently, with language that is both complex and accurate (Ellis & Barkhuizen, 2005). Noting where L2 learners' CAF is weaker may suggest the extent of learners' explicit, and potentially implicit, L2 knowledge. In doing so, there may be implications for L2 instruction.

The study of CAF developed out of the early work on learner language. Corder's (1967) study of learner errors and Selinker's subsequent work on interlanguage (1972) began the trend toward examining accuracy in language production. According to Housen and Kuiken (2009), authors next wrote about the need to distinguish between instructional activities promoting L2 accuracy versus fluency. In the 1990s, the benefit of measuring and developing linguistic complexity was added to the discussion (Housen et al., 2012a). Skehan (1989) was the first to propose a proficiency model that incorporated all three dimensions of performance and to stress their interconnectedness. Skehan (2009) and others (e.g., Ellis & Barkhuizen, 2005; Housen et al., 2012) argue that learners have limited attention and a limited amount of working memory. As a result, if a learner prioritizes one component, such as accuracy, in his or her speech or writing, the learner has less attention to pay to the other two components. In other words, if an L2 learner focuses on the production of linguistically complex language, his or her accuracy and fluency may decrease.

Since the 1990s, CAF has frequently been used as a dependent variable in psycholinguistic and information processing studies that examine the effects of student and classroom factors on L2 acquisition (Housen & Kuiken, 2009). From this body of work, CAF has come to be seen as independently measurable, but interrelated, components of L2 performance. These components may vary according to the context of speech production and to student characteristics (Housen & Kuiken, 2009). Most recently, researchers have begun to examine CAF as a primary research focus (Housen & Kuiken, 2009). For example, Ferrari (2012) conducted a longitudinal study comparing the CAF development of four Italian learners to that of native Italian speakers. She also addressed task features that may have related to variability in CAF measurements.

CAF is often calculated through frequency counts or ratios that give a global estimate of a learner's performance (Norris & Ortega, 2009). There are a variety of different measures that have been used to study each component. Most of them can be applied to the analysis of speech or writing samples. However, they may have to be operationalized differently for each language modality (Ellis & Barkhuizen, 2005) because characteristics of fluent speech differ from those of fluent written text (Ellis & Barkuizen, 2005). Each measure of complexity, accuracy or fluency addresses different aspects of the component and produces slightly different results. Therefore, recommended best practice is to use multiple measures for a given component (Ellis & Barkhuizen, 2005; Norris & Ortega, 2009).[5] An overview of how others in the field have defined and measured each component, along with a general discussion of issues or cautions for collecting and analyzing data, follows.

[5] Ellis and Barkhuizen (2005) note that because so many different measures have been used to describe CAF, it is challenging to compare results of different studies or to synthesize results across studies. For these reasons, the authors recommend the field should agree on a set of common measures that could be widely implemented.

**Complexity.** ***Description of complexity.*** In the SLA literature, complexity has the most variability in definitions of the three CAF components (Palotti, 2009). The term complexity has been used in two main ways. First, it has been used to describe the cognitive complexity of a L2 task in terms of a student's degree of processing difficulty. This type of complexity is affected by learner variables such as the amount of attention a learner gives to the task. Second, complexity has also been used to refer to the difficulty of linguistic elements that a learner produces (e.g., sentence structure, vocabulary). Linguistic and cognitive complexities are related. Housen et al. (2012) state that linguistic complexity is one part of cognitive complexity, but the two types of complexity are not equivalent. Unlike cognitive complexity, linguistic complexity is a feature of what the learner actually produces. This review will focus on linguistic complexity because complex language is more typically used in academic settings. For example, the academic language of textbooks, and sometimes of teachers' presentations, is generally more linguistically complex than everyday language (Tarone & Swierzbin, 2009). Therefore, measuring a learner's linguistic complexity is an important piece of CAF studies documenting academic language use in schools.

Features associated with academic language complexity include nominalization (when a verb or adjective is used as a noun), increased use of dependent clauses, increased use of sophisticated language functions, and a wider range of vocabulary usage than in everyday settings (Chamot, 1983; Chamot & O'Malley, 1987; Dutro & Moran, 2003; Nemeth & Kormos, 2001; Schleppegrell, 2004; Solomon & Rhodes 1995; Tarone & Swierzbin, 2009). This type of language is referred to by Ellis and Barkuizen (2005) as "elaborated language" (p. 139). In order to become skilled at using elaborated language, L2 learners must be willing and ready to use structures and vocabulary that are at the upper boundaries of their interlanguage, and thus, not fully internalized (Ellis & Barkhuizen, 2005). However, it is important to keep in mind that using academic language is not a natural occurrence for any student, regardless of English proficiency. Typically, fluent English speakers may not be exposed to complex academic language in the general education curriculum until upper elementary school (Tarone & Swierzbin, 2009). As a result, some native speakers may also have difficulty mastering complex linguistic forms (Ferrari, 2012). L2 learners who are separated from the mainstream classrooms in ESL or bilingual education programs may or may not be exposed to linguistically complex academic language at the same age, depending on the structure and goals of the program.[6]

***Measurement of complexity.*** According to Ellis and Barkhuizen (2005), there have been a variety of measures of speech complexity incorporated into CAF studies. Selected measures are listed below along with examples of studies that have used each type.[7] The studies included the following measures of:

- how much an individual speaker contributes to a conversation in which he or she is engaged (e.g., number of turns, mean turn length; see Tonkyn, 2012);
- the occurrence of cognitively or linguistically complex language functions, such as argumentation or hypothesizing, that are common in a particular style of discourse (e.g., Nemeth & Kormos, 2001);
- syntactical or grammatical complexity such as the number of subordinate clauses present in the language sample, or a ratio of the length of an utterance to a chosen language production unit (Larsen-Freeman, 2006; Norris & Ortega, 2009; Foster, Tonkyn, & Wigglesworth, 2000; Robinson, Cadierno & Shira, 2009).[8] Higher levels of complexity are thought to indicate higher levels of L2 proficiency (Bygate, 1999) and an increased ability to process language (Foster et al., 2000);

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[6] There are a limited number of studies documenting the actual academic language students are exposed to or are expected to learn. See Peercy (2011) for a description of two junior high ESL classrooms that intentionally instructed students in academic language needed for the mainstream classes students would enter.

[7] This is a general list that has been simplified for the purposes of this literature review. Bulte and Housen, 2012 have noted more than 40 kinds of complexity measures have been used in research studying the effects of task structure on learner language.

[8] Measurements of this type require a precise way of dividing speech into units. For complex oral language, the unit that is typically recommended is the Analysis of Speech, or A-S, unit advocated by Foster, Tonkyn and Wigglesworth (2000). It includes an independent clause or sub clausal unit with any related subordinate clauses (Foster et al., 2000, p. 365). An A-S unit is based on the idea that speakers tend to pause at the boundaries of syntactic units to plan their next utterance. By measuring the amount of linguistic complexity in an A-S unit (e.g., mean number of clauses; see Levkina & Gilabert, 2012; Tonkyn, 2012), researchers gain insight into how a learner's planning process relates to their CAF.

- “lexical richness” (Ellis & Barkhuizen, 2005, p. 155) that indicates either the variety of vocabulary words used in relation to the total number of words (e.g., Type-Token Ratio or TTR;[9] see Ortega, 1999) or a comparison of the learner’s vocabulary use to a word frequency list developed through corpus analysis (e.g., the Lexical Frequency Profile proposed by Laufer & Nation, 1995).[10]

***Complexity measurement cautions.*** As previously noted, increased linguistic complexity is associated with language used in an academic setting. However, the use of complex language is not necessarily appropriate, from a native speaker standpoint, for every task and in every context (Ferrari, 2012; Palotti, 2009). L2 learners need to learn to adjust their language complexity according to the requirements of the situation in which they are communicating (Palotti, 2009). Thus, a measure of a learner’s linguistic complexity may not be, by itself, sufficient to describe L2 production. Consideration of the adequacy of a given degree of complexity for a particular research task and context may be important to incorporate as well (Housen et al., 2012; Skehan, 2009).[11] The nature of the L2 learning task plays a key role in establishing an appropriate degree of language complexity (Bygate, 1999; Ferrari, 2012; Palotti, 2009; Skehan, 2009). Certain types of tasks tend to generate more complex language. For example, in a study of Italian L2 learners, Ferrari (2012) found greater linguistic complexity occurred in students’ speech when they were giving a speech compared to when they were engaged in pair work with another student. Simply revising an existing task to be more complex does not

[9] The traditional TTR calculation has been criticized for being overly sensitive to the length of the language sample (Kuiken & Veder, 2012). There are other methods for calculating a TTR that may be used. Guiraud’s Index (see DeJong, Steinel, Florijn, Schoonen, & Hulstijn, 2012) is commonly used in studies of task-related effects on learner language (Bulte & Housen, 2012). Guiraud’s Index calculates the total number of words used by the square root of the number of different words used. Vermeer (2000) found that Guiraud’s Index is the most valid for measuring the proficiency of lower level L2 learners with smaller vocabularies.

[10] The Lexical Frequency Profile is often used in studies of written L2 samples and indicates the degree of sophisticated (i.e., infrequently used) vocabulary production in learner language.

[11] Palotti (2009) states that the concept of adequacy can be incorporated either in the interpretation of CAF measures or as a fourth component of CAF. If adequacy is factored in to data interpretation, the researcher must question whether higher frequencies or ratios for a particular measure truly represent more proficient language use. If adequacy is added as a fourth component of CAF, the researcher must measure the degree to which the learner’s L2 production meets the goals of the language task.

ensure that learners produce more complex language. If complex language production is desired, the task must be designed with this goal in mind (Palotti, 2009).

Another complexity factor to consider is that the degree of linguistic complexity can be expected to show increases and decreases as the learner incorporates, and internalizes, new grammatical forms at higher proficiency levels (Ferrari, 2012). When a learner is trying to use a new grammatical form, his or her attention is focused on the form. As a result, the learner's complexity might drop for a time. Researchers should expect the growth of linguistic complexity to occur in a non-linear fashion and must interpret linguistic complexity data accordingly.

**Accuracy.** ***Accuracy description.*** The CAF component of accuracy is the most consistently defined in research literature (Housen et al., 2012a). Studies generally include a measure of the degree of error in a L2 learner's speech as an indicator of how much grammatical knowledge the learner has fully internalized (Ellis & Barkhuizen, 2005).

Common measures of a learner's L2 accuracy include:

- the frequency of either error-free clauses or clauses with errors (e.g., Foster & Skehan, 1996; Larsen-Freeman, 2006; Mehnert, 1998; Skehan & Foster, 1997);
- errors per one-hundred words (e.g., Mehnert, 1998);
- the frequency of lexical errors (e.g., Feryok, 2013; Tonkyn, 2012);
- the use of appropriate and correctly formatted verbs (e.g., Tonkyn, 2012; Wigglesworth, 1997; Yuan & Ellis, 2003);
- the presence of appropriate plural endings (e.g., Wigglesworth, 1997);
- the use of noun modifiers (e.g., Ortega, 1999), and;
- the use of indefinite articles (e.g., Ortega, 1999; Wigglesworth, 1997).

***Accuracy measurement and cautions.*** Similar to the measures for complexity, the measures of accuracy rely on a comparison of the learner's L2 speech to target language rules or norms. Calculating error may seem relatively straightforward on the surface. Yet, defining an error in a language sample can be challenging for two primary reasons (Lennon, 1991). First, a clear standard of "error-free" measurement must be established as a point of reference. Disagreement exists over whether that standard should be the formal system of language rules (e.g., Ellis & Barkhuizen, 2005), the actual language use of native speakers (Wolfe-Quintero, Inagaki, & Kim, 1998), or the language use of non-native speakers if research is done, for example, where an international version of English is dominant (Ellis, 2008; Housen et al., 2012; Palotti, 2009). Lennon (1991) believes "error-free L2" production is the production of language likely to be used by a native speaker in a similar context. Lennon's view acknowledges that native speakers of a language often may not produce error-free language themselves, particularly in informal speech where certain elements may commonly be deleted (Lennon, 1991, 2000). In some contexts native speakers may make the stylistic choice to use language that might be considered an error in the most formal written English (Ferrari, 2012; Lennon, 2000). Even with errors, native speaker language may still be judged to be comprehensible by other native speakers (Palotti, 2009), calling into question the value of judging L2 learner accuracy by grammatical rules.

A second reason why defining a language error may be challenging is that there are different types of errors in L2 production that may affect a learner's comprehensibility to different degrees (Lennon, 1991). For example, a global sentence structure error would have a much larger effect on L2 comprehensibility than a localized error such as dropping a plural ending on a noun (Lennon, 1991). Errors of differing degrees can occur in the same language sample, and they may affect each other. To illustrate, a sentence structure error, a verb tense error, and a missing plural may occur in the same language sample. The sentence structure error may make it difficult to determine the appropriate verb tense that a learner should use. In such a case, Lennon (1991) recommends calculating the number of errors based on only the error with the largest effect on meaning. To make this kind of determination, a researcher may need to examine a much larger language sample (Lennon, 1991), and may need to make subjective judgments intended to communicate. Errors may also arise when two error-free units of language are combined in a way that creates an error, just by their juxtaposition (Lennon, 1991). For example, a grammatically correct independent clause with one verb tense may be combined with a grammatically correct dependent clause with a different, incompatible, verb tense to create a whole that is difficult to comprehend because of the juxtaposition of the two clauses. Again, such a conflict between elements of an utterance makes it difficult to identify the location of the error (Lennon, 1991). The researcher needs to develop a set of clearly written guidelines in order to ensure he or she makes these types of determinations consistently (Lennon, 1991).

**Fluency.** ***Description.*** Similar to complexity, the definition of fluency also has multiple meanings in the literature (Rossiter, Derwing, Manimtim, & Thomson, 2010). The most common definition applied to research studies regards fluency broadly as the "ease, smoothness, or eloquence" of language (Housen et al., 2012a, p. 4; also see Rossiter et al., 2010). However, some researchers have a narrower definition that focuses on specific dimensions of fluency such as speed, or the degree of hesitation-free language production (i.e., breakdowns, repairs, repetitions). Speed measures indicate the efficiency of processes for storing and recalling information (Towell, 2012). They can be applied to speaking or writing. In contrast, hesitation measures are only used in studies of oral language production (Ellis & Barkhuizen, 2005). Hesitation measures such as pauses indicate the extent to which a learner has internalized language chunks and how much time is needed to think or plan parts of an utterance (Ellis & Barkhuizen, 2005; Towell, 2012).

The potential for variability in fluency measures can be observed by comparing the way several studies have defined and measured it. Lennon's definition of fluency (1990) included the idea of producing speech or text at native-speaker speed. In contrast, Ellis and Barkhuizen (2005, p. 139) view fluency as real-time language production with minimal pauses or hesitations. Some researchers conceive of levels of fluency that incorporate not only rate and ease of language production, but also the degree of linguistic creativity and humor in a language sample (e.g., Lennon, 2000). Despite the variability in fluency measures used, calculating language production rate and the number or location of hesitations is fairly typical for studies of low-proficiency L2 speakers (Derwing, Munro, & Thomson, 2007).

***Measurement.*** Speed-related fluency measures that have been used in studies include:

- the rate of speaking or writing (e.g., De Jong et al., 2012; Derwing, Rossiter, Munro, & Thomson, 2004; Mehnert, 1998; Michel et al., 2007; Tavakoli & Skehan, 2005; Yuan & Ellis, 2003);

- the number and/or length of pauses (e.g., Derwing et al., 2004; Foster & Tavakoli, 2009; Foster & Skehan, 1996; Mehnert, 1998; Skehan & Foster, 1997);
- the number of pauses filled with words like "um" (e.g., De Jong et al., 2012; Michel et al., 2007), and;
- the length of text or speech between pauses (e.g., Mehnert, 1998; Mora & Valls-Ferrer, 2012; Tavakoli & Skehan, 2005).

Hesitation-related fluency measures include:

- the number of incomplete utterances or sentences (e.g., Skehan & Foster, 1999);
- the amount of silence (e.g., Foster & Skehan, 1996; Tavakoli & Skehan, 2005);
- the number of self-initiated repairs to speech errors (e.g., De Jong et al., 2012; Wigglesworth, 1997; Tavakoli & Skehan 2005), and;
- the instances of reformulated speech or text (e.g., Foster & Skehan, 1996; Skehan & Foster, 1999).

***Measurement cautions***. The literature provides cautions for interpreting L2 fluency data. First, as previously mentioned in regards to the adequacy of CAF measures, Palotti (2009) warns that faster rates of speaking or writing should not be equated with more accurate or comprehensible language production. In short, faster does not always mean better.

Second, Lennon (2000) and Skehan (2009) caution against assuming that counting the number of pauses in non-native speaker speech is sufficient to indicate a lack of L2 proficiency. Examining the placement of those pauses and how they compare to the location of pauses for native speakers may be more helpful in gauging a student's general proficiency.

Third, as with other components, the nature and structure of the task is a crucial factor in a learner's demonstration of fluency. For example, Ferrari (2012) found that the type of language task in which the learner was engaged influenced the degree of fluency. In her study, both native and non-native Italian speakers in public schools were more fluent on tasks requiring peer interaction than on monologue production tasks (e.g., picture description) that entailed a greater degree of linguistic complexity. The extra attention students were required to pay to linguistic complexity in the monologue may have decreased the amount of attention they could pay to fluency. In addition, Skehan and Foster (1999) found that the amount of task structure related to the learners' fluency. More structured tasks generated more fluent language. Derwing et al. (2004) stated that the topic of a task and its familiarity to learners was associated with fluency variations. More familiar topics with which learners had previous speaking experience promoted greater fluency because students had earlier opportunities to develop concepts and vocabulary.

Fourth, some researchers warn that while longitudinal linear growth in fluency over time may be expected more readily than linear growth in complexity or accuracy (Ferrari, 2012), students' opportunity to use the L2 outside of class is an important determinant of fluency growth (Derwing et al., 2007). Without continued exposure to the language outside of school and direct instruction in oral fluency, little change may occur. Derwing et al. (2007, p. 376) recommend that learners need explicit fluency instruction in paraphrasing, appropriate pausing, and using "formulaic sequences", which are memorized high-frequency chunks of text that are commonly found in native-speaker speech. If a learner can use formulaic sequences at least some of the time, he or she may have more working memory free to attend to other aspects of language production (Derwing et al., 2007).

***Lessons learned.*** This overview of the CAF literature has several implications for researchers intending to apply CAF measures to the analysis of learner language.

First, because there are so many different CAF measures used in studies, a researcher should be clear about which ones he or she incorporates into a study. Consideration should be given to utilizing some of the more commonly used measures, where appropriate, so that the resulting data can be compared to that of other studies.

Second, the components of CAF addressed should be clearly defined. Where standards of measurement, such as the amount of "error", are needed, transparent descriptions of the standards chosen are also crucial to provide.

Third, because each measurement of a CAF component gives a slightly different perspective on it and results may vary for a particular type of language task, a researcher should use multiple measures and apply them to multiple language samples collected over time.

Fourth, to ensure consistent analysis, it is useful for a researcher to develop a set of clear guidelines for how measurements of CAF have been applied (e.g., how to reconcile multiple conflicting grammatical errors in an utterance).

Fifth, the researcher should consider the design of the research task, and its potential influence on CAF, carefully if non-naturalistic L2 data are collected. For example, some tasks may not require the use of sophisticated or complex language, and thus, may lead language samples that are different than what the researcher might need.

Sixth, all CAF data must be carefully interpreted, with consideration given to the context under which a language sample was produced, and the appropriateness or adequacy of the language in relation to the desired task outcomes. Higher frequencies or ratios for any measure should not necessarily be interpreted as more proficient L2 use for a given task. Establishing native-speaker norms for CAF may be a key to interpreting the appropriateness of L2 learner speech in some contexts.

Seventh, when interpreting data, a researcher must carefully reflect on the relationships between multiple contextual factors that may inhibit or support a learner's opportunity to grow in fluency, accuracy, or complexity. For example, students who do not receive explicit L2 fluency instruction and do not use the L2 outside of class may not show expected fluency gains on CAF measures. At the same time, however, the structure of the task used to elicit language data may play a role in the degree of fluency a learner demonstrates.

The potential influence of classroom context and student characteristics on CAF measures speaks to the value of combining CAF analyses with an in-depth examination of the social and cultural factors that may influence language use patterns. Activity Theory is a particularly useful descriptive theory that can be used to investigate these types of connections between the individual and the environment. The next section of this review will provide an overview of Activity Theory and some key research studies on L2 learning.

### Activity Theory Studies of L2 Learning

Activity Theory is one of several interrelated sociocultural theories used to study language learning (Swain & Deters, 2007; Zuengler, Miller, Hinkel, Jenkins, & Kern, 2006). It is difficult to review the body of Activity Theory literature in L2 learning for a number of reasons. One of the primary challenges in reviewing the literature on Cultural Historical Activity Theory and L2 learning is that there are multiple definitions of the theory. In addition, studies may not rely exclusively on Activity Theory as a theoretical framework. Researchers may borrow pieces of other socially and culturally informed theories for their studies to create a multi-perspective approach. Furthermore, some studies may contain elements that align with an Activity Theory perspective, but are not identified as such. Given the complexity of the literature, a more productive approach for this literature review is to first identify the three stages of Activity Theory that have evolved over a period of nearly a hundred years (Nardi, 1996; Roth & Lee, 2007) and to identify a corresponding L2 learning studies associated with each. These studies largely do not address academic language features. Therefore, additional relevant studies that are clearly socially and culturally-oriented, and which address academic language use in K-12 content classrooms, will be described.

**The evolution of Activity Theory.** Generally speaking, Activity Theory focuses on the mediation of the mind by human activity (Roth & Lee, 2007; Thorne, 2005). However, because there have been multiple versions of Activity Theory proposed by different individuals, there is not a cohesive conceptualization of it (Tolman, 2006). It is a descriptive theory (Kaptelinin & Nardi, 2012) that is constantly evolving as each generation of researchers attempts to create a more unified vision of the relationship between an individual person and his or her environment. There have been three versions of it to date (Kaptelinin & Nardi, 2012; Roth & Lee, 2007; Tolman, 2006; Yamagata-Lynch, 2010). Each of these versions has been associated with the ideas of a particular researcher.

***First generation.*** The first version of Activity Theory is, in fact, SCT, which was developed in Russia in the early 1900s. The prevalent social and psychological views at the time either described learning as resulting from factors in the environment or resulting from factors within the learner (Kaptelinin & Nardi, 2012; Yamagata-Lynch, 2010). In contrast, Vygotsky (1978, 1997) believed that human learning and behavior resulted from a combination of external and internal factors. In his view, an individual learner could use a tool that was the product of a particular culture, and which was relevant to the activities of a particular group, to support his or her own internal cognitive development (Lantolf, 2000; Kaptelinin & Nardi, 2012; Vygotsky, 1978, 1997). The learner can use that tool to perform a more difficult activity than he or she can do alone, and increase his or her cognitive skills. In doing so, the tool shapes the learner's present behavior, but it also has the potential to change the learner's thinking processes as he or she internalizes the support it offers (Kaptelinin & Nardi, 2012; Lantolf, 2000). Cole and Engestrom (1993) represented Vygotsky's SCT with the mediated action triangle shown in Figure 2.1.

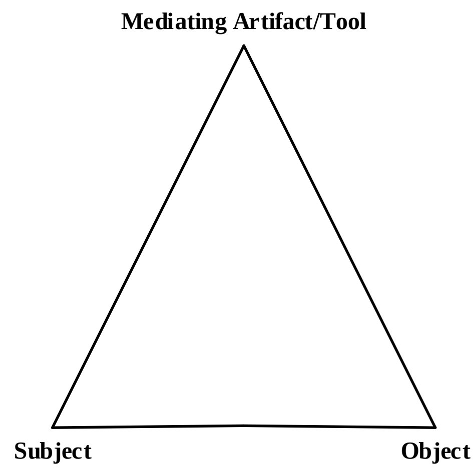


*Figure 2.1.* Vygotsky's mediated action triangle (from Cole & Engestrom, 1993).

In Figure 2.1, the subject is the individual performing an activity (Cole & Engestrom, 1993; Kaptelinin & Nardi, 2012; Yamagata-Lynch, 2010). The object is the immediate goal of the activity, such as learning fractions in math class. The mediating artifacts or tools could include physical objects (e.g., books, computers), and non-physical objects (e.g., language) that provide cognitive support to the learner. As the learner gains more experience using the artifact or tool, he or she internalizes some of the support provided by it. In theory, the learner eventually becomes able to do the task independently if the support provided by the mediator is appropriate (Lantolf, 2000; Vygotsky 1978, 1997; Kaptelinin & Nardi, 2012; Yamagata-Lynch, 2010). The movement from supported performance to independent functioning through the use of tools constitutes learning in SCT (Hardman, 2007). In Figure 2.1, social and cultural factors are included in the top vertex labeled “mediating artifacts and tools”. Those artifacts and tools have been developed and refined over time by a particular culture. By their nature, they encapsulate the collective knowledge of other users, so in interacting with the tool or artifact, the learner is interacting with a social and cultural group (Lantolf, 2000; Nardi, 1996). The SCT model implies, but does not visually represent, cognitive change in an individual learner participating in a collective, social context (Hardman, 2007).

Language can be a powerful mediating tool (Lantolf, 2000). Academic language reflects the culture of schooling and the community of mathematics teachers and students who use language to discuss content. When language is the mediator, typically another human being is involved.[12] Aljaafreh and Lantolf (1994) conducted a classic example of a first generation Activity Theory (SCT) study where language acted as the primary mediator of student L2 learning. The researchers studied foreign students taking an English writing course at an American university. During weekly tutoring sessions the students read aloud essays that they had written in class and they attempted to locate and correct grammatical errors with the assistance of the researcher/tutor. In advance, the tutor selected a set of grammatical errors to target for error correction. If the student made one of the targeted errors in writing, and was unable to detect and correct errors alone, the tutor would give increasingly more direct levels of assistance. Forms of assistance ranged from indirect (e.g., hinting at a sentence with an unspecified error) to direct (e.g., explicitly telling the student what the error was and how to fix it). The tutor based the kind of help offered on the student’s verbal and nonverbal requests for help. The study examined whether this type of oral mediation would increase learners’ grammatical proficiency in a second language.

Most students in Aljaafreh and Lantolf’s study (1994) could not find a grammatical error and fix it independently at the start of the 8-week study. After receiving several weeks of grammar feedback some learners could either avoid making

[12] In a complex classroom environment, however, the ways in which a teacher uses the textbook and other classroom materials may structure opportunities for language production (Guerrettaz & Johnston, 2013). The use of such materials, and the resulting opportunities for language use, may vary depending on other classroom factors. Thus, there may not be a simple cause and effect relationship between teacher language use and student language use.

an error or consistently identify and fix the grammatical error without direct assistance. However, the researchers demonstrated that the path from a learner being completely regulated by the tutor's L2 support to becoming totally self-regulated varied according to the type of collaborative interaction the individuals established. For example, if the tutor ignored the learner's cues and gave too much direct help, the learner never internalized the error correction and did not move toward self-regulation.

***Second generation.*** In the 1940s, Vygotsky's student, Alexander Leont'ev, took the basic concepts of SCT, and reformulated them so that a learner's goal-directed activity, rather than mediation, became the focus of the theory (Hardman, 2007; Lantolf, 2000). This reformulation of SCT was called Activity Theory, and it happened, in part, because of a concern that SCT did not fully resolve the separation between the learner's external and internal environments (Yamagata-Lynch, 2010). By shifting the unit of analysis to activity, Leont'ev tried to more fully integrate both the external and internal factors into a model of learning (Yamagata-Lynch, 2010). Table 2.1 shows a concise attempt at summarizing his ideas on activity.

Table 2.1

*Hierarchy of Activity (Madyarov & Taef's [2013, p.80] adaptation of Lantolf & Thorne, 2006)*

| **Everyday Description** | **Unit of Analysis** | **Oriented Toward** | **Carried Out By** | **Time Frame** |
|---|---|---|---|---|
| Why something takes place | Activity | Motive, transformation of object | Community and/or society | Recurrent, cyclic, iterative |
| What is being done | Action | Goal | Individual or group | Linear, finite |
| The actual doing | Operations | Condition(s) | Individual | Present moment, process ontology |

For Leont'ev, an individual person could be seen as an agent who intentionally performs goal-directed activity, using the tools of a particular culture, and functioning within a particular community (Lantolf, 2000; Kaptelinin & Nardi, 2012; Madyarov & Taef, 2012; Yamagata-Lynch, 2010), for example, students in a 9$^{th}$ grade math class using calculators to perform math problems. To second generation activity theorists, the activity (e.g., completing math problems) is what mediates the learner's thinking, not the tool directly (Lantolf, 2000; Kaptelinin & Nardi, 2012; Madyarov & Taef, 2012;

Yamagata-Lynch, 2010). Leont'ev described hierarchical layers of activity, as shown in Table 2.1. Moving up from the bottom row of Table 2.1, each level of activity shapes the next one. Thus, operations (i.e., what an individual does in the present moment under a specific set of conditions) shape actions (i.e., what is being done in the near future by an individual or group to accomplish a goal), which in turn shape activity (a recurrent, longer-term activity driven by motives; Lantolf, 2000; Kaptelinin & Nardi, 2012; Madyarov & Taef, 2012; Yamagata-Lynch, 2010).

A key tenet of Activity Theory is that two individuals may perform the same activity, for example, learning math in a second language, but their actions and operations may be different because they have different motives or goals for the activity (Engestrom, 2001; Yamagata-Lynch, 2010). For example, two students may both be learning math in English, but one motivated student may be working with manipulatives to solve a fraction problem while a disengaged student avoids using the manipulatives and copies the answer off a classmate's paper. While it appears that they are both completing the same worksheet, the two students are performing different operations and actions, due to their varying levels of engagement. However, one could argue that the student who is copying answers is not necessarily learning the same thing as the classmate who does the worksheet as assigned. This idea of multi-layered activity is particularly useful for thinking about L2 learning where students may be assigned tasks that they realize in different ways and with differing degrees of success. Understanding each person's goals is important to understanding the activity that is observed (Lantolf, 2000; Kaptelinin & Nardi, 2012; Madyarov & Taef, 2012; Yamagata-Lynch, 2010).

Engestrom (2001) developed a widely used Activity Theory triangle to represent Leont'ev's idea of a system of activity that is shown in Figure 2.2.[13]

[13] It is important to note that, according to at least some scholars (e.g., Kaptelinin & Nardi, 2012), Engestrom added or changed elements in Leont'ev's theory when creating the model shown in Figure 2.2.

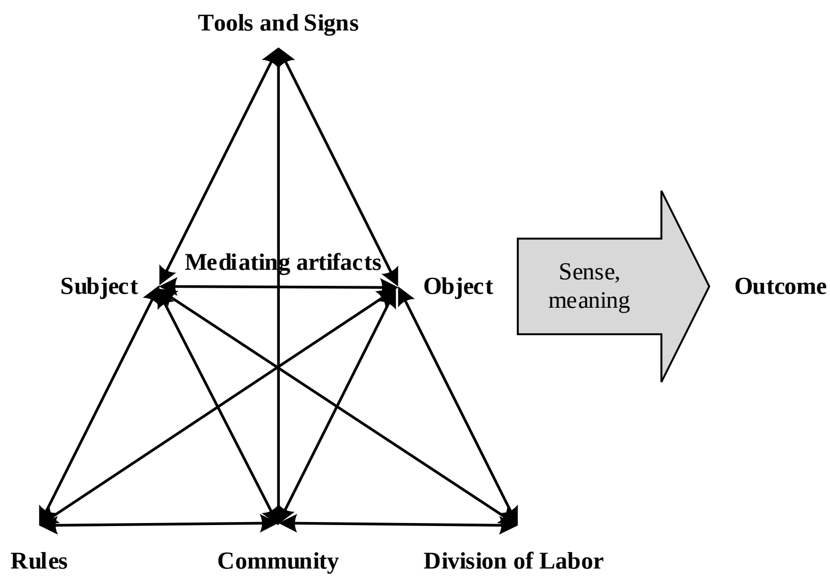


*Figure 2.2.* Second generation Activity Theory.

Figure 2.2 shows the interactions between the key activity-related factors within an activity system. The smaller triangle inside the top of the larger triangle is essentially Vygotsky's model of mediated action (Yamagata-Lynch, 2010). The Subject(s) of the activity system is the individual or group who are participating in the activity being studied (Lantolf, 2000; Kaptelinin & Nardi, 2012; Madyarov & Taef, 2012; Yamagata-Lynch, 2010). The Object is the immediate result of the activity (e.g., completing a fractions problem) and the Outcome is the longer term, ongoing, result (e.g., learning math in English). Tools and Signs are the physical and non-physical things that the subject uses to reach the objective and the outcome (e.g., language, math symbols, books, and computers). Tools and signs are sometimes called "artifacts" in some Activity Theory studies. The bottom of the triangle represents the social context of the activity system that helps to shape the activity. Community is the group involved in the activity (e.g., ELLs taking 9th grade pre-algebra and their teacher). The community provides the individual with guidance about how to use tools, and how to achieve the object and outcome. Community values and practices shape the way that a particular activity takes place. Rules are the norms, standards and agreements that the community has about participating in the activity. Division of labor refers to the way in which tasks are divided across things and people in the activity system (e.g., collaborative groups of students divide up a task and share the work equally). Double-ended arrows between each of these components of the activity system represent the mutual influence they can have upon each other (Lantolf, 2000; Kaptelinin & Nardi, 2012; Madyarov & Taef, 2012; Yamagata-Lynch, 2010). For example, if a classroom task allows L2 learners to generate their own project on a topic of choice (rules), the choice can influence the way students are grouped (community), and the way work is divided (division of labor), which can ultimately change the object of the activity.

Although Yamagata-Lynch states that much of U.S. Activity Theory research is informed by Leont'ev's second generation theory, there appear to be few L2 studies that exclusively identify with it. However, there are some studies that address how variations in learners' goals for an activity result in different outcomes for individuals or groups. In one such study, Storch (2004) conducted an examination of 33 university students in an ESL writing class as they worked in pairs on typical writing activities. She identified four patterns of pair interaction that influenced the outcome of the pair work. These patterns were characterized by varying levels of mutuality and equality in the partners' contributions. Pairs that were most successful at accomplishing the tasks were those where both partners contributed equally and supported each other (a collaborative structure) or where one partner become the expert and mentored the other in completing the activity (an expert-novice structure). Through student surveys and interviews, Storch (2004) examined students' attitudes about pair work and discovered that the successful pairs valued working together and helping each other. The less successful pairs, where one or both partners tried to dominate the interaction without involving the other person, were characterized by the dominant individual's desire to maintain control and complete the activity efficiently. The dominant students often preferred to work alone, wanted to demonstrate their knowledge, felt their partner lacked the skills to do the activity, or did not like the activity. The passive students often wanted to hide their lack of English skill and chose the passive role as a way to save face. While all of the students were engaged in the same activities, the actions they took in pairs depended on their personal goals. Some actions led to a successful result while others did not.

There are some issues that have been noted with second generation Activity Theory. First, it primarily represents only the activity of an individual person (Kaptelinin & Nardi, 2012), and as a result, it may be challenging to apply to classroom research contexts where most activity is collective (Hardman, 2007). Some researchers argue that second generation Activity Theory did begin a movement away from SCT's exclusive focus on the individual toward a greater emphasis on collective activity and social action that has been fully realized in third generation Activity Theory (Hardman, 2007). These researchers argue that the distribution of activity over all of the separate factors in an activity system (see Figure 2.2) is a collective sharing of activity (Kain & Wardle, n.d.).

An additional issue that scholars have identified with second generation Activity Theory is that it deemphasized the role of mediating tools and artifacts in learning (Hardman, 2007). Leont'ev incorporated the concept of mediation by tools and artifacts into the idea of activity, shown at the top of Figure 2.2. For Leont'ev, the particular types of mediating tools or artifacts were not a key component of the theory, because a learner can change mediators based on his or her needs and the conditions of the activity (Kaptelinin & Nardi, 2012; Madyarov & Taef, 2012; Yamagata-Lynch, 2010).

***Third generation.*** Third generation Activity Theory is associated with the work of Yrgo Engestrom (1987, 2001) and the Scandinavian school of Activity Theory, but it has expanded to other countries and incorporated a variety of perspectives (Engestrom, 2001; Nardi, 2006). In its most basic form, third generation activity theory examines the interaction between multiple activity systems in which a given individual or group participates. Changes in one system may create changes in another system. For example, a math teacher may be a member of both the activity system of her fourth hour pre-algebra class that is learning fractions and a member of a content-based language learning study group. The teacher can bring tools created in the study group into her fourth hour math class, thereby creating a change in both activity systems. A simplified model of third generation activity theory is shown in Figure 2.3.

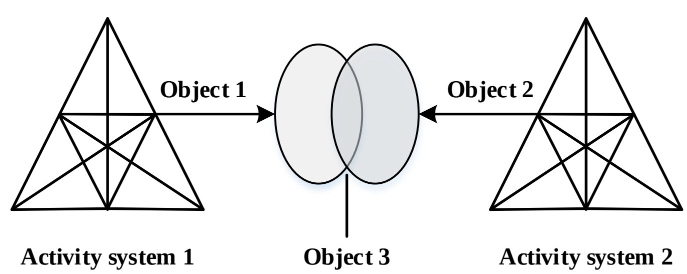


*Figure 2*.3. Third generation Activity Theory (adapted from Engestrom, 2001).

Figure 2.3 shows that the two activity systems pictured interact, and through that interaction create a new object (Object 3), thus changing each of the separate systems. A unique feature of third generation Activity Theory is an emphasis on contradictions, or tensions, which may arise within elements of an activity system, or between overlapping activity systems. These tensions develop because mutually exclusive elements of an activity system can create obstacles to obtaining the objective (Engestrom, 1987; Yamagata-Lynch, 2010). According to Engestrom (1987), there are four kinds of tensions that may occur. First, there may be primary contradictions where there are multiple values connected with the same element (e.g., mediating tools) in an activity system. For example, the teacher dislikes the math curriculum because it does not address certain key skills she feels are important to teach, but the students like the book because it is engaging. Secondary contradictions develop when participants in an activity system try to incorporate a new element of the activity. For example, if a math teacher attends a teacher study group on effective content and language teaching, conflicts may arise when she tries to use ideas from the study group in her classroom. The Tertiary contradictions arise when someone or something introduces a more advanced object that has the potential to change activity (e.g., the math department introduces a new textbook that contains more complex math problems than the teacher uses in class, but the teacher prefers the old text). Finally, quaternary contractions can exist between two related activities (e.g., the students often arrive late to class because of participation in athletic events and they miss important math lessons). These kinds of tensions have the possibility to produce positive change in an activity system if they are resolved effectively (Yamagata-Lynch, 2010).

As an example of a third generation Activity Theory study, Madyarov and Taef (2012) studied university L2 learners in Iran who were participating in an content-based L2 course because they were members of an ethnic minority group that was not allowed to physically attend universities. The teachers were largely fluent English speakers located outside of the country. The researchers found that most of the six focal students finished the critical thinking skills course. In this way, the course could be considered a success. However, due to the fact that each student had multiple overlapping activity systems that played a role in their course participation, students experienced tensions that had both positive and negative effects on content and L2 learning.

Some students took the course simply to fulfill a requirement. Others took it because they wanted to learn the content. Still others took it because they wanted to practice their English skills with teachers who were largely native speakers. The study traces learners' differing outcomes in the course, including one student who dropped out, back to the tensions they experienced. For example, some students experienced a tension between resources and class rules within their activity system for the course. They needed to regularly participate in online discussion groups in order to get a good grade (rules), but they lacked the high speed Internet connection and easily accessible computers to do so (tools). Some students posted assignments late as a result and failed to participate in online discussions. According to class rules, they should have been penalized with lower grades. However, the teachers were sympathetic to students' difficulties and did not penalize the rule breakers. Other students who originally had the motivation to learn and complete the assignments became disengaged over time. These students switched their goal to simply finishing the course and doing the bare minimum of independent work, defeating the collaborative intent of the course design.

**Characteristics of L2 Activity Theory studies.** A review of the fifteen peer-reviewed studies on L2 learning that explicitly incorporated Activity Theory showed that most studies focused on university students learning English.[14] Only three studies included children (Wong et al., 2012; Dominguez et al., 2013; Yamada, 2005), and, of these, only one study was conducted in a U.S. classroom (Dominguez et al., 2013).

The majority of the fifteen studies addressed students' participation in L2 activities, but not their actual L2 production. Topics included:

- collaborative interaction and its relationship to student beliefs (Storch, 2004);
- collaborative interaction and its relationship to task design (Gutierrez, 2006, 2008);

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[14] Studies of computer-mediated communication (CMC) are largely excluded from this review even though they may indicate an affiliation with Activity Theory. These studies typically focus more on the design of the technology and user interface issues rather than on language learning.

- student engagement or investment in L2 tasks or activities (Haneda, 2007, Parks, 2000);
- student engagement in math tasks or activities (Dominguez, Lopez Leiva, & Khisty, 2013);
- L2 learning motivation (Kim, 2011);
- activity system tensions that influenced student participation (Basharina, 2007; Madyarov & Taef, 2012);
- student L2 learning strategies (Donato & McCormick, 1994; Lai, 2013), and;
- academic discourse socialization methods (Morita, 2004).

L2 Activity Theory studies that do relate to language production tend to examine mediators of oral or written language without describing characteristics of the language actually produced. These studies address:

- the relationship between gestures and private speech (McCafferty, 2002), and;
- vocabulary retention (McCafferty, Roebuck & Wayland, 2001; Wong, Chen, & Jan, 2012).

Only one peer-reviewed L2 learning study directly affiliated with Activity Theory (Yamada, 2005) described characteristics of the language that learners produced. As part of a larger study, Yamada (2005) analyzed the lexical density of 120 university English students' L1 and L2 private speech on an L2 partner task to determine the effectiveness of private speech as a mediator. She observed that L2 private speech was often in the form of repetitions of information to keep important information in students' short term memory. In contrast, L1 private speech was used for metalanguage to guide the student through problem solving about the task. Differences between students' L1 lexical density levels appeared to relate to students' proficiency with the task, and how much thought they had to put into task completion. Lower density did not necessarily correspond to students' actual language proficiency.

Of the four studies that addressed L2 production in some way (McCafferty, 2002, McCafferty et al., 2001; Wong, et al., 2012; Yamada, 2005) none of them addressed the unique context of a public school classroom for ELLs (e.g., multiple language speakers, short class periods, teachers unprepared to teach ELLs) and related that context to actual language use, even though they identified themselves as Activity Theory studies. Because these studies all occurred in language classrooms, or outside of class entirely, they tended to discount the elements of the whole classroom activity system that might affect language production and to focus on a single element such as potential mediators of language production (McCafferty, 2002; Wong et al., 2012; Yamada, 2005), or a learner's "goal-directed activity" (McCafferty et al., 2001). Furthermore, none of the studies examined language used during typical classroom conversations, and thus, they did not capture the complexity inherent in real-time language use. Two studies examined language used during an L2 task or intervention conducted primarily for research purposes (Wong et al., 2012; Yamada, 2005). One included natural speech about a pre-identified discussion topic between a native-non-native-speaker pair outside of a classroom (McCafferty, 2002), and one examined individual student language production on an L2 task (McCafferty et al., 2001).

**Lessons learned from the literature.** The research literature on Activity Theory was most useful for understanding how a complex and variable theory has been applied to the design of L2 learning studies and the interpretation of data. However, given the field's emphasis on participation in L2 learning activities to the exclusion of performance, there are few models of Activity Theory studies that could directly inform the design of this study on academic language production. Because most of the relevant Activity Theory studies focus on adults studied while performing L2 research tasks, there is a need for studies focused on K-12 learners using natural language in authentic academic contexts.

## Other Relevant Studies

Two studies based on other socioculturally-informed theories of learning do address academic language production for K-12 ELLs taking content courses. Because of the relationship of their theoretical foundations to Activity Theory and their emphasis on content-based language learning, these studies helped to inform the design of this dissertation. Each of the studies is described below.

**Hansen-Thomas.** Hansen-Thomas (2005, 2009) conducted an ethnographic case study of six Latino middle school ELLs' participation in three math classrooms. As the theoretical basis for her study she relied on Community of Practice (see Sfard, 1998) which is a branch of Situated Learning Theory, but has ties to sociocultural theory. Her study emphasized the relationship between the amount of students’ participation in the classroom community and acquisition of math discourse.

Most of Hansen-Thomas’ data and findings (2005, 2009) related to ways in which classroom context affected students’ class participation and how they were socialized into academic language use. Even though the students’ math teachers used the same curriculum, each of them used it to different degrees and had unique ways of structuring classroom interaction. The teacher’s style and instructional choices established a particular set of discourse practices. These practices led to successful learning for some students, but not for others. For example, a motivated ELL who was perceived as a good math student received frequent opportunities to take part in conversations about math problems because the teacher called on him often. Because he was perceived as a capable math student he thrived in a noisy, somewhat chaotic classroom that was largely teacher-centered and where students competed for turns to talk. In contrast, a newly arrived ELL with limited L2 speaking and listening skills, plus a need for one-on-one, focused attention from the teacher, struggled in the same classroom. He was offered chances to participate in the math discussion in his L1, but declined to participate because he wanted to use English.

In addition to examining the characteristics of students’ participation in the community of practice, Hansen-Thomas (2005, 2009) also provided some basic description of successful students’ use of language functions, a particular feature of students’ Academic English proficiency. The successful students generally spoke more and used a greater variety of language functions, particularly more complex functions, than did the less successful students. Complex functions included giving a rationale or reasoning, verbalizing solutions to math problems, evaluating and questioning. However, the differences Hansen-Thomas (2005, 2009) noted between the more successful and less successful students were only based on one day’s data. There may have been longitudinal variations in students’ use of language functions that were not captured.

Among her many findings, Hansen-Thomas (2005, 2009) identified three factors that played a critical role in students’ classroom success and their movement from being on the periphery of the classroom community to being in the center. The first factor was the number of opportunities students had to participate in the classroom discourse. More opportunities were related to greater acquisition of math discourse styles. Second, a student's math skill influenced the degree to which the student intentionally used math discourse. Some of the students with lower skills resisted participating in the community of practice and were reluctant to use math discourse with their peers. Third, students needed explicit instruction and support in how to develop their mathematical discourse. Some teachers did not explicitly address language use in class. Hansen-Thomas' (2005, 2009) many recommendations for improving the acquisition of the math register included implementing direct, focused instruction on the features of academic discourse. In order to provide such instruction, Hansen-Thomas (2005, 2009) stated that teachers required additional training on the characteristics of ELLs and ways to determine appropriate academic language learning goals. A second major recommendation was that ELLs needed extensive exposure to people who could scaffold their math content and language learning. An expert could be another student who could explain cultural differences, aspects of math discourse, and connections between the context of math fractions problems (e.g., cooking, carpentry) and the underlying math concepts. An expert could also use the first language to explain concepts when needed. Because fellow students were often the only experts available in Hansen-Thomas' study (2005, 2009), attention to improving the effectiveness of small group and pair work was recommended.

**Zwiers.** Zwiers (2006, 2007) integrated multiple socioculturally-oriented theoretical and conceptual frameworks from sociolinguistics, cognitive psychology, SLA, and the teaching of academic language into a longitudinal case study of academic language development for four focal ELLs in middle school content classrooms.[15] As part of the study, Zwiers (2006, 2007) identified the frequency of selected academic language components in both teacher and student language. These components included

[15] Zwiers studied English Language Arts, Science and Social Studies classrooms. Math classes were not included in his study.

specific grammatical forms, academic vocabulary, and complex language functions.[16] He supplemented naturalistic language data with teacher interviews about attitudes toward academic language. Non-linguistic data were coded with themes taken from research literature.

Zwiers' primary research finding (2006, 2007) was that because teachers were unaware of academic language in their discipline, they focused on making content accessible to ELLs, rather than on explicitly teaching language. In fact, some teachers engaged in what he termed "linguistic enabling" (Zwiers 2007, p. 102), allowing students to produce answers with everyday language. Teachers allowed the use of everyday language in order to be nonjudgmental, to encourage participation, and to maintain the pacing and focus of instruction. Thus, student language production typically did not contain many of the features that Zwiers intended to analyze. In part, the lack of academic language was created by activities that provided so much context that students could communicate with gestures rather than words. Students typically wanted to use the everyday language patterns that were familiar and comfortable to them. When students did use academic language, they tended to do so because of the presence of an external motivator such as teacher modeling of the desired language.

Of the academic language that was used, a comparatively small amount was observed during pair or small group interactions because the tasks did not require it (Zwiers, 2006). However, academic language use did occur during large group discussion. For example, class discussions prompted students to explicitly connect their thought to another speaker's thought (e.g., "That's true, I guess, but…"; Zwiers, 2006, p. 114). In addition, the teacher's verbal feedback to students during question-response sequences helped to build students' academic language skills indirectly. The teacher modeled ways of thinking through answers, the use of higher-level cognitive strategies, and possible language choices. By repeating and rephrasing student responses, teachers

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**16** Zwiers addressed the language functions of comparison, identifying cause and effect, persuasion, explanation, evaluation and interpretation based on Scarcella (2003). He identified targeted grammatical features (e.g., passives, nominalization, complex sentences, and cohesion and coherence strategies) through a literature search (see Bartolome, 1998; Chamot & O'Malley, 1994; Scarcella, 2003).

also prompted students to re-evaluate, elaborate, and clarify their answers. However, not all teacher language supported academic language use by students. Some kinds of teacher language use limited the academic language students produced. For example, the frequent use of display questions limited the amount of in-depth discussion and academic language.

Other factors that influenced academic language use included an informal teacher-student relationship with extensive amounts of one-to-one conversation, and a curricular emphasis on teaching a large number of topics rather than covering fewer topics in-depth. By covering a large number of topics, teachers did not have the time to address academic language.

Zwiers' study (2006, 2007) led to a variety of implications for future research and instruction. Only those most relevant to this dissertation are presented here. First, content teachers need to know the types of academic language used in their disciplines so that they can explicitly teach it to students. Teachers must design instructional tasks and conditions so that students are required, and motivated, to use academic language. Second, teachers need training to develop varied questioning routines, and to plan activities that build higher-level cognitive skills along with complex language. Training should help teachers to focus lessons on the most essential topics so that they have time to develop academic language in greater depth. Finally, teachers should model task-related thinking for students, even if they model confusion or uncertainty about a solution process. Doing so exposes students to language they need to express content skills and knowledge.

**Lessons learned from related studies.** The complex work of Zwiers (2006, 2007) and Hansen-Thomas (2005, 2009) illustrates that it is possible to combine multiple theoretical frameworks to examine both the sociocultural and linguistic features of academic language in naturalistic classroom contexts. Both studies described specific features of academic language used in particular content areas. However, the study of academic language functions was the only feature the two studies both examined. Both studies provided useful information about how the researchers operationalized these features and a description of potentially relevant classroom factors affecting language use patterns.

The next chapter describes the methodology used in this study to examine ELLs' academic language use in a high school mathematics classroom.

# CHAPTER 3: METHODOLOGY

This interpretive case study of academic language use in the math classroom by four focal ELLs is framed by Activity Theory (e.g., Engestrom, 1987). Activity Theory does not have prescribed data collection or analysis techniques that are commonly used across research studies. Therefore, I designed a layered case study that incorporates both qualitative and quantitative forms of data on students' language use in context. For the analysis, I adapted methods from the areas of mediated discourse analysis (MDA; Meyer, 2001; Norris & Jones, 2005; Scollon, 2001a, 2001b) and analysis of learner language (Ellis & Barkhuizen, 2005; Swierzbin & Tarone, 2009).

Two sets of research questions guide this study:

1. *In what ways is the mathematical communication of ELLs shaped by the classroom context in which it is embedded?*
    a. How do classroom structures (e.g., grouping arrangements, resources available, grading policies, rules) influence a classroom of ELLs' academic language use?
    b. How do ELLs participate in shared language routines or practices that have developed in this class?
    c. How do people and artifacts in the classroom mediate, or inhibit, ELLs' academic language use?
2. *What do focal ELLs do with mathematical/academic English in the classroom?*
    a. How does the academic language produced by individual students during instruction vary in its complexity, accuracy and fluency (CAF)?

Research question one is most directly informed by Activity Theory, which emphasizes the important influences of complex contextual variables upon the phenomenon being studied. My interest in this study is to describe the actual language students used in classroom discussions, and to relate the language to broader contextual variables. Thus, the data analysis for question one focuses on the classroom as a whole and attempts to describe some of those variables in detail. MDA techniques are used to examine elements such as teacher language, the textbook's view of the role of language, and classroom structures or procedures (e.g., large group versus pair discussions, daily opening routines). These elements have the potential to mediate or inhibit academic language use for all students in the room.

Research question two narrows in on the academic language of four specific learners in the classroom. It relies on theories of second language CAF (see Ellis & Barkhuizen, 2005) to describe the characteristics of students' academic oral language on five selected days. Data analysis for research question two is largely quantitative, but these data are intended to describe the learners' English proficiency in a holistic way that is much more concrete than simply citing a score on a standardized language proficiency test. Therefore, the quantitative data still fit the overall interpretive intent of the case study.

**Rationale for Case Study**

A productive classroom has been described in some literature as the equivalent of a three-ring circus where teachers play the role of the ringmaster (Scigliano & Hipsky, 2010; Smith & Geoffrey, 1968; Weinstein, Woolfolk, & Dittmeier, 1994). Like a three-ring circus, a productive classroom requires both the teacher and the students to attend to many different variables in the environment simultaneously if effective teaching and learning are to occur. Case study methodology is particularly well suited to capturing this complexity in a classroom setting where there are multiple behaviors that the researcher cannot manipulate (Merriam, 2001; Yin, 2009). When studying second language (L2) learners there are many variables that could influence academic language use. These variables include: (a) policies of the district and school; (b) statewide tests; (c) language used in the content area; (d) language demands of the curriculum; (e) teacher beliefs; (f) teacher practices; (g) classroom assignments; (h) student beliefs and attitudes; (i) students' native language and length of time in the country; (j) students' previous experiences with the content. It is difficult to predict exactly which elements may be the most salient in a given setting. Case studies are an especially valuable form of research in situations such as this where the context and the phenomenon being studied are intertwined (Yin, 2009). An additional strength of case studies is they can use a wide variety of data sources to create a rich description of a situation from multiple viewpoints and relate those viewpoints to the phenomenon being studied (Merriam, 1998).

This study incorporates seven different data sources that include artifact analysis, field notes, video and audio recordings, reflective interviews with the teacher, stimulated recalls with the students, and brief student attitudinal questionnaires adapted from Doepken, Lawsky and Padwa (1993). Table 3.1 shows each of the research questions along with the corresponding data sources.

Table 3.1

*Methods of Data Collection and Sources of Data by Research Question*

| Research Question | Method of Data Collection | Sources |
|---|---|---|
| 1 | Artifact analysis | Textbook, curricular materials, homework, in class assignments |
| 1,2 | Transcription of classroom interaction | Audio and video recordings |
| 1,2 | Reflective interview/ Stimulated recall | Reflective interview(s) with teacher and stimulated recall with students while reviewing video and audio clips |
| 1 | Observations (Field notes) | Class instruction and interaction |
| 1, 2 | Student attitudinal questionnaire | 20 item questionnaire |

Each of these data sources are described in more detail in the data collection section of this chapter.

## Study Design

**Human subjects approval.** The university Internal Review Board, or IRB, reviewed all study recruitment and data collection materials in December of 2009. These materials included (a) a complete description of the study along with a plan for recruiting subjects and a description of audio and/or videotaping procedures. Due to differences in school district videotaping policies, I developed separate research protocols for a district that might only allow audiotaping and one that might allow video and audiotaping; (b) copies of data collection materials; (c) parent consent forms in English and Spanish, which is the most commonly spoken language by ELLs. I provided assurances that I would translate these forms into other languages, and use district staff to provide oral interpretations in parents' native languages, if needed; (d) student assent forms in

English. One of the requirements of the study was that focal students have enough English proficiency to participate in oral interviews. Therefore these forms were developed in simplified English that could be read aloud to students; (e) a teacher consent form; (f) secondary participant consent forms for other adults and non-focal students who might be present in the classroom during audio and videotaping, but who were not the focus of the study.

The university IRB committee asked for clarification on district audio and videotaping policies and required that I simplify assent and consent forms. Instead of having a secondary participant assent/consent form I was directed to create a study information sheet for these individuals that did not include a signature. After reviewing the requested information and changes, the IRB gave conditional approval for the study in February of 2010 (See Appendix A). The approval letter stated that full approval would not be granted until I submitted a letter from a school or district administrator. I met with the school principal to explain the study and obtained his written approval to conduct the project. I then completed a district IRB form, which was similar in nature to the university IRB form.[17] Once the district IRB committee gave approval for the project, I submitted both the district IRB communication and the principal letter to the university IRB. I did not contact any potential student participants about the study until after school and district approval had been submitted to the university IRB committee and I had written permission to begin the research.

**Research site.** ***District.*** The first-ring suburban school district in which this study took place adjoins a mid-size metropolitan area in the Midwestern United States. On its website the Franklin district reports that it includes seven communities with a combined population of more than 100,000 residents.[18] Franklin enrolls approximately 12,000 students in Kindergarten through 12th grade each year, and typically about 11% of these students are ELLs. Liberian speakers of an English Creole (called “Liberian English” in this study) represent a large percentage of the ELL population. The district has experienced challenges in effectively educating Liberian students given the grammatical

[17] The school and district documents are not included here to protect the anonymity of the research participants.

[18] Pseudonyms are used for the district and schools, as well as for the research participants.

differences between standard American English and Liberian English. Low-income students, indicated by their free or reduced lunch status, made up slightly less than half of the student population of Franklin (45%) in 2011, the year after this study took place. This was eight percent higher than the state average for that same year (37%). The students who attend Franklin are racially and ethnically diverse. In 2011, the state department of education reported that slightly over half of Franklin's students were Caucasian (52%), while 48% were students of color. The students of color included primarily Black (27%) and Hispanic students (12%). Other racial and ethnic groups were represented to a lesser degree (Asian 8%, and American Indian 2%).

The Franklin district has nine elementary schools (grades K-5), two middle schools (grades 6-8) and two high schools, Lincoln and Washington, which serve grades 9-12 Both high schools have received national recognition for being among the top 1,500 schools in the nation based on the number of students taking college-level courses. A variety of special programs are offered for students who need extra academic support or challenge. These programs are located at one of the high schools, rather than being offered at both of them. For example, Lincoln High School, the setting for this study, offers three unique programs for the district. First, it houses the two-year International Baccalaureate (IB) program for advanced study leading to an internationally recognized diploma. It also offers the Advancement via Individual Determination (AVID) program to help high school students with a grade point average of 2.0-3.5 succeed in college preparatory classes and increase their participation in school activities. Lincoln also contains some of the support programs for students needing extra help. For example, in 2008-2009, the English as a Second Language (ESL) program had moved to Lincoln from its previous home at Washington High School. Two ESL teachers followed the program to Lincoln and a third teacher was in the process of transitioning from the junior high school in 2010. The ESL students who had previously attended Washington also moved to Lincoln with the program.

The district has a general goal of academic excellence for all students in order to prepare them for 21$^{st}$ century jobs. In spite of gaining national recognition for academic programming, there were a number of students who had not passed state standards-based assessments in 2010. To emphasize high academic achievement for all students, the superintendent posted a call online for new community partnerships and approaches to improve student achievement.

***The school.*** Lincoln High School is located in what had once been a working class and middle class, largely Caucasian, neighborhood in the 1960s. Over time the neighborhood became increasingly racially, ethnically, and linguistically diverse. It has also become increasingly financially stratified. While Caucasian students are still the largest group, Black students are growing in number. African immigrants have become the predominant group of ELLs in the school. The housing areas around the school reflect the changing economic status of the residents. A mile or two away from the school in one direction there is a peaceful lake with well-kept homes around the shore and docks for boats. The school's more affluent students live here. A few miles in the opposite direction lays an urban area that is slowly recovering from serious storm damage that occurred several years prior to the study. In the storm damaged area, homes are in need of repair and many foreclosure signs can be seen. Many of the lower income students of color live in this neighborhood.

At the time of the study the school website echoed the superintendent's commitment to academic excellence, but in a slightly different manner. Mr. Fields, the African-American principal, emphasized that, at Lincoln, all students had *"the chance"* to reach their highest academic ability. Lincoln's academic achievement, as measured by state math and reading accountability tests, climbed steadily for several years and then reached a plateau in 2010. In that year, approximately 63% of the school's 9th through 12th grade students were proficient on the state English Language Arts test. Only 35% were proficient on the mathematics test. Lincoln did not make Adequate Yearly Progress goals (AYP; see Chapter 2) in either reading or math during that school year. In contrast, achievement at Washington High School was higher during that same time period. Seventy-nine percent of Washington's students were proficient in reading and 43% were proficient in math during the same year.

***The math class.*** The math department at Lincoln High School, in collaboration with ESL teachers from the school and from Central Junior High, determined that it would offer two sheltered remedial math courses designated specifically for 9th grade ELLs. One was an introductory math class, taught by Mr. Lee, an Asian American teacher. This class focused on ideas of number and the basic operations of adding, subtracting, multiplying and dividing. The second class, Ms. Grant's pre-algebra course, contained more advanced concepts such as fractions, positive and negative integers, and coordinate graphs (see syllabus in Appendix B). A non-ELL counterpart to the sheltered pre-algebra class, Math 1, was where fluent English speakers with the same types of math learning needs were placed. Math 1 contained similar concepts to the ELL pre-algebra course, but was taught at a faster pace and a slightly higher level. The ELLs were placed together in their own remedial math sections so that the teachers could integrate language development into the classes. The two ELL math teachers, Ms. Grant and Mr. Lee, received coaching from the district ESL curriculum coordinator. They attended monthly meetings with the ELL science and social studies teachers. At those meetings, teachers of ELL content courses shared success stories and discussed challenges in their teaching. They also learned about instructional strategies for working with L2 learners using the Sheltered Instruction Observation Protocol (SIOP) model (Echevarria et al., 2010) that was endorsed by the district.

Incoming ninth grade ELLs were placed into either one of these two ELL math classes, or a mainstream algebra class, based on the recommendations of their ESL teachers. ESL teachers at Central Junior High and Lincoln High School made placement decisions using the results of a math test given in the spring of the previous school year. ESL teachers also considered students' English language skills as a determining factor in course placement. After receiving the recommendations of the ESL staff, Mr. Lee and Ms. Grant made some changes to classroom assignments based on their perceptions of the math skills of incoming ninth graders.

Tenth and eleventh grade students who were new to the district, or who had been in the ELL math classes in prior years, could still take pre-algebra if they had not yet received a passing grade. They could also be moved back into ELL classes if they had been struggling in a mainstream math classroom. For example, one sophomore in Ms. Grant's class had been taking mainstream math at Washington High School the year before the study. When she moved to Lincoln with the ELL program she was put back into an ELL math class. Notably, the two ELL math courses addressed content that was contained in state elementary school math standards. Ms. Grant's first semester syllabus listed the instructional units as:

1. Order of mathematical operations.
2. Number sets (e.g., whole numbers, integers, rational numbers, and real numbers).
3. Graphing points and lines.
4. Solving math equations.

The second semester syllabus contained many of the same topics with the addition of fractions and polynomials. "During this semester, we will look at various Pre-Algebra/Algebra topics such as fractions, polynomials, graphing (points and lines) and solving equations. There will be a strong emphasis on the vocabulary surrounding these topics" (Ms. Grant's ELL Pre-algebra syllabus).

Both math and ESL staff indicated that it was important for students in the ELL math courses to gain the missing skills and knowledge from the lower grade levels.

After completing the ELL math sequence, students with a passing grade would be placed in mainstream algebra classes the following year. In Ms. Grant's class some exceptions to this process had been made. She had moved a few of the higher-level math students out after the first semester because she felt they could succeed in the mainstream algebra classroom that covered grade-level standards-based content. For the ELLs who remained in Ms. Grant's pre-algebra course, the ESL teaching staff expressed doubt that they would ever reach grade-level in mathematics before they left high school.

Ms. Grant's classroom was made up of both Hispanic and African ELLs. The Hispanic students were of Mexican heritage, although it was unclear if the students had been born in Mexico. The African students in Ms. Grant's room came from Liberia, Kenya and Nigeria. Most of them were Liberian and had lived in the United States since they were in early elementary school. The Kenyan and Nigerian students were more recent immigrants to the United States who had often received instruction in similar math content in their home countries. All of these African students had been at least partially exposed to English in Africa. The Nigerians reported that their teachers sometimes used a form of British English for instruction in public elementary school. The Kenyan student was from a rural area where English was not taught extensively in school, but she had some familiarity with it nonetheless. The Liberian students spoke Liberian English, a mixture of English, French and African languages, with each other. While they knew a relatively large amount of English vocabulary, the Liberian English speakers used some markedly different grammar and pronunciation patterns compared to American English. Native English speakers listening to the students use Liberian English in Ms. Grant's classroom were often unable to comprehend any of the conversation. These same Liberian students were able to switch speech patterns and styles to sound more like American English speakers when they were talking to non-Liberian students or their teachers.

**Participants.** In a case study of specific individuals within a larger classroom context, everyone in the classroom is a participant in the research to some degree. Because of the in-depth nature of the data collection and the extensive participant involvement that I planned, it was appropriate to highlight a small number of focal students (n=4) and the teacher to serve as primary participants. I considered the eight remaining students and the teacher's aide as secondary participants. The secondary participants were recorded on audio and video tapes, but they were not the focus of my investigation.

***Primary participants.*** Descriptive information about the four focal students is contained in Table 3.2.

Table 3.2

*Demographic Information on the Focal Students.*

| Name | Grade | Age | Country | Time in U.S. | Languages Spoken | Language of Prior Schooling |
|---|---|---|---|---|---|---|
| Naomi | 10 | 17 | Liberia | 6 years+ | Liberian English; Loma | Unclear |
| David | 10 | 18 | Liberia | 6 years+ | Liberian English; Bassa; Gola | Unclear in Liberia; some French in Cote d'Ivoire |
| Marie | 9 | 16 | Kenya | 1 ½ years | Kikuyu, Swahili | Swahili |
| Jesse | 9 | 16 | Nigeria | Unclear | Yoruba | English; possibly mixed with Yoruba |

As seen in Table 3.2, the two male and two female focal participants ranged in age from 15-18, were enrolled in grades 9 or 10, and represented three different African countries. All of these students could possibly be considered students with limited or interrupted formal education (i.e., SLIFE) because they lacked basic academic skills and knowledge, were several years behind their same-grade peers in learning content, and they struggled with English literacy (DeCapua, Smathers, & Tang, 2009).[19]

Naomi was a 17-year old, tenth-grade, Liberian student who had been in the U.S. since grade two and was a long-term ELL. She had a young child at home and may have missed some time in school due to the birth of her child. Naomi was fully mainstreamed in all her other courses except math. At home she spoke a mixture of Liberian English and a tribal language called Loma. She indicated that she was less fluent in Loma because she only spoke it with her grandmother. It was unclear whether Naomi had attended any school in Liberia prior to coming to the U.S.

David was a tenth grade Liberian male student who had turned 18 just prior to the start of the study. As a young child he had briefly attended school in Liberia, and also in Cote d'Ivoire. It was unclear which language was used for instruction in Liberia. When his family fled to Cote d'Ivoire for a short time he went to school in French, but he remembered very little of the language.

David had been in the United States since early elementary school, but he had a history of frequent school changes. At the time of the study, he was talking about changing schools yet again the following fall so that he could play soccer for a local charter school with a championship team. He indicated that he intended to return to Lincoln in the winter of 2011 after soccer season finished. David struggled to learn academic content. Ms. Grant felt that he might have had an undiagnosed learning difficulty, but his difficulties may also have stemmed from inconsistent schooling.

At the request of a parent, David had been mainstreamed at his previous schools. He had only been identified for ESL services when he came to Lincoln High School in the fall of 2010. In Liberia David had been exposed to Liberian English and two tribal languages (Bassa, Gola) that were common along the western coast and northwestern border of Liberia. David was fluent in conversational American English, and could often

[19] There are other terms used to describe such students, including students with interrupted or inadequate formal education (i.e., SIFE), and long-term ELLs (LTELLs). These students face significant challenges in developing grade-level academic English, basic literacy and numeracy, and acquiring academic skills in a relatively short time period compared to native-English-speaking peers (DeCapua et al., 2009).

switch into the cadence and grammatical forms characteristic of Black English. This oral fluency served to hide his status as an ELL.

Marie, age 16 and in ninth grade, had arrived in the U.S. from Kenya the fall before the study began. She had attended several years of school in rural Kenya, where the language of instruction was Swahili. However, the language spoken by her family and community in Kenya was Kikuyu. In the United States Marie still spoke Kikuyu and Swahili at home and in her church. Her English skills were not proficient, and she struggled in particular with speaking. However, in reading and writing she was stronger than some of the students who had been in the country much longer. Her previous math instruction in Swahili and her English reading and writing skills helped her to become one of the top math students in Ms. Grant's class.

Jesse was a Nigerian ninth grader who was approximately 16 years old and spoke Yoruba at home. School records were not clear as to when he and his family had emigrated to the U.S. He privately reported that he had spent a few years in another state before moving to the Midwest. However, his school records stated that he had arrived in the district in middle school after coming directly from Nigeria. Jesse had taken math in Nigeria and often protested at having to repeat that instruction in the U.S. At least some of his Nigerian mathematics instruction was similar in content to what he learned in Ms. Grant's class, and was taught at least partially in British English.

In addition to the students, Ms. Grant was also a primary participant. She was a Caucasian woman from a small town in the Midwest who had been teaching for approximately six years. Ms. Grant had obtained a Master's degree in secondary mathematics education after she began teaching. She spoke Spanish because she had lived and worked in South America for a few years after college. Despite, having some Spanish skills, she only spoke English in class.

After the end of the previous school year Ms. Grant was asked to teach the higher section of the two ELL math courses in 2009-10. Because of the timing of this assignment, Ms. Grant had only been able to attend part of the summer staff development sessions on teaching sheltered content classes. She had been able to meet with the previous instructor of the higher ELL math class to obtain copies of the syllabus and discuss instructional content.

During the school day Ms. Grant taught several different math courses, including pre-calculus for fluent English speakers. Her pre-calculus class started five minutes after the end of her ELL pre-algebra class. As the ELLs left her room, the pre-calculus students entered and took out materials, leaving little time for the ELLs to ask questions in private.

***Secondary participants.*** Ten additional individuals were present in the classroom during instruction, and thus appeared on audio and video tapes. They were not, however, the focus of the study so they were considered secondary participants. First, there were eight additional students. Four of them were Spanish-speaking (Luis, Jorge, Antonio and Ana), three Liberians who spoke Liberian English (Michael, Victoria, Hope), and one additional Nigerian student who spoke Yoruba (James). The secondary student participants had not been selected as primary participants for a variety of reasons. These reasons included low levels of oral English, irregular attendance patterns, inconsistent class participation and irregular completion of homework assignments, disruptive behavior during class, or uncertainty about whether they would stay enrolled in school. For these reasons, the teachers and I determined that their involvement was best suited to being secondary participants.

Ms. Johnson, the ELL aide, was also a secondary participant. She came into the room to support instruction a few days each week. Ms. Johnson, a Caucasian woman, had worked in the ELL program at the school for several years. She ran a support room where the students could go for homework help, and she attended the two ELL math classes on alternating days. When she attended Ms. Grant's class, she typically entered the room just after class started. She became a semi-active participant in the lesson. She stood off to the side of the room while Ms. Grant presented material, occasionally calling out questions to the teacher in order to clarify points she thought were confusing to students. At other times "Ms. J.", as the students called her, would walk around and talk with individual learners to keep them on track. She typically could explain the math material as well as the teacher. Ms. J. had a long-term relationship with several of the students and one of them called her "Mom". She could often be seen with an arm around a student's shoulder, giving the student advice about homework, managing school schedules or solving problems with lunch money accounts. She joked with students and teased them about their personal lives. Ms. Johnson was the one who knew which sports teams students were on or the extra-curricular activities in which they participated. She would often ask students about a big game or choir concert. She could chat with the Mexican students in Spanish and seemed to have experience with Mexican customs and culture.

***Role of the researcher.*** My role in this research project was that of both researcher and classroom participant. In order to build trust with the students and gain more insight into how they thought about math, I become a kind of third teacher in the classroom. I acted as a partner for pair work, answered student questions about assignments, and explained math concepts that were unclear. Even at times when I tried not to interact with students so that I could concentrate on taking field notes, they sought me out for help, calling me "Teacher". Because I had the opportunity to develop this type of relationship with students, they told me things about their educational history and their struggles with math that I might not have known otherwise. This knowledge strengthened the research process by adding another layer of context to the data interpretation.

In addition to helping students, I assisted Ms. Grant as well. I prepared sets of manipulatives, passed out worksheets and interacted with students in the style of the teacher's aide when Ms. Johnson was not in the classroom. Through working alongside Ms. Grant, I was able to engage in a kind of dialogic coaching where we exchanged ideas about how language development may have affected the learning of specific students. The teacher took some of the insights she gained through our conversations and adapted her instruction. For example, after I noted that a particular student always asked to write answers to problems on the board instead of presenting them verbally, the teacher changed her style of interacting with that student. The changes allowed more time for the student to compose her answer orally, without relying on visuals to convey her ideas. The collaborative conversation with Ms. Grant allowed us to relate to each other on a more equal basis and to share our expertise in math and L2 instruction rather than having me assume the role of "expert" simply because of my status as a researcher. In a collaborative relationship we could openly discuss challenges and I could act as a second pair of eyes and ears to help her learn more about students than she typically had time to do in class.

## Data Collection

The data collection for this study evolved in four stages. These stages included: (a) time spent getting to know the students and the classroom; (b) initial data collection and preliminary analysis; (c) additional data collection via feedback from the teacher and students; (d) an in-depth analysis after the school year had ended.

**Phase 1: Classroom observation and artifact analysis.** I chose to spend several weeks as a participant observer in Ms. Grant's classroom prior to beginning study recruitment and data collection. During the winter of 2010, while waiting for school, district and university approvals to begin my research, I attended class two days a week. Over time, as the teacher and students became used to my presence, I increased my attendance so that I was present every day. I helped the teacher prepare lesson materials, collected and returned assignments, and worked individually with students during class activities. The extra time allowed me to learn more about the context of the classroom and to gain insight into areas of particular challenge for students. I brushed up on my own math skills, reviewed textbooks, and talked with Ms. Grant and the ESL staff about the program and students.

The extra observation time was also beneficial because it helped me develop relationships with students. Ms. Grant's students had seen number of extra adults come in and out of their classroom over the course of the school year. Two student teachers came to observe a sheltered content classroom. The incoming ESL teacher observed a class to help him design an advanced ESL class for the following school year. In addition, Ms. Grant arranged for three substitute teachers because she was preparing to move at the end of the school year and needed to finalize her moving arrangements. The students tended to be friendly with all adult visitors and responded to them like teachers. However, students were slightly cautious about how much personal information they revealed to strangers. I wanted students to get to know me and to give them time to learn to trust me before I asked about the possibility of video and audio taping their classroom conversations. It was important for students to see me as someone who would add to their educational experience rather than just take their stories from them in order to benefit myself.

Earning students' trust became especially important because a member of the school student body had been shot and killed suddenly one weekend just prior to my first visit. Lincoln's staff and students had gone on with instruction as usual after the young man's death, but they were visibly shaken. When I first began attending class, the school was in "Code Yellow" mode, or a partial lock down, as a way to ensure that students stayed calm and focused. Doors were locked during class periods, and students were only allowed to be in hallways between classes. Administrators and teachers with a free hour sat in the hallways to maintain a peaceful atmosphere. Students posted pictures of the young man in the school entrance, and held small memorial ceremonies in the school parking lot. Some students carried Kleenex and cried openly. Allowing myself extra time to simply be with the students helped me determine when it was appropriate to raise the subject of a research study. Many of the students in Ms. Grant's classroom had never met the young man who died, but they still were affected by his death.

During this observational phase of the study I also reviewed the available classroom textbook. Ms. Grant had a set of *Access Math: Building Literacy through Learning* textbooks (Gusman, Shefelbine & Duran, 2004) that she had used during the first semester of the course. *Access Math* is a textbook created specifically for ELLs and students with language processing disabilities. Just before the fractions unit started, Ms. Grant decided to use the first part of a two-part online curriculum called the *Rational Number Project: Initial Fractions Ideas* (Cramer, Behr, Post, & Lesh, 2009), which is referred to as *RNP 1* here. Reviewing *Access Math* (Gusman et al., 2004) helped me to understand how her views on math language supported the switch to a new curriculum.

**Phase 2: Recruiting focal and secondary participants.** After I had volunteered in Ms. Grant's classroom for several weeks, I met with her, and with the two ESL teachers, to discuss potential focal students for the study. I selected four students who provided "information rich" cases (Merriam, 1998). As suggested by Stake (1995), I made every effort to ensure balance and variety in student characteristics in order to maximize the chances of learning from each individual case. Ms. Grant's students varied in their native language use, the number of languages they spoke, the time they had spent in ELL programming and their English proficiency. There was also diversity in the length of time they had been in the United States and in their prior exposure to math instruction in their first language (see Table 3.2). My selection criteria included students who attended class regularly and had sufficient oral English skills to take part in research interviews.

The math and ESL teachers contributed insights into students' personal situations (e.g., emotional or behavioral challenges, family situations that might lead to a change in enrollment, students' willingness to interact with an unknown adult, etc.). These insights proved to be invaluable, particularly when working with a population of Liberian refugee students and their families who had experienced significant trauma during, and after, the years of the Liberian civil war. My original plans had been to recruit two Hispanic and two African students as focal participants. However, the Mexican students either did not meet my participation criteria or teachers believed that personal situations limited the students' ability or willingness to participate. One of the Hispanic students was experiencing some stress in her family and was potentially going to be sent to Mexico to live with grandparents. The teachers felt that her continued attendance in class was too unpredictable for her to make a reliable research participant. Two Mexican male students did not attend class at all for the first several days of the semester. When they finally arrived, one dropped out of school soon after. The other attended for a few days and then began to skip class with the fourth Hispanic student who had originally been a regular attender. When these two boys were present, their willingness to participate in classroom activities was often limited and their classroom conversations were frequently about personal topics. For these reasons, I selected my four focal ELLs from among the African students, ensuring that students represented different language groups.

After conferring with the teachers, I met with potential focal students individually and explained the research study. I explained what research meant, showed the students a sample PhD dissertation, and reviewed consent and assent forms with them (see Appendix C for copies of these forms). I sent home study information they could review with their parents or guardian. I obtained signed parent consent and student assent forms from three students. One focal student, David, was a legal adult at age 18 and signed his own consent forms. I met individually with the teacher and explained the study prior to attending her class. She signed a consent form once it became clear that her students were willing to participate. The secondary participants received a study information sheet, which I explained orally. The sheet contained information about the study, the video and audiotaping procedures, and students' right to request that they be seated off camera.

**Phase 3: Data collection and preliminary analysis.** Once I obtained all the necessary permissions to conduct research I began to collect multiple forms of data. The specific data sources for this study included:

- video and audiotapes of classroom interaction. The tapes provided data on the language to which ELLs were exposed in the math classroom as well as identifying potential mediators of academic language production;
- researcher field notes. Initially, a series of questions addressing participant behavior and settings (Goetz and LeCompte, 1984) guided my field notes (see Appendix D). Over time, the field notes evolved to include aspects of classroom interaction that the video and audiotapes did not easily capture (e.g., daily objectives, the instructional focus, and math problems written on the whiteboard). In addition, the notes described off-camera social interactions between participants, participant gestures and facial expressions, on-task and off-task behaviors, classroom interruptions, and school events that impacted instruction. Immediately after class these notes were summarized onto an audio recorder and the recording was later transcribed verbatim;
- a teacher interview to obtain her thoughts on academic language goals and expectations for the class;
- stimulated recalls performed by the student, and reflective interviews performed by the teacher, while watching selected video and audio tapes of classroom interaction provided participants' views on what was happening with language and content learning;
- a student questionnaire about their attitudes toward academic language and math provided insight how these attitudes may have played a role in students' academic language learning;
- artifact analysis of classroom and school materials that conveyed academic language and content learning expectations. These artifacts included the math curriculum (*RNP 1*), the syllabus, handouts, worksheets

and quizzes. I intended to do an in-depth analysis of daily homework assignments. However, I was rarely able to do so because relatively few students turned them in until the end of the semester;

- review of other materials such as seating charts, attendance records, student demographic information, grades, and the special ESL-focused math curriculum that was available, but was not used for the fractions unit because the teacher felt it contained too much language (for more on this alternate curriculum see Chapter 4).

Rather than taking a typical approach to data collection where data are collected first and analyzed and interpreted later (LeCompte & Schensul, 2010), this study used an iterative approach in which data collection, analysis and interpretation occurred simultaneously. One cycle of activities suggested new questions and data sources that were pursued in additional rounds of data collection/analysis/interpretation as knowledge gaps became evident. Figure 3.1 displays the iterative cycles of data collection and analysis in this study.

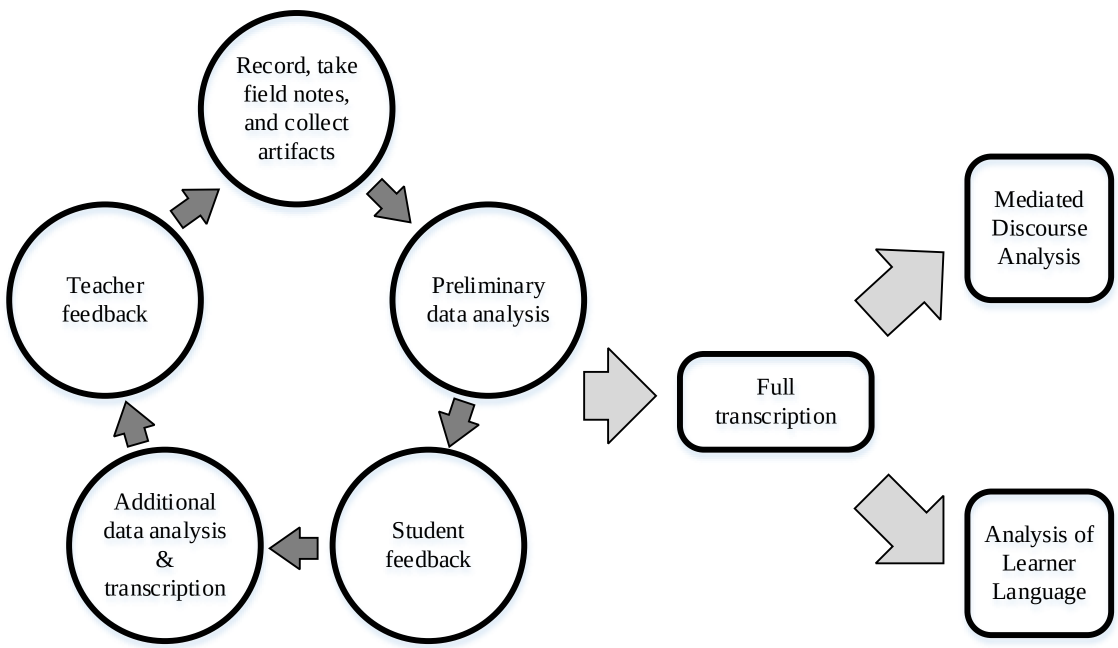


*Figure 3.1.* Iterative data collection, analysis and interpretation process.

As shown in the top circle on the left side of Figure 3.1, each day I made two audio and one video recording of instruction from different points in the room. I selected one of the focal students, and placed one recorder and a microphone on a desk near this person. Digital audio recorders were placed inside a mesh pencil pouch and put on the shelf under a student's desk or on top of an adjacent empty desk. Putting this recorder out of students' direct line of vision helped to ensure the most natural interactions. The second audio recorder was placed on the teacher's overhead projector cart. This second recorder captured Ms. Grant's speech during large group interactions in which she stood at the board or the overhead projector. The video camera was located on the side of the classroom, near the door, in order to be able to focus on the teacher's presentation of material and her interaction with the focal student of the day. While the audio and video recorders were running, I sat as close to the selected focal student as possible in order to take field notes. My notes included the entire class, but they contained more content directly pertaining to that student.

When taking field notes I indicated any interesting language-related episodes that I wanted to explore as possibilities for the stimulated recalls with students. The episodes were chosen based either on a student's positive use of academic language or a lack of academic language use. After class I located the relevant sections of the video and audiotapes and transcribed them simply. Then I contacted the student the next day before class to set up an individual meeting time during his or her study hall. The individual meetings were for the purpose of conducting stimulated recalls about the recordings. I attempted to schedule these one-on-one sessions within a day or two of the day of the recording date, but frequently school and student schedules did not allow for us to meet immediately.

During two separate stimulated recall meetings with focal students I played sections of video or audio recording while the student followed along on the written transcript. I then prompted the student with a series of general questions to find out what he or she was thinking and doing at the time of the recording (see Appendix E). If the recording involved a class assignment, I brought along a copy of the worksheet. These conversations with students were audio recorded and became an additional data source. During the student interviews I also administered the math attitude questionnaire and conversed with students to find out more about their language background and their previous math instruction. After the meetings I transcribed sections of their stimulated recall protocol that highlighted areas of understanding or misunderstanding.

Ms. Grant and I reviewed the same video and audio clips that I had examined with students, and she read selected portions of the stimulated recall transcripts. I had originally planned to have her review and discuss at least one clip from every focal student. However, the in-depth discussion of video clips took a great deal of the teacher's limited free time. For this reason, Ms. Grant was able to review and discuss only one student's data in depth. I shared additional information with her orally during the few minutes before class, via e-mail or by leaving hard copies of notes for her to review as she was able.

In Phase Three I reviewed the new fractions curriculum, the *RNP 1*, which the teacher decided to use instead of *Access Math*. I also examined homework assignments and quizzes when possible. Students were inconsistent about turning work in on time, and some did not complete assignments at all. On a few occasions, students turned in several late assignments at the end of a grading period. When this happened Ms. Grant had to quickly grade and return the assignments before I could review them.

I was present in the classroom for approximately four and half months, but I was able to formally observe instruction and collect data for only thirteen class periods between April and early June of 2010. The delay in beginning to collect data occurred for multiple reasons such as vacations, statewide testing, time needed to receive university and district permissions to conduct research, and time needed to obtain student consent and parent assent. To keep data consistent, I made the decision to begin data collection on May 6, 2010 just after the teacher began a new math unit on fractions that lasted for approximately five weeks.

On the thirteen days when I could observe and record lessons, I rotated the focal student for the day. My choice depended on who was present and remained in class for the entire lesson. On days where there were relatively few students present I was able to attend to two focal students at once. Table 3.3 shows the focal students for each of the days on which data collection occurred, along with days when data collection was not possible.

Table 3.3

*Timing of Student Observations (O) and Stimulated Recalls (SR)*

| | **Marie** | | **Jesse** | | **David**[a] | | **Naomi**[b] | |
|---|---|---|---|---|---|---|---|---|
| | **O** | **SR** | **O** | **SR** | **O** | **SR** | **O** | **SR** |
| May 6 | X | | | | | | | |
| May 7 | | | | | | | X | |
| May 10 | | | | | X | | | |
| May 11 | | X | | | X | | | |
| May 12 | | | X | | | | | |
| May 13[c] | | | | | | | | |
| May 14[d] | | | | | | | | |
| May 17 | | | | X | | | X | |
| May 18 | X | | | | | | | |
| May 19 | X | | X | | | | | |
| May 20 | | | | | X | | | |
| May 21 | X | | X | | | | | |
| May 24 | | | | | X | | X | |
| May 25 | | X | | | | | X | |
| May 26 | | | | | X | | | |
| May 27[c] | | | | | | | | X |
| May 28[c] | | | | | | | | |
| May 31[d] | | | | | | | | |
| June 1 | | | | | | | X | |
| June 2 | | | X | | | | | |
| June 3 | X | | | | | | | |
| June 4 | | | | X | | | | |
| June 7 | | | X | | | | X | |
| June 8[e] | | | | | | | | X |
| June 9[e] | | | | | | | | |
| Total | 5 | 2 | 5 | 2 | 5 | 2 | 6 | 2 |

[a] David was absent on 5/21/10, and 6/9/10. He attended only part of a class on 6/4/10. [b]Naomi was absent on 5/19/10, 5/20/10, 5/21/10. [c] Substitute Teacher – no observation. [d] School holiday. [e] No instruction due to other activities.

Each student was observed five times and interviewed twice, with the exception of Naomi who was observed six times. Reflective interviews happened as soon after observations as the student was able to meet. In addition to student observations and interviews, Ms. Grant was formally interviewed twice (May 3, May 20), participated in daily discussions during her preparatory hour, and gave feedback on preliminary data analyses by e-mail. As shown in Table 3.3, once the study had formally begun, I was unable to collect data on six days due to factors such as the presence of a substitute teacher who was not a study participant, a school holiday, or a change in activities (e.g., a work day to make up missing homework, a class party).

## Transcription

Detailed transcription took place in June of 2010, after the end of the school year. Video recordings were the primary data source for the full transcriptions. Audio-recordings served as supplemental data sources if videotapes were unclear or missing a key interaction that occurred off camera. I began transcribing using a modified form of the Jefferson transcription system (Atkinson & Heritage, 1999; Jefferson, 2004). The Jefferson system draws attention to phenomena that are a key part of the organization of speech, such as intonation, turn taking, and overlapping speech. I used Wood and Kroger's (2000) modification (see Appendix F for details and a portion of a sample transcript), but I adapted it further as I determined that a larger grain size was appropriate to the analysis of such a significant amount of natural language data. Due to the highly interactive nature of the conversations and the frequency of incomplete utterances, I chose to stop transcribing elements such as the length of a speaker's pause or the speed of speech.

## Data Analysis

Recordings of field notes, stimulated recalls and the teacher reflective interviews were all secondary data sources. I transcribed and analyzed them thematically using codes that emerged through repeated readings (see Glaser & Strauss, 1999). The detailed transcriptions of classroom interaction were the primary data source that formed the basis of two separate, but complementary, analyses designed to build a picture of the academic language use of each of the four focal students in the classroom context.

**Research question 1.** For an in-depth look at mediation of academic language I adapted an analytical technique used in Mediated Discourse Analysis (MDA; Scollon, 2001a, 2001b). MDA is a form of Critical Discourse Analysis that focuses on the mediation of social actions, and the role of language in those actions (Jones & Norris, 2005). According to Scollon (2001a, 2001b), language may, in fact, be the most frequent mediator of actions. This emphasis on mediation is shared with sociocultural and Activity Theory, thus, making some of the analytical tools associated with MDA appropriate for this study.

To identify a representative sample of classroom language for an in-depth linguistic analysis, I divided the thirteen transcripts into sections by the primary type of activity contained in them (i.e., opening routine, lesson presentation, other). I then analyzed 50% of the transcripts from the two primary section types (opening routines and lesson presentations). Modifying a transcription style from Scollon (2001a, 2001b), I reorganized the selected sections to separate each speaker's turn of talk into different rows in a table. In addition I moved all of the information about the communicative context, including gestures and actions, into another column. Separating these elements from speech allowed me to more easily examine the potential mediating effect of contextual factors like actions and gestures. I also added columns to the table describing classroom structures that may have influenced language use (e.g., class groupings, routines, etc.), and potential mediators and detractors from student academic language use (see Appendix G for a sample). As stated previously, I defined mediation as a person, object, language, or process that assists a student in comprehending or producing more academic language, or more complex academic language, than the student was capable of doing independently.

After organizing the transcripts in this manner to describe potential mediators and detractors, I was able to identify common elements of the classroom context that repeatedly supported or inhibited students' academic language use. In all, I performed a mediated discourse analysis of seven days' opening routines and six lesson presentations. To ensure I had captured a representative sample of the classroom language, I examined the sections of transcripts I categorized as 'other'. The 'other' sections typically involved quiz or test administration. I also examined those sections not selected for transcription, to determine whether there were additional analyses I needed to complete. No additional analyses were required.

**Research question 2.** For research question two, I selected five of the thirteen transcripts for each focal student and performed CAF analyses.[20] The CAF analyses used a variety of measures compiled by Ellis and Barkhuizen (2005) through a review of the second language acquisition (SLA) research literature. Table 3.4 contains a list of the

[20] The selected transcripts included both days when students were the focus of field notes and stimulated recalls, as well as days when they were not. When possible, transcripts from the same lessons were chosen across students in order to be able to make comparisons for that lesson (see Chapter 6). Some variations were necessary in order to maximize the amount of language students produced.

measures I selected for this study. A full definition of each measure, with supporting examples from classroom transcripts, is provided in Appendix H.

Table 3.4

*CAF Measures Used for this Study*

| Complexity | Accuracy | Fluency |
|---|---|---|
| A-S units (text length) | Percentage of A-S units[a] with self-corrections | Number of false starts |
| Mean number of verbs per A-S unit | Percentage of accurate verb phrases | Number of repetitions |
| Number of turns | Percentage of target-like plurals | Number of interjections |
| Mean turn length | | |
| Type-token ratio | | |
| Number of verbs used | | |
| Frequency of explaining function | | |
| Frequency of comparing/contrasting function | | |
| Math vocabulary[b] | | |

[a]A-S unit = Analysis of Speech unit (see Foster, Tonkyn & Wigglesworth, 2000); defined as one speaker's utterance including an independent clause or sub-clausal unit and any related sub clauses. [b]Math vocabulary is often counted as an accuracy measure in the research literature, but here is analyzed by comparing students' vocabulary choices to the General Service Word List (GSL; West, 1953) and the Academic Word List (AWL; Coxhead, 2000). Thus, it is counted as a complexity measure.

The definitions of each of these terms were initially drawn from the literature (Crookes, 1989; Duff, 1986; Ellis & Barkhuizen, 2005; Foster, Tonkyn & Wigglesworth, 2000; Skehan & Foster, 1999; Tarone & Swierzbin, 2009; Wigglesworth 1997). A second rater and I met several times over a period of roughly eight weeks to negotiate the wording of the definitions in detail, adapt the calculation procedures to my data, practice coding samples of data, and check inter-rater agreement of the measures calculated for each of the four focal students on one day's transcript (5-7-10). [21] At that time we determined that a change in the description of students' math vocabulary was appropriate. Ellis and Barkhuizen (2005) report that a "percentage of target-like vocabulary" is a commonly used way of measuring an L2 learner's vocabulary use. However, comparison to an idealized native-English speaker norm is problematic. In natural oral speech, native speakers use a wide range of vocabulary and structures that also vary in the degree of

[21] The second rater for this study held a doctorate in linguistics and had published on the topic of CAF analyses.

CAF. The second rater and I believed that comparing a non-native speaker's oral language to only the most formal and grammatically correct native-speaker speech would distort the way language is actually used by native speakers. Therefore, instead of applying Ellis and Barkhuizen's (2005) suggested formula I calculated the percentage of students' vocabulary on the General Service Word List (GSL; West, 1953) and the Academic Word List (AWL; Coxhead, 2000). Measuring vocabulary use by comparison to corpora was a complexity measure rather than an accuracy measure. The vocabulary analysis will be described in more detail at the end of this section.

The second rater and I practiced calculating the CAF measures for a student who was a secondary participant, and thus, not included in the final analyses. We discussed this student's transcript in detail and made multiple revisions to the coding definitions as we worked with his data. Then we calculated the CAF measures for all four focal students on one transcript from a day where all of the students were present in class (5-7-10). We met twice to compare the coding of the focal students' data. The first meeting was dedicated just to examining Jesse's language because he produced more speech than other students. A second meeting addressed the remaining three students.

Inter-rater agreement was calculated by speaking turn, based on both the presence of a particular measure (e.g., the times when the speaker had false starts) and the absence of that measure (e.g., the times when both raters agreed that there were no false starts). Agreement percentages were obtained for selected measures that the second rater and I agreed were crucial to correct calculation of other measures listed in Table 3.4. Table 3.5 shows these percentages.

Table 3.5

*Inter-Rater Agreement across Students on the 5-7-10 Transcript*

| Student | Fluency | | | Accuracy | | Complexity |
|---|---|---|---|---|---|---|
| | False Starts | Repetitions | Interjections | Accurate Verb Phrases | Self-Corrections | A-S Units[a] |
| David | 92% | 92% | 92% | 100% | 100% | 92% |
| Jesse | 93% | 97% | 94% | 96% | 100% | 87% |
| Marie | 100% | 92% | 100% | 100% | 92% | 92% |
| Naomi | 97% | 100% | 94% | 92% | 97% | 92% |

[a]A-S unit= Analysis of Speech Unit (Foster et al., 2000)

Agreement between the two raters was typically between 92% and 100% across measures for all students. The one exception was an 87% agreement rate for Jesse's A-S units. These units can be difficult to accurately identify in speech that is co-constructed by multiple speakers or in speech that is extremely disfluent. Jesse often completed other speaker's utterances or spoke at the same time as others, creating challenges in determining which A-S units to attribute to him. The second rater and I discussed variations in our approaches to coding Jesse's speech and reached consensus. Our agreement on A-S units was 92% for the remaining three focal students.

After calculating inter-rater measures for the 5-7-10 transcript, I independently coded four other transcripts per student, analyzing a total of five of thirteen days (38%). I used the coding definitions and examples contained in Appendix H as my guide.

***Vocabulary analysis.*** To assess students' vocabulary use in the five selected class periods used for CAF analyses,[22] I calculated the percentage of students' vocabulary on the General Service Word List (GSL; West, 1953) and the Academic Word List (AWL; Coxhead, 2000). The GSL (West, 1953) is a list of the 2,000 most frequent words in non-academic English and was developed via an analysis of written texts. It is divided into a list of the first 1,000 most common words (the GSL 1), and a list of the second 1,000 most common words (the GSL 2). An English speaker who knows all of the 2,000 words on the lists and the corresponding word families is said to understand approximately 90% to 95% of everyday speech and 80% to 85% of familiar written texts (Granger & Paquot, 2010; Nation, 2006; Hirsh & Nation, 1992) The AWL (Coxhead, 2000) is an extension of the GSL and it contains 570 word families which are commonly found in academic texts across content areas. The AWL excludes words found on the GSL, technical words used exclusively in a particular field (e.g., math terms, and proper nouns (University of Wellington, 2012). As previously mentioned, calculating vocabulary measures in this way is a type of linguistic complexity measure.

[22] Students did not always speak in class on days they were a focal student. For this reason, vocabulary analyses were completed for the same five class periods that were chosen for CAF analyses.

# CHAPTER 4: CLASSROOM CONTEXT

A major tenet of Activity Theory is that we can only understand an outcome identified as important if we look at the context, particularly the social relationships and interaction, in which that outcome is situated. For this study, a thorough examination of the ELL pre-algebra classroom environment is necessary in order to have a complete understanding of the focal students' patterns of academic language use that will be presented in Chapter Five. The context of Ms. Grant's fifth-period ELL pre-algebra class was complex, with a number of interacting variables that influenced the amount and type of expected language use, as well as the language students actually produced. Figure 4.1 shows a modification of an activity triangle (Engestrom, 1991; Lantolf and Thorne, 2006) that contains each of the contextual elements typically examined in a study based on Activity Theory, with details on how those elements were realized in Ms. Grant's classroom.

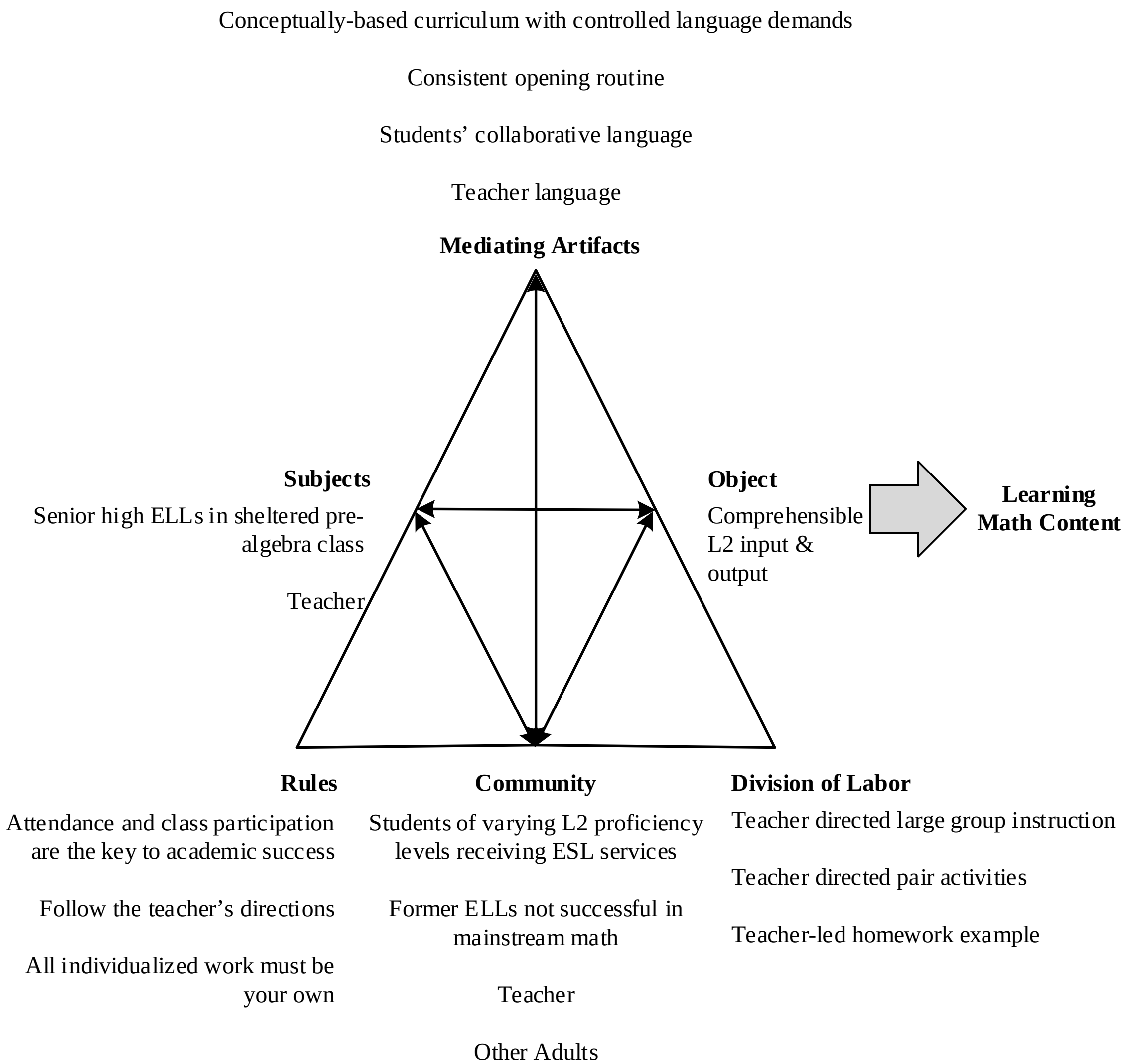


*Figure 4.1.* The activity system of Ms. Grant's classroom.

## Subjects

The subjects, shown on the left of Figure 4.1, are the individuals who take part in the activity of learning math in Ms. Grant's classroom. The students were the focus of this analysis, and Ms. Grant, by the nature of her interaction with the students, was also a subject in the activity of the classroom. Initially twelve ELLs were enrolled in the 45-minute class, and one dropped out during the first few weeks of the semester. The remaining eleven students included five from Liberia, three from Mexico, two from Nigeria and one from Kenya. At the time of the study, ten out of the eleven students were still in ELL programming at the school. One Liberian student, Naomi, had previously been mainstreamed for all of her classes and was technically no longer considered an ELL. However, she had experienced difficulty in a mainstream math class so she was reenrolled in ELL pre-algebra for 2009-2010. Ms. Grant was a sixth-year, veteran math teacher with a master's degree in teaching secondary mathematics. It was her first year teaching the ELL pre-algebra class.

Each of these subjects had their own set of beliefs and values about learning math, and learning English, that influenced all the interactions within this activity system. Chapter Six provides more information about the beliefs and values of four focal students whose experiences and academic language use are used as illustrative examples for this case study. In short, the two highest achieving students in the classroom, Marie and Jesse, both valued the study of math a great deal. They saw Ms. Grant's "easy" class as a stepping stone to harder content that they wanted to study. These two students had already learned fractions previously, most likely in a different language in Africa. They needed to consolidate and fine tune their understanding of the content they had already learned, while learning to express their understanding in English. They willingly completed every homework assignment and participated in every large group discussion, as they were able, given their limited vocabulary in English.

The other two focal students, David and Naomi, both thought math was generally important, but they saw Ms. Grant's class as a hurdle they had to jump over so that they could graduate and get a job. These two students were both long-term ELLs who had been born in Liberia and who had conversational proficiency in English. They struggled to see the application of the math content to their lives. Furthermore, they did not see the relevance of being in an ELL class that limited their access to grade-level content and other types of academic opportunities. They both had adult responsibilities in life already (e.g., a child, an independent living situation) and thought they already knew English because they had lived in the United States several years. By being in an ELL class they worried that they were missing out on the "real" content they should have been studying in order to graduate. This made Naomi and David more resistant at times to the activities of the classroom.

Ms. Grant supported the idea of a sheltered classroom for teaching math and English to ELLs, but her expertise was with the mathematics content. She believed most, if not all, students struggle with fractions, and that her ELLs were no different from fluent English speakers in this regard. Therefore, she prioritized teaching fractions concepts rather than teaching mathematical procedures (i.e., operations) to perform with fractions. Furthermore, Ms. Grant believed that requiring, and thus teaching, a particular kind of English in the math classroom only acted as a barrier to the participation of students from ethnically and linguistically diverse backgrounds. To this end, she downplayed the need for grammatical accuracy or the use of particular vocabulary words as long as communication was clear and it indicated an understanding of the content. (For more on Ms. Grant's beliefs about mathematics language see Chapter Six.)

**Object and Goal**

On the right side of Figure 4.1 is the object, or short-term result of the activity, and the outcome, which is a future goal. In a sheltered content classroom like Ms. Grant's, part of the object of the activity was to make the language input, in the form of both written texts and teacher language, comprehensible. Sheltered instruction proponents tend to define comprehensible input as "clear and appropriate teacher language to ensure that speech is appropriate for ELLs in terms of rate, clarity, avoidance of idiomatic language or slang, especially for beginning language learners" (Hansen-Thomas, 2008; p. 169). A second part of the object of activity was to support comprehensible language output by students. Although comprehensible output is not typically a concept included in sheltered instruction, it is an important part of communicative competence in a second language (Swain, 1985). The creation of comprehensible language input and output supported the long term goal of students learning the math content in a second language in which they were not proficient. Comprehensible output by students was important to Ms. Grant because it allowed her to gauge their level of content comprehension. However, it is important to note that this was a remedial content course with material developed for third to fifth graders. Thus, the materials were created with language presumably appropriate for fluent English-speaking children who were much younger than Ms. Grant's students, and the expectations for student language production were most likely reduced as well.

## Rules

As previously mentioned, in an activity system such as the one shown in Figure 4.1, rules are the norms or standards that the group has about participating in the activity. Ms. Grant provided students with a written syllabus that contained many requirements relating to classroom procedures (e.g., how to turn in homework, grading policies, etc.), but in a broader sense there were other rules about behavior and attitudes that were evident in daily classroom interactions. These rules influenced students' engagement with the mathematics content and their use of language.

**Consistent attendance and participation.** Consistent attendance and classroom participation were expected for academic success. Although this rule was not explicitly stated to students during my time in the classroom, it was reinforced in a number of ways at both the building and classroom levels. First, the doors of every classroom were closed and locked a few minutes after the bell rang for the start of each class period. Anyone coming late to class had to knock on the door and interrupt instruction to gain entry to the room.

Second, access to school hallways was restricted during class time and was only allowed for certain purposes. No hallway passes were allowed for the first or last ten minutes of class. Each student was only allowed a hall pass once during the semester for personal reasons, such as forgetting an item in their locker. During the last week of class there were no hall passes permitted. There was some flexibility allowed for special circumstances, such as a trip to the dean's office for a mediation session between arguing peers, or a visit to the nurse's office for an ill student. Students were clearly expected to be in their classrooms during instructional time.

Third, the teacher tried to engage students immediately with quiet work on academic content to help them transition to the math lesson for the day. Many of Ms. Grant's fifth-period class gathered in the hallway before the bell rang. During that time they began extended conversations that carried into the classroom. Ms. Grant established a system to reward students who came in the room promptly, took out their books, and quietly completed a task from the blackboard in their notebooks. The task involved copying daily math and language objectives that Ms. Grant was required to post (see Chapter Six for more details). A daily Instructional Focus (IF) problem, which was a kind of review or warm up problem, was also a part of the opening task. Students copied the IF problem and then solved it. A sample of these objectives and the IF, from days prior to the beginning of the study, is shown in Table 4.1.

Table 4.1

*Sample of Daily Objectives and the Instructional Focus*

| | Math Objective | Language Objective | Instructional Focus |
|---|---|---|---|
| **4-20-10** | Students will determine fraction amounts of circles. | Students will write fractions in word form. | Using the fraction circles, find (and write) three different ways to cover 1 yellow piece. |
| **4-21-10** | Students will create new representations of fractions. | Students will use fraction words. | Find the pieces that make the following three shapes<br>1. Make black use: blue, brown, blue, yellow<br>2. Make yellow use: blue, blue, pink, green<br>3. Make blue use: red, red, green |
| **4-22-10** | Students will use numbers to represent fractions. | Students will translate fractions written as words and numbers. | *Use small shapes to cover big and say how many it takes [drawing here]* |

By copying the objectives, students had the opportunity to silently read and rehearse the text of the objectives in case they were chosen to read them aloud to the group. Students who performed the task within a set period of time received paper tickets that they could exchange for a weekly chance at a prize drawing. Prizes included small toys, gift cards to a nearby sandwich shop, school supplies, and school t-shirts. As soon as students entered the classroom Ms. Grant started a timer. Only those students who had completed the task by the end of the time period were given the reward. The tickets were also used at other times when students were distracted and chatting during independent or pair work. Ms. Grant would casually walk around the room and hand out tickets to students on task. Students who volunteered for classroom duties or to demonstrate solutions at the board were also given tickets to promote continued engagement.

Finally, Ms. Grant's emphasis on consistent engagement during lessons was also evident in her interactions with students. A student with his or her head on the desk might be reminded once or twice to sit up straight and pay attention. The next step was typically being removed from class for a conference with the teacher in the hallway. The last step was a trip to the guidance counselor's office if school-level discipline was required.

**Follow the teacher's directions.** Another unspoken rule that was repeatedly, but slightly less consistently, emphasized was to follow the teacher's directions about issues such as where to sit, when to take out manipulatives, who to partner with for pair activities, and when to start or stop talking. Failure to follow the teacher's directions generally resulted in the same series of actions as a failure to pay attention in class. For example, Ana, a Mexican student, repeatedly refused to work with her assigned partner, Marie, during pair work. Ms. Grant restated her directive to work with Marie a few times, then removed Ana from class for a hallway conversation, and finally asked her to go to the Dean's office. Ms. Grant frequently reminded students that if they did not follow the class rules there was not a good reason for them to stay in the room. She did occasionally allow individual students to negotiate a flexible application of the rules if the student was calm, respectful, and focused on the lesson. In such a situation she was much more likely to agree to flexibility than if a student openly refused to follow her directions, was unengaged during instruction, or was confrontational. For example, on one day mid-way through the fractions unit, several key students in the classroom refused to take out the fraction circle pieces after Ms. Grant had asked them to do so more than once. Ms. Grant stopped instruction to let the students know that their compliance was expected and to remind them that the manipulatives had been shown to increase students' learning. Most students eventually did take out the fraction circle pieces, with much complaining.

**Do your own work.** In Ms. Grant's classroom there was extensive large group discussion of the lesson and modeling of how to do the assigned tasks. However, when it came time for in-class pair work, or on assignments at home, students were expected to do their own work. For example, Ms. Grant might orally explain a homework sheet, read the directions aloud to the class, demonstrate several problems to the group, and provide them with the first few answers. Then she expected the students to take the work home and finish it alone. Several students chose not to do homework, and many turned in late assignments just before the end of the grading period. In these cases, the teacher simply marked their grade lower for missing or late assignments. However, in one case Ms. Grant had several students turn in a homework assignment with handwriting that was recognizably from one of the top math students in class. In that case, Ms. Grant returned ungraded homework to all of the students, and explained that it was not appropriate to turn in someone else's work. Chapter Six describes how students' lack of English academic oral proficiency may have played a role in the copying that sometimes took place.

**Classroom Community**

A third key element of the activity system was the classroom community. The community was made up of students, Ms. Grant, the teacher's aide, Ms. Johnson, and me. However, the individual members present on any given day, and the way they interacted with each other varied considerably depending on who was present.

When certain students were present in class there was a greater likelihood that the teacher had to spend more time disciplining students and less time covering math content. When this happened the whole class spent less time producing language related to the math materials. For example, Hope was a Liberian-born high school junior who, when she was present in class, was frequently not focused on the lesson. She talked loudly off topic in a way that disrupted the work of other students and the teacher's lesson presentation. She teased classmates about issues like their poor English skills or not doing homework, and sometimes she started arguments. One argument engulfed most of the students, and it took a great deal of instructional time for Ms. Grant to bring peace to the classroom. The top math students in Ms. Grant's classroom privately admitted that they felt Hope created a distraction for everyone.

James was another student who altered the tone of the entire class by attempting to dominate the large group conversations. When he was present he frequently volunteered to demonstrate a solution to a problem, but he would stand at the board with his back to his classmates. He talked directly to the teacher in a way that excluded others from the conversation. He had a firm belief that the way he had learned math in Nigeria was better than the way American schools taught it. He wanted to convince Ms. Grant that his knowledge was valid. In many cases his solutions were confusing to the teacher because they used a different presentation format than the one she used. His answers were also wrong at times. He did not know how to correct errors because he was focused on demonstrating a process he had learned to apply, rather than evaluating the appropriateness of the answer. When other students were demonstrating work at the board, James sometimes interrupted them to correct them and suggest a different, more complicated way to do the problem. When he was not the one demonstrating work, he often sang, checked his cell phone, drummed on his desk, began conversations off topic in a loud voice, argued with other students, or asked to go to the bathroom.

When Hope and James got the class off track it could take the entire class period to go through the opening ten minute warm-up. In some cases the class never got to the instruction for the day. On one such occasion Ms. Grant scolded the class at length and asked them each to write out recommendations for improving classroom behavior as the day's homework assignment. When Hope and James were both absent more students participated in the discussions and engaged with the mathematics material.

In addition to students coming and going, Ms. Grant was also absent at times. Her absence created an atmosphere where students were generally much less involved with the academic content, and produced less language related to math. Ms. Grant took several days of personal holiday to make preparations for moving and changing jobs at the end of the school year. Substitute teachers were usually asked to give a quiz or a test. At these times students easily became unfocused and would attempt to break the classroom rules Ms. Grant had created. They switched assigned seats, talked while the substitute was talking, provided each other with answers on the quiz or test, and left their school supplies in their lockers so they could not fill in test answers on their papers. On one occasion when there was a substitute teacher who had a background in math, Ms. Grant asked the substitute to deliver a lesson on coordinate graphing. Graphing was another topic area she thought students had difficulty comprehending, and most students had not studied it before. The substitute teacher did not follow the teacher's standard opening routine for the class, which was an activity designed to transition students into quiet, focused work in class. As a result, students talked continually throughout the lesson. The substitute lectured to the few students sitting near the overhead projector, but she had to raise her voice to be heard. When Ms. Grant returned she found that none of the students understood the content of the lesson that the substitute teacher had delivered. Ms. Grant taught the same lesson a second time, and her classroom management and manner of instructional delivery supported students in learning the material.

Ms. Johnson, the ELL aide, was another member of the classroom community who was present only two or three days a week. “Ms. J.”, as the students called her, assisted Ms. Grant’s and Mr. Lee’s ELL math classes on alternate days. By providing a great deal of individualized attention, Ms. J. helped many students stay focused on the lesson and engaged them with the material. When working with students she frequently could anticipate the material that was not comprehensible to them. She either retaught the material, or provided a clearer explanation that connected to students’ experiences. She also provided additional modeling of how to solve problems. On the days when Ms. Johnson was not present to provide individualized attention, the students seemed less likely to stay on task during independent work time, or to talk to their partner during pair work.

Finally, I was also a member of the classroom community. Over time I had begun to take on a role somewhat similar to Ms. Johnson. When she was not in class I provided support for students. I passed out and collected papers, created materials, filled in as a partner for pair work activities, answered students’ questions about assignments, and repeated directions. When Ms. Johnson was present I did not need to participate as extensively, but the students still thought of me as another teacher who was available to help them.

**Division of Labor**

A fourth element of the classroom activity system was the way the power structure was made clear through the division of labor. The division of labor included both the way students interacted with each other and the way students interacted with teachers or other adults. There were norms for these interactions that shaped the ways in which language was used within the classroom. The classroom was primarily teacher-directed with some flexibility to allow for a few areas of choice in how students followed the teacher’s direction.

Ms. Grant provided a substantial amount of structure to each day’s lesson and to the classroom environment, so that lessons would flow smoothly. She assigned students’ seats in the room, and seating assignments were rotated once or twice during the grading period. She directed the flow and pacing of activities, and was the one to choose the objectives and instructional focus for the day. She chose the curriculum, which included both large group and pair activities. During large group activities she led the discussion or she called upon a student to demonstrate a solution to the class. She often used a set of sticks with students' names written on them to choose someone to "volunteer" for an activity. Sometimes the student selected had to read a problem or an objective verbatim. At other times they could choose the language they wanted to use to present a solution. Ms. Grant stood nearby to coach the student and ensure that he or she read the text correctly or obtained the correct solution.

During pair work, Ms. Grant assigned the pairs after giving careful thought to which students could work well together. In some cases she asked a student to work alone if she believed the student could not stay on task in a pair. At times she allowed some students to negotiate a partner other than the one she assigned, but this was not typical. She walked around and monitored conversations while pairs worked. If students had a misunderstanding, she interacted with them to guide their thinking. Pairs had some flexibility in how they talked about their task, but the structure of the activities was entirely determined by the teacher and the curriculum. In addition, Ms. Grant graded all of the quizzes, tests, and homework assignments. If students broke classroom rules, she administered any immediate consequences.

Most students cooperated with the teacher's plans because they liked her and felt she was a good teacher. However, they sometimes protested, either verbally or through their behavior, when there were teacher-established practices with which they did not agree. For example, students protested when they were assigned to complete pair work with a particular classmate whom they did not like. They also resisted when the teacher asked them to use manipulatives and materials that they felt were childish. Chapter Six provides more information about student resistance.

### Mediating Artifacts

According to Lantolf and Thorne (2006), an artifact is a material, an idea, or an activity that is part of the goal-directed activity. It may be visible to the observer, such as in the case of a textbook, a computer program, or audible speech used to guide a student. In some cases the mediating artifact may not be visible to an observer, such as in the case of internal language that a student creates in his or her mind to support the completion of a task. [23] These artifacts are said to mediate thinking because they support higher levels of thought than the student can independently perform. As students become more and more skilled with the content, they should become more able to voluntarily regulate their own thinking instead of having something in the environment act as the regulator.

Ms. Grant's students were at lower levels of content and second language proficiency, and some were newcomers to the country. They relied extensively upon external mediators in the environment, such as the speech of Ms. Grant or Ms. Johnson. They were still in the process of developing their own internal mediation in a second language. Some students occasionally reported that they mentally counted or performed mathematical procedures while thinking in their native languages. Exactly how often this mental translation occurred, and whether it supported math comprehension, was unclear. The majority of the Liberian students may have had very limited, if any, mathematics instruction in a language other than American English.

The four potential external mediators that were most evident in Ms. Grant's classroom were: (a) a conceptually-based curriculum with controlled language demands; (b) a consistent opening routine each day that synthesized learning from the previous day and set the objectives for the lesson; (c) the teacher's use of language to support content comprehension through modeling, prompting, questioning and rephrasing of students' words, and; (d) student language that was used to collaboratively build an explanation or justification of a problem that few students were capable of constructing independently. Each of these mediators had a connection to language.

**A language-reduced, conceptually-based curriculum.** One of the key potential mediators of mathematics content learning, and thereby of academic language use, was the *Rational Number Project: Initial Fractions Ideas* (RNP1; Cramer, Behr, Post, & Lesh, 2009) curriculum that Ms. Grant used. The *RNP* 1 materials have been developed for grades 4-6, but have been successfully used with adults in remedial mathematics settings as well (Cramer et al., 2009). These materials rely heavily on oral presentation and discussion of visual materials (e.g., manipulatives, models, and diagrams) that are designed to build conceptual understanding of fractions. The regular use of manipulatives

[23] Internal language is language an individual learner thinks, but does not speak aloud, in order to guide his or her learning. For example, a student may mentally translate the teacher's English speech into his or her native language. The mental translation process would not be apparent to an observer.

and models in the *RNP 1* curriculum is intended to support children in appropriate thinking about the fractional concept of part-whole relationships and in judging the size of fractions (Behr, Wachsmuth, Post, & Lesh, 1984). There are two primary physical objects used to build students' knowledge of these concepts: fractions strips, and fraction circle pieces. Ms. Grant's students folded paper strips into thirds, then into sixths, and colored different units on the strips so that they could compare similar quantities like two-thirds and four-sixths. They used the model to talk about the concept of fraction equivalence in everyday language. Other times they placed one set of colored fraction circle pieces on top of another one to talk about how much space the pieces covered. Students also related the overlapping pieces to the concept of fraction equivalence. Performing the physical actions supported the use of language to describe the actions.

The language requirements of the *RNP* 1 curriculum have been developed for a target audience of mainstream native-English speaking elementary school students. Therefore, the curriculum minimizes the need for extended reading or writing of text. It also minimizes the need to use mathematical vocabulary.

The *RNP* 1 does not have a student textbook. There is only a teacher's guide, which includes master copies of student worksheets and overhead transparencies. The teacher's guide gives step-by-step instructions for presenting materials orally to students. Most of the instructions are not scripted verbatim. However, they are worded in a way that could easily influence the language a teacher uses to present the materials, as illustrated in the following example from Lesson 2. The words in Step 2 suggest a direct question a teacher could ask:

> Large Group Introduction
>
> 1. Ask the students to take out a black circle. Model how to divide the black circle into 2 equal parts by showing that 2 yellow parts cover the whole circle.
> 2. Note that one black equals 2 yellows or 2 yellows equal 1 black. Ask: Are the 2 parts covering the whole equal? (Cramer et al., 2009, p. 1)

In Lesson 2, roughly 75% of the words written in the Lesson Overview and Teaching Actions sections are found in the first one thousand words of the General

Service List (GSL; West 1953), [24] indicating that they are common everyday words (e.g., “a”, “big”, “circle”, “develop”, “each”, “find”, “group”, “how”, “idea”, “know”, “large”, “model”, “name”, “once”, “page”, “question”, “real”, “say”, “take”, “unit”, “want”, “you”). Only about 9% of the words in these same sections come from the second one thousand words of the GSL. GSL 2 words are less frequently used than the GSL 1 words, but are still relatively common in everyday speech and writing. The GSL 2 words include color names (i.e. “brown”, “gray”, “pink”, and “yellow”) along with the words "correct", “divide”, “explore”, “lesson”, and “pair”. A similar amount (9%) of the words come from the Academic Word List (AWL; Coxhead, 2000), which are general academic words not specific to a content area. The AWL words include “assess”, “assign”, “conclude”, “context”, “scenario”, and “similar”. These AWL words appear in directions to the teacher that are not scripted for the teacher to say to the class. As an example, the third step in the presentation of Lesson 2 contains the word “conclude”. The text says, “Conclude by stating that when 2 equal parts equal one whole, each part (pick up 1 yellow) is called one-half. This yellow piece is one-half of the black circle” (Cramer et al., 2009, p.1).There is very little use of specialized math vocabulary in Lesson 2 except for numbers and fraction names.

The words the teacher uses to present the material might influence his or her expectations for words the students should comprehend and use orally. In Lesson 2, common every day words used by the teacher might logically be expected for student language production as well. In addition, the prompts in the teacher’s guide imply language functions that students need to use in their response. In Lesson 2, the students most likely would answer the teacher’s requests for information (e.g., Are the 2 parts covering the whole equal?) with one word such as a “yes” or “no”. In later lessons the teacher’s guide suggests that students orally perform language functions such as compare and contrast (e.g., How are the two models alike?), justify why an answer is correct or incorrect (e.g., Why does your model show 2/3?), or describe a solution process (e.g., How do you fold the paper strip to make four equal parts?).

[24]There is a comments section for each lesson which sometimes uses more academic vocabulary to explain to teachers why the lesson is structured in a particular way. For example, in Lesson 5 “The action on the manipulative reinforces the meaning of the symbol”. The Comments are directed only to the teacher, and are not included in the analysis of vocabulary presented here.

The *RNP 1* has no particular grammatical requirements established for either the teacher's or the student's speech. The way activities are introduced in the teacher's guide suggests that certain grammatical elements, such as comparatives or equatives, might be used for particular activities. However, if a student has some other way to express an idea accurately, their wording is considered acceptable. The teacher's guide makes no reference to adapting lessons for ELLs or to ways in which ELLs might use language differently than fluent English speakers.

For students, reading text is restricted to reading the directions and problems on student worksheets. However, in most cases when Ms. Grant's students were presented with text, the teacher read the directions and the first few problems aloud. Students were only asked to independently read the problems assigned for homework. Similarly, little production of written responses is required by the *RNP 1*. Homework assignments typically allow students to use a combination of words, pictures and numbers to answer a question. For example, in this in-class activity for an early fractions lesson, students could answer the questions orally in places marked "Say the word" and draw a picture when directed (Cramer et al., 2009).

1. The yellow piece is the unit.

   How many blues cover the yellow piece? ________

   1 blue is ______ of the yellow.

   (Say the word)

6. Draw a picture of a pizza. Show on your drawing the pizza cut into 2 fair shares. (Lesson 2, Student Page A)

In later lessons the student sheets still use the same format, although the amount of text presented is longer and more like a traditional word problem. The text sometimes requires more sophisticated inferences than it does in the early lessons. Even though the text is more sophisticated, students still only need to draw a picture and write a fraction for the estimate, as shown in the following problem from Lesson 20.

1. Marty ate some candy. He ate 1-half of a whole Hershey bar before lunch. He ate 1-fourth of a whole Hershey bar after lunch. About how much of one candy bar did he eat? With your fraction circles, find out the exact amount of

a Hershey bar that Marty ate. Draw pictures to show what you did with the circles. Estimate first!!!

Estimate: ______________________ (Student Page A)

In this problem students can use the manipulatives to model the solution, and then draw a picture showing what they did with the manipulatives. No words are required in the answer. However, to answer the Hershey bar problem correctly, students need to be able recognize how to draw the answer to the problem. Through the use of the words “before lunch”, “after lunch”, “exact amount of a Hershey bar that he ate”, and the use of the plural on “draw pictures” it is implied that the students should draw three separate pictures. These pictures would show how much chocolate Marty ate before lunch, how much he ate after lunch and exactly how much he ate in total. The pictures students are to draw would mimic the order of a problem solution written out in numbers and symbols. Before students draw the picture, they are also supposed to write, in numbers or words, an estimate for how much chocolate Marty ate. This ordering of steps is stated in the last two words of the problem, “Estimate first.”

**A consistent opening class routine.** Each day, instruction began with a brief opening routine that linked previously learned content to new content and highlighted related language. Ms. Grant had students participate in this opening routine using several different language modalities, and she modeled the language she wanted students to read and respond to.

The school principal asked teachers to begin every class with a brief review of the lesson’s content objectives and the Instructional Focus (IF) problem that reviewed key concepts from previous lessons (See Table 4.1). Students were required to record the objectives and solve the IF on journal pages that were periodically collected and graded by the teacher. The district policy for sheltered ELL content courses required that language learning objectives accompany the content objectives for the day’s lesson.

When students entered the room, Ms. Grant had both the content and language objective displayed on the whiteboard for students to copy onto their journal pages. She handed out reward tickets to students who sat down quietly and copied the objective within a two or three minute period. The class then drew name sticks from a can to choose someone to read the objectives aloud to the group. Ms. Grant provided support with unknown words as needed. She also reread the objectives to ensure that students heard a native speaker model. At this point she displayed the IF and followed the same routine by asking a student to read it aloud, with her support if needed, before she reread the IF problem aloud. The IF was typically either a question that asked students to estimate fraction sizes or it was a word problem taken from the curriculum. Students usually solved the problem on their own first and then the class discussed the solution together.

For students, this brief opening routine incorporated content review, repeated practice with reading, the use of multiple language modalities, a native speaker model of oral reading, exposure to a slightly more academic style of text or to text similar to what they would see on homework assignments, and linguistic support to aid comprehension, as needed. In addition, it helped students who were absent to understand the material they had missed.

**Teacher's use of language.** Ms. Grant was an attentive teacher who used her own language to get students to reexamine incorrect thinking and elaborate on answers. She did so through repeated prompting, questioning and rephrasing of students' utterances to support them in conveying accurate mathematical ideas. To a lesser extent she also prompted for specific elements of correct language use, such as pronunciation of words or the use of a particular mathematics term. However, because Ms. Grant was primarily focused on the communication of mathematical content, she prioritized the meaning of student utterances over the form of those utterances. The following exchange shows how Ms. Grant used her speech to prompt the students' to reevaluate an incorrect answer to a question about the relative size of two different fractions.

On this day, students were asked to compare a fraction to the known quantity of one-half and to tell whether the fraction was larger or smaller than one-half. Students still made the mistake of thinking that the fraction with the largest number in the denominator was bigger in size (e.g., 1/12 was bigger than 1/2). In Excerpt 4.1, the teacher used a combination of questioning and rephrasing students' language to guide Michael and Jesse toward a correct answer. However, she stopped short of requiring them to produce the answer.

Excerpt 4.1 [5-07-10]

MS. GRANT: … Is one-twelfth more than a half or less than a half?
JESSE: Is less than a half.
MICHAEL: More than.
ANA: Less than.
MS. GRANT: One-twelfth?
MICHAEL: Wai-, wai-, wai-, I (wa)s just kidding.
MS. GRANT: O:k.
JESSE: It’s more than a half.
MS. GRANT: How much would, well how much would a half be if I had twelve pieces. How many twelfths is a half?
JESSE: That would be-
NAOMI: Six. Six.
MS. GRANT: Six-twelfths?
MICHAEL: Yes.
JESSE: Yes, six-twelfths.
MS. GRANT: All right. So this is less than, so we’re going to practice writing out is less than, and we’re gonna do the symbol. Ok?

In lines 2 through 8 of Excerpt 4.1, the teacher did not directly state that students were wrong when they gave conflicting answers about the relative size of the two fractions. Instead, in lines 5, 9, and 10, she asked questions designed to elicit the correct answer from Michael, the student who had made an error. To address his incorrect thinking, in line 5 Ms. Grant repeated the fraction as a question, “One-twelfth?” Michael clearly understood that she was correcting him because in line 6 he answered “I was just kidding”. It was unclear whether Michael truly recognized the error in his thinking, so the teacher let him go with a thoughtful “O:k” in line 7. Then, in line 8 Jesse also stated that one-twelfth was larger than one-half. Ms. Grant followed up in line 9 with a question designed to get Jesse to visualize the number of twelfths that would be equivalent to one-half. “How many twelfths is a half?” she asked. Naomi gave the answer, “Six”, in line 12. In line 13 Ms. Grant rephrased Naomi’s answer to be more complete, “Six-twelfths?” This conversion of one-half to an equivalent fraction using twelfths in the denominator was necessary for students to compare the sizes of the two fractions. Through Ms. Grant’s questioning and rephrasing, in line 15 Jesse could perform the task of converting one-half to six-twelfths. However, at that point the teacher answered the original question of whether one-twelfth was larger or smaller than one-half by providing the answer, “So this is less than” in line 16. Jesse was not asked to demonstrate that he could correctly choose the larger fraction.

In Excerpt 4.1 students did not produce long utterances and, therefore, there was very little language to correct. Jesse dropped a subject, “It”, when he said “is less than a half” in line 2, but there were no other language form errors. Other than prompting for complete answers (e.g., “Six-twelfths?”) the teacher did not address language use.

When the teacher did use her speech to address the form of students’ utterances, she often focused on pronunciation errors. Excerpt 4.2 shows the type of pronunciation modeling that the teacher provided.

Excerpt 4.2 [5-07-10]

MS. GRANT: All right. Naomi I’m going to give you one more try to explain what you said before. Go for it.
NAOMI: One over fifty because ah, I can’t say the d word.
MS. GRANT: The denominator.=
MICHAEL: =Denominator.
NAOMI: Denom- ((sighs))
MICHAEL: Denomee, I’m gonna say nator
MS. GRANT: DeNOMinator.
MICHAEL: Nator! Nator!
NAOMI: The denominator is um, not the same, so we look at the numerator is the same, so we gonna do one, one over fifty because of the, um, denomirator.

In line 3 of Excerpt 4.2, Naomi stopped in mid-utterance to ask the teacher for help pronouncing the word “denominator”. Ms. Grant pronounced the word normally in line 4. When Naomi still struggled in line 6, Ms. Grant responded in line 8 by exaggerating “*DeNOMinator.*” Naomi could then say the word correctly in line 10, although she mispronounced it the second time as “*denomirator*” in line 11.

Excerpts 4.1 and 4.2 show that Ms. Grant’s language acted as a powerful shaper of students’ speech. Her language generally supported them in communicating more precise understandings of mathematics and using English more accurately. In addition, the format of her questions had the ability to create opportunities for extended speech that showed evidence of more complex language functions and thought. In Excerpt 4.3 she asked the question “How can you decide?” referring to choosing the larger of two fractions. Michael responded with a lengthy utterance describing the procedure he would use to determine the answer:

Excerpt 4.3 [05-07-10]

MS. GRANT: All right. What if we ha:ve different numerators, three and five,=

MICHAEL: Right here!

MS. GRANT:= but the <u>same</u> denominator? Then how can you decide? Michael?

…

MICHAEL: First we have to look at the denominator and we look at denominator (while we look at it) we looking at the biggest number because the denominator is same thing so we now we gonna look at the denominator so five over six bigger than three over six.

In Excerpt 4.3, Michael utters forty-eight words in one breath (lines 6-9), using the vocabulary word “denominator” three times, appropriately forming the comparative “bigger than” and adding a few words like “First” and “now” to indicate the order of steps in the solution process. This type of extended response was somewhat unusual for the students in Ms. Grant’s classroom because she frequently used a closed-ended question format like the one shown in Excerpt 4.4. Closed-ended questions simply required the student to identify which of two choices was correct.

Excerpt 4.4 [5-07-10]

MS. GRANT: So two-thirds. Is that more than a half or less than a half?

JESSE: More than a half.

In Excerpt 4.4, line 1, when the teacher asked “Is that more than a half or less than a half?”, Jesse had a fifty percent chance of getting the answer correct regardless of whether he knew the reason. In line 2 he merely repeated “More than a half” in answer to her question. It is difficult to tell just what Jesse knew about fraction size because he produced so little speech.

**Students’ collaborative use of language.** In large group discussions multiple students sometimes attempted to co-construct statements or answers to problems. In Excerpt 4.5, two students collaborated to construct an idea about the relationship between the size of the denominator in a fraction and the size of the corresponding fraction circle piece.

Excerpt 4.5 [5-07-10]

1 MS. GRANT: All right, so no:w, you said one over fifty and remember the
2 smaller the denominator-
3 NAOMI: The denominator is. Cause it, um, the numerator-
4 MS. GRANT: All right, so if the numerators are the same-

5 …
6 JESSE: You just look at denominator.
7 MS. GRANT: Look at the denominator.
8 NAOMI: Yah. The smaller it is then-
9 JESSE: [Waving his hands] The bigger the-
10 NAOMI: =the back is.
11 …
12 MS. GRANT: All right. So the smaller the number=
13 JESSE: The bigger the pieces.
14 MS. GRANT: =the bigger the pieces. Yep. The bigger each piece is.

In Excerpt 4.5, lines 1 and 2, Ms. Grant prompted students to speak by beginning, “The smaller the denominator is –” and pausing. She intended for students to finish her statement. In line 3, Naomi recognized the intent of the teacher’s prompt and repeated the words “The denominator is” as she tried to figure out the appropriate form for her answer. She appeared to need time to think about the grammatical construction using comparatives to state a relationship between two things (e.g., “The smaller x is then the bigger y is.”). Instead of continuing to use the comparative, in line 3 she started the phrase over again with a different construction. She stated, “Cause it, um, the numerator–.” Then she broke off again to think about what she wanted to say. The teacher rephrased her initial prompt in line 4 without the comparative, saying, “All right, so if the numerators are the same –.” This time, in line 6, Jesse finished the teacher’s statement by providing the somewhat vague answer, “You just look at the denominator.” In line 7 the teacher repeated his statement in an effort to get him to elaborate on it. Naomi then jumped into the conversation again in line 8, having figured out the comparative construction she needed to use. She began, “The smaller it is then –”. In line 9 Jesse added “the bigger the”, and Naomi finished in line 10 with “the back is.”

To get Naomi and Jesse to restate their complete thought, Ms. Grant prompted them in line 12 to say it again using more precise words. Adding emphasis to the important words she began, “All right. So the <u>smaller</u> the <u>number</u> is –.” In line 13 Jesse was able to accurately state “The bigger the pieces.” Jesse captured the idea of the relationship between the size of the number in the fraction denominator and the size of the fraction circle pieces. Neither Naomi nor Jesse were able to express this thought independently using the comparative form, but working together and relying on the teacher’s support, they were able to co-construct it. Notably, this type of collaborative discussion rarely occurred during pair work because math-related conversations were not sustained for any length of time due to the nature of the pair work activities. It was only in the large group setting that extended exchanges about mathematics occurred and peers had the ability to collaborate to express an idea.

As this chapter’s description of the classroom context with an Activity Theory lens illustrates, there were a large number of factors that potentially could have influenced language learning opportunities and outcomes in Ms. Grant’s ELL pre-algebra course. These factors included: (a) classroom rules reinforcing the importance of participation and consistent engagement with the math content, an emphasis on following the teacher’s directions for classroom activities, and the importance of independent work by students; (b) changing membership in the classroom community on a daily basis; (c) a division of labor weighted more heavily toward the teacher, and; (d) the presence of a variety of potential mediators that may or may not have supported academic language production.

The interrelationship of all of these factors naturally created some tensions, or as Activity Theorists call them, contradictions, within the activity system of Ms. Grant’s classroom. These tensions influenced the way in which language was actually used and the expectations for students. In addition, some other tensions were added into the system from forces outside of Ms. Grant’s classroom. Before examining those tensions, it is important to understand the nature of the academic language students produced. Chapter Five describes the language used by the four focal ELLs in terms of its complexity, accuracy, and fluency (CAF). Chapter Six then describes the tensions in the activity system in more detail and relates them to opportunities that were, or were not, provided for students to develop their academic language skills.

# CHAPTER 5: ACADEMIC ENGLISH PRODUCED BY FOUR STUDENTS

In this chapter I explore the academic English of four students in Ms. Grant's ELL pre-algebra classroom. As previously mentioned, these four students were chosen as exemplars because they had regular class attendance, had sufficient English skills to participate in the research study, and they represented a variety of home languages. Information about the students is presented as four individual cases. Each case begins with a detailed description of the student's language background, previous educational history, and current academic content and English proficiency assessment scores. Afterwards, I present a summary analysis of each student's English complexity, accuracy, and fluency (called CAF in the research literature), taken from transcripts of classroom interaction on five separate days during an approximately six-week period in the spring of 2010. (The complete analyses for all four students can be found in Appendix I.)

Findings for the two Liberian students, David and Naomi, are presented first. These cases represent ELLs who have been in U.S. schools for many years and are still in English Language Development programs. West African Immigrant students like David and Naomi are thought to be among those with the greatest linguistic challenges in U.S. schools because they have to learn a kind of English that may be similar in some ways to the creolized variety that they spoke in Africa, yet different in other ways (de Kleine, 2009). These differences may have a lasting effect on students' reading comprehension and academic achievement in standard American English classrooms (de Kleine, 2009). Findings for Jesse and Marie, two relatively recent African immigrants with prior education in their native language, follow. Marie was a Kenyan immigrant whose early schooling in her home country was provided in a second language she did not speak at home. In elementary school she had minimal exposure to English. In Kenya she had studied fractions concepts before. Jesse was a West African student from Nigeria who had been taught elementary math at least partially in British English. He also had studied fractions in a previous classroom. Jesse and Marie are exemplars of academically successful ELLs who can draw on content knowledge learned in their home country to support the learning of similar content matter in standard American English, despite limited English skills.

**David**

David was a stocky Liberian 18 year-old in 10th grade who typically was quite extroverted. He had a brilliant smile and loved to joke with newcomers to the classroom as a way of initiating them into the group. His family originally emigrated from Liberia to Cote d'Ivoire when he was in the primary grades. He had briefly attended elementary school in Liberia, and then in Cote d'Ivoire as a young child. He moved to the United States in approximately fourth grade.

David reported that he had familiarity with five languages, although it was not clear whether he was fluent in any of them. At home he spoke Bassa, a language found along the central Liberian coast. He only used this language in conversation. At school in Liberia he may have used a mixture of Liberian English and standard American English.[25] English is the official language of education in Liberia, and some schools use American textbooks (Ngovo, 1998). David had not attended many years of school in his home country so his formal English reading and writing skills may have been weaker than his speaking and listening skills. He also reported that he could read and write in Gola, a language of western Liberia that is spoken near the border with Sierra Leone. In addition, during his few years of schooling in Cote d'Ivoire he had been exposed to French, which was the language of the education system. He often expressed a wish that his French skills were stronger, like those of his older siblings who had learned more of the language in Cote d'Ivoire schools. Finally, David had returned to learning American English when he arrived in the United States in fourth grade. He had changed schools approximately six times since arriving. Each time he switched, his family requested that he be excluded from ESL services because they believed he did not need them, given his exposure to Liberian Standard English. However, when he came to Lincoln High School,

[25] For many Liberians who were born in the country, English is their second or third language, acquired after they learned a tribal language. There are several creolized versions of English that developed in Liberia (de Kleine, 2009) and exist alongside the standard American English taught in schools and used by a small percentage of educated elite (Ngovo, 1998). Because Liberians may not make a distinction between all these varieties of English, the creolized versions are referred to as Liberian English here. In formal writing used by educated Liberians there may be little visible difference between Liberian English and American English (Ngovo, 1998). However, in oral language there may be some clear grammatical and phonetic differences between them because of the influence of tribal languages upon Liberian English (Singler, 1991, 1997; de Kleine, 2009). Ngovo (1998) states that Liberia has had a relatively high illiteracy rate among African countries, and therefore much of the population may have only been exposed to oral Liberian English in some form.

David was told he had to be registered as an ESL student. He was unhappy about his ELL status and felt that his family was disappointed in him because he was not in mainstream classes.

Academically, David's limited large-scale content assessment scores indicated that he was in the 1st percentile for reading and mathematics on the state assessments the last time he was assessed. His most recent state English proficiency assessment scores in reading (from grade 8 or 9) identified him as not proficient and placed him at a level two out of four levels. According to state assessment documents, students scoring at a level two could be successful with simple reading activities that involved familiar vocabulary. In writing David was also not proficient. He scored three out of five possible points, indicating that he could write varied sentences with some less frequently used vocabulary and basic grammar. His grammatical constructions might contain errors. He could also, most of the time, clearly state a main idea even though it might not be supported with evidence. David's listening and speaking scores were rated on an informal teacher-completed checklist. The checklist scores were subjective and varied across years because different ESL teachers observed his language to be at different levels, depending on the classroom context. In 8th grade he had been rated at the early advanced level in listening and speaking, while in 9th grade he was only rated at the intermediate level. He carried on a personal conversation with little difficulty and frequently used humor. When he chose to, he could also change his cadence, grammar, and vocabulary to sound more like speakers of Black English.

David did not like mathematics, but he felt that it was an important subject for him to study so that he could go to college. He believed that high school in the United States was too easy, and he wanted to return to Liberia to complete a second high school degree so that he would be prepared for college. However, despite his complaints about easy high school courses in the United States, he struggled academically in ELL classes. He frequently did not turn in his homework assignments for Ms. Grant's class, and he often demonstrated misconceptions about fractions on class work. Ms. Grant suspected that David might have had some kind of undiagnosed learning disability, but his difficulties might also have also stemmed from his inconsistent prior schooling and lack of ESL instruction. At the end of the semester, he received a D- in ELL pre-algebra. The teacher thought she might still recommend that he advance to a mainstream mathematics class.

**David's CAF in Academic English.** This section provides excerpts from transcripts of five selected class periods between April and June of 2010 to highlight David's CAF in oral English.

***Fluency.*** Table 5.1 shows the total number of disfluencies in David's utterances on a particular day, and the number of words spoken after the disfluencies were removed from the transcripts.

Table 5.1

*David's Oral Fluency and Total Number of Spoken Words*

| | Date of Transcript | | | | |
|---|---|---|---|---|---|
| | **5-6-10** | **5-11-10 (F)** | **5-20-10 (F)** | **5-25-10** | **6-7-10** |
| **Fluency** | | | | | |
| False Starts | 0.0 | 3.0 | 11.0 | 3.0 | 0.0 |
| Repetitions | 1.0 | 5.0 | 6.0 | 5.0 | 1.0 |
| Interjections | 0.0 | 1.0 | 7.0 | 5.0 | 0.0 |
| **Total Number of Words Spoken** | 26.0 | 306.0 | 371.0 | 191.0 | 86.0 |

(F) = Focal student on this day.

As shown in Table 5.1, the amount of language David produced, measured by the total number of spoken words, varied substantially across days. This was partly due to the fact that David was undergoing some significant life changes at the time of the study. These changes affected his engagement with the mathematics lessons. He turned 18 years old in the winter before the study began. He had been living with extended family but was asked to move out of their home. He had at least one living parent, but living with this parent was not an option for unknown reasons. Living alone entailed finding a job, buying a car to get to work, and finding an apartment. He had to do all of these things while still attending high school. His living situation weighed heavily on his mind, particularly on May 6$^{th}$, the first day shown in Table 5.1. This was the first day he mentioned the change in his living arrangements and his behavior was noticeably different from his usually outgoing personality. He was quiet and preoccupied on that day, uttering few words during the lesson (26.0). However, his few words were spoken fairly fluently. There was only one repetition in his private speech during seatwork time, as shown below in Excerpt 5.1 (May 6, 2010). It occurred when David was studying a worksheet problem that showed a shape divided into four equal pieces. He needed to use his pencil to divide the four pieces into eight equal-sized pieces.

Excerpt 5.1

1 David: Cut it into how many pieces, eight. So it's xx.[26] That's four, four.

(David, Transcript, May 6, 2010)

In line 1, David seemed to repeat the word "four" for emphasis rather than because he had difficulty formulating his idea in English.

In contrast to his behavior on May 6th, on May 11th and May 20th, David returned to his typically outgoing style of interacting with his teacher and classmates (see Table 5.1). He joked, told stories, and teased other students. On the 11th he produced substantially more language than on the 6th (306 words compared to 26), and on the 20th he produced the most language of any of the five days (371 words). Toward the end of the semester, on May 25th and June 7th, his language production tapered off again to 191 words and 86 words, respectively.

The style of the lessons on all five of the selected days was similar. There was a large group review of objectives and previously learned material, followed by a large group introduction to new material. The large group activities were primarily led by the teacher. Ms. Grant prompted students to read objectives, to read and solve problems, and she modeled new concepts on the overhead projector using manipulatives. Usually large group activities were followed by either pair work, at which time David often began to talk off topic with his partner, or individual work, during which he was usually silent. The pair and individual work was used to practice concepts the teacher had introduced.

The number of false starts, repetitions and interjections that occurred in David's speech varied over time along with the amount of language production. On May 6th and June 7th when he produced comparatively little language, his disfluencies included only a single repetition of a word. On May 11th and 20th when he produced the most language, he had multiple false starts (3.0 and 11.0), repetitions (5.0 and 6.0), and interjections (1.0 and 7.0). One reason why David produced more language overall on some days was that he volunteered to read lesson objectives and word problems aloud to the class. When he read aloud he often struggled to pronounce the words correctly. His difficulty with oral

[26] xx in transcripts represents unclear or inaudible language

reading created greater disfluencies in his speech than when he conversed with a teacher or classmate. For example, in Excerpt 5.2 (May 20, 2010), lines 1 through 3, David was conversing with a classmate during pair work. There were no false starts, repetitions or interjections:

Excerpt 5.2

David: I know how to do it that way. You divide it. Just go ahead and do it how I say it. I don't know how to explain it. It's like how many times you would go into it.

(David, Transcript, May 20, 2010)

In contrast, on that same day David became much less fluent in Excerpt 5.3 (May 20, 2010) when he attempted to read aloud the Instructional Focus (IF). The words in italics are words he read aloud.

Excerpt 5.3

David: "*Victoria say that,"* er, *"five-twelfths is more than one-halfs. Is Victoria correct? Is Victoria correct? Write a sentence explaining how you will*", no, "*you will*", no, "*you know if five-twelfths is more than one-halfs.*"

(David, Transcript, May 20, 2010)

In Excerpt 5.3, he took three attempts to correctly read the sentence "*Write a sentence explaining how you know if five-twelfths is more than one-half.*" In line 1 he added the interjection "er". In line 2 he added a plural 's' on the word "half", and repeated the question "*Is Victoria correct?"* Twice in line 3 he misread the verb 'know', and he appeared to want to change it from the present tense to the future tense ("you will"). He seemed to be aware of the tense error, and after two false starts he corrected it to "you know". In line 4, again, he added a plural 's' to "half". Oral reading difficulties like these may have been an indicator of poor decoding skills and limited reading comprehension, which were also evident in his state reading test scores.

***Accuracy.*** Two measures of accuracy, the percent of grammatically accurate verb phrases and the percent of target-like plurals, proved to be the most useful indicators of

David's grammatical accuracy.[27] Table 5.2 shows these two measures across the five days selected for analysis.

Table 5.2

*David's Grammatical Accuracy*

| | Date of Transcript | | | | |
|---|---|---|---|---|---|
| | **5-6-10** | **5-11-10 (F)** | **5-20-10 (F)** | **5-25-10** | **6-7-10** |
| **Accuracy** | | | | | |
| Percent of Accurate Verb Phrases | 100.0% (6/6) | 96.8% (61/63) | 96.3% (78/81) | 94.1% (32/34) | 99.9% (15/16) |
| Percent of Target-Like Plurals | 100.0% (3/3) | 100.0% (6/6) | 70.6% (12/17) | 100% (3/3) | 50% (1/2) |
| Total Number of Words Spoken | 26.0 | 306.00 | 371.0 | 191.0 | 86.0 |

(F) = Focal student on this day

As the table shows, David's grammar was generally correct on the two measures calculated. Between 94.1% (May 25th) and 100% (May 6th) of David's verb phrases were grammatically accurate. In other words, they contained the correct form of the verb for the tense chosen and had appropriate verb endings for singular or plural subjects. Occasionally he uttered a sentence with some verb tense errors such as those contained in Excerpts 5.4 (May 20, 2010) and 5.5 (May 25, 2010):

Excerpt 5.4

1 David: "*With your fraction circles found the corr-, ex-, react amount*."

(David, Transcript, May 20, 2010)

Excerpt 5.5

1 David: You should put like grey go over blue and see how many is left over.

(David, Transcript, May 26, 2010)

In Excerpt 5.4, line 1, David made a verb tense error when he used the past tense, "found", while reading aloud a problem written in the simple present tense. In Excerpt 5.5 his verb errors were more complicated. In line 1 he chose two verbs, "put" and "go", where only "put" was needed. "Go" did not agree in form with "grey". In addition he also had a number error where he used the singular form of "is" instead of the plural "are".

[27] The percentage of self-corrections was calculated, for David and the other focal students, but is not presented here because it occurred relatively infrequently and varied little across days. It is included in the complete CAF data tables found in Appendix I.

David had varying amounts of difficulty constructing the correct form of plural nouns, depending on how much language he produced. On three days (May 6th, 11th and 25th) he used fewer than 10 plurals, and all of them were correct. On June 7th he incorrectly formed one out of only two plurals used. Again, this error occurred when he was reading text aloud, as shown in Excerpt 5.6 (June 7, 2010).

Excerpt 5.6

1 David: *"Susan wants to add 1-halfs and 3-fourths. Write a sentence to describe the*
2 *first step (in) finding this sum."*

(David, Transcript, June 7, 2010)

In Excerpt 5.6, David mistakenly added a plural to "half" in line 1, similar to the plural he correctly read on "fourths".

The largest number of plural errors occurred on May 20th, the date when David produced the most language. On that day he formed only about 71% of his plurals correctly (12 of 17). Two of the five errors again occurred when he again added an 's' on the word "half" while reading a problem aloud. The remaining three errors occurred when he dropped a plural 's' on the fraction words "sevenths", "twelfths", and "thirds".

***Complexity.*** Complexity measures used in this study include those that measured the structure of David's syntax, the variety of different words he knew of a particular grammatical form (i.e., verbs), and whether he could perform key language functions that had increasing levels of cognitive complexity. Table 5.3 shows selected measures that highlight the variability in David's English complexity across days.

Table 5.3

*Selected Measures of David's English Complexity*

| | Date of Transcript | | | | |
|---|---|---|---|---|---|
| | **5-6-10** | **5-11-10 (F)** | **5-20-10 (F)** | **5-25-10** | **6-7-10** |
| **Complexity** | | | | | |
| A-S Units | 8.0 | 87.0 | 79.0 | 50.0 | 16.0 |
| Mean number of Verbs per A-S unit | 0.7 | 0.9 | 1.3 | 0.9 | 1.4 |
| Percentage of A-S units with 2+ verbs | 0.0 | 11.4 | 10.1 | 5.0 | 0.2 |
| Number of Turns | 4.0 | 48.0 | 54.0 | 41.0 | 11.0 |
| Mean Turn of Length (words per turn) | 6.5 | 6.4 | 6.9 | 4.6 | 7.8 |
| Number of Verb Forms Used | 4.0 | 21.0 | 27.0 | 19.0 | 13.0 |
| Instances of Explaining Function | 1.0 | 0.0 | 0.0 | 1.0 | 1.0 |
| Instances of Justifying Function | 0.0 | 1.0 | 0.0 | 2.0 | 0.0 |

| | | | | | |
|---|---|---|---|---|---|
| Instances of Comparing/Contrasting Function | 0.0 | 0.0 | 1.0 | 1.0 | 0.0 |
| **Total Number of Words Spoken** | 26.0 | 306.0 | 371.0 | 191.0 | 86.0 |

(F) = Focal student on this day.

*Analysis of Speech (A-S) units with verbs.* Generally, the measures of syntactical and grammatical complexity show that when David produced a larger number of English words orally, he tended to create more complex language. An Analysis of Speech, or A-S, unit is a syntactic unit for measuring spoken language. According to Foster, Tonkyn, and Wigglesworth (2000), it is made up of an independent clause or a sub-clausal unit with any related subordinate clauses. On May 11$^{th}$ and 20$^{th}$, when the number of words David produced was highest (306 and 371 words, respectively), he had the largest number of A-S units (87 and 79).

During large group discussion in Ms. Grant's class, complete sentences were often not required because of the nature of the teacher's questioning, students' co-construction of responses, and the regular use of visuals and manipulatives to which everyone could refer by a color name or by a gesture. In such a context students often dropped verbs in clauses because their utterances were usually comprehensible without the verbs. However, on the days where David produced more speech, his A-S units were likely to contain a verb. There were 0.9 verbs per A-S unit on May 11th and 1.3 verbs per A-S unit on May 20th. Furthermore, on these days a greater percentage of David's A-S units had embedded clauses that contained more than one verb (11.4% of A-S units on 5-11 and 10.1% on May 20th), an indicator that he used more complex syntax like compound sentence structure or relative clauses. In contrast, on other days when less language was produced, David's syntax tended to be simpler. On those days the percentage of A-S units with multiple verbs ranged from only 0% to 5% of his total A-S units. One reason David may have produced more A-S units with multiple verbs on days he spoke more was that he read aloud on those days. The text he read aloud often contained embedded clauses with additional verbs. Excerpt 5.7 (May 20, 2010) shows the type of simple sentence structure he produced in natural conversation. In this excerpt he used only the verb "be" with simple sentence structure.

Excerpt 5.7

1 David: That'**s** a half right there.

(David, Transcript, May 20, 2010)

In contrast, in Excerpt 5.8 (May 11, 2010), line 1, he read aloud an objective that contained a relative clause starting with “that”, and two verbs (“list”, “are”).

Excerpt 5.8

1 David: “Students, “*List three fractions that are equivalent to 1-half.*”

(David, Transcript, May 11, 2010)

*Speaking turns.* On the two days with greater language production, David not only spoke more words in total, he also spoke more frequently (see Table 5.3). Frequency is indicated by the increase in the number of his speaking turns. He took 48 turns on May 11th, and 54 turns on May 20th, compared to only 4 turns and 13 turns on the days with comparatively fewer words uttered (May 6th and June 7th). However, speaking more often did not necessarily mean producing more words per turn. Typically, the average number of words per turn was between six and seven, regardless of how much language David produced.

When David produced more words he also produced a larger variety of verb forms than he did on days where he spoke less. For example, on May 6th, David spoke only 26 words in total and he only used four verb forms: “be”, “bend”, “cut”, and “go”. He used these verbs all in the simple present tense. In comparison, on May 20th, when he spoke a total of 371 words, he used twenty-seven different verb forms: “ask”, “be”, “call”, “clean”, “cover”, “cut”, “divide”, “do”, “explain”, “**find”**, “get”, “go”, “help”, “**increase”,** “know”, “look”, “need”, “**rain”**, “read”, “**rise”**, “say”, “see”, “think”, “trust”, “understand”, “wait”, and “write”. Of these 27 verbs, the four verbs printed in bold were unique to David’s speech on this particular day because they occurred in a word problem that David read aloud to the class. It is uncertain whether he would have used those verbs if he had not been reading text aloud. On the 20th, when speaking naturally, David tended to use verbs in the simple present, present progressive or future tenses. The only instance of using the verbs in the past tense on that day was when he read a math word problem aloud.

*Language functions.* As part of the complexity measures, the frequency of three key language functions was appraised in David’s oral language: (1) explanation (i.e., narrating a solution or giving the steps in an approach to solving problems); (2) justification; (3) comparison/contrast. These language functions were chosen for analysis because they were explicitly elicited by the curriculum and they were also encouraged by the teacher. On the Taxonomy of Educational Objectives (Krathwoll, 2002), which is a revision of Bloom's Taxonomy intended for classifying educational goals and objectives, explaining and comparing/contrasting display knowledge. Thus, they are at a lower level of cognitive complexity than functions involving the understanding and use of knowledge, such as justification of solutions to a math problem. It should be noted that the level of cognitive difficulty of a particular language function might differ by content area and classroom context. For example, the function of comparing was somewhat narrower in scope in Ms. Grant's classroom than it might be in other math classes, or in different content classes such as social studies (see Zwiers, 2007). The *RNP 1* curriculum only required students to compare the size of two fractions based on a single dimension rather than on multiple dimensions. Stating which fraction is the larger of two is less complex than comparing and contrasting the causes of two American wars, as Zwiers (2007) described in his research in social studies classrooms.

David's speech contained infrequent use of the three language functions, even on days where he produced more language. He explained/narrated a process and justified answers to problems just three times each (explanation on May 6th, 25th, and June 7th; justification on May 11th and 25th). These language functions appeared slightly more often than the function of comparing and contrasting, which occurred twice (May 20th and 25th).

David used the following general patterns for expressing these language functions Explanation/Narration:

a. Listing steps - *[Action 1] [Action 2] [Action 3]*.

Excerpt 5.9 (May 6, 2010)

Ms. Grant: What, what's <u>do this</u> mean?

David: Go back to your thirds. Go back to your sixths. Bend it in.

b. Read steps from paper – *It said "____"*.

Excerpt 5.10 (May 11, 2010)

David: It said, circle. Circle is the biggest fraction. "*Use the fraction circles to show the xx compare the largest fraction, circle* *the largest fraction, if the fractions are equal, circle both."* It's a circle. Circle. Circle this one. They say circle, then they say compare…

c. Multiple Actions with Chronological & Logical Connectors Plus a Condition – *I say first thing you should [action 1], but if [condition] then [action 2]*

Excerpt 5.11 (May 7, 2010)

David: I say first thing you should look at numerator and the denominator but if the denomirator is the same you add it up.

Comparison

a. Be [comparative]

Excerpt 5.12 (May 20, 2010)

Ms. Grant: How many pieces? So like in the first one, seven-tenths, how many pieces are the circles cut into?

David: Ten pieces. Cut it in ten so is more than. It can't be a half. So is more than it, there would be two left over.

b. It was [equative].

Excerpt 5.13 (May 25, 2010)

Ms. Grant: Did you think that the multiplication side was easier or more difficult than the division?

David: It was the same.

Justification

a. Causal effect/result connector + [reason]

Excerpt 5.14 (May 11, 2010)

Ms. Grant: So if I give you an example and I sa::y, nine over eighteen, I want you to write how do I know that nine- eighteenths is a half or isn't a half.

David: [To partner]: Because it's not listed over there.

b. [Reason Only]

Excerpt 5.15 (May 25, 2010)

Ms. Grant: Why is it easier doing the multiplying?
David: You just put numbers in the blank. You, you double it.

c. I [action]. [reason with ‘when’]

Excerpt 5.16 (May 25, 2010)

Ms. Grant: All right, so the question is, what do we do. Are we going to
add, subtract, multiply or divi:de?
David: Well, I say, um I look at the word ‘spend’…When you have
five dollars, take it to the store, you spent something, the
money that you xx is still subtracting.

Dalton-Puffer (2007) argues that the various language functions operate at different levels of students discourse. As can be seen in David’s speech, in Excerpts 5.9 to 5.16, solving problems/narrating and justifying are what Dalton-Puffer (2007) labels macro functions. These functions cover multiple A-S units and do not always contain particular lexical or grammatical features. For example, in Excerpts 5.15 and 5.16 we know that David was justifying an answer because of the context in which his utterances occurred. He never used the word “because” in either excerpt. In Excerpt 5.15, line two, David’s statement “You just put answers in the blank” followed the teacher’s question “Why?” Because of its proximity to her question it can be interpreted as a justification. In Excerpt 5.16, David immediately followed his answer in line three, “I look at the word spend”, with a reason for why he thought the word spend indicated the use of subtraction in a word problem (“When you have five dollars, take it to the store, you spent something…”). In this excerpt the “because” was unstated, but it was implied.

Solving problems and narrating was also a macro function that did not have specifically prescribed grammar or syntax, but in David’s speech this language function (see Excerpts 5.10 and 5.11) did include some logical connectors. Logical connectors enabled David to show a relationship between two or more sentences, or between a sentence and a clause. David used a few logical connectors to indicate the order of steps in a problem (e.g., “First thing” in Excerpt 5.11), and contrast (e.g., “but” in Excerpt 5.11). Logical connectors were not always included when David performed this language function, such as in Excerpt 5.9, line 2, when David simply described one action at a time in a solution process with a brief pause in between.

Dalton-Puffer (2007) uses the term micro function to refer to language functions that do require particular structures or words. One of David's two examples of comparison, Excerpt 5.12 (line 4), showed that he could use the comparative "more than", when required to do so. In addition, David also used an equative, "the same (as)" in Excerpt 5.13, although he dropped the word "as" so the equative was not fully stated.

Across excerpts, David used a limited variety of types of logical connectors to indicate relationships between elements of his statements. In Excerpt 5.11, line 1, which was an explanation/narration, he used the connector "[the] first thing" to indicate a possible first step in a process. However, he did not continue listing other steps. He followed that with "but" in line 2, and then he described an alternate step under a different set of circumstances. He also used the causal connectors "so" (Excerpt 5.12, line 4), and "because" (Excerpt 5.14, line 4).

***Vocabulary***. As discussed in Chapter 3, accuracy measures used in research studies often include a measure of whether a student made native-like vocabulary choices when speaking (Ellis & Barkhuizen, 2005). As previously mentioned, such studies may use a formula that calculates the amount of lexical error a non-native speaker's speech contains by comparing to the "ideal" of native-speaker lexical choices. However, native English speakers make vocabulary errors too, and the choice by non-native speakers to use different vocabulary than native speakers does not necessarily represent an error (Cook, 1999). Thus, it is difficult, and perhaps inappropriate, to use native-speaker speech as the standard for judging correct vocabulary. For this study, instead of calculating the percentage of native-like vocabulary, I calculated the percentage of students' vocabulary on the General Service Word List (GSL; West, 1953) and the Academic Word List (AWL; Coxhead, 2000). Measured in this way, vocabulary use became a complexity measure. As mentioned, the GSL (West, 1953) is a list of the 2,000 most frequent non-academic words that was developed through an analysis of written texts. It is subdivided into the GSL 1, which contains the first 1,000 most common words, and the GSL 2, which contains the second 1,000 most common words. An English speaker who knows all of the 2,000 words, and the related word families, on the GSL understands the majority of everyday speech and familiar written texts (Granger & Paquot, 2010; Nation, 2006; Hirsh & Nation, 1992) The AWL (Coxhead, 2000),[28] an extension of the GSL, is comprised of 570 word families which are commonly found in academic texts in a variety of content areas, but are not found on the GSL. The AWL excludes technical words used exclusively in a particular field (e.g., math terms) and proper nouns (University of Wellington, 2010).

Figure 5.1 shows, from the five selected lesson transcripts, the proportion of David's vocabulary on the two GSL sub-lists, the AWL, and those not contained on any of the lists.

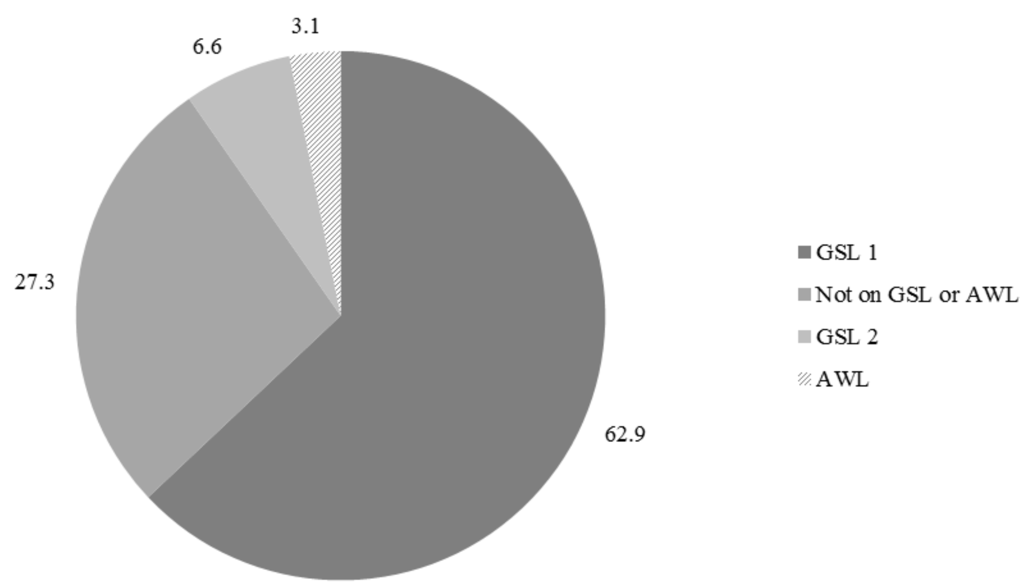


*Figure 5.1.* The percentage of David's vocabulary on the GSL and AWL.

Of the words included in this analysis, the majority (62.9% + 6.6% = 69.5%) were common everyday words found on the GSL1 and GSL 2 lists. The largest portion, approximately 63%, represented GSL 1 basic words such as "about", "be", "can", "do", "if", and "let". (For a complete listing of David's GSL 1 vocabulary, see Appendix I). GSL 1 words also included some that might typically be thought of as school words used by adults, but which are also used in everyday settings outside of school. These included "compare", "describe", "divide", "equal", "explain", "find", and "increase".

[28] An updated version of the AWL, called the Academic Vocabulary List or AVL, was published by Gardner and Davies in August of 2013, after the completion of this study.

GSL 2 words are everyday words that are generally used less frequently than those on the GSL 1 list (University of Wellington, 2010). Only 6.2% of David's vocabulary (n=17 words) was found on the GSL 2. These words included: "ahead", "bend", **"bicycle"**, "brown", "check", "**correct**", "**exact**", "**list**", "pink", "**pool**", "quick", "**rain**", "**swimming**", "thank", "tomorrow", "whole", and "zero" (see Appendix I for the complete list). The seven GSL 2 words in bold type above (41% of his GSL 2 words) were read aloud. It was not clear whether he would have used those words independently in conversation.

Only 3.1% of David's total vocabulary (n= 8 words), was found on the AWL. As mentioned previously, the AWL words typically are found in a variety of academic contexts and do not include technical words unique to the field of math. David's AWL words were: "challenge", "definitely", "**equivalent**", "grade", "partner", "plus", "positive", and "**sum**". Only the two words "equivalent" and "sum" (25%), highlighted in bold, were words David read aloud. The others were all words he used independently during conversation.

Word lists like these do have limitations (Hyland & Tse, 2001). The GSL, although still widely used, is more than 50 years old and may not capture current language use, especially by teenagers. For David, 27.3% of his vocabulary (53 words) was not found on the GSL 1, the GSL 2, or the AWL. These words included names, numbers, specific math words (e.g., "denominator", "times", "numerator", "fraction"), some words frequently used by teenagers (e.g., "really', "hey", "ok", "DVD"), and some school related words (e.g., "score", "worksheet", "packet").

Overall, David's GSL 1 words from the five selected days covered 16.6% of the complete GSL 1 list (166/1000 word families), 1.7% of the GSL 2 list (17/1000 word families), and 1.4% of the AWL list (8/570 word families). Although he most likely knew more words than he used during these five selected lessons, he primarily relied on the most commonly used everyday words from the GSL 1 to communicate his mathematical understanding.

**Summary of David's CAF.** David was a student who demonstrated a fair amount of variability in his CAF across the five selected days. Personal factors affected the amount and complexity of language he produced, and most of that language was produced during large group discussion rather than during pair work. On days when he participated minimally in class his utterances were short (5-8 words), mostly grammatically accurate (with the exception of some plurals and misread verb tenses), and fairly fluent. On days when he participated more, he still had relatively short utterances, but he took more speaking turns. On these days his speech was more disfluent, particularly when reading text aloud, but his language was also more complex. When he participated more he was more likely produce complete A-S units without dropping verbs, and to produce compound sentence structure or relative clauses. However, some of the complex syntax observed in his speech occurred in the text he was reading aloud.

David frequently relied on vocabulary from the GSL 1, representing the most commonly used words in everyday speech and writing. Many of his GSL 2 words, which were slightly less frequent but still common in everyday language, occurred while he was reading math problems or objectives aloud. He was able to use some academic words from the AWL independently, but did not do so frequently. He demonstrated the use of approximately 16% of the words on the GSL 1 list and 1.7% of the words on the GSL 2 list, indicating that he was perhaps far from mastery of the list.

David did not use the language functions of explaining, justifying and comparing/contrasting often in his oral language production. When he did produce them, he was able to use some grammatical constructions to support the language function. For example, he used a limited number of logical connectors to indicate the sequence of steps in an explanation, and he could use a comparative or equative construction to make a statement about the relative size of two fractions.

**Naomi**

Naomi was a 10$^{th}$ grade, approximately 16 year-old, young mother with long, pink, braided hair extensions, big earrings, and a sparkly pair of cat eye glasses. She lived with extended family who helped her care for her toddler. She had plans to graduate from high school and become a nurse so she could support her child. Naomi gave slightly conflicting information about when she had moved to the United States from Liberia. At different points in time she said she had moved in fourth grade and that she had moved when she was eight. She had been in the Franklin district for roughly seven years at the time of the study.

Naomi primarily used Liberian English to communicate at home and with her Liberian friends in school. In math class she said she still thought in Liberian English and then she had to adjust the words she spoke to be those she thought were appropriate for school in the United States. It was unclear whether she had attended school in Liberia, and thus, whether she had been exposed to American Standard English reading and writing before coming to the United States. With her grandmother she spoke a little Loma, a language from northeastern Liberia near the border of Guinea. However, she reported that her oral fluency in Loma was limited.

Naomi had mixed academic achievement results as indicated by her state content and English proficiency assessment scores. Her reading, math and science test scores were generally low. Her 2010 state reading assessment scores placed her at the eighth percentile, which was not proficient. In that same year she was also not proficient on the state writing assessment for English language arts. Her science test scores from grade 9 placed her at the first percentile. The last set of state math test scores available for Naomi was from 7$^{th}$ grade, when she had scored at the fourth percentile.

Her results on the state English language proficiency (ELP) assessment showed that she did have some particular strengths in English. Naomi had scored proficient (five of five possible points) on the writing section in 2010. State assessment documents described students at this level as being successful at most English writing tasks. Students with 5 points displayed academic writing that was generally on topic and clearly organized. They could use a variety of sentence types with appropriate academic vocabulary and could provide evidence to support main ideas. Naomi's ELP reading scores placed her at level three out of four, which was not proficient. State assessment documents described students with three points as able to comprehend simplified academic texts, without pictures or visual supports that contained some academic vocabulary. They are also able to make some inferences while reading, and determine cause and effect relationships.

On the 2009 combined listening and speaking observation checklist that formed a portion of the state ELP assessment Naomi earned three out of five possible points. With this score it was determined she was non-proficient in speaking and listening. Corresponding assessment documents stated that students at Naomi's level could understand oral English speech that was spoken at a slower than usual pace with shorter phrases and sentences. In addition, a student at level three could convey a spoken message clearly but with some grammatical errors and difficulty selecting the right vocabulary. Naomi's scores on the listening and speaking checklist had proven to be unreliable across years because she had scored proficient at earlier grades. Each year the checklist was filled out by an ESL teacher and Naomi had studied with several different ESL teachers over her seven-year period in the district.

Naomi valued math as a subject but was uncertain as to whether it would help her in her goal to become a nurse. She often shook her head while looking at a math assignment and commented that math was easier for her before she had her child. She believed that she could no longer focus her thoughts as well as she used to. She also thought that students who had a higher level of proficiency in English most likely did better at math than she did. Naomi was generally a conscientious student. She attended math class regularly except for the three-day suspension she received for being involved in an argument with another student.

Sometimes during in-class work Naomi was unfocused and chatted with other students. She reported that she was not extremely motivated to do the math assignments. One reason she gave for her lack of motivation was her continuing ELL status. As mentioned previously, the year before the study began Naomi had attended the other high school in the district, Washington High School, where the ELL program had originally been located. At Washington she had been mainstreamed in every subject. However, when she moved to Lincoln High School she had been reenrolled in the ELL pre-algebra course. She frequently complained that ELL pre-algebra was too easy and she wanted to be moved out of the class. One day in conversation she commented "I think if I listened and want to do it, and pay attention, it won't be that hard. But sometime I think 'Oh, this class is too easy. It's ESL and nobody cares' (Naomi, Interview, 5-27-10)." Despite her complaints, she typically turned in her math homework. At the end of the semester, Naomi received a B+ in the ELL pre-algebra class.

**Naomi's CAF in oral English.** This section provides excerpts from transcripts of five selected class periods between April and June of 2010 to highlight Naomi's fluency, accuracy and complexity in oral English. Due to her absence from school, the days selected for Naomi may differ from those selected for other focal students.

***Fluency.*** Table 5.4 shows the total number of false starts, repetitions, and interjections in Naomi's speech on each of the five selected days. It also shows the total numbers of words spoken after the disfluencies were removed from the transcripts.

Table 5.4

*Naomi's Oral Fluency and Total Number of Spoken Words*

| | **Date of Transcript** | | | | |
|---|---|---|---|---|---|
| | **5-6-10** | **5-7-10** | **5-25-10** | **5-26-10** | **6-7-10** |
| **Fluency** | | | | | |
| False Starts | 0.0 | 4.0 | 0.0 | 0.0 | 3.0 |
| Repetitions | 1.0 | 1.0 | 0.0 | 0.0 | 2.0 |
| Interjections | 3.0 | 8.0 | 3.0 | 0.0 | 6.0 |
| **Total Number of Words Spoken** | 171.0 | 181.0 | 59.0 | 55.0 | 170.0 |

As illustrated in Table 5.4, at the time of the study, the amount of language Naomi produced (i.e., total number of spoken words) varied substantially across days. Days that she spoke fewer words were those immediately following her return to class after a three-day absence. On May 6th and 7th she uttered 171 and 181 words, respectively. On her first day back in class after an absence (May 25th) she was confused about the content she had missed so she was particularly quiet. She uttered only 59 words that day and 55 words the next day (May 26th). Her total utterance became longer again on the last day of class (170 words). On the days where she spoke fewer words overall, her fluency errors were minimal. For example, on May 26th she had no fluency errors and uttered statements such as these: "Can you help me for a second? I don't know how to do this." On May 25th she did have a few disfluencies, with three interjections that were commonly used when she was searching for a word.

On days when Naomi produced more language, her fluency errors increased somewhat, although not substantially. On May 7th when she had the most disfluencies (four false starts, one repetition, eight interjections), those disfluencies typically happened when she struggled to read text aloud or when she was searching for a word she could not remember. For example, in Excerpt 5.17 (May 7, 2010), when reading a language objective aloud, Naomi struggled to read the word "written" in line 1, which resulted in a false start. She had a second false start when she stopped reading later in line 1 as she came to math symbols for greater than, less than and equal to. In line 3, she admitted that she did not know how to read the symbols.

Excerpt 5.17

| | | |
|---|---|---|
| 1 | Naomi: | "*Students will use wr- , students will use written words and symbols for-*" |
| 2 | | [She stops reading when she reaches the greater, less than and equals symbols] |
| 3 | Student: | Equivalent. |
| 4 | Naomi: | I don't know how you say that. |

(Naomi, Transcript, May 7, 2010)

Later in the same class period, shown in Excerpt 5.18 (May 7, 2010), the teacher called on Naomi to explain why she thought one-half was bigger than one-fourth. Naomi used two interjections in line 6 (um, oh) because she could not remember the word she wanted to use.

Excerpt 5.18

| | | |
|---|---|---|
| 1 | Ms. Grant: | All right so I'm just going to think of a couple examples. If I say |
| 2 | | one-fourth o:f, and one-half and you say which one is bigger? One-fourth |
| 3 | | or one-half, which is the bigger … fraction? |
| 4 | Naomi: | One-half. |
| 5 | Ms. Grant: | One-half? Why? |
| 6 | Naomi: | It has to be divided into two, um, oh what do they call it? |

(Naomi, Transcript, May 7, 2010)

After this exchange between Ms. Grant and Naomi, Ms. Grant pointed to the word wall to suggest words Naomi could use. Other students called out words such as "denominator". Naomi eventually gave up trying to express her thought because she could not articulate her intended meaning.

As previously mentioned, the style of the lessons on all five days was similar. Large group review and introduction of material was followed by pair work or individual practice with new concepts. Naomi was sometimes focused during pair work and sometimes unfocused, depending on the partner she was assigned. When Naomi worked with Marie, the Kenyan girl who was the top math student in class, the two girls were focused and on task. When she worked with Victoria, another Liberian student who had the most limited English skills, Naomi often did not talk to Victoria because she grew tired of having to help a struggling classmate. When she worked with Hope, a Liberian student who was frequently off task, she often chatted about personal matters and did not engage with the math problems.

***Accuracy.*** Two measures of accuracy, percent of grammatically accurate verb phrases and percent of target-like plurals, were the most useful indicators of Naomi's grammatical accuracy.[29] Table 5.5 shows these two measures across the five days selected for analysis.

Table 5.5

*Naomi's Grammatical Accuracy*

| | Date of Transcript | | | | |
|---|---|---|---|---|---|
| | **5-6-10** | **5-7-10** | **5-25-10** | **5-26-10** | **6-7-10** |
| **Accuracy** | | | | | |
| Percent of Accurate Verb Phrases** | 100.0% (28/29) | 96.9% (31/32) | 100.0% (7/7) | 100.0% (10/10) | 100.0% (31/31) |
| Percent of Target-Like Plurals | 75.0% (6/8) | 100.0% ( 1/1) | 0.0% ( 0/1) | n/a (0/0) | 100.0% ( 2/2) |
| **Total Number of Words Spoken** | 171.0 | 181.0 | 59.0 | 55.0 | 170.0 |

As the table shows, Naomi's grammar was usually relatively accurate. On four of the five days (May 6th, 25th, 26th, and June 7th) she made no verb phrase errors. Her utterances contained the correct form of the verb for the tense chosen and had appropriate verb endings for singular or plural subjects. In Excerpt 5.19 (May 7, 2010) she made only one verb phrase error in line two by deleting the verb "be" from a present progressive tense construction ("we gonna do").

Excerpt 5.19

1 Naomi: The denominator is, um, not the same, so we look at the um, numerator
2 is the same, so we gonna do one, one over fifty, because of the
3 denomirator.

(Naomi, Transcript, May 7, 2010)

In Naomi's case, dropping the verb "be" tended to be more a stylistic choice, perhaps reflecting Black English or Liberian English speech patterns, more than a grammatical error.

[29] The percentage of self-corrections was initially calculated as a grammatical accuracy measure, but is not presented here because it occurred relatively infrequently. Data on this measure can be found in the complete CAF tables located in Appendix I.

In addition to using correct verb forms, Naomi's plurals were also correct much of the time, although she did not use many plurals in any given class period. She made three plural errors out of twelve total plurals used during the selected classes. These errors occurred on May 6th (2 errors) and May 25th (1 error). Naomi's plural errors were relatively sophisticated for a language learner. For example, in Excerpt 5.20 (May 6, 2010) she described a set of fraction circle pieces of different colors and sizes. In line 1 when she stated how many pieces of which color could combine to make a fourth, she turned the word "red" into a noun instead of an adjective. However, she then did not use a plural on the word "red" even though there were four red pieces.

Excerpt 5.20

1 Naomi: Ah four red.

(Naomi, Transcript, May 6, 2010)

On May 25th, shown in Excerpt 5.21, the only plural error she made was the deletion of an 's' on the noun "problem" (line 1) when she was reading an objective aloud.

Excerpt 5.21

1 Naomi: "*Students will write their own, story problem.*"

2 Ms. Grant: All right so today we're going to write some story problem**s**…

(Naomi, Transcript, May 25, 2010)

Naomi's deletion of the plural 's' in line 1 still made sense in the context of the sentence. The teacher repeated the objective in line 2, adding the plural 's' on "problems", but she did not comment further.

***Complexity***. Table 5.6 shows selected measures that highlighted the variability in Naomi's English complexity across days.

Table 5.6

*Selected Measures of Naomi's English Complexity*

| | **Date of Transcript** | | | | |
|---|---|---|---|---|---|
| | **5-6-10** | **5-7-10** | **5-25-10** | **5-26-10** | **6-7-10** |
| **Complexity** | | | | | |
| A-S Units | 48.0 | 40.0 | 20.0 | 14.0 | 39.0 |
| Mean number of Verbs per A-S unit | 0.9 | 1.3 | .55 | 1.3 | 1.1 |
| Percentage of A-S units with 2+ verbs | 6.2% (3/48) | 10.0% (4/40) | 5.0% (1/20) | 0.0% (0/14) | 10.0% (4/39) |
| Number of Turns | 36.0 | 36.0 | 16.0 | 13.0 | 27.0 |

| | | | | | |
|---|---|---|---|---|---|
| Mean Turn Length (words per turn) | 4.7 | 5.0 | 3.7 | 4.2 | 6.3 |
| Number of Verb Forms Used | 13.0 | 14.0 | 5.0 | 7.0 | 17.0 |
| Instances of Explanation Function | 0.0 | 0.0 | 0.0 | 0.0 | 2.0 |
| Instances of Comparing/Contrasting Function | 0.0 | 2.0 | 0.0 | 0.0 | 1.0 |
| Instances of Justifying Function | 1.0 | 4.0 | 0.0 | 0.0 | 0.0 |
| **Total Number of Words Spoken** | 171.0 | 181.0 | 59.0 | 55.0 | 170.0 |

Generally, the measures of syntactical and grammatical complexity illustrate that when Naomi generated more speech (i.e., a greater number of total words), she tended to create more complex language. On May 6th and 7th, and June 7th, when the number of words she produced was the highest (171.0, 181.0, and 170.0 words, respectively), she also had the largest number of A-S units (48.0, 40.0, and 39.0). With the exception of May 25th, her A-S units across days ranged from including 0.9 to 1.0 verbs, indicating that her speech units were usually likely to contain a verb. For example, on May 7th, a day with an average of 1.3 verbs per A-S unit, some of Naomi's more complete statements included those found in Excerpts 5.23-5.25:

Excerpt 5.23 (May 7, 2010)

1 Naomi: I don't know how you say that.

Excerpt 5.24 (May 7, 2010)

1 Naomi: Yeah, I know that one.

Excerpt 5.25 (May 7, 2010)

1 Naomi: I'm hungry.

These statements each contained a verb. They were all made independently and were not in response to questions that someone asked her.

Naomi's language for the May 25th class period was different because it was her first day back in class after an absence. As a result, she had difficulty following the content of the discussion. The few times that she spoke that day she was more likely to respond to a direct question. In these types of statements she could delete the subject and the verb, as illustrated by Excerpt 5.26 (May 25, 2010):

Excerpt 5.26

Ms. Grant: What do we call this number on top?

Naomi: Numerator.

(Naomi, Transcript, May 25, 2010)

In Excerpt 5.26, line 2, Naomi simply provided a one-word answer (“Numerator”) to the teacher’s wh- question (“What do we call this number on top?”), rather than making a complete statement with a verb (e.g., It’s called the numerator).

As with David, A-S units with more than one verb were calculated as an indicator of increased syntactic complexity. Naomi’s speech was actually more syntactically complex on two of the three days that she produced less language, May 7th (36.0 A-S units), and June 7th (27.0 A-S units). Excerpts 5.27 (May 7, 2010) and 5.28 (June 7, 2010) show the complexity that she was capable of producing:

Excerpt 5.27

Ms. Grant: Ana, can you tell us why you said a half is bigger?

Ana: I don’t know.

Naomi: Because when you draw the square and divide it into two one-half it will be bigger than one-fourth.

(Naomi, Transcript, May 7, 2010)

Excerpt 5.28

Ms. Grant: What should we do?

Naomi: …You first look at the bottom number which is the denominator.

(Naomi, Transcript, June 7, 2010)

In Excerpt 5.27, line 3, Naomi used two subordinating conjunctions, “because” and “when” to introduce a compound subordinate clause with two verbs (“*because when you draw the square and divide it into two one-half*”*)*. In Excerpt 5.28, line 2, she used the logical connector “first” to indicate a sequence, and the relative pronoun “which” to introduce a relative clause (“which is the denominator”). She also used the verbs “look” and “is”. Notably, on the two occasions when Naomi produced these examples of complex syntax, the teacher had asked her to perform a more complex language function like justifying an answer to a problem and explaining a solution.

Written text did not seem to be a significant mediator of Naomi’s production of complex syntax because she was not often given the opportunity to read aloud. On the five selected days, Naomi read aloud only twice. The first time she tried to read aloud, shown in Excerpt 5.17, she was not able to finish the sentence because she did not know the words that corresponded with a set of mathematical symbols. This example was categorized as a false start, and thus not included in complexity calculations provided in Table 5.6. On the second day she read aloud, shown in Excerpt 5.29 (May 25, 2010), she read a language objective that contained simple sentence structure with only the verb "write":

Excerpt 5.29

1 Naomi: "*Students will write their own story problems.*"

(Naomi, Transcript, May 25, 2010)

Excerpts 5.27 and 5.28 clearly demonstrated she was capable of producing more sophisticated sentence structure than that contained in the text she read aloud in Excerpt 5.29.

On the three days with greater language production, Naomi not only spoke more words in total, and had more complex constructions, she also spoke more frequently. Frequency is indicated by an increase in the number of speaking turns that corresponded to an increase in the number of words produced. She took 36 turns on both May 6th and 7th, and on June 7th she took 27 speaking turns. In comparison, she took fewer turns (16 and 13) on May 25th and 26th when she uttered fewer words overall (59 and 55 words). For Naomi, an increase in the number of speaking turns was typically related to a slight increase in the average number of words per turn. On the three days where she uttered the most words, the number of words per turn ranged from 4.7 to 6.3. In contrast, on the two days with fewer turns she used 3.7 and 4.2 words per turn.

Similar to the other complexity variables, Naomi produced a larger variety of verb forms on days where she produced more total words. For example, on May 25th Naomi spoke only 59.0 words in total and she only used five verb forms: "do", "know", "minus", "start", and "write". One of these words, "minus", was an adjective that Naomi used as a verb: "Oh you minus [the top number] from the, um, other one, the bottom number also" (Naomi, Transcript, May 25, 2010). Naomi primarily used these verbs in the present tense, but demonstrated that she was also able to independently use a few of them in the past tense (e.g., "Did you do that?"*)*. One verb, "write", occurred in the future tense in a sentence that she read aloud ("*Students* *will write* *their own story problems.")*

In comparison, on June 7th when Naomi spoke 170 words in total she used seventeen different verb forms:  "be", "**count",** "divide", "do", "draw", "**excuse**", "**feel"**, "**finish"**, "go", "have", "know", "look", "put", "say", "see", "**times"**, and "write". Of these seventeen verbs, the five printed in bold were unique to Naomi's speech on this particular day. They occurred in natural speech, shown in Excerpts 5.30-5.34 (June 7, 2010), rather than when reading text aloud.

Excerpt 5.30 (June 7, 2010)

1 Naomi: Excuse me! This is my turn.

Excerpt 5.31 (June 7, 2010)

1 Naomi: It feels so good.

Excerpt 5.32 (June 7, 2010)

1 Naomi: I finished it.

Excerpt 5.33 (June 7, 2010)

1 Naomi: And then do it on the other side, you count it by two.

Excerpt 5.34 (June 7, 2010)

1 Naomi: So you times two by four.

Again, similar to one of the other selected days, Naomi took an adjective, "times" and used it as a verb in Excerpt 5.34. Excerpts 5.30, 5.31, 5.33 and 5.34 were all in the present tense. Only Excerpt 5.32 was in the past tense.

As part of the complexity measures, three key language functions were appraised in Naomi's oral language production: (1) Explanation (i.e., narrating a solution or giving the steps in an approach to solving problems); (2) justification of an answer; (3) comparison/contrast.

On most days, Naomi's speech contained infrequent use of these language functions, with the exception of May 7th. She narrated a solution process only one time on June 7th, compared and contrasted three separate times, twice on May 7th and once on June 7th, and justified the answers to math problems once on May 6th, and four times on

May 7th. Naomi used the following general patterns for expressing these language functions.

Explanation/Narration

*a.* Listing steps with chronological logical connectors - *[You first x and then y…]*

Excerpt 5.35 (June 7, 2010)

| | | |
|---|---|---|
| 1 | Ms. Grant: | You know how to do it? What should we do? |
| 2 | Naomi: | Ok, (you look at the) -… You first look at the bottom number, |
| 3 | | which is the denominator…And then, you have to see what, um, |
| 4 | | two and four can go like, what can go in two and four…So I say, |
| 5 | | um, is they both have four in common…So you times two by |
| 6 | | four…And then do it on the other side, you count it by two. |
| 7 | | So… So, it would be eight on the bottom, you, you draw the |
| 8 | | line for eight. It's eight, that would be four, eight and |
| 9 | | six…Then six. It'd be six plus, four plus six is um, um- |
| 10 | | Ten… You divide it by two…Divide it. Five and four on |
| 11 | | the bottom. |

Compare/Contrast

a. *[The (comparative) x is then the (comparative) y is.]*

Excerpt 5.36 (May 7, 2010)

| | | |
|---|---|---|
| 1 | Ms. Grant: | All right, so if the numerators are the same- |
| 2 | Jesse: | You just look at denominator. |
| 3 | Ms. Grant: | Look at the denominator. |
| 4 | Naomi: | Yah. The smaller it is then- |
| 5 | Jesse: | The bigger the- [struggling to find the words] |
| 6 | Naomi: | =the back is. |

b. Statement of shared element - *[They both have x.]*

Excerpt 5.37 (June 7, 2010)

| | | |
|---|---|---|
| 1 | Naomi: | So I say, um, is they both have four in common. |

Justification

a. Question implying reason

Excerpt 5.38 (May 6, 2010)

| | | |
|---|---|---|
| 1 | Naomi: | Ms. Grant? This one's not going to work. The second one, |
| 2 | | make it into fifteen equal parts? |
| 3 | Ms. Grant: | Why not? |
| 4 | Naomi: | How you gonna make it into fifteen? |

b. Reason only

Excerpt 5.39 (May 7, 2010)

[In answer to the question: One-fourth or one-half, which is the bigger fraction?]

| | | |
|---|---|---|
| 1 | Ms. Grant: | One-half? Why? |
| 2 | Naomi: | It has to be divided into two, um, oh what do they call it? |

*c.* Causal effect/result logical connector + [reason]

Excerpt 5.40 (May 7, 2010)

| | | |
|---|---|---|
| 1 | Ms. Grant: | All right. Naomi I'm going to give you one more try to |
| 2 | | explain what you said before. Go for it. |
| 3 | Naomi: | One over fifty because ah, I can't say the d word. |
| 4 | | Denom- ((sighs)) |
| 5 | | The denominator is um, not the same, so we look at the |
| 6 | | numerator is the same, so we gonna do one, one over fifty |
| 7 | | because of the, um, denomirator. |

Similar to David's language functions, Naomi's language functions were divided into those considered to be macro functions that did not have mandatory grammatical and syntactical patterns, and micro functions that are said to have required patterns (Dalton-Puffer, 2007). Explaining or narrating a solution or an approach, and justification of an answer were both macro functions. In Naomi's example of explaining/narrating (see Excerpt 5.35) she did use a limited number of sequential logical connectors to suggest the order of steps in a solution process (e.g., "You first", and "and then" in lines 3, 6 and 9). She tended to use these same two constructions repeatedly rather than using other sequential connectors such as "second", "third" or "next". She also used the effect/result connector “so” to describe a step she performed as a logical consequence of a previous step or to introduce a conclusion (line 7 ,“So it would be eight on the bottom”).

For the language function of justification, typically Naomi provided a reason for some previous statement she or someone else had made (see Excerpts 5.38 to 5.40). She used a variety of constructions for justifications including asking a question in Excerpt 5.38, line 4, to imply the reason for a statement she had just made. At times she also used a causal effect/result connector such as “because” before the reason (see Excerpt 5.40, line 3), although she did not do so consistently.

Naomi’s comparisons (Excerpts 5.36 and 5.37) were of two types. The first type was a co-constructed conditional (also called correlational) comparative like the one found in Excerpt 5.36 (“The smaller it is, then the bigger the back is”; see Celce-Murcia and Larsen-Freeman, 1983, p. 498).[30] The wording of the statement was a little unclear due to the use of the imprecise term “back”. However, the construction was relatively sophisticated and required a precise format with two comparatives (“smaller”, “bigger”) each introduced by the article “the” and with parallel verb forms (“is”). Naomi (lines 4 and 6) and Jesse (line 5) each constructed part of this comparative and were able to time their utterances so that the separate parts joined into a complete statement. A conditional comparative, which in this case stated an expected outcome under a particular condition, is associated with more advanced levels of English proficiency (Celce-Murcia & Larsen-Freeman, 1983). Neither Jesse nor Naomi were advanced enough in their oral skills, according to their state and district English proficiency assessment scores, to have constructed this type of statement alone. However, together they mediated each other’s language complexity by creating a piece of the whole statement that the other person could build upon. A second type of comparison that Naomi made, in Excerpt 5.37, included naming a common element shared by two objects (“They both have four in common”). In this case there was no comparative grammatical form used. Instead, the statement of the common element was introduced by the word “both”.

***Vocabulary.*** As an additional indicator of complexity, I calculated the percentage of Naomi’s vocabulary on the GSL lists and the AWL list. Figure 5.2 shows the

[30] This example is also presented in Chapter 4 as an example of mediation.

proportion of Naomi's vocabulary on these lists, as well as those not contained on any of them.

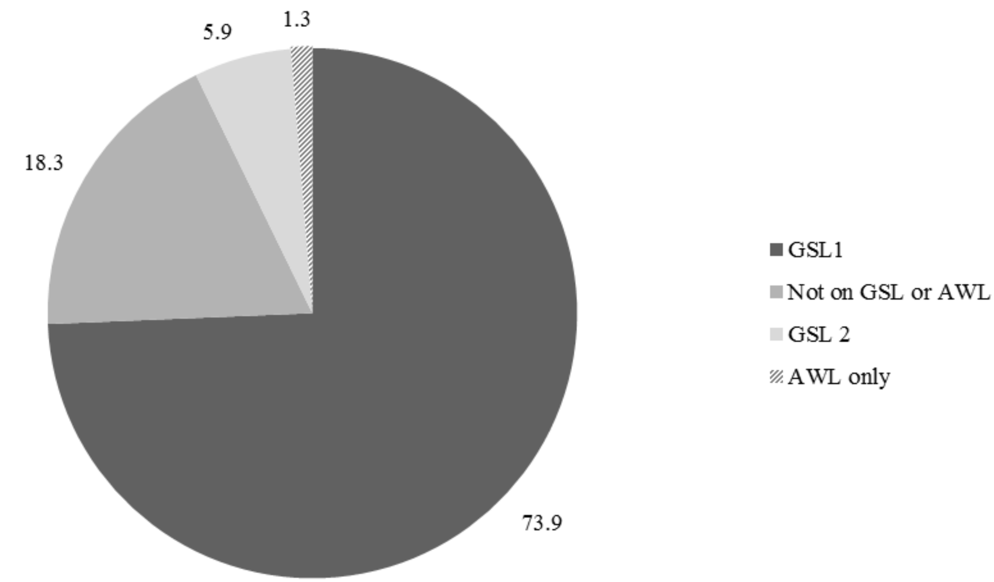


*Figure 5.2.* The percentage of Naomi's vocabulary on the GSL and AWL.

Of the words included in the analyses, more than three-fourths (73.9% + 5.9% = 79.8%) were common everyday words found on the GSL1 and GSL 2 lists. The largest proportion (73.9%) of Naomi's vocabulary was made up of GSL 1 basic words such as "like", "less", "the", "them", "use", "word", "yes" and "you" (For a complete listing of Naomi's GSL 1 vocabulary, see Appendix I). Her GSL 1 words also included some words that might also be used in academic contexts. These words included "common", "count", "divide", and "problem".

Only 5.9% of Naomi's vocabulary was found on the GSL 2 (n=9 words). These words were: "bottom", "check", "excuse", "hungry", "pink", "quick", "sorry", "stuff", and "ticket". She used all of these words independently because she did relatively little reading aloud.

A much smaller percentage, 1.3% (n=2 words) of Naomi's total vocabulary was found on the AWL. Naomi's AWL words were "equivalent" and "symbol". The word "symbol" was included in text that Naomi was asked to read aloud for the class. As shown in Excerpt 5.22 (May 25, 2010), line 3, she was able to use the word "equivalent" independently after being explicitly prompted by the teacher.

Excerpt 5.22

| | | |
|---|---|---|
| 1 Ms. Grant: | What's the word, for, two fractions that look different but they're |
| 2 | | the same? [She holds both hands up next to her ears.] |
| 3 Naomi: | Equivalent. |

(Naomi, Transcript, May 25, 2010)

Referring back to Figure 5.2, 18.3% (n=28 words) of Naomi's vocabulary words were not found on either the GSL 1, 2 or the AWL. These words included names, numbers, specific math words ("denominator", "minus", "times", "numerator", "fraction"), some words frequently used by teenagers (e.g., "bogus", "gosh", "never mind", "really"), and some school-related words (e.g., "students", "worksheet").

Overall, Naomi's GSL 1 words from the five selected days covered 11.3% of the complete GSL 1 (113/1000), <1% of the GSL 2 list (9/1000), and <1 % of the AWL (2/570). Like David, Naomi most likely knew more vocabulary than she used during these five class periods. Even so, given the limited range of the GSL 2 and AWL vocabulary that she produced, it was likely that she did not understand all of the details of the largely oral instruction that took place in Ms. Grant's classroom. When asked if there were words she did not understand during the teacher's presentations, Naomi thoughtfully commented that it was not individual words that were difficult for her to understand. Instead, she thought it was the combined meaning of the individual words that was sometimes difficult for her.

**Summary of Naomi's CAF.** Naomi, like David, was a student who demonstrated variability in her CAF across the five selected days. Confusion about instruction she had missed combined with her changing level of motivation and engagement, and her feelings about her assigned partner for pair work, affected the amount and complexity of language she produced.

Naomi was generally fluent when she spoke. On the days she spoke comparatively little, her fluency errors were minimal. On days she produced more speech her fluency sometimes decreased. The day when she produced the most speech, she also had the most disfluencies in her speech (May 7th). This was a day where she struggled to read text aloud and searched for vocabulary words to express a thought. Her grammar was typically error free. Occasionally her speech patterns included a dropped “be” verb, which may have reflected dialect differences associated with Liberian English or Black English rather than an error.

The length of her utterances was typically short (3-6 words), regardless of how much she participated in class. Overall, there was not a clear relationship between greater speech production and greater syntactic complexity. She produced some of her most complex utterances on days when she spoke relatively little. She did not read aloud often. Therefore, interacting with written text did not seem to be a mediator of greater syntactic complexity.

In general, Naomi used common everyday vocabulary to talk about math. More than two-thirds of her words consisted of those found on the GSL 1 and GSL 2. She used few academic words from the AWL (n=3). In total, her word use covered only about 11% of all the words on the GSL 1 and less than 1% of the words on the AWL, indicating that she may not have had sufficient vocabulary knowledge to comprehend all of the classroom instruction. Sometimes when she was speaking to the class she broke off in the middle of a thought because she could not find the right word to express her idea.

Naomi’s speech contained few examples of the language functions examined (Explanation, Justification, Comparison/Contrast). She used only a small number of logical connectors to help support the expression of these language functions, and she tended to use the same connectors repeatedly (e.g., “And then”). She did not produce the function of comparing and contrasting independently, but she was able to jointly produce a rather sophisticated form of a comparison with another student.

**Jesse**

Jesse was a 9$^{th}$ grade Nigerian boy of approximately 15 or 16 years old. He had been in the U.S. somewhere between one-and-a-half and three years. School records and Jesse’s verbal report differed on the date he arrived. Privately, Jesse indicated that his family had first settled in a southern state, where he had attended school. His parents were worried about the quality of the education he was receiving in that southern state. His mother had stayed behind to work and his father moved the children to the family’s current location. In Ms. Grant’s class, Jesse said he was repeating some of the fractions content. He once mentioned that a previous teacher may have used the same curriculum that Ms. Grant chose to use for her fractions unit. Jesse had recently been named to the Lincoln High School honor roll at the time of the study and had hopes to attend college after graduation.

At home Jesse spoke Yoruba, a language of southwestern Nigeria. He reported that at least some of his primary schooling in his home country had been in English, the national language of instruction in Nigeria. Jesse stated that his teachers used British English, but it was not clear to what extent his teachers mixed English with another language. Surakat (2010) states that there are several varieties of Nigerian English ranging from the Pidgin English spoken by Nigerians who have limited exposure to the language in school settings only, to the "near-native speaker" variety of English spoken by elite, highly educated Nigerians who use it in daily life outside of school (Surakat, 2010). The level and quality of English spoken by teachers in Nigeria may vary between rural and urban schools, and public versus private schools (Surakat, 2010). Thus, Nigerian students who, in theory, attend school in English can have very different experiences with the language.

Jesse had a collection of assessment scores that provided conflicting information about his academic content knowledge, and his English skills. His most recent state ELP reading assessment scores, from the fall of 2009, identified him as not proficient and placed him at a level two out of four. According to state assessment documents, students scoring at a level two could be successful with simple reading activities that involved familiar vocabulary. However, on the state ELP writing test he had scored at level five, which was considered proficient. To score at a level five, he had to demonstrate the ability to use a variety of school vocabulary, use varied sentence types in a well-developed paragraph, have good grammar, and clearly support his ideas with facts. Jesse had no available listening and speaking scores from the observational checklist that was a component of the state ELP assessment. In conversation he spoke English with a strong accent which was at times challenging for native English speakers to comprehend. Because Jesse was a relatively strong math student, he was often called on to help his classmates with math assignments. However, he appeared to lack the oral fluency to explain tasks to them. His classmates reported that he often ended up completing assignments for them rather than explaining them in words (see Chapter 6 for more details).

Jesse liked math and believed it was an important subject for him to study so that he could go to college. At the time of the study he typically was one of the few students who completed and handed in his homework on time. This had not always been the case. Earlier in the year, Ms. Grant had called Jesse's father to discuss her concern that Jesse was not attending to the instruction in class and was not completing the work. After the phone call home, Jesse's behavior had changed. He credited her with getting him back on track. At the end of the semester, Jesse received an A- in ELL pre-algebra. The teacher planned to advance him to a mainstream algebra class in the fall of the following school year.

**Jesse's CAF in oral English.** This section provides excerpts from transcripts of five selected class periods between April and June of 2010 to highlight Jesse's CAF in oral English.

***Fluency.*** Table 5.7 shows the total number of disfluencies in Jesse's utterances on each of the five selected days, as measured by the number of false starts, repetitions, and interjections. It also shows the total number of words spoken after the disfluencies were removed from the transcripts.

Table 5.7

*Jesse's Oral Fluency and Total Number of Spoken Words*

| | Date of Transcript | | | | |
|---|---|---|---|---|---|
| | **5-6-10** | **5-19-10 (F)** | **5-21-10 (F)** | **5-26-10** | **6-7-10 (F)** |
| **Fluency** | | | | | |
| False Starts | 3.0 | 1.0 | 19.0 | 10.0 | 0.0 |
| Repetitions | 6.0 | 0.0 | 16.0 | 8.0 | 0.0 |
| Interjections | 4.0 | 3.0 | 19.0 | 24.0 | 1.0 |
| **Total Number of Words Spoken** | 143.0 | 178.0 | 530.0 | 342.0 | 43.0 |

(F) = Focal student on this day.

As shown in Table 5.7, like David and Naomi, the amount of language Jesse produced (i.e. total number of spoken words), varied substantially across days. Jesse was typically the most on task, both mentally and verbally, during the large group review, presentation and discussion portion of the lesson. During pair work he usually worked with the same partner, Michael, and the two boys had a close relationship. They laughed and joked with each other, but they could focus on work when they needed to do so. However, when they worked together there was little math-focused conversation. They tended to show each other their work, and then to copy each other's answers. As a result, the language represented in Table 5.7 was primarily produced during large group activities.

Similar to David and Naomi, the number of false starts, repetitions and interjections that occurred in Jesse's speech also varied substantially over time. On June 7th, when he produced relatively little language (43 words), he had only one interjection ("Oh"). In contrast, on May 21st when he produced the most language (530 words), he had the greatest number of disfluencies. One reason why he produced so much more language on that day was that several of the more dominant personalities in the classroom were removed from class for misbehavior. There were only a few students remaining during large-group discussion. Jesse responded positively to the small class size and the increased opportunity to speak. On that day he read aloud the objectives and sample problems on more than one occasion, which also increased his language production.

On May 21st Jesse's language contained 19 false starts, 16 repetitions, and 19 interjections. Typically, when he read aloud daily objectives and math problems, or when he tried to express a complex idea that took more than a few words to say, his speech was much less fluent. His decreasing fluency while reading aloud is highlighted in Excerpts 5.41 and 5.42 (May 21, 2010):

Excerpt 5.41

1 Jesse: "*Is the sum greater than, great than, great than, or less than one.*"

(Jesse, Transcript, May 21, 2010)

Excerpt 5.42

1 Jesse: "*Richard has two-third of a pencil. And, and Marie had one-sixth of a*
2 *pencil. Ah, what, which, which of them had, had the most pencil?*"

(Jesse, Transcript, May 21, 2010)

In these two excerpts, repetition of words may have occurred, in part, because Jesse was nervous reading in front of the class. In Excerpt 5.42, line 1 and 2, he read aloud a word problem he had created as homework. Presumably, he was familiar with the text, but in line 2 he still had one interjection (ah), and two repetitions (which, had).

Jesse also had a sense of humor and sometimes used repetition to make a joke, as shown in Excerpt 5.43 (May 21, 2010), line 3, where he repeated the word “me” four times to call attention to himself as a possible volunteer for a task.

Excerpt 5.43

| | | |
|---|---|---|
| 1 | Ms. Grant: | Jorge do you want to try to model [the problem] up here? |
| 2 | | [She points at the overhead projector] |
| 3 | Jesse: | Yeah, me too. Me, me, me, me! |

(Jesse, Transcript, May 21, 2010)

***Accuracy.*** Two measures of accuracy, percent of grammatically accurate verb phrases and percent of target-like plurals, proved to be the most useful indicators Jesse’s grammatical accuracy. Table 5.8 shows these two measures across the five days selected for analysis.

Table 5.8

*Jesse’s Grammatical Accuracy*

| | Date of Transcript | | | | |
|---|---|---|---|---|---|
| | **5-6-10** | **5-19-10 (F)** | **5-21-10 (F)** | **5-26-10** | **6-7-10 (F)** |
| **Accuracy** | | | | | |
| Percent of Accurate Verb Phrases | 100.0% (23/23) | 100.0% (27/27) | 98.0% (99/101) | 96.4% (53/55) | 100.0% (11/11) |
| Percent of Target-Like Plurals | 89.0% ( 8/9) | 36.0% (4/11) | 75.0% (21/28) | 27.3% ( 3/11) | n/a (0) |
| **Total Number of Words Spoken** | 143.0 | 178.0 | 530.0 | 342.0 | 43.0 |

As the table shows, Jesse’s verb phrases were usually correctly formed. Between 96.4% (May 26th) and 100% (May 19th and June 7th) of them were accurate. They contained the correct form of the verb for the tense chosen, and had appropriate verb endings for singular or plural subjects. Occasionally he did drop the verb “be” from his sentences, as shown in line 2 of Excerpt 5.44 (May 26, 2010):

Excerpt 5.44

| | | |
|---|---|---|
| 1 | Ms. Grant: | I think we need to use the word ‘how’. How much- |
| 2 | Jesse: | How much more candy bar left. |

(Jesse, Transcript, May 26, 2010)

In line 2, Jesse deleted the verb “is” after the subject “candy bar”.

In Excerpt 5.45 (May 21, 2010), line 1, Jesse also made two verb phrase errors when he dropped the ‘s’ on the word “lives” twice in line 1 while reading the math problem aloud.

Excerpt 5.45

| | | |
|---|---|---|
| 1 | Jesse: | Ok. “*Joe live four, four-tenth of a mile from school. Mary live one-* |
| 2 | | *six, of a mile away.”* |

(Jesse, Transcript, May 21, 2010)

These types of subject-verb agreement were relatively infrequent.

Correct formation of plurals appeared to be more problematic for Jesse. On the days where he used nouns requiring plural markers (May 6th, 19th, 21st, and 26th) he made at least one plural error on each day. Usually the dropped plurals occurred on the endings of fraction names, as shown in lines 2 and 3 of Excerpt 5.46 (May 26, 2010), below:

Excerpt 5.46

| | | |
|---|---|---|
| 1 | Ms. Grant: | All right, so which fraction is bigger? |
| 2 | Jesse: | Seven-eight. |
| 3 | Jesse: | Hah hah. That’s like seven-eight. |

(Jesse, Transcript, May 26, 2010)

Twice, in lines 2 and 3, Jesse dropped the plural marker on the word “seven-eighths”. Notably, many fraction words end with a consonant cluster like ‘ths’. He did not typically drop the plural ‘s’ on nouns that were not fractions. For example, he included the ‘s’ on the word “heads” in line 2 of Excerpt 5.47 (May 19, 2010):

Excerpt 5.47

| | | |
|---|---|---|
| 1 | Ms. Grant: | I want you to use your fraction circles please. |
| 2 | Jesse: | Why? Let’s do it in our heads. |

(Jesse, Transcript, May 19, 2010)

***Complexity.*** Similar to David’s and Naomi’s, Jesse’s complexity measures include those that measure the structure of his syntax, the variety of different words he knew of a particular grammatical form (i.e., verbs), and whether he could perform key language functions that had increasing levels of cognitive complexity. Table 5.9 shows selected measures that highlighted the variability in Jesse’s English complexity measures across days.

Table 5.9

*Selected Measures of Jesse's English Complexity*

| | Date of Transcript | | | | |
|---|---|---|---|---|---|
| | **5-6-10** | **5-19-10 (F)** | **5-21-10 (F)** | **5-26-10** | **6-7-10 (F)** |
| **Complexity** | | | | | |
| A-S Units | 53.0 | 66.0 | 185.0 | 129.0 | 15.0 |
| Mean number of Verbs per A-S unit | 0.6 | 0.5 | 0.6 | 0.5 | 0.7 |
| A-S units with 2+ verbs | 5.7% | 0.0% | 0.1% | 3.1% | 6.7% |
| Number of Turns | 48.0 | 56.0 | 151.0 | 117.0 | 14.0 |
| Mean Turn Length (words per turn) | 3.0 (143/48) | 3.2 (178/56) | 3.5 (530/151) | 2.9 (342/117) | 3.0 (43/14) |
| Number of Verb Forms Used | 13.0 | 12.0 | 29.0 | 11.0 | 8.0 |
| Instances of Explaining Function | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 |
| Instances of Comparing/Contrasting Function | 0.0 | 1.0 | 1.0 | 0.0 | 0.0 |
| Instances of Justifying Function | 0.0 | 0.0 | 3.0 | 0.0 | 0.0 |
| **Total Number of Words Spoken** | 143.0 | 178.0 | 530.0 | 342.0 | 43.0 |

(F) = Focal student on this day.

Generally, the measures of syntactical and grammatical complexity show that Jesse's utterance complexity did not tend to correspond to the total number of words he spoke. The number of A-S units he produced did relate to the number of total words he produced. For example, on June 7th when he spoke the fewest words (n=43), he did have the smallest number of A-S units (15.0) of any of the five days. In contrast, on May 21st when he uttered the most words (530.0) he produced the largest number of A-S units (185.0). However, as shown by the low figure for the mean number of verbs per A-S unit (0.5-0.7 across days), even when he spoke a large number of words he tended to speak in short phrases that often did not contain a verb. Excerpt 5.48 (May 6, 2010) contains an example of this type of A-S unit that was missing both a subject and a verb, yet was completely comprehensible within the shared classroom context of working with colored fraction pieces.

Excerpt 5.48

1 Ms. Grant: What do you think it is?

2 Jesse: Pink and red.

(Jesse, Transcript, May 6, 2010)

Jesse could utter complex A-S units that contained more than one verb when he was given the opportunity to do so. Typically, these complex A-S units with multiple verbs comprised a small percentage of his total A-S units (ranging from 0% on May 19th to 6% on June 7th), but he could produce them independently, as Excerpt 5.49 (May 6, 2010) illustrates.

Excerpt 5.49

Jesse: Question?

Ms. Grant: Yes Jesse?

Jesse: Um, isn't it top number…that we're gonna use to divide everything? Like he… used three, three, [holding his pen horizontally and moving it from top to bottom to indicate parts of the fraction], three, three, and he used two, two here.

(Jesse, Transcript, May 6, 2010)

In addition to the verb "isn't" in line 3 of Excerpt 5.49, Jesse created a complex sentence by using a relative clause starting with "that" and the verbs "is" and "use" as well as the infinitive "to divide". In lines 4 to 6 he was able to create a compound sentence with two parallel phrases that both incorporated the verb "use" ("Like he used three, three", plus "he used two, two here"). These two phrases, each containing a verb, were joined together by the conjunction "and".

Jesse was also occasionally required to use multiple verbs when reading aloud objectives written by the teacher or when reading problems from the curriculum. These texts provided him with examples of complex sentence structure, but it was unclear whether he thought of them as models for his own speech, given how little emphasis there was on language use in the curriculum. Excerpt 5.50 (May 21, 2010) contains an example of a read aloud text that contained three sentences with complex structure that had embedded clauses using more than one verb.

Excerpt 5.50

Jesse: "*Alice noticed that there was three-fourths of a pizza left after the party. She, ate, a-*" What's that?

Ms. Grant: Slice.

Jesse: "*A slice of pizza that was the size of one-eighth of a whole pizza. How much pizza was left after her ate the slice?*

(Jesse, Transcript, May 21, 2010)

In lines 1 and 2 of Excerpt 5.50, Jesse read aloud a sentence with a relative clause beginning with “that”. The complex sentence included the verbs “notice” and “be”. Starting in line 4, and continuing in line 5, he read aloud a complex sentence with a second relative clause, also beginning with “that” (“A slice of pizza that…”). He read text including the logical connector “after” to introduce a sub clause and incorporating the verbs “was” and “ate”.

There was one unique aspect of Jesse’s utterances that sometimes made it difficult to determine the complexity he was capable of producing independently. Jesse sometimes produced the same statements made by other students or adults in the room. These identical utterances occurred so close in time to the original statements that it appeared he was echoing them. Echoing could have been a compensation strategy that Jesse used to make up for L2 weaknesses. However, given his relative content knowledge strength compared to other students, repetition might also have been a way to validate a thought he had that was similar to another student, and to attend to the language they used to express the idea. Excerpt 5.51 (May 21, 2010) contains an example of this echoing behavior.

Excerpt 5.51

| | |
|---|---|
| Ms. Grant: | So, what was the, can we write a little equation and say |
| | what did we do here?  We took four-sixths. |
| Jesse: | We took four-sixths. Wait. Four-sixths equals |
| Ms. Grant: | I heard a minus. |
| Jesse: | Minus, um one-sixth. |
| Jesse: | Equals to - |
| Marie: | Three-sixths. |
| Jesse: | Three-sixths. |

(Jesse, Transcript, May 21, 2010)

In Excerpt 5.51, Jesse echoed words used by his teacher and classmate, Marie, to construct a mathematical formula. In line 3 he echoed the teacher’s phrasing of “We took four-sixths” from line 2. In line 4 Ms. Grant commented that she heard someone use the word “minus”. Jesse then used that same word, “minus”, in his utterance in line 5, and added his own contribution “one-sixth”. He independently used the words “equals to” in line 6, but then in line 8 he again appeared to echo his classmate Marie’s answer, “three-sixths". Combining all of Jesse's words across lines creates the clear statement "We took four-sixths…minus…one-sixth…equals to…three-sixths", but Jesse borrowed five of the eight words from the speech of others.

As part of the complexity measures, the same three language functions were appraised in Jesse's oral language production: (1) explanation/narration; (2) justification of an answer, and; (3) comparison/contrast. Jesse's speech contained infrequent use of any of these language functions. All of them (1 explanation/narration, 1 comparison/contrast, and 3 justifications) occurred on the day that he produced the most language (May 21st). Typically his oral language consisted largely of answering the teacher's questions.

He used the following general patterns for expressing the three language functions:

Explanation/Narration

a. List of steps with conditional, additive, and chronological and logical connectors plus a justification with a causal/result connector - *Because if we [action], then that is [color]. [Reason].*

Excerpt 5.52 (May 21, 2010)

| | |
|---|---|
| Jesse: | Because, like, if we put three, three, um, three of those, like |
| | there's three of those- |
| Ms. Grant: | Ok. |
| Jesse: | =then one ah, one over eight, that's grey. And we'll put it- |
| | because that's less than, it's not a whole circle. |
| Ms. Grant: | Ok. |
| Jesse: | And that's why I said it's less than. |

Justification

a. Causal effect/result connector + [reason]

Excerpt 5.53 (May 21, 2010)

| | |
|---|---|
| Ms. Grant: | So how could we show that? |
| Jesse: | That's five eighths. |
| Jesse: | Or six-eights. |
| Ms. Grant: | <u>Six</u> eighths? |

Jesse: Yeah. Because we’re, ah, we’re not, we’re not adding. We’re subtracting, away from, ah, the, um, ah, the three-fourths.

Excerpt 5.54 (May 21, 2010) - Read evidence from text

Ms. Grant: What kind of problem is this? Are we going to be adding or subtracting?
Jesse: S-, s-, subtracting.
Ms. Grant: Subtracting? What makes you think its subtracting?
Jesse: Because=
Victoria: *“How far”*.
Jesse: = *“how far”*.
Marie: *“How [much] farther from school.”*
Jesse: *“How [much] farther from school.”*

Excerpt 5.55 (May 21, 2010) - Gave explanation/narration with logical connectors

Ms. Grant: Ok Jesse do you want to tell us why you think you have to subtract?
Jesse: Because, like, if we put three, three, um, three of those, like there’s three of those… then one ah, one over eight, that’s grey. And we’ll put it-, because that’s less than, it’s not a whole [gestures with hands in circle shape]…it’s not a whole circle [makes circle shape again]. And that’s why I said it’s less than.
Ms. Grant: Are there…[she thinks]…you said you thought less than. Do you see the words less than?
Jesse: No.
Ms. Grant: What words do you see in there that make you think it should be subtract?
Jesse: Ah, wait- [thinking]

Comparison/Contrast

a. It is [comparative] than [fraction].

Excerpt 5.56 (May 19, 2010)

Ms. Grant: Is it more than a half, this candy bar?

2 Jesse: No.

3 Ana: Le-, less.

4 Jesse: It's less than a half.

Excerpt 5.57 (May 21, 2010)

1 Ms. Grant: So we can say four-tenths minus one-fifth.

2 Jesse: That's more than half. Sorry, more than a half.

Jesse had comparatively few instances of explaining/narrating, justifying or comparing/contrasting because in most cases he simply answered the teacher's informational questions with a brief statement that was often not a complete A-S unit. When he did use explanation/narration he primarily listed steps (see Excerpt 5.52) with a variety of logical connectors such as the chronological and logical connector "then" (line 4), and the additive connector "and", to indicate the order of those steps. In line 4 he appeared to use the additive connector "and" in place of the chronological connector "then" ("And we'll put it because that's less than"). Even with the use of these connectors, his exact meaning was somewhat vague because he frequently relied on general pronouns like "those" (lines 1 and 2), "that" (line 4), and "it" (lines 5 and 7) to communicate his ideas. It was not easy to determine the noun to which they referred. Jesse structured his explanation as a justification, and used the causal/result connector "because" in line 1, creating a kind of dual purpose language function. Further, he also added the conditional connector "if" in line 1.

The examples of justification (see Excerpts 5.53-5.55) typically incorporated the use of the causal/result connector "because" followed by a reason (e.g., Excerpt 5.53, lines 5-7; Excerpt 5.54, line 5; Excerpt 5.55, line 3). However, the way that Jesse structured the reason differed across examples. Sometimes the relationship between his reason statement and what he was attempting to justify was not clear. For example, in Excerpt 5.53, lines 5-6, he named a math process ("We're not adding. We're subtracting…") as his reason for providing the answer six-eighths to a problem, without explicitly stating how subtracting resulted in six-eighths. He seemed to be unaware of the intent of Ms. Grant's question in line 4, "Six-eighths?" She used stress to indicate that perhaps he had an incorrect answer that she wanted him to fix. In Excerpt 5.54, Jesse read text aloud ("how far" in line 7 and "how [much] farther from school" in line 9) as evidence to support his answer that another math problem was asking him to subtract. Again, after he read the text he did not explicitly state why the words required subtraction so his reason was somewhat vague. Finally, in Excerpt 5.55 he provided an explanation/narration of a solution process as a justification statement and incorporated logical connectors to indicate the sequence of steps. Jesse used the causal/result connector “because” in line 3 plus the conditional connector “if” (“Because, like, if we put three, three, um, three of those…”). Then in lines 5 and 7 he used the additive connector “and” as well as the chronological and logical connector “then” to introduce more steps in the process as well as to introduce his conclusion. In Excerpt 5.55 Jesse provided more detail in his reasoning than was required for the problem context. He did not need to state the entire solution process; he simply needed to give a reason to justify his answer. The abundance of detail plus his overuse of vague pronouns such as “it” and “those” in lines 3-5 made his justification challenging for a listener or reader to comprehend.

Comparisons were sometimes required by the wording of a problem on which students were working. At times they were asked to use the mental strategy of comparing a fraction to a known quantity such as one-half or one to judge the relative size of the fraction. As mentioned previously, in the context of these problems the teacher often structured her language as a question with a forced choice (e.g., Is the answer larger or smaller than ½?). This type of question did not usually require an overt comparison statement. Instead it typically required students like Jesse to make a mental comparison and then to name the result of that comparison (e.g., bigger). Because Jesse was frequently asked questions of this nature, his use of the comparative forms “less than” in Excerpt 5.56 and “more than” in Excerpt 5.57 were somewhat atypical.

***Vocabulary.*** The percentage of Jesse’s vocabulary on the General Service Word (GSL) and the Academic Word List (AWL) was calculated as an additional indicator of complexity. Figure 5.3 shows the proportion of Jesse’s vocabulary on the GSL lists, the AWL, and those not contained on any of the lists.

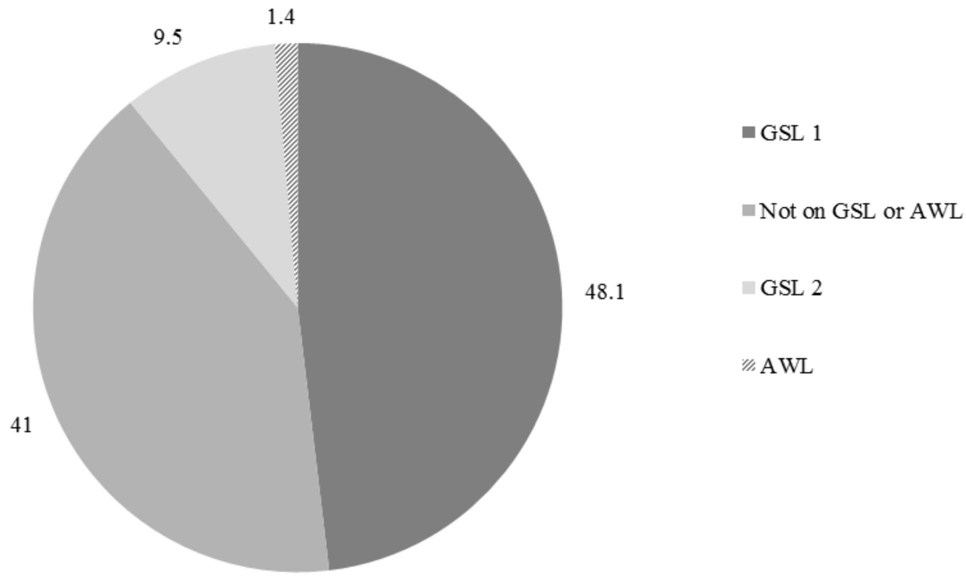


*Figure 5.3.* The percentage of Jesse's vocabulary on the GSL and AWL.

Of the words included in the analyses (n= 210 words across days), slightly more than half (49.1% + 9.15% = 57.6%) were common everyday words found on the GSL1 and GSL 2 lists. Approximately 48% of Jesse's vocabulary (n= 101 words) was made up of GSL 1 basic words such as "a", "bar", "do", "get", "I", "man", "number", "red", "their", "wait", and "yesterday". (For a complete listing of Jesse's GSL 1 vocabulary, see Appendix I). His GSL 1 words also included a few that might typically be thought of as school words used by adults, but which are also frequently used in everyday speech. These included "difference", "divide", and "notice".

Only 9.5% of Jesse's vocabulary (n=20 words) was found on the GSL 2. These words included "bend", "fold", and "purple" (see Appendix I for the complete list). An even smaller percentage, 1.4% of Jesse's total vocabulary (n= 3 words), was found on the AWL. Jesse's AWL words were: "**estimate**", "**participate**", and "partner". "Partner" was the only AWL word he used completely independently. "Estimate" was a word found in text he read aloud to the class. "Participate" was a misreading of the word "prepare" in a language objective that Jesse read aloud.

The remaining 41% of Jesse's vocabulary (n= 86 words) was not found on the GSL 1, the GSL 2, or the AWL. These words included names, numbers, specific math words (“minus”, “math”, “subtract”), some words frequently used by teenagers (“pizza”, “candy”, “kidding”, “wow”, “whatever”), and some school-related words (e.g., “quiz”, “students”, “worksheet”). It also included a more obscure word, “haughty”, that Jesse used to describe a classmate.

Overall, Jesse’s words from the five selected days covered roughly 10% of the complete GSL 1 (101/1000), 2% of the GSL 2 list (20/1000), and <1% of the AWL (3/570). It was likely that his productive vocabulary on other days could have included more words from the GSL and AWL word lists. Also, Jesse may have understood more vocabulary than he could use, given that he was at least partially educated in English. No measure of vocabulary comprehension was included in this study. Even so, despite these facts it appeared that Jesse’s English vocabulary knowledge was much more limited than the 5,000 or more words required to understand everyday speech and common everyday texts (Granger & Paquot, 2010; Hirsch & Nation, 1992; Nation, 2006), not to mention the knowledge required to understand academic speech and mathematics texts.

**Summary of Jesse’s CAF.** Jesse’s CAF was highly variable across the five selected days. He produced more speech on days when there were fewer people in class, or when particularly dominant personalities were absent, so there were more opportunities to speak. He also produced more speech on days he was asked to read objectives or math problems aloud to the class. On days when he produced more speech, his fluency tended to decrease. In part, the decrease in fluency may have been related to nervousness when reading aloud, or possibly to poor English reading skills.

Jesse’s grammar showed mixed strengths and weaknesses. He typically produced accurate verb phrases, with some occasional elimination of the verb “be” which may have been related to a dialect difference or may have been an error. However, he struggled at times with dropping the plural endings on nouns. The majority of Jesse’s errors with plural endings occurred on fraction words such as “seven-eighths” where he dropped the ‘s’ and made “seven-eight”. It is unclear whether this error reflected some patterns from his first language of Yoruba or whether he had difficulty pronouncing the consonant cluster “ths”.

He usually spoke in short phrases of approximately three-word chunks that did not include a verb phrase. Typically he produced this kind of response to the teacher’s yes/no or forced choice question (e.g., Teacher: Was the answer larger or smaller? Jesse: Larger), but the short phrase also occurred when he echoed other students responses. Echoing was a strategy he relied on to either compensate for weak L2 skills or to validate language choices made by other students.

Jesse produced few examples of the language functions of interest for this study, but he produced more justifications than comparisons or explanations. Instead of verbalizing a comparison, he typically thought it silently after he was prompted by the teacher and he named the result of the comparison (e.g., Teacher: Is the answer more than a half or less than a half? Jesse: Less.) On three of the five selected days he did not produce any of the highlighted language functions. Most of his language production provided information in response to the teacher's questions. When he did produce one of the selected language functions, he could use a limited number of basic logical connectors (e.g., because, and then), primarily to show a relationship between an answer and a justification, or to show the next step in a solution.

Jesse tended to use common everyday words to talk about mathematical ideas. Slightly more than half of his vocabulary was made up of words found on the GSL 1 and 2. The majority of these words were the basic words found on the GSL 1. Only a few of his words represented academic language found on the AWL. In total, his vocabulary choices covered 10% or less of the GSL 1 and GSL 2, indicating that he may have lacked the vocabulary knowledge needed to comprehend the math instruction.

**Marie**

Marie was a tall, thin, 16 year-old Kenyan girl in 9th grade. She had close-cropped hair and a quiet demeanor. Marie often wore t-shirts with sayings on them such as the school motto or the name of a popular candy bar. As the only East African student in Ms. Grant's class, she often did not interact much socially with the other students during class time. She was often seen carrying an English novel which she sat and read while other students got settled at the start of class. About 18 months before the start of the study, Marie's family had emigrated from Kenya to the United States. She had only attended school in the Franklin district since she had arrived in the United States. She primarily used Kikuyu, a language of central and west-central Kenya, at home with her family. In urban and suburban Kenyan schools with a linguistically diverse student body, instruction in grades 1-3 is typically offered in Kiswahili, the lingua franca of Kenya, which is a second language for many students. However, in rural areas, Kiswahili may be less commonly spoken (Cleghorn, 1992). Therefore, Marie may have been instructed in Kikuyu for her first three years of primary school, which is a common practice in rural schools with a linguistically homogenous student body (Bunyi, 2005; Cleghorn, 1992). The country's official language of English is, in theory, the sole medium of content instruction from grade 4 on (Cleghorn, 1992). From that point on, curricular materials and exams are typically written in English (Nyaga & Anthonissen, 2012). Yet, given that many teachers may lack fluency in English (and possibly in Kiswahili), they may often code-switch using either the local language and/or Kiswahili to make content presented in English more accessible to students (Bunyi, 2005; Cleghorn, 1992; Nyaga & Anthonissen, 2012).

Marie reported that she had attended several years of schooling in Kiswahili. Her proficiency in each of the language modalities is unknown since Kiswahili was her L2. She had also spoken Kiswahili at church events in her community in Kenya, and she still spoke the language at her church in the United States. Marie said that she had only a little exposure to English when she was in primary school. Even so, her utterances in Ms. Grant's class could be quite formal, and they incorporated a style of speaking that suggested some study of the language. During class she often did not speak much, but in one-on-one conversation she could be quite articulate, as shown in Excerpt 5.58 (May 11, 2010). In this excerpt I had just asked her if she had any difficulties solving four problems on a worksheet.

Excerpt 5.58

Marie: They are all the same size and they were trying to confuse us with the
'A' which can't be possible. We didn't have that.[31]

(Marie, Interview, May 11, 2010)

Because Marie was relatively new to the country she had not been required to take all the reading, mathematics and science subtests of the state assessment as a 9th grader. She had taken the state writing test and she received a score of not passing. She also had

[31] This utterance is grammatically correct and uses complex structure, yet it is slightly difficult to interpret because of Marie's use of vague pronoun referents such as "they" to refer to different subjects in lines 1 and 2.

district reading scores on a computer-adaptive assessment that was equated to the state standards-based reading assessment. The district reading assessment scores indicated that she scored at the 12th percentile in the winter of 2009. The 12th percentile was not a high enough score to pass the state reading assessment.

On the state ELP assessment Marie was much stronger in reading and writing than some of the other students in Ms. Grants' class. She received a score of 4 out of 5 on the writing test and 3 out of 4 on the reading test. Neither of these scores placed her at the proficient level, but state assessment documents indicated that students with similar scores were successful at many English reading and writing tasks, especially if they were designed for L2 learners. Students with these scores could understand and use common school vocabulary and even some infrequently used academic words. In reading, students at level three could identify cause and effect relationships and make inferences about the text even when there were few supporting visuals. For writing, students at level four could create a variety of sentence types and add some detail to support their main ideas. The grammar of a level 4 student was usually fairly accurate while the writing was on topic and reasonably well organized.

Marie hoped to graduate from an American high school and be a banker. To support her goals, she wanted to take every math class that she possibly could because she believed American math classes were easy. She reported that math classes in Kenya had been difficult, and she regularly received low scores on exams there. She had already studied fractions in Kenya in sixth grade and still used some math terms she had learned there (e.g., "Least Common Multiple" or LCM, and "Greatest Common Divisor" or GCD). In Ms. Grant's class she was one of the top math students and one of the few students to receive an A for her final grade. Ms. Grant planned to recommend that she take the mainstream algebra class in the fall of her 10th grade year.

**Marie's CAF in oral English.** This section provides excerpts from transcripts of five selected class periods between April and June of 2010 to highlight Marie's CAF in oral English.

***Fluency.*** Table 5.10 shows the total number of false starts, repetitions, and interjections in Marie's speech on each of the five selected days. It also shows the total number of words she spoke after disfluencies were removed from the transcripts.

Table 5.10

*Marie's Oral Fluency and Total Number of Spoken Words*

| | Date of Transcript | | | | |
|---|---|---|---|---|---|
| | **5-6-10 (F)** | **5-18-10 (F)** | **5-21-10 (F)** | **5-26-10** | **6-7-10** |
| **Fluency** | | | | | |
| False Starts | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 |
| Repetitions | 2.0 | 0.0 | 3.0 | 0.0 | 0.0 |
| Interjections | 0.0 | 0.0 | 1.0 | 0.0 | 1.0 |
| **Total Number of Words Spoken** | 51.0 | 30.0 | 84.0 | 78.0 | 55.0 |

(F) = Focal student on this day.

As shown in Table 5.10, at the time of the study, Marie produced very little speech in class on the five selected days. Her total number of words ranged from 30 on May 18th, to 84 on May 21st. The reason why she produced so little language some days was not clear. However, there were days when Marie did not have enough money in her student account to eat lunch before coming to class. Hunger may have affected her participation. She also had some conflict with one other female student in the room that may have decreased her willingness to participate in the large group discussion. On May 21st she spoke a greater number of words, in part, because she tried to explain her thinking about a problem. It took her several tries to express her idea. Similarly, on May 26th she read aloud a math word problem that she had created so that the class could try to solve it. On that day she was asked to read her problem several times and her total word count reflects multiple readings of the same text.

In general, Marie seemed to try to produce speech that was relatively error free. The largest number of disfluencies in her speech, two false starts, three repetitions and an interjection, occurred on May 21st. Most of them were contained in Excerpt 5.59, lines 1-18, as Marie struggled to explain the process for finding an answer to a problem. In this excerpt, Ms. Grant stopped other students from interrupting so that Marie had time to formulate her ideas.

Excerpt 5.59

1 Ms. Grant: What could we do to find out exactly how much it is?

What’s the process? Marie?

Marie: We find each half and which color can fits here. I don’t know.

[A student tries to interrupt.]

Ms. Grant: Well, let’s let Marie finish. So find out what color fits in the, empty space?

Marie: The empty space. And then I guess it’s red because-

Ms. Grant: Marie, can you tell us now, I’ve never seen it done that way. I think that’s a really good idea. So if the red is the missing much is this?

Marie: Eleven-twelfths.

Ms. Grant: Eleven-twelfths. How did you know that?

Marie: Because when, when you take xxx, ah eleven can, eleven can when you take eleven pieces of, eleven reds, when you arrange them-

[Another student asks for a turn to speak.]

Marie: When we arrange reds here, it’s gonna, you’re gonna need elevens, eleven reds to, to cover this, this, this piece to help it.

(Marie, Transcript, May 21, 2010)

In lines 7, 13, and 14-15 of Excerpt 5.59, Marie’s speech contained multiple false starts. She began an idea in line 7 with “I guess it’s red because” and then broke off her speech before finishing the thought. In line 13 she picked up her thought again at “because”, but broke off again after “when you arrange them”. Her interjection in line 13 (“ah”) and repetition of the words “to” and “this” in line 18 also indicated she was searching for words, although she did finish her thought. Each time she struggled, one of the Nigerian male students raised his hand and asked for permission to finish her answer. If the teacher had not been aware of Marie’s need for extra time to speak it is unlikely that Marie would have completed her sentence.

On a typical day, Marie was on task during large group discussions and appeared to be engaged with the material even if she did not speak much. During pair work she did not typically interact a great deal with her assigned partner. She appeared to prefer to work alone on the task.

***Accuracy.*** As with other students, the two measures of grammatical accuracy that I calculated for Marie were the percent of grammatically accurate verb phrases and the percent of target-like plurals. Table 5.11 shows these two measures across the five days selected for analysis.

Table 5.11

*Marie's Grammatical Accuracy*

| | Date of Transcript | | | | |
|---|---|---|---|---|---|
| | **5-6-10 (F)** | **5-18-10 (F)** | **5-21-10 (F)** | **5-26-10** | **6-7-10** |
| **Accuracy** | | | | | |
| Percent of Accurate Verb Phrases | 100.0% (7/7) | 50.0% (3/6) | 91.7% (11/12) | 100.0% (9/9) | 100.0% (7/7) |
| Percent of Target-Like Plurals | 100.0% (1/1) | 100.0% (6/6) | 100.0% (8/8) | 100.0% (2 /2) | 100.0% (1/1) |
| **Total Number of Words Spoken** | 51.0 | 30.0 | 84.0 | 78.0 | 55.0 |

(F) = Focal student on this day.

As Table 5.11 shows, when Marie spoke, her grammar was usually relatively accurate. Although she did not use many plurals on any given day (i.e., eight or fewer), her plural forms were 100% correct on each of the five selected days. However, she did have instances of difficulty with verb phrases. On four of the five days (May $6^{th}$, $21^{st}$, $26^{th}$, and June 7th) she made either zero or one verb phrase error. Her utterances contained either the incorrect form of the verb for the tense chosen or the incorrect verb endings for singular or plural subjects. In Excerpt 5.60 (May 18, 2010), the teacher asked students to estimate the size of a fraction in a word problem involving a recipe for play dough. Instead of estimating, Marie described the exact solution process. In that description she initially made two verb phrase errors and then one additional error when she repeated her answer at the teacher's request:

Excerpt 5.60

Ms. Grant: So the question is, let's estimate... Estimate how much flour he used….How much flour did he use?...More than one cup. How do you know it's more than one cup?

Marie: Three pinks makes a half and then two blues makes a half and then the remainder is one-fourth.

Ms. Grant: Oh, will you say that one more time please Marie.

Marie: Three pinks makes a half, two blues make a half and then the

8 remainder is one, one fourth.

(Marie, Transcript, May 18, 2010)

In Excerpt 5.60, line 4, Marie should have used the verb "make" without the 's' because she had a plural subject such as "three pinks" or "two blues". When she repeated her answer in line 7, she made the same error on 'three pinks makes", but corrected the subject-verb agreement error on "two blues make". This example of error correction provides an indication that she was mentally monitoring her grammatical accuracy.

***Complexity.*** Table 5.12 shows selected measures that highlighted the variability in Marie's English complexity across days.

Table 5.12

*Selected Measures of Marie's English Complexity*

| | **Date of Transcript** | | | | |
|---|---|---|---|---|---|
| | **5-6-10 (F)** | **5-18-10 (F)** | **5-21-10 (F)** | **5-26-10** | **6-7-10** |
| **Complexity** | | | | | |
| A-S Units | 11.0 | 8.0 | 25.0 | 17.0 | 9.0 |
| Mean number of Verbs per A-S unit | 1.0 | 0.7 | 0.9 | 0.7 | 1.1 |
| A-S units with 2+ verbs | 0.0 | 0.0 | 2.0 | 0.0 | 2.0 |
| Number of Turns | 7.0 | 4.0 | 25.0 | 14.0 | 9.0 |
| Mean Turn Length (words per turn) | 7.3 | 7.5 | 3.4 | 5.6 | 6.1 |
| Number of Verb Forms Used | 6.0 | 2.0 | 15.0 | 5.0 | 6.0 |
| Instances of Explaining Function | 1.0 | 2.0 | 0.0 | 1.0 | 2.0 |
| Instances of Justifying Function | 1.0 | 2.0 | 1.0 | 0.0 | 0.0 |
| Instances of Comparing/Contrasting Function | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Total Number of Words Spoken** | 51.0 | 30.0 | 84.0 | 78.0 | 55.0 |

(F) = Focal student on this day.

Generally, the measures of syntactic and grammatical complexity show that when Marie generated more speech (i.e. greater number of total words), she tended to create slightly more complex language. On May 21st and 26th, when the number of words she produced was the highest (84 and 78 words respectively) she also had the largest number of A-S units (25 and 17). With the exception of May 25th, the mean number of Marie's verbs per A-S unit ranged from 0.7 to 1.1, indicating that her utterances were usually likely to contain a verb. For example, on June 7th, a day with an average of 1.1 verbs per A-S unit, two of Marie's more complete statements are shown in Excerpt 5.62 (June 7, 2010).

Excerpt 5.62

1 Marie: You need a common number which you have to divide four by five. And
2 then you get one (and) one over four.

(Marie, Transcript, June 7, 2010)

The two statements, in lines 1 and 2, were made in answer to the teacher's open-ended question, "How else could we write it?"

Examining A-S units with multiple verbs as an indicator of syntactical complexity, on May 21st and June 7th Marie did produce two complex A-S units that contained multiple verbs. Marie produced these utterances when she was attempting to explain the answer to a math problem. Excerpts 5.63 to 5.66 (from May 21st and June 7th, 2010) highlight the verb phrases Marie produced:

Excerpt 5.63 (May 21, 2010)

1 Marie: …find each half and which color can fits…

Excerpt 5.64 (May 21, 2010)

1 Marie: …gonna need eleven reds to cover this piece to help it…

Excerpt 5.65 (June 7, 2010)

1 Marie: …is to look at the least common factor that can divide by both fractions to get…

Excerpt 5.66 (June 7, 2010)

1 Marie: …need a common number which you have to divide…

In three of these examples, (Excerpts 5.63, 5.65, and 5.66) Marie used a main clause with a dependent, relative clause beginning with the pronoun "which" or "that". There was a verb in both the main clause and the dependent clause (e.g., "find" and "fit" in Excerpt 5.63). Excerpt 5.64 was also complex because she used two infinitives side by side ("to cover", "to help") after the verb "going to need".

The number of her speaking turns was also calculated as an indicator of complexity. On the two days with greater language production, Marie not only spoke more words in total, but she also took more turns (25 turns on May 21st, and 14 turns on May 26th). The other days her turns ranged from 4 (May 18th) to 9 (June 7th). On the days when Marie took more turns, her average turn length was actually shorter than it was on days with fewer speaking turns. On the date she uttered the most words, May 21st, she spoke an average of only 3.4 words per turn. One reason for the shorter speaking turns that day may have been that she answered many of the teacher's forced choice (i.e., yes/no) questions, and doing so did not require extended language production. Excerpts 5.67 through 5.69 (May 21, 2010) provide examples of Marie's brief one or two word answers in response to the teacher's questions.

Excerpt 5.67

1 Ms. Grant: Do you want to say anything more?

2 Marie: No.

(Marie, Transcript, May 21, 2010)

Excerpt 5.68

1 Ms. Grant: Is that what you're saying?

2 Marie: Yeah.

(Marie, Transcript, May 21, 2010)

Excerpt 5.69

1 Ms. Grant: Are we trying to add on or take away the one grey?

2 Marie: Take away.

(Marie, Transcript May 21, 2010)

In contrast, on the date Marie had the largest number of average words per speaking turn, May 18th, she only took four turns, but she uttered 7.5 words per turn. Two of these turns resulted from providing a justification for an answer to a math problem, and then repeating the justification. The initial 18-word answer containing the justification is shown in Excerpt 5.70 (May 18, 2010).

Excerpt 5.70

1 Ms. Grant: How do you know it's more than one cup?

2 Marie: Three pinks makes a half and then two blues makes a half and then

3 the remainder is one-fourth.

(Marie, Transcript, May 18, 2010)

The verb Marie used most often across all five selected days was "be". She used it in the past, simple present, and present progressive tenses (e.g., "What are you doing here" on May 6th and "What was the question?" on June 7th). On May 21st when she uttered the largest number of words, she also produced the greatest variety of verb forms. These included: “**arrange”**, “be”, “**come”,** “**cover”**, “do”, “**draw”, “equal”, “explain”**, “find”, “**fit”,** “**go”, “help”, “know”**, “need”, and “**take away”.** The eleven verbs in bold print were unique to her responses on this day. The words did not occur in written text because she did not read aloud on this day. Rather, she was able to use the words independently in her speech

Similar to the other focal students, three key language functions were appraised in Marie’s oral language production: (1) Explanation/narration of a solution or approach to solving problems; (2) justification of an answer; (3) comparison/contrast.

Marie’s speech contained one or two uses of solving problems or justifying an answer on each of the five selected days. She had six instances of solving problems in total (one on May 6th, two on May 18th, one on May 26th, and two on June 7th) and four instances of justifying an answer (one on May 6th, two on May 18th, and one on May 21st). She did not have any occurrences of making comparisons or contrasts. She used the following general patterns for expressing these language functions.

Explanation/Narration

a. Listing steps with pronouns, modal verbs and additive connectors – [*You can x][You can also y]*

Excerpt 5.71 (May 18, 2010)

Ms. Grant: What were you going to say Marie?
Marie: You can also change the sign like division to multiplication and then you do the, the sign.
Ms. Grant: Oh so you’re saying if you take, you’re saying if you take one-fourth you could do multiplication?
Marie: Yeah, like, like this…You multiply…Three over twelve. You can divide it by three. You can also (multiply).

b. Listing steps with logical connectors – [x] and then [y]

Excerpt 5.72 (May 18, 2010) – Sequential connectors

Ms. Grant: How much flour did he use?...More than one cup. How do you know it’s more than one cup?
Marie: Three pinks makes a half and then two blues makes a half and

then the remainder is one-fourth.
Ms. Grant: Oh, will you say that one more time please Marie.
Marie: Three pinks makes a half, two blues make a half and then the remainder is one, one-fourth.

Excerpt 5.73 (May 26, 2010)

Ms. Grant: Marie, do you want to add anything?
Marie: I was looking for a half, like a half of eight is four. And (next)
Marie: seven. So then two more…remain.

Excerpt 5.74 (June 7, 2010)

Ms. Grant: Marie. Want to read your sentence for us please?
Marie: Yeah. *"The first thing is to look at the least common factor that can divide by both fractions to get (an answer)."*

Excerpt 5.75 (June 7, 2010)

Ms. Grant: What would this number, be written as, if it's not an improper fraction. How else could we write it?
Marie: You need a common number which you have to divide four by five. And then you get one (and)…one over four.

Justification

a. Causal effect/result logical connector + reason

Excerpt 5.76 (May 6, 2010)

Marie: You multiply…Three over twelve. You can divide it by three. You can also (multiply).
Ms. Grant: Yeah, but if you say multiply I think you have to do three times three.
Jesse: Is that nine? No!
Marie: Yeah, because of the (difference).

Excerpt 5.77 [5-18-10] - *Teacher provides causal/effect connector and student gives reason*

Ms. Grant: Hah hah. [Watching Marie] Oh, perfect. All right, so you could

| | | |
|---|---|---|
| 2 | | say you know that it's less than a half becau:se… |
| 3 | Marie: | Xxx fourths and the halves. |
| 4 | Ms. Grant: | So it doesn't fill the whole half. |
| 5 | Marie: | Yeah. |

Excerpt 5.78 [5-18-10] – Reason= list steps in solution process with logical connectors

| | | |
|---|---|---|
| 1 | Ms. Grant: | More than one cup. How do you know it's more than one cup? |
| 2 | Marie: | Three pinks makes a half and then two blues makes a half and then |
| 3 | | the remainder is one-fourth. |
| 4 | Ms. Grant: | Oh, will you say that one more time please Marie. |
| 5 | Marie: | Three pinks makes a half, two blues make a half and then the |
| 6 | | remainder is <u>one</u>, one-fourth. |

In general, when narrating the solution to a problem (see Excerpts 5.71-5.75), Marie tended to rely on a few repeated sequential logical connectors to indicate the steps in the solution process. For example, she used "and then" multiple times (e.g., Excerpt 5.71, line 3, and Excerpt 5.72, lines 2-4 and 6), sometimes varying it a little with "and next" or "so then" (Excerpt 5.73, line 3). Similar to other exemplar students, Marie was able to use the sequential connector "first" (Excerpt 5.74, line 2), but she used it in a statement where there were no additional points requiring the subsequent connectors like "second" and "third" or "final".

For the justification function (Excerpts 5.76-5.78), Marie tended to use the causal effect/result logical connector "because" followed by a reason for a previous statement that she or someone else had made. This pattern was similar to those displayed by the other exemplar students. However, Marie struggled to balance the need for a succinctly worded reason with the need to provide enough detail so that listeners could understand her intended meaning. For example, in Excerpt 5.76, line 6, Marie provided a reason after the word "because", even though a justification was not directly requested by another speaker. However, she simply stated "because of the difference" in reference to the teacher's comment about needing to change her written solution on the board. Marie's answer was comprehensible to the teacher when they were both looking at the written solution, but is incomprehensible to a reader of the transcript who lacks the same shared context. Greater elaboration, perhaps even giving an example of numbers from the problem, could have created greater clarity.

In Excerpt 5.77, there was also a causal/effect connector followed by a reason, but in this example, the teacher used the connector “because” as part of her prompt in line 2. Ms. Grant broke off the sentence hoping that a student would continue her statement, and Marie did continue it in line 3 by providing the reason. Again, similar to the first example, the language she chose for her reason was more descriptive than analytical. She simply stated the sizes of the fraction pieces with which the class was working (“fourths and the halves) but she did not provide enough explanation of what it was about those pieces that led her to conclude that the size of the fraction was smaller than a half. The listener or reader must try to fill in the missing context. Finally, in Excerpt 5.78, Marie provided too much detail when asked to justify how she knew that the amount of an ingredient needed for a recipe was greater than one cup. Instead of providing a synthesis of the evidence, Marie narrated the steps in the solution process in lines 2 and 3, and again in lines 5 and 6 (“Three pinks makes a half, two blues make a half, and then the remainder is one-fourth”). She arrived at a factually correct solution, but did not clearly relate that piece of evidence the teacher’s question “how do you know”.

***Vocabulary.*** As an additional indicator of complexity, I calculated the percentage of Marie’s vocabulary on the GSL lists (1 and 2), as well as the AWL list. Figure 5.4 shows the proportion of Marie’s vocabulary on these lists, as well as those not contained on any of the lists.

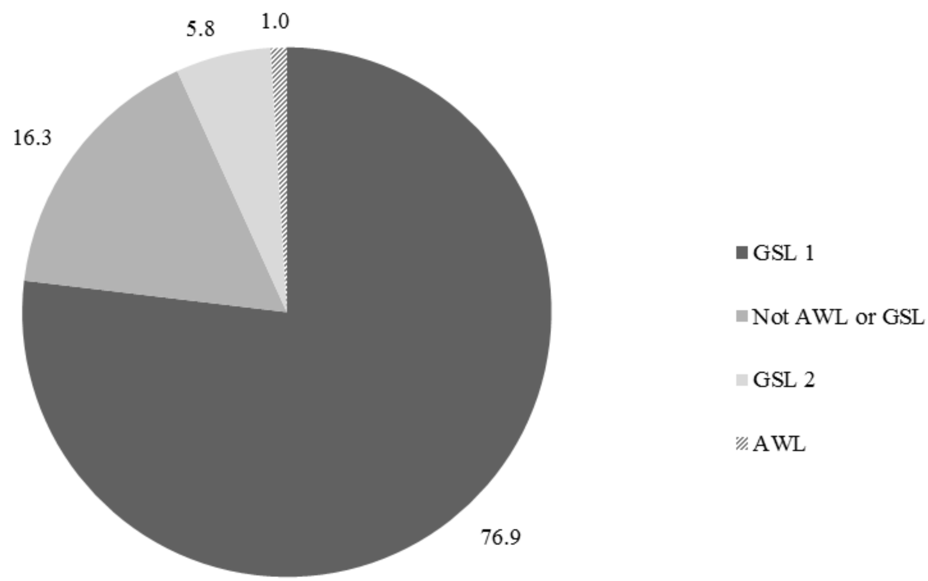


*Figure 5.4.* The percentage of Marie's vocabulary on the GSL and AWL.

Of the words included in the analyses, more than three-fourths (82.7%) were common everyday words found on the GSL 1 and GSL 2 lists. The largest proportion (76.9%) of Marie's vocabulary was made up of GSL 1 basic words such as "a", "be", "can", "do", "eat", "from", "get", "have", and "I"(For a complete listing of Marie's GSL 1 vocabulary, see Appendix I). Her GSL 1 words also included a few that occurred both in everyday and in school-related speech. Such words included "answer", "common", "equal", and "half". Only 5.8% of Marie's vocabulary was found on the GSL 2 (n=6). Her GSL 2 words were: "arrange", "empty", "farther", "greys", "multiply", and "pink".

She used only one word (1% of her total vocabulary), "factor", from the AWL. Marie wrote the word in an answer to a question the teacher asked the class as part of the instructional focus (IF) on June 7th. In Excerpt 5.61 (June 7, 2010), lines 2 and 3, she later read aloud the text she had written.

Excerpt 5.61

Ms. Grant: Marie. Want to read your sentence for us please?

Marie: Yeah. *"The first thing is to look at the least common factor that can divide by both fractions to get (an answer)."*

(Marie, Transcript, June 7, 2010)

It is important to note that “factor” is a word that has both a general academic meaning and a math specific meaning. The AWL usually does not include math-specific content words on the list. In Excerpt 5.60, line 2, Marie used the math-specific meaning when she referred to the “least common factor”. This was a math term her teacher in Kenya had taught her.

Of Marie’s total vocabulary 16.3% (n= 17 words) of the words were not found on either the GSL 1 or 2 or the AWL. Again, these words included names, numbers, specific math words (e.g., “fraction”), and some words frequently used by teenagers (e.g., “pizza”, “birthday”, “dad”).

Overall, Marie’s GSL 1 words from the five selected days covered 8% of the complete GSL 1 list (80/1000), <1% of the GSL 2 list (6/1000), and <1 % of the AWL list (1/570). Her vocabulary comprehension may have been larger than her production on these five days. Even so, the limited range of vocabulary that she actually produced indicates that she most likely did not have sufficient vocabulary knowledge to understand all of the classroom conversation (Granger & Paquot, 2010; Hirsh & Nation, 1992; Nation, 2006).

**Summary of Marie’s CAF.** Marie produced very little oral language across the five selected days. She was usually engaged in the lesson and followed the discussion. It was not clear if her quietness was a general personality trait, or due to other factors such as conflict with her assigned partner for pair work, distraction from hunger,[32] a lack of familiarity with the particular method of teaching fractions, or difficulty comprehending the language of instruction. She seemed to try to control the amount of errors in her speech and did not speak unless she had a well thought out utterance. When she did speak it was typically either to read aloud a problem she had created as an assignment or to explain her solution process. One time when she tried to explain the steps in a solution she struggled so much with expressing her thoughts that other students immediately volunteered to finish her answer.

Marie’s grammar was fairly fluent, but it was clear she put a great deal of thought into forming her utterances. She did not use many plural nouns, but when she did they

[32] Marie was a student who may have been hungry during math class and this may have affected her participation. She did not always have enough money in her student account to eat lunch.

were always correct. She had more difficulty constructing correct verb phrases. The verb she chose did not always agree in number with the noun and sometimes it was not the correct tense for the message she wanted to convey.

When she spoke, her speaking turns were short. She typically used 3 to 7 words per turn. When the teacher asked her information questions she often replied with a one word answer such as “Yes” or “No”. She was capable of producing longer turns with more complex utterances. For example, she often used relative clauses when she was trying to explain the answer to a problem. Each of the five days there were one or two examples of Marie explaining a problem solution or justifying her answer. Sometimes her justifications were a repetition of the solution steps rather than an explanation of why her solution was correct. Marie did not produce any comparison or contrast statements on the five days studied. When she was explaining solutions or justifying her answer she did use a few logical connectors to show the order of solution steps or cause and effect. However, she did not use a wide variety of connectors.

Like her classmates, Marie typically used common everyday words to talk about mathematical ideas. More than three-fourths of her vocabulary was made up of words found on the GSL 1 and 2. The majority of these words were the basic words found on the GSL 1. Less than one percent of her words represented academic language found on the AWL. In total, her vocabulary choices covered 8% of the GSL 1 and less than 1% of the GSL 2, indicating that she most likely lacked the vocabulary knowledge needed to fully comprehend the math instruction.

**Cross-Case Summary**

The data presented in this chapter highlight the great variability in students’ CAF across days. After examining their language use for five separate class periods it is possible to describe students’ language performance given a particular set of contextual factors (e.g., curriculum, teacher language, opportunities for interaction, student motivation and engagement), but is not possible to describe a more stable underlying level of “proficiency” in oral English because the limits of what students could produce were not clear. What is clear, is that these four focal students were usually “doing” math, with varying degrees of success, using the most basic every day vocabulary and relatively short and simple syntactical structures. When they produced only brief answers to the teacher's questions, their grammar was often correct, but when an occasion arose for them to speak longer, and to produce a more complex utterance, grammar and fluency difficulties became more evident. Generally speaking, students did not frequently use the more complex and sophisticated language functions of explaining, justifying or comparing/contrasting, even though these language functions were a part of the curricular content. They appeared to have some knowledge of the logical connectors needed to perform these language functions, but did not use a wide variety of connectors.

From an Activity Theory perspective, the observed academic language outcomes in this ELL pre-algebra class can be linked to a variety of tensions that occurred within and between elements of the classroom activity system (See Chapter 4 for description of these elements). There were also some tensions created by forces outside of Ms. Grant's classroom (e.g., school and district policies, state testing requirements) that had a direct impact on the amount and kind of language that students produced. Chapter 6 describes these tensions, and their relationship to the academic language students used.

# CHAPTER 6: TENSIONS AFFECTING POTENTIAL ACADEMIC LANGUAGE MEDIATORS

As Chapter 5 has shown, the focal students in Ms. Grant's class did not produce much academic language during instruction. There were some potential mediators that had the ability to support and positively influence the desired object of academic language use so that students could reach the long-term goal of learning the academic content (see Figure 4.1 in Chapter 4). These mediators included a conceptually-based curriculum with controlled language demands, teacher language, peer language when working in collaborative groups or pairs, and a consistent opening routine incorporating discussion of both language and content objectives as well as a review of previously learned material. Not every potential mediator that exists has the intended effect on the object for a variety of reasons (Ko, Schallert, & Walters, 2003; Najassi & Swain, 2000). For example, mediators may not provide the appropriate level of support for the student. Students may not recognize the mediators or may not choose to take advantage of them for reasons having to do with the students' personal goals and objectives. In addition, other elements within, or outside of, the activity system may affect a potential mediator's ability to support the desired objective.

Third generation Activity Theory proponents (e.g., Engestrom, 2001; Russell & Yanez, 2003; Yamagata-Lynch, 2010) often discuss the concept of tensions or contradictions between elements within an activity system, and between the goals and objectives of the multiple inter-related activity systems to which students and teachers belong. If these tensions are resolved, they can lead to changes in the activity system which may be beneficial to reaching the objective (Yamagata-Lynch, 2010). If they are unresolved they can create impediments to attaining the objective (Engestrom, 1987; Yamagata-Lynch, 2010). In Ms. Grant's classroom there were tensions within the activity system that were created by differences in teacher and student perceptions of the tools, rules, community and division of labor (see Chapter 4). These internal tensions constrained the language that students needed to use during instruction. There were also tensions outside of the activity system that influenced the content Ms. Grant taught and lowered the expectations for student learning.[33]

This chapter will describe three key tensions. These tensions were: (a) providing remedial versus grade level instruction; (b) balancing the teaching of math and the teaching of language, and; (3) following adult versus students' preferences for instructional approaches and activities. The first two tensions involved entities outside of Ms. Grant's classroom, but these tensions had the ability to influence what happened within the classroom as well as how students perceived instruction. The third tension, located primarily within the activity system, was between the adult's and the students' beliefs and preferences for instructional approaches and activities that could have supported academic language learning. Understanding the way that these tensions shaped opportunities for academic language use provides a context in which to make sense of the actual academic language data presented in Chapter 5.

Figure 6.1 shows a modified version of the activity triangle first presented in Chapter 4. It labels the external entities that had the ability to impact the activity system of Ms. Grant's classroom and adds large grey arrows to locate each of the three key tensions that will be described in more detail in this chapter.

[33] Investigating other intersecting activity systems was not the intent of this study. However, from the data there emerged some clear indications of the existence of other activity systems that created tensions affecting academic language expectations and use in this particular classroom.

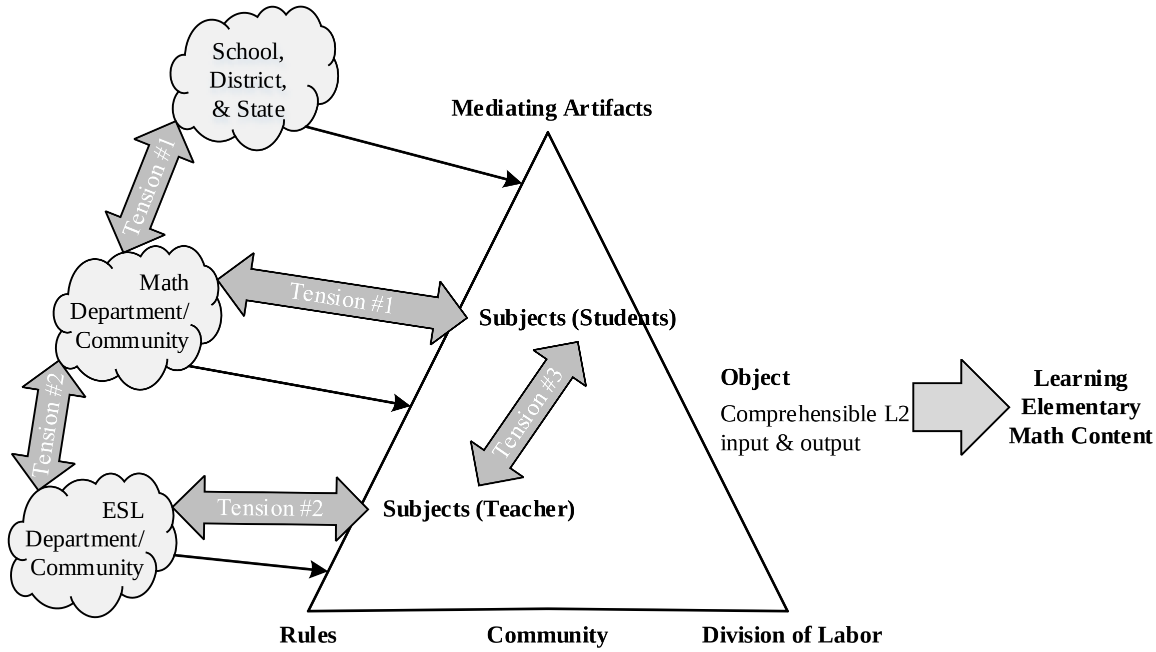


*Figure 6.1.* Tensions influencing the ELL pre-algebra activity system.

## Tension One: Remedial Versus Grade Level Instruction

One of the tensions in Ms. Grant's ELL pre-algebra classroom might be characterized as a backward looking versus a forward looking approach to content curriculum and instruction. Each of these approaches had implications for the degree of difficulty and complexity of the embedded academic language expectations.

A backward-looking approach, consistent with a remedial philosophy, determines what content students have not mastered that they were expected to master at some previous point in time. It then aims to fill in the missing skills and knowledge students should already have by reteaching the content that was not learned, often using materials that have lower academic language expectations (Callahan, 2005; Harklau, 1994). Students are typically required to demonstrate mastery of the remedial content before they move on to more difficult content. In this way, access to more challenging academic language associated with more difficult content is denied to students in remedial courses until they master the lower-level concepts and skills. In contrast, a forward looking approach, consistent with standards-based instruction, identifies what content and academic language is important for all students at a particular grade level to learn (e.g., the standards). Educators then develop ways in which students with a variety of skill sets can work towards mastery of those standards. The materials and the pacing may be adapted to allow students with limited English proficiency to learn, and there may be some reteaching of embedded skills. However, the emphasis of standards-based instruction is clearly on mediating the learning of ELLs so that they can achieve to their fullest potential.

In Ms. Grant's situation, the math department at Lincoln High School emphasized a remedial focus to content learning for ELLs while the school, district and state policies adhered to standards-based instruction for all students. These differing philosophies created a tension felt most strongly by the students. Their lack of access to grade-level standards-based instruction, and the associated academic English skills, affected their ability to pass a mandatory standards-based graduation component of the state math assessment and to receive a diploma.

**Remedial math as departmental policy.** Incoming ELL ninth-graders at Lincoln had all been tested on basic math skills at the end of middle school. If they did not demonstrate sufficient skills with basic content, by a de facto departmental policy, they were placed in one of the two remedial ELL math courses to learn the content they had not yet mastered. The lower-level ELL math course dealt with basic math principles and the higher course, Ms. Grant's class, incorporated pre-algebra concepts. Ms. Grant's syllabus was built around topics that students should have started learning in upper elementary school and mastered by junior high school. The first semester syllabus for Ms. Grant's class listed the units of study as the order of mathematical operations, number sets, graphing points and lines, and solving equations. The syllabus for the second semester, the one in which the study took place, listed units on fractions, polynomials, more work on graphing points and lines, and more work on solving equations. During the time that I was present, I saw the students work with adding positive and negative numbers using a number line, learning beginning concepts of coordinate graphing, and a large part of the semester was spent on learning fractions. I did not observe any instruction on polynomials or solving equations. In theory, students had to obtain a passing grade in Ms. Grant's class in order to be advanced to a mainstream algebra class the following year. If they did not achieve a passing grade, most likely they would be required to repeat pre-algebra for another year.

As previously mentioned, Ms. Grant used the RNP1 curriculum which was developed for fifth graders and was available online. On the RNP1 website, the introductory materials indicated that this elementary curriculum had been successfully used with adults in remedial instruction settings. Ms. Grant intended to move quickly through the *RNP 1* materials and spend the majority of the unit on the *Rational Numbers Project: Fractions Operations and Initial Decimal Ideas* (hereafter referred to as *RNP 2)* materials that had been developed for junior high students. However, she found that her students' fractions knowledge and skills were so limited that she needed to cover the *RNP 1* information in greater depth than she had anticipated. As a result she never used the *RNP 2* materials, and all instruction was based on the elementary school module.

**Externally mandated content and English proficiency standards.** The remedial approach to math instruction in this classroom existed within a larger educational system, at the school, district, and state levels that promoted a policy of grade-level standards-based content teaching for all students in kindergarten through twelfth grade (see Chapter 2 for more on this topic).

The state algebra standard for ninth through eleventh graders was:[34]

> ***Standard:*** *Understand the concept of function, and identify important features of functions and other relations using symbolic and graphical methods where appropriate.*
>
> ***Benchmark 9.2.1.1*** *Understand the definition of a function. Use functional notation and evaluate a function at a given point in its domain. For example: If* $f(x)=\frac{1}{x^2-3}$*, find f (-4).*

There were also mandatory state English Language Proficiency (ELP) standards for ELLs (see Chapter 2). The ELP standards for this particular state listed general skills that students in grades 9-12 should have in the areas of speaking, listening, reading and writing by English proficiency level (e.g., beginning, intermediate, advanced, transitioning). They identified what activities or tasks students at each proficiency level generally could do with social and academic language as a function of a presumed natural course of language development, rather than describing specific language features or

[34] Standards presented are taken from state documents but are not identified by state name to preserve the anonymity of the participating district, school, teachers and students.

skills that a student should be taught for a specific content area. (For a summary of the academic English skills described at each proficiency level in the state ELP standards, please see Appendices J and K.)

The speaking and listening standards were largely the same across all grade levels with the addition of a few more complex skills at the secondary level (e.g., inferring a speaker's intended meaning or using content specific vocabulary) for advanced and transitioning level students. These standards were general and did not target specific aspects of language that Ms. Grant could have taught her pre-algebra students. Examples of intermediate-level listening and speaking standards for $9^{th}$-$12^{th}$ grade students are provided below:

> ***Listening:*** *[An intermediate student can] Understand main ideas of academic content.*
>
> ***Speaking:*** *[An intermediate student can] Give simple oral reports.*

In contrast, the academic reading and writing standards were relatively simple at the elementary level and became much more detailed and complex at the secondary level. The reading and writing standards also became increasingly complex for advanced proficiency levels compared to beginning proficiency levels. However, like the listening and speaking standards, these standards were not specifically related to reading and writing math content. Thus, they gave little concrete direction about teaching academic language for sheltered math teachers like Ms. Grant. Examples of a reading and writing standard for intermediate-level ELLs in grades 9-12 are provided below:

> ***Reading [****An intermediate student will be able to] Understand parts of simplified content-area texts.*
>
> ***Writing*** *[An intermediate student will be able to] Write short answers for simple classroom tasks.*

The state ELP standards made one explicit connection to math language, but did so only for students at the highest English proficiency level (i.e. transitioning). This connection related to a specific language function students should be able to perform in the math classroom:

***Mathematical Reasoning:*** *[Transitioning students] Support mathematical results by explaining why the steps in a solution are valid and why a particular solution method is appropriate.*

The lack of detail about specific aspects of academic language to teach implied that students below the transitioning level were presumed not to be taking math classes and did not need to develop math language skills.

**The relationship between instruction and standards.** Neither Ms. Grant's syllabus nor the instructional materials and activities referenced the state ELP standards for secondary students. The syllabus did refer to the state content standards using the term "graduation standards": *"This class will focus on mathematical concepts and vocabulary that are related to the math curriculum and the [state] Graduation Standards."*

The words "***related to***" the standards carried greater meaning in this particular remedial classroom than perhaps either the teacher or the students realized. As previously indicated, the grade 9-11 algebra standard emphasized algebraic functions that contained fractions (See Benchmark 9.2.1.1). However, the instruction in this classroom emphasized understanding of basic fraction concepts. Basic fractions concepts were addressed primarily in the 3rd and 4th grade math standards, a portion of which is shown below.

**Grade 3** *Strand: Number and Operations*

***STANDARD:*** *Understand meanings and uses of fractions in real-world and mathematical situations.*

***Benchmark 3.1.3.1*** *Read and write fractions with words and symbols. Recognize that fractions can be used to represent parts of a whole, parts of a set, points on a number line or distances on a number line.*

***Benchmark 3.1.3.2*** *Understand that the size of a fractional part is relative to the size of the whole.*

***Benchmark 3.1.3.3*** *Order and compare unit fractions and fractions with like denominators by using models and an understanding of the concept of numerator and denominator.*

**Grade 4** *Strand: Number & Operations*

***STANDARD:*** *Represent and compare fractions and decimals in real-world and mathematical problems using arithmetic.*

***Benchmark 4.1.2.1*** *Represent equivalent fractions using fraction models such as parts of a set, fraction circles, fraction strips, number lines and other manipulatives. Use the models to determine equivalent fractions.*

***Benchmark 4.1.2.2*** *Locate fractions on a number line. Use models to order and compare whole numbers and fractions, including mixed numbers and improper fractions.*

***Benchmark 4.1.2.3*** *Use fraction models to add and subtract fractions with like denominators in real-world and mathematical situations. Develop a rule for addition and subtraction of fractions with like denominators.*

***STANDARD****: Represent and compare fractions and decimals in real-world and mathematical situations; use place value to understand how decimals represent quantities*

***Benchmark 4.1.2.4*** *Read and write decimals with words and symbols; use place value to describe decimals in terms of thousands, hundreds, tens, ones, tenths, hundredths and thousandths.*

The majority of the selected third and fourth grade standards and benchmarks were addressed by the *RNP 1* curriculum. Ms. Grant originally intended to teach material for the second standard, grade 4, Benchmark 4.1.2.4 ("*Read and write decimals*…"), which was covered in the *RNP 2* curriculum, but she did not finish the RNP 1 materials associated with the preceding benchmarks. Thus, if her 9$^{th}$ through 11$^{th}$ grade students were successful with the *RNP 1* curriculum they would still have only been considered to partially meet the 4$^{th}$ grade math standard. Math achievement level descriptors, written statements about what math knowledge and skills students need to have to demonstrate varying levels of content proficiency, indicated that mastery of fractions was assumed by seventh grade (see Appendix L).

This examination of the math content and academic English proficiency standards demonstrates that the basic fractions concepts the students were learning, while embedded in the 9$^{th}$ grade math standards, were clearly several grade levels below where students needed to be. As a result, the language to which students were exposed, and the expectations for their own language production, was most likely below grade level as well. For example, Ms. Grant's students had little exposure to even the key math vocabulary from the 9th grade algebra standards (e.g., feature, function, functional notation, point, and domain). They also were not instructed in how to read and interpret the mixed language and symbols of a function such as the one listed in the ninth grade standard.

**Student perspectives on instruction.** Many students acutely felt the tension between the remedial approach of the class and the standards-based achievement promoted by the school and district. They wanted to learn grade-level content even though they often displayed poor performance on homework assignments and tests of the third and fourth grade fractions material. They yearned to be mainstreamed, and to have the educational choices that came with being a mainstream student. One Liberian boy described how he wanted to get out of the ELL math class because he wanted to sing in the choir and to learn French. Because he was still taking ELL content courses he was not allowed to choose those elective courses. Naomi, a tenth grade Liberian student, had been moved back to ELL pre-algebra from a mainstream math classroom. Thus, she had some exposure to grade-level content. As a result, she was very aware that the math content she was learning in Ms. Grant's class was easier than the grade-level content. In Excerpt 6.1 (May 21, 2010), Naomi expressed her frustration with the remedial emphasis and pacing of the ELL pre-algebra course:

Excerpt 6.1

Naomi: I think when I'm doing the ELL math I'm not ever going to pass the [state test] because ok like you're in 10th, you're supposed to be doing algebra I? And I'm still doing pre-[algebra]. When I'm in 11th I'm supposed to be doing geometry? And I'm gonna be doing algebra. I'm gonna be way behind, I'm not gonna be able to pass because if on the [state test] they not gonna have all pre-algebra. And if I have all, if that, if that's the only thing that I know I'm probably never going to be able to pass the test because I've never studied those. I'm gonna be behind and I really wanna be able to pass my test.

(Naomi, Interview, May 21, 2010)

Naomi could clearly articulate the expected progression of math content learning (lines 2-4) and she was very aware that she might not be allowed to graduate from high school if she had not studied the content needed to pass the state math assessment. She had a goal to become a licensed practical nurse and knew that the remedial math courses acted as a barrier to her achievement of that goal.

Other students echoed that same refrain of wanting more difficult content and a faster pace of instruction despite the fact that they struggled to learn the third and fourth grade material. Hope, also a Liberian student, was a junior who should have been in the lower level ELL math class. Due to some behavioral issues she had been moved to Ms. Grant’s smaller class so that the teacher could pay more attention to her. Hope voiced regular concerns about the slow pace of content coverage. She did so despite the fact that she had only a basic understanding of beginning math concepts. She had experienced significant difficulty understanding a previous unit on adding and subtracting positive and negative numbers. Depending on the day, her levels of attention to the class material varied, as did her concept comprehension. Some days she was interested and engaged in the lesson and could demonstrate a solution at the board. Other days she chatted with students while the teacher was presenting material and did not participate in the lesson. A few times she was removed from class for behavioral issues. Even so, her calls for harder content continued.

When asked about the students’ concerns about the remedial curriculum, the ESL staff and the math teacher acknowledged that they were aware of the students’ desire to be mainstreamed and to learn more difficult content. The teachers commented that these students typically did not have an accurate understanding of their limited English ability, and the degree to which they lacked foundational math concepts and skills needed to succeed in the mainstream algebra course. The school staff expected that many of the students in Ms. Grant’s room would not graduate from high school because there simply was not enough time for them to improve their English, strengthen their math skills, and make up the content they had missed at lower grade levels. As an example, some students in Ms. Grant’s room still counted the answers to addition and multiplication problems on their fingers because they had not memorized math facts. Some students thought through the solution to a math problem in their native language and then tried to translate it into English. Others were not familiar with math symbols like those for greater than greater than (>), and less than (<). Still others struggled to read and comprehend a few sentences of written text in a math problem or a set of activity directions.

As this section illustrates, the district and departmental policy of remedial math for ELLs limited students' opportunity to learn not only the more challenging grade-level math content but also more challenging academic English with a wider variety of math vocabulary and greater linguistic complexity. One byproduct of this tension between widespread mandates for standards-based education with exceptions for ELLs was that students felt discontented in Ms. Grant's class. The discontent may have fueled their resistance to some of the instructional methods and activities that could have supported learning. The discontent occurred despite the fact that many students struggled to learn the below-grade material.

### Tension Two: Balancing Math and Language Instruction

Achieving the optimal balance between teaching math content and teaching academic language was an important tension that characterized Ms. Grant's classroom. The amount and type of academic language that was used in her classroom was influenced by district and school policies, the amount of training and expertise she had developed in English language development instruction, and her beliefs about math language.[35]

**District and school policy.** In designating a specific section of pre-algebra for ELLs, district and school ELL staff intended to create a place in which ELLs' language learning needs might continue to be met while the students learned academic content required for high school graduation. The very creation of this type of class implied that the district and school administrators thought that both math content and language were important for students' academic success. However, there was no available policy statement that described how a balance between teaching math and teaching language should be achieved. It was left up to individual teachers to decide whether one of these areas took priority during instruction, whether the balance of focus should shift back and forth, or whether the two areas should be weighted equally.

[35] The curriculum also played a role in the balance of math and language instruction in Ms. Grant's classroom. This topic will be addressed later in the chapter.

**The role of teacher background and expertise.** In Ms. Grant's classroom, math instruction and communication of correct mathematical meanings were typically prioritized over language instruction because Ms. Grant was a math expert, with a Master's degree in math education, who knew her math content well. She had taught the content to other students, primarily fluent-English speakers, and she knew where students typically had mathematical misconceptions in understanding fractions. She chose her curriculum and designed the math instruction to address these areas. Planning language instruction was much more challenging for her because she had not taught the ELL pre-algebra class before. As a result, she had difficulty seeing the language of her discipline and connecting it to student's current skills in English.

Excerpt 6.2 (May 3, 2010) illustrates that when Ms. Grant began teaching ELL pre-algebra at the start of the school year she thought of math language as just vocabulary; specific math words that did not necessarily communicate how well students understood mathematical concepts. Because the math curriculum de-emphasized the use of mathematical vocabulary, and because she did not believe students needed to use the mathematical register to be successful she then struggled to determine what aspects of language to teach her ELLs.

Excerpt 6.2

Ms. Grant: I just know that I struggle with the language piece because I don't really know…exactly what I'm supposed to be doing. So I'm like, well I'll try to get you to talk as mu-, talk more, write more, but it's the writing piece that I find so hard 'cause it's... unless it's a word problem, and I don't think, when I started and it's "Add these decimals", "subtract these decimals", when it was all process stuff, we never really did any writing…So it took the first, like, quarter and a half before we really were…doing something with words …written.

(Ms. Grant, Interview, May 3, 2010)

In Excerpt 6.2, line 3, Ms. Grant indicated that creating oral and written language production opportunities became her academic language focus, although she had difficulty finding meaningful ways to incorporate writing opportunities (lines 3-8).

Ms. Grant did not easily relate to L2 teaching ideas about language functions (e.g., using English to make comparisons, arguments and justifications for math problem solutions). When I showed her a list of possible language function students might perform in a classroom, she considered the list thoughtfully and commented that the words had different meanings to a math teacher. For example, a commonly mentioned language function in the L2 literature is evaluation of a previously made statement by another speaker (Chamot & O'Malley, 1994). Ms. Grant interpreted the word "evaluate" in a mathematical context in which students would insert a number into an equation and obtain an answer. She struggled to interpret the word evaluate differently for academic language functions than she did for mathematical reasoning.

Ms. Grant's uncertainty over what language, and how much language, to teach was evident in her daily opening routine. Sheltered content teachers were asked to begin each class by reviewing math and language objectives for the lesson, along with review and practice of the Instructional Focus (IF) problem. This opening routine was required by the principal for all classes, although only the ELL content classes incorporated language objectives. A sample of those math and language objectives, along with the instructional focus, is contained in Table 6.1 below.

Table 6.1

*A Sampling of Ms. Grant's Daily Math and Language Objectives*

| Date | Math Objective | Language Objective | Instructional Focus |
|---|---|---|---|
| **4-23-10** | Students will compare fractions. | Students will write sentences comparing fractions. | Look at your fraction strips of paper. Determine which fraction is largest.<br>1. 1/3, ¼, 1/12<br>2. 2/3, 2/6, 2/12 |
| **4-26-10** | Students will order fractions. | Students will explain how to put fractions in order. | Which is the larger fraction?<br>1. 1/9 or ¼<br>2. ¾ or 3/10<br>3. 5/7 or 3/7 |
| **4-27-10** | *None—Most students on a field trip this day* | | |
| **4-28-10** | Students will determine equivalent fractions. | Students will explain how to find a larger fraction. | Determine if the shaded part shows 2-fourths. Write yes or no. [Teacher inserted pictures.] |
| **4-29-10** | Students will determine equivalent fractions | Students will compare fractions. | Which is the larger fraction?<br>2/9 or 2/4<br>¾ or 3/10<br>4/7 or 4/12<br>What do each of these problems have in common? |

| | | | |
|---|---|---|---|
| **4-30-10** | Students will take a quiz comparing fractions. | Students will list equivalent fractions. | Which is the larger fraction?<br>1. 2/5 or 2/6<br>2. 3/7 or 3/10<br>3. 4/7 or 5/7 |

Table 6.1 demonstrates that Ms. Grant created language objectives that fit with her view of teaching academic language by creating more opportunities for language production. For example, on 4-30-10 the objective was "*Students will list equivalent fractions."* Students were required only to write a list of equivalent fractions and then share them orally with the class. There was no explicit language instruction related to creating or presenting the list.

As part of some of the language objectives listed in the Table 6.1, there were distinct uses of language that characterized what the students were being asked to do. Sometimes it was necessary to look at the content objectives to see the embedded language. For example, on 4-23-10 the content objective was "*Students will compare fractions*", using the verb "compare". The accompanying IF, "*Determine which fraction is largest*", contained a superlative form of the adjective "large". Comparing the size of two fractions was also evident in objectives for 4-26, 4-28, and 4-29. Language goals could have included the use of comparatives such as "bigger than", "smaller than", and equatives like "equal to". They might also have connected the words and symbols such as greater than (>), less than (<), or equal to (=) to indicate the relationship between two fractional amounts. The teacher might also have included some instruction on the way native English speakers typically perform the language function of comparing when they are talking about the size of two objects (e.g., verb tenses used, simple versus complex sentence structure, content vocabulary words like numerator and denominator). However, Ms. Grant was not able to create these kinds of language objectives on her own.

One challenge associated with the production-focused language objectives was that there was no clear way to conduct ongoing formative assessments of students' language skills. It was possible for the teacher to document whether students did or did not create a list of equivalent fractions. However, without a more detailed statement of how students were to do this (e.g., Students will use the words "greater than", "less than", or "equal to" to compare the size of two fractions) it was difficult to meaningfully measure student progress in learning the necessary English skills. As a result, it became increasingly challenging to determine whether students' English changed over the course of the semester.

A reason that Ms. Grant may have had more difficulty planning language instruction was that she had received limited amounts of training in teaching L2 learners due to the lateness of her teaching assignments at the end of the previous school year. She had only been able to attend part of a mandatory summer training class on sheltered instructional strategies that was offered through another school district. During the school year she did attend monthly study groups conducted by the district ESL curriculum coordinator. During these monthly meetings ELL content teachers met to read texts on sheltered instruction, and to discuss teaching challenges and successes. Given that these teachers represented a variety of topic areas such as social studies, science and math, there was little targeted support given to Ms. Grant for ways to teach math content.

**The influence of teacher beliefs.** The teacher's belief about the value of using a specific math register was another factor that caused her to prioritize teaching math content over teaching language. Scarcella (2003) states that there are differing views on the nature of academic language and whether it is a well-defined entity that can be taught to students. Some educators and researchers believe that what is considered appropriate language use varies widely across and within content areas (e.g., Street & Street, 1995; Zamel, 1998). Because, in this view, there is no precise standard of language that must be used in a content area, the philosophy is that educators should be more accepting of the language varieties students bring from their home and communities outside of school. Teaching a specific register or variety of formal academic English is thought to marginalize diverse students by discounting their own ways of expressing ideas (Street & Street, 1995; Zamel, 1998). Ms. Grant's own view of the language of mathematics was in line with this viewpoint. She wanted students to talk about math using everyday language that came to them naturally.

As a result of her views about language, Ms. Grant primarily attended to the content and accuracy of student's communication about mathematical ideas rather than to language form or function. For example, early in the fractions unit, she did not introduce the words "numerator" and "denominator", even though the math content clearly included these concepts. The elementary-school level curriculum explicitly directed teachers not to use the terms and the introductory activities with manipulatives did not require the words. In the first few lessons, students were representing fractions with the fraction circle pieces and saying things like “two yellows make a black”. When two students spontaneously introduced the words “numerator” and “denominator” during the large group portion of one lesson, other students began to try to use those terms in discussion and in written answers to homework problems. Ms. Grant was surprised at how readily students picked up and used these math terms because a fellow student had used them. She believed that if she had used the mathematical terms, students would not have responded in the same way.

When students showed an interest in using the words “numerator” and “denominator”, Ms. Grant began to use the words herself, she posted them on the word wall as a resource for students, and she began to intermittently scaffold students’ oral language to continue the use of “numerator” and “denominator” to some extent. In Excerpt 6.3 (May 7, 2010), Ms. Grant attempted to elicit the correct use of the word “numerator” during large group conversation.

Excerpt 6.3

Ms. Grant: All right, so if you drew the picture one-half, would be more than one-fourth. All right, so, and that’s if you have the sa:me, what is this top number called?

Michael: Denominator?

Ms. Grant: Say it again?

Naomi: No numerator.

Students: Numerator.

Ms. Grant: NUMerator. NUMerator.

Michael: Hah hah. That’s what I said! I said it was numinAtor.

Michael: Whatever.

Ms. Grant: All right. What if we ha:ve different numerators, three and five=

Michael: Right here!

Ms. Grant: = but the same denominator? Then how can you decide? Michael?

Michael: ((Speaking rapidly without a breath)) First we have to look at the denominator and we look at denominator (while we look at it) we looking at the biggest number because the denominator is same thing so we now we

gonna look at the denominator so five over six bigger than three over six.
Ms. Grant: All right. So if the denominators are the same you look at the numerator,
the bigger number is more pieces so that's bigger.

(Transcript, May 7, 2010)

In Excerpt 6.3, lines 2-3, the teacher tried to elicit the word "numerator" by asking "What is this top number called?" When Michael mistakenly provided the word "denominator" in line 4, the teacher prompted "Say it again?" in line 5 to indicate that he had made an error. Michael's classmates recognized his error, even though he appeared not to notice the mistake at first. After his classmates provided the correct word in lines 6 and 7, and the teacher repeated the word a few times in line 8 to model the correct pronunciation, he was able to use the word in line 9. However he mispronounced the word as "numinator" and added "whatever" in line 10, as if to indicate that the exact pronunciation was not important to him. The teacher did not directly comment on his mispronunciation. Instead, she acknowledged the mathematical idea he contributed and she continued to discuss the math content using the words 'numerator" and "denominator" (lines 11 and 13). Michael appeared to incorrectly use the word "denominator" instead of "numerator" again in line 17. However, the teacher merely rephrased his statement with the word "numerator" in line 18 and continued. Michael did have not any additional opportunities to use the word "numerator" in this lesson so it was not clear whether he had internalized either the correct meaning or the correct pronunciation.

In Excerpt 6.3, Ms. Grant prompted for the correct use of a math term when the student chose to use math vocabulary, but used the wrong word. Most of the time, when students did not choose to use math vocabulary, Ms. Grant accepted whatever phrasing the student used so long as the language communicated the correct mathematical idea, as shown in Excerpt 6.4 (May 12, 2010).

Excerpt 6.4

Ms. Grant: [Is this fraction] more than a whole or less than a whole? More
than a whole unit or less than a whole unit.
Students: Less than!
Jesse: Less than a whole unit.
Ms. Grant: Less than. How do you kno:w by looking at these two numbers?

Ana: Because the down number and the, the down number and the-

Jesse: Because the, denominAtor and the numerator-

Michael: Is not the same.

(Transcript, May 12, 2010)

In Excerpt 6.4, line 6, Ana used the grammatically incorrect phrase “the down number” to refer to the denominator. In lines 7-8, two other students built a collaborative response to the teacher’s question that did contain the appropriate term “denominator” (line 7), and which communicated the correct mathematical idea. Therefore, Ms. Grant did not correct Ana’s language use.

Ms. Grant mentioned during an interview that she intentionally tried to match the language her student’s used. On one previous occasion, shown in Excerpt 6.5 (May 11, 2010), Ms. Grant herself had deliberately used the phrase “the down number”, to explain an activity to students:

Excerpt 6.5

Ms. Grant: So, I want you and your partner to think of what’s the word that should go in the blank? “*The denominator is blank the amount of the numerator.*”

Hope: It’s bigger than.

Ms. Grant: That’s true, the denominator is <u>bigger</u> than the numerator.

Jesse: The denominator is larger.

Hope: It’s less than.

Ms. Grant: The denominator is the bottom, the <u>down</u> number.

(Transcript, May 11, 2010)

In Excerpt 6.5, Ms. Grant appeared to believe that students were not understanding what word to insert into a blank in a sentence (see lines 1-2) because the students did not understand the meaning of the word denominator. In line 8, she provided “the down number” as an explanation, matching a pattern of student language use that she had heard in class another day.

While Ms. Grant’s attention to scaffolding and directly teaching the language of math varied, she gave consistent attention to scaffolding students’ cognition about math problems, as shown in Chapter 4 (see Excerpt 4.1). As previously mentioned, if students got the wrong answer on a problem, she rarely told them directly that their answer was incorrect. Instead, she prompted and questioned students, drew pictures, and gave examples, until they were able to get the right answer on their own. This type of scaffolding and teacher mediation of student cognition was a much more consistent part of Ms. Grant's interaction with students about math content than it was for academic language use.

### Tension 3: Teacher Versus Student Preferences for Learning

Ms. Grant chose a curriculum that was designed to include several best practices in instruction that might have scaffolded both content and language learning, yet the students responded negatively to some of those best practices. Negativity about some of the mediating tools limited the ways in which those tools could support academic language use. Student resistance was the most evident for: (1) A conceptual approach to mathematics instead of the procedural approach with which several students had previously been instructed; (2) The use of manipulative and models to develop conceptual understanding; (3) Pair work and small group work instead of large group discussion. The *RNP 1* curriculum was designed to intentionally create active involvement with concrete models as a way of building concept comprehension, and small group work was important to allow students the chance to talk to different audiences about mathematical ideas. The teacher valued the conceptual approach, which was in keeping with current philosophies about the teaching of fractions that were advocated by the National Council of Teachers of Mathematics. Each of these aspects of instruction could have supported students' academic language use as they developed concepts through hands-on experiences to build background knowledge, worked extensively with concrete materials to decrease the abstractness of fractions, and had the opportunity to obtain linguistic support from peers.

**Conceptual approach to teaching math.** ***Teacher values and beliefs about fractions.*** Ms. Grant chose to spend a large chunk of instructional time, nearly six weeks out of a semester, on fractions. She explained this decision by describing a common conceptual difficulty that most of her math students, regardless of the level, had with the idea of a fraction. She felt that even her native English speaking pre-calculus students had a "debilitating fear" of fractions and would only perform well on fractions problems with a graphing calculator. Because of the high levels of fractions fear and misunderstanding that she observed in all of her high school math students, and because she saw evidence of ELLs' conceptual misunderstandings on their math placement tests, Ms. Grant chose to stop using *Access Math*, the previous curriculum, and change to the *RNP 1*.

The district provided Ms. Grant with a classroom set of *Access Math* textbooks that had been developed specifically for middle school ELLs and students with disabilities who had language processing difficulties. Ms. Grant chose not to use it for the fractions unit, even though she had used it for previous units. She believed that *Access Math* did not emphasize the important math concepts enough and it contained too much language. In Excerpt 6.7 (May 3, 2010) she explained the reasons for her choice. Referring to the *Access Math* series she said:

Excerpt 6.7

Ms. Grant: I don't know if I love it. I love that it has lots of words and diagrams and pictures. But it doesn't seem like it, I've tried using just like, let's read through the book, we'll read through the book together, go through examples, talk through it. And it doesn't seem to get us where we want to be, math-wise, for a lot of it…I just feel like it has so much talk about it… and the downfall is, it's not, you can't get it online, um, you know so it's hard to be able to just pull it up and say "All right let's read here." You know, I'd have to get an overhead or borrow a student book to get it…so it's not that easy to use, like to show everyone. So when we read through it I think a lot of students just kind of lose their place…It's good 'cause it does have really good ideas about how to introduce the topics. I've used that. It's got some objectives, I like that. Um, we've used it for vocabulary and finding definitions. But sometimes I feel like it gives too much [sic] words. If you looked at like a standard math textbook it wouldn't, it wouldn't write out in words how you do the whole problem and this one does…You know, so when I've used it we'll, like, read the intro. We'll read the key concepts, we'll read the vocabulary, and maybe do some, like one of the activities or something. But typically we don't read through all of the stuff. Like I'll just model it. …And we have done some of the homework, um, they have, I don't know if I showed you this. [She pulls a book off her desk.] They have a practice book so I've used these, that correlate to the book. And it's like the same as the homework, just in worksheet form. And that seems to go pretty well. And on these they have good word problems and writing, like questions explain this or my as summary etcetera. And they've got vocab activities well. So that I would say I use more than the book.

(Teacher Interview, May 3, 2010)

In Excerpt 6.7, lines 13-16, Ms. Grant indicated that the *Access Math* textbook contained too many words to describe details about mathematical procedures that most mainstream math textbooks did not include. The book was difficult for students to read and comprehend (lines 9-10), indicating that perhaps students' reading proficiency in English was low. Therefore she used the textbook and workbook for activity ideas, vocabulary study, and homework assignments (lines 16-26), but not as the primary instructional material. Instead of having students read the text she modeled many of the concepts orally (line 19).

In Excerpt 6.8 (May 3, 2010) Ms. Grant compared and contrasted the language use in the *Access Math* book to the *RNP 1.* She said:

Excerpt 6.8

Ms. Grant: I feel like it's [the *RNP 1*] a little bit basic, like we haven't talked about numerators and denominators, or anything like that, um, but I wonder if that, I haven't looked through the middle school part as much, so I wonder if it's just the elementary? But I like that every problem has an "explain your thinking", or draw a picture, or write a sentence to explain it, instead of just the, what's the answer. Because I think through the semester I've not done enough of explain, explain, explain, it's just here's the math, what's the answer.

(Ms. Grant, Interview, May 3, 2010)

Ms. Grant had previously mentioned that she liked the *RNP 1* because it fit well with her belief in learning fractions concepts before learning procedures. In Excerpt 6.8 she added that she also liked it because it provided extensive opportunities for language production (lines 4-6), which was in keeping with her view of academic language. For these reasons she was willing to accept that, as she described it, the math content vocabulary was "a little bit basic" (line 1).

***Student comprehension.*** Despite Ms. Grant's strong beliefs that the conceptual approach was best for students, and concurrence by NCTM, the students struggled with the conceptual approach for two reasons. First, some of the students had already learned a more process-oriented approach of performing operations with fractions. They were now being asked to stop using those procedures. Second, the modeling of concepts like fraction equivalence was confusing for some students.

*Limited use of procedural knowledge.* The *RNP 1,* which was written primarily for upper elementary students, delayed all use with symbols and mathematical processes like adding or multiplying fractions until the next module (*the RNP 2)*. The *RNP 1* introductory text described the curricular emphases in this way:

> The RNP Level 1 materials develop the following topics: (a) part-whole model for fractions, (b) concept of unit, (c) concepts of order and equivalence and (d) addition and subtraction of fractions at the concrete level. The concrete models used are fraction circles, paper folding and chips. It de-emphasizes written procedures for ordering fractions, finding fraction equivalences, and symbolic procedures for operating on fractions. Instead it emphasizes the development of a quantitative sense of fraction. (Cramer, Behr, Post & Lesh, 2009, pp. 13-14*)*

The de-emphasis on performing procedures was intentional because, as the curriculum writers stated:

> Difficulties children have with fraction addition and subtraction come from asking them to operate on fractions before they have a strong conceptual understanding for these new numbers. They have difficulty understanding why common denominators are needed so they revert to whole number thinking and add numerators and denominators. *(*Cramer et al., 2009, p. 13)

When Ms. Grant chose a curriculum that framed students' difficulties in terms of poor conceptual understanding, rather than limited English proficiency, she generally did not account for English proficiency as a factor in what ELLs could understand and do with the content. In Excerpt 6.9 (May 3, 2010), when Ms. Grant was asked to comment on the relationship between student's English proficiency and their understanding of fractions content, she provided a normative perspective that all students had trouble with the concepts regardless of language proficiency level:

Excerpt 6.9

Kristi: So it sounds to me like what you think you're seeing trouble with fractions may not be language related =
Ms. Grant: Right.
Kristi: =might have some relationship to language but not directly?
Ms. Grant: Perhaps.
Kristi: Ok.
Ms. Grant: Because I just feel like everybody has so much trouble with fractions that I don't really know what it is.
Kristi: …Even the kids who've had them before, I mean like James and Marie have both studied them in their own country, right?
Ms. Grant: Mhm. Yeah…I would say Marie and Jesse and James and Michael, you know, are doing pretty well with it but they still have mistakes and even have made comments "I don't need to use these circles I know this answer." And then they have them all wrong and we talk through it…

(Ms. Grant, Interview, May 3, 2010)

The students Ms. Grant named in line 11, Marie, Jesse, James and Michael, had previously learned a more process-oriented approach to mathematics. Most of them had learned fractions in another country first. That instruction had incorporated a school language in which they were not fluent and that they did not use at home. These students knew how to write math formulas and had at least some familiarity with mathematical operations such as adding and subtracting fractions. In lines 12-15 Ms. Grant stated that they continued to have misperceptions about the reasons for applying a certain procedure or the correct way to calculate answers. They simply followed a set of steps they had been taught and often did not evaluate the correctness of the resulting answer. Because these students knew something about the more advanced skills that were deliberately not included in the RNP 1 curriculum, they struggled to withhold that knowledge and sometimes became frustrated when there were limited opportunities to show what they thought they knew. They also resisted using the math manipulatives (lines 13-14).

James, one of the more vocal students in class, was just such a student. He had learned a procedurally-oriented fractions curriculum in Nigeria. James enjoyed engaging in large group discussions where he could display his sometimes incorrect procedural knowledge for adding and subtracting fractions, as well as finding common denominators. He used a different style of representing written fractions problems when demonstrating work at the board. This Nigerian style of fractions problems was unfamiliar to the teacher, and there often was not time during a lesson for her to try to figure out the similarities between the way she wanted James to show his comprehension of the topic, and the way in which he had learned it in Africa.

In Excerpt 6.10, the class was discussing how to compare the size of two fractions with unlike denominators to determine which one was bigger. The teacher led the students through an example involving one-fourth and one-half. She prompted students to explain how they knew the answer. She was looking for an explanation that contained a reference to the fraction circle pieces students had been working with. Students gave a satisfactory answer and then she provided a new pair of fractions, 1/50 and 1/60. Again, she asked them “Which one is bigger”? In Excerpt 6.10 (May 7, 2010), James raised his hand and tried to describe a procedure for converting fractions to a common denominator; a topic that the conceptually based curriculum did not cover.

Excerpt 6.10

James: But in math it says that, um, if you, if you multiply, if you
multiply these numbers by two, it’s gonna give you sixty. Is
gonna, if the, if multiply this number, the numerAtor the
denominAtor, by two, is gonna give you two over hundred. And,
six, um, one, um, two, um, over (one) twenty-
Ms. Grant: Uh huh.
James: Then you gotta compere [sic ] which one is <u>bigger</u>.
Ms. Grant: But you’re still in the same case where your numerators are the
same and the denominators are different so-
James: Well-
Ms. Grant: We’re not really ready to do that yet.

(Transcript, May 7, 2010)

James clearly thought he knew a process that he could apply in the situation the class was discussing, but in lines 1-5 of Excerpt 6.10 he struggled to describe what he knew in words. His speech contained frequent false starts and attempts at rephrasing, indicating that he was spending a great deal of mental energy trying to formulate his thoughts in English. In order to keep students to the conceptual focus that was contained in the curriculum, Ms. Grant stopped James from discussing his more advanced procedural knowledge (line 11). After she stopped him from speaking, James responded with an angry "Hmmph!" and participated less actively in the lesson from that point on. Not being able to draw on his background knowledge, even if it was only partially correct, prevented him from being engaged in the discussion and limited his use of academic language.

*Extensive modeling.* A key design element of the *RNP 1* curriculum was moving between multiple representations of mathematical concepts. According to Kramer et al. (1999), the instructional model underlying the materials is based on the work of developmental psychologists like Jerome Bruner (scaffolding), Jean Piaget (constructivism) and Zoltan Dienes (math learning through play). The model includes five types of mathematical representation in which students need to be fluent. These types include: real life situations, pictures, manipulatives, verbal symbols and written symbols. The *RNP* developers state that children learn best when they actively participate in making connections between each of these types of mathematical representation (Kramer et al., 1999). Therefore the lessons required students to use different types of representation in the same lesson, typically starting with the use of physical models and manipulatives. For example, the students might work with manipulatives to develop the concept of fraction equivalence, then create a written sentence describing the equivalent pieces of a fraction circle, then write a mathematical fraction equivalence statement using numbers and symbols, and then orally explain and justify the correctness of their math sentence. Physical objects were intended to support the acquisition of fractions concepts, but could also assist students in visualizing abstract language. In theory, the use of manipulatives and visuals was an appealing aspect of the *RNP 1*. Visuals are often recommended as a way to build conceptual understanding in a L2 so that students understand what they are expected to talk or write about (e.g., Echevarria et al., 2010).

Despite the promise of using manipulatives and models, even students who were less reliant on applying procedures to fractions still had difficulty comprehending the use of manipulatives. Students had to mentally process what was happening with the manipulatives, perhaps by thinking in their native language, and at the same time hear and understand whatever English descriptions of the manipulatives were given by the teacher.

One notable example of the confusion students experienced related to converting fractions with different denominators into equivalent fractions using fraction circle pieces to visually represent the conversion. In Lesson Eight, the teacher originally introduced the idea of converting an existing fraction into an equivalent fraction by placing two different colored sets of pieces on top of each other to show that they covered the same space. Then, in Lesson Twenty, she removed the bottom set of fraction circles. Removing the bottom set of pieces symbolized the process of converting the fraction they represented to the fraction represented by the top pieces. The process was not written out in words, but the teacher narrated her actions verbally, as directed by the *RNP 1* Teacher's Guide. The physical action with the manipulatives was intended to help students develop an implicit understanding of the procedure that would be written in symbols eventually.

Naomi, one of the Liberian students, was particularly confused by the procedure the teacher performed. She had been absent from class for a few days and missed some lessons leading up to the demonstration of fraction conversions. When she returned to class the teacher, assuming all students had previously observed her using the pieces to demonstrate fraction conversion, modeled the following problem on the overhead:

> *Velicia spent 1/3 of her allowance on a CD and 4/6 of her allowance on a movie. What fraction of her allowance did she have left? Draw pictures to show what you did with the circles.* (Cramer et al., 2009, p. 166, Lesson 21, Student Page A)

In order to perform the calculation, students had to convert one-third into the equivalent fraction of two-sixths, and then subtract both two-sixths and four-sixths from one. Ms. Grant used the fraction pieces to show how one brown piece, or one-third, covered the same amount of space as two purple pieces, or two-sixths. Then she removed the brown pieces from underneath the purple pieces. She placed a whole black circle next to the purple pieces to show the idea of one minus two-sixths minus four-sixths, but there were no symbols to indicate the subtraction process. Naomi looked startled as she watched Ms. Grant perform the switch and she became quiet.

In Excerpt 6.11, when Naomi reviewed this portion of the videotape after class, she verbalized how confusing it was to watch the teacher modeling a fraction conversion such as this one.

Excerpt 6.11

| | | |
|---|---|---|
| 1 | Kristi: | What were you thinking while she was demonstrating that on |
| 2 | | the board? Do you remember? |
| 3 | Naomi: | I was thinking “Oh wow. That’s kind of confusing. I just don’t get |
| 4 | | it at all. Because I was gone for three days. I just don’t get it at all |
| 5 | | and- |
| 6 | Kristi: | The confusing part was watching her with the pieces = |
| 7 | Naomi: | Yeah. |
| 8 | Kristi: | =or listening to the words? |
| 9 | Naomi: | Well, listening to the words and trying to picture her do it I was |
| 10 | | kind of confused. |
| 11 | Kristi: | Yeah. Sometimes if I look at her and then I look away for a |
| 12 | | second I find my brain isn’t in the same place as the pieces. |
| 13 | | Do you ever have that happen? |
| 14 | Naomi: | ‘Cause she’s talking at the same time while she’s doin’ the pieces. |
| 15 | Kristi: | = she had the big one and the little one and she was- |
| 16 | Naomi: | Switching. |
| 17 | Kristi: | So that’s the place? |
| 18 | Naomi: | Yeah. I just lost it. I’m like “Oh my God what is she doing? |

(Naomi, Interview, 5-27-10)

In lines 9-10 and 14 of Excerpt 6.11 Naomi pointed out that she had difficulty watching the teacher modeling the problem with manipulatives while simultaneously listening to, and trying to comprehend, her words about the process she was performing.

Despite, or perhaps because of, the unit’s heavy emphasis on modeling concepts without providing the written numbers and symbols, at the end of the unit many students still did not understand what a fraction written in numbers represented. When a final test question asked students to compare the size of two fractions several students answered that a larger number in the denominator represented a bigger, instead of a smaller, fraction. Fraction size and what a fraction represented were the key points of several lessons. This student error was the very one that led Ms. Grant to choose a conceptually-based curriculum in the first place. In addition, even though students had been taught several lessons on converting fractions with unlike denominators to a common denominator so that the fractions could be added or subtracted, at the end of the semester some students still added or subtracted unlike denominators without performing this step. It was difficult to know the degree to which students had comprehended the manipulatives-based teaching, perhaps because of low English proficiency levels, or whether the difficulties on the final quiz related to students not yet having internalized enough of the content instruction to be able to independently demonstrate their knowledge without support from the teacher.

***Student beliefs about learning math.*** Although the teacher's guide made a convincing case for how "play" with fraction circles helped students build a mental model of fractions, students reacted negatively to the fraction circle pieces from the first day they were introduced. For younger elementary students, the use of fraction pieces might have been an engaging activity precisely because it felt like play rather than work. However, for these teenagers, several of whom were already looking ahead to graduation exams and transitions out of high school, the use of manipulatives felt childish to them. While the math and ESL teachers believed that the manipulatives were exactly what was needed to mediate the development of students' mathematical ideas, regardless of whether students enjoyed working with them, the students resisted this form of mediation. Students complained that they were not being treated like adults and they could not see how the manipulatives supported their ability to do the math. Midway through the *RNP 1* module several students simply stopped taking out their fraction circle sets when the teacher asked them to do so. One day, after repeated instructions to take out the manipulatives, the teacher responded with frustration and a lengthy discussion of reasons for the students' resistance ensued, which is shown in Excerpt 6.12 (May 21, 2010).

Excerpt 6.12

Ms. Grant: [Writing <1 and >1 on the board] Ok, so is it less than one or is it greater than one? … Or you can write out the words if you'd rather write out the words… Once you estimate, I want you to take out your fraction circles and try it. [Moving over to stand by Jorge and Jesse.] So three-fourths plus one-sixth.

[Jesse continues looking through bag for pieces. Jorge sits looking at the board and doesn't take his pieces out.]

Ms. Grant: Three-fourths plus one-sixth. [She walks over to Luis and James]. Fraction circles please!

James: ((Softly mimicking the teacher)) Fraction circles please.

Ms. Grant: Three-fourths plus one-sixth. [Turning and looking at Jorge's empty desk] All right, can I just remind you that even though you may…do you not like working with these circles?

Luis: Yeah.

Jesse: Not this time.

Luis: They're very annoying.

Ms. Grant: They're very annoying?

Jesse: No, they-

Ms. Grant: Can I remind you that they were tested in classrooms and this is the best way to learn about fractions?

[Some mumbling from students]

Jorge: They do get annoying.

Jesse: Yeah.

Ms. Grant: So they do get annoying, but, I would rather have a little bit annoying and say "When I'm done working with them I'm gonna know fractions."

[More mumbling from students.]

Luis: I don't know.

James: No, but the reason why, it's not because it's tested or something. Humans like us not have patience to remove, bring out something and then put it back again-

James: You know?

Ms. Grant: You don't have the patience or the energy?

James: I don't have the patience, of doing that, like, like, you or any other kid gonna have the patience to do it. I can’t do that.

Victoria: Hah hah. You lazy!

James: I can’t do it. I can’t do it.

Ms. Grant: Is it lazy?

James: Yeah.

Ms. Grant: O:h! We can’t be lazy! We can’t be lazy.

James: It’s not being, it’s not only being lazy, but I don’t have time for that, you know?

Luis: Yeah.

Ms. Grant: All right, well I don’t have time for people to just sit here and not learn. So that’s why I need you to be active. The more active you are, the more you will learn, so I need you to be active.

James: But they make-, you know I was –

Ms. Grant: So it’s not an option right now. I need you take out your fraction circles and get started.

James: I know, but I’ll, I’ll use my-

Ms. Grant: The faster we go through these-

Jesse: The better will be!

Ms. Grant: The sooner we can stop using them, but if everybody slowly goes through, we end up using them all the time.

James: I use them.

Ms. Grant: So, I’m gonna set my timer. I’m gonna give you <u>one</u> minute=

Jorge: They make me mad though!

Luis: Oh God!

Jorge: They make me frustrated.

Ms. Grant: = to get your fraction circles out.

Luis: [I feel like I’m in] first grade.

Ms. Grant: If the time goes and you do not have your fraction circles out, you will have a conference with me in the hallway to explain yourself and depending on that, after that you will be going down to the Dean’s if I don’t think your excuse is a good one. [She sets the timer] You’ve got one minute to get your fraction circles out. Let’s go.

[Jesse sighs and gets out his fraction circles. Victoria gets her fraction circles out. Jorge takes out his pink fraction equivalency sheet but does not appear to get out his fraction circles.]

(Transcript, May 21, 2010)

In Excerpt 6.12, when students resisted using the manipulatives, Ms. Grant tried to explain the research base behind the conceptual approach (lines 19-20) and the value of active learning (lines 44-45). These two concepts resonated with her beliefs about good teaching and learning. However, the students, particularly James, were not convinced by arguments about good teaching practice (line 28). Students had complained previously about the manipulatives being childish, but on this day they also complained about feeling frustrated (lines 28-30, 33-34, and 58), and said that working with the pieces was a waste of time (lines 40-41). While working with the fraction circle pieces in class, it was common to see students dropping pieces on the floor, looking for a lost piece that was not in the correct bag, flattening out pieces that got bent, and borrowing missing pieces from their neighbor. Some students seemed to have difficulty physically laying out the pieces neatly on a desk top to make a circle shape. In addition, when they were required to make a drawing of a physical model, particularly if they needed to divide a circle into a larger number of pieces such as fifteenths, several students immediately asked for the teacher or aide’s help or asked another student to draw it for them.

After several weeks of attempting to require students to use the manipulatives, the teacher relented and simply allowed students to use the manipulatives if they wished. When she did so, students complained much less about the childish nature of the curriculum, and some still chose to use the manipulatives on difficult problems. However the potential mediation of these fraction circles, and their ability to support language production, was limited as a result. At the end of the semester, only a few students had mastered the conceptual ideas of fraction size and fraction equivalence, and very few could actually describe those ideas in spoken words, written symbols, or written words, as the curriculum required. The teacher never completed the *RNP 1* module, and did not move on to the *RNP 2* module, which was intended for middle school students and might have been more age-appropriate. Toward the end of the unit she began to incorporate greater use of symbolic representation and began to focus on adding and subtracting fractions. These changes to the curriculum seemed to satisfy students’ need for what they perceived as more challenging curriculum. On the final exam, several students could not recognize problems similar to those done in large group and pair work with manipulatives.

## Pair Work

The *RNP 1* incorporates pair or small group work into each lesson with the intent of supporting students' ongoing exploration of ideas presented in the large group discussion portion of the lesson. While the *RNP 1* does not contain a detailed rationale provided for the benefit of pair work, NCTM advocates for the value of collaborative learning in secondary mathematics classes (Horn, 2012). According to Horn (2012), from a math instruction perspective, collaborative learning has a number of advantages for teen learners. These advantages include: (a) engaging individual students' thought processes to support sense making about math content; (b) creating an engaging learning environment that allows teenage students to be active learners and to socialize while learning; (c) providing a potentially non-threatening environment for students to share thought processes that may contain errors; (d) allowing students from diverse backgrounds and perspectives to work together to understand a concept. However, Horn (2012) notes that despite its many benefits, successfully implementing collaborative work in a math classroom can be a complex process, and student attitudes toward working the peers may vary. From an L2 learning perspective, collaborative student work is also thought to have value because it can be used to solve students' linguistic problems and to mediate new L2 learning (Swain, Brooks, & Tocalli-Beller, 2002).

Ms. Grant had tried to use small group work during the first semester of the ELL math class, with little success. Although she did not elaborate on the reasons why students had difficulty in small groups, she did indicate that during the second semester, with a carefully chosen partner, she could be more successful at getting a maximum of two students to engage with each other about the math content. However, many students still had difficulty working in pairs. The African students, in particular, seemed to prefer a large group discussion format. Each of these issues added to the tension between the adults' preference for certain learning activities and methods, and the students' preferences.

***Student difficulty working effectively with peers.*** Ms. Grant kept partners the same on all pair activities in the curriculum for several class periods. Then she typically rotated partners and changed the assigned seats so students sat close to the new partner. In one case, the assigned pair (Jesse and Michael) worked so well together that Ms. Grant allowed them to continue to work together for the entire semester. Despite a constant banter back and forth between them, these two students were capable of more focused attention to the pair work than other students. However, this attention frequently involved copying answers to problems without much discussion of the math ideas, and with relatively little academic English required.

In contrast to Jesse and Michael, there were at least three other pairs that did not work well together for reasons relating to disparate English proficiency or content knowledge levels, personality conflicts, or a shared preference for social conversation during work time. Victoria, a young Liberian woman who had perhaps the lowest English proficiency of any student in the class, and also the lowest content comprehension, often needed her partner to do more of the pair work because she did not understand the task. When she was partnered with Naomi, the highest achieving Liberian female in the classroom, Naomi often stopped participating in the pair work part-way through the activity and complained about doing most of the work. Ana and Marie were another frequently assigned pair who clearly disliked each other. They would not even sit together or talk with each other about the work. Marie was a quiet young woman from Kenya who had arrived to the U.S. most recently but who also was the top math achiever in Ms. Grant's class. Ana was the only Mexican female student in the class and often showed conceptual misunderstandings about what a written fraction represented. When Ms. Grant announced that Marie and Ana would be partnering on an activity usually it was Ana who protested and refused to move her desk near Marie. The tension between the two girls was evident. On at least one occasion when Ana protested she was removed from class for uncooperative behavior. Finally, David, a talkative Liberian boy, typically engaged in social conversations during work with any partner. David's off topic conversations ranged from the type of tattoo he wanted to get to discussion of the lunch menu, and complaints about being in ELL classes. In each of these situations where partners did not work well together, little math-related conversation occurred.

The lack of math-related content conversation in pairs may have related to several factors. First, the tasks did not necessarily require any collaborative activity that involved language. For example, in the first lesson students were asked to explore with fraction circles and fill out a worksheet showing the relative sizes of different colored pieces. Students were assigned to do the work in pairs, but each student had their own set of fraction pieces and their own worksheet. They merely had to write an answer next to a word or picture showing each piece. There was no need for students to share materials or talk together about the task unless they did not understand the directions.

Second, students' language proficiency levels and their knowledge of how to talk about academic tasks may have been too limited for unsupported pair work. These students could socialize with each other and talk easily about their out-of-school activities. Sometimes their ability to joke and tease each other in English made it seem as if they were more fluent in oral English, and understood more speech, than perhaps they actually did. As mentioned previously, Ms. Grant believed that Jesse, a top math student given his previous instruction in Nigeria and the U.S., was involved in cheating on homework assignments because his writing appeared on other students' papers. As I came to know the students more and they opened up to me, one focal student shared that she turned in Jesse's work because she had been absent and had asked Jesse to explain how to do a problem on a topic she had missed. Jesse could not easily explain in English how to do the problem so he finished the problem for her instead. If Jesse, one of the better math students, did not have the English skills to explain how to do a math problem, it was likely that many of the other students had similar difficulties, which may have led to a lack of productive peer discussion during pair work.

Third, as Storch (2004) found in her study of pair work in L2 classes, students' motives and goals for learning math, and whether they shared those goals with their partner, may have influenced interactions during pair work. For example, Marie was a relatively competent math student who worked hard in class because she saw math as important for achieving her goal of becoming a banker. In contrast, Ana, the partner who refused to work the Marie, was a student who struggled with basic fractions concepts. Ana was one of the students who, at the end of the fractions unit, still thought that a larger number in the denominator of a fraction represented a bigger fraction. Ana was very reluctant to draw attention to herself in math class. During large group instruction she frequently spoke English in a voice just above a whisper, and she rarely demonstrated answers to math problems at the whiteboard. Avoiding working with Marie, the best math student in class, may have been Ana's way of saving face if math was difficult for her. Ana was also experiencing behavioral challenges both at home and school that were significant enough to possibly end her school career in the United States and return her to live with extended family in Mexico. She did not have the same goal of obtaining a college education that required the study of math, like Marie did. These differing motivations may have led to a situation where the girls felt they could not easily work together.

*Student preference for large group format.* Overall, the class generally seemed to prefer the large group discussions and demonstrations led by the teacher, in comparison to pair work. As previously explained in Chapter 4, during those large group conversations, students could collaboratively explain a solution or justify an answer in ways that they did not appear able to do alone. During those large group discussions the teacher, a fluent-English speaking math expert, was always present to model concepts, prompt for correct answers and rephrase what students said to keep the conversation going. Students appeared to prefer interacting with her, or with Ms. J., the ELL aide, to interacting with each other. The large group format might also have been a more familiar and comfortable format for students with prior education in another country where much larger student to teacher ratios and teacher-fronted instruction were the norm. However, in Ms. Grant's class, large group participation patterns among students from different language backgrounds were not the same. The African students took an active part in large group conversations more frequently than the Mexican students did. The three Mexican students often quietly looked at their desk, drew on their folders and perhaps muttered an answer to the teacher's question now and then. These students could essentially hide in a group discussion in ways they could not during pair work.

On one occasion, a change in the power structure of the large group portion of the lesson led to extended student discussion, greater attention to the language used in student-created problems, and greater numbers of students participating in the math talk. Shifting a student into the central role, rather than the teacher, created the difference in overall student engagement. On this day Ms. Grant asked students to create their own fractions story problem as homework and to be ready to share that problem in class for other students to solve. Only four of twelve students completed the homework assignment, but the resulting discussion of those four problems lasted the entire hour and involved many of the students. Ms. Grant still directed the flow of the conversation, by choosing which student read a problem, and by prompting for certain elements in the discussion. Occasionally she helped shape the language of the problem to be more complete or correct. However the student who wrote the problem became the content expert and other students were required to ask questions of the problem creator, rather than the teacher.

**Conclusion**

This chapter highlights three important tensions in the activity system of Ms. Grant's classroom that minimized academic language expectations and opportunities for students to use such language. First, remedial instruction that incorporated a curriculum designed for young learners contained lower language expectations than typical grade-level math courses might. At least some students were aware that they were being taught well-below grade-level, which in turn created frustrations with the class despite the fact that students had difficulty mastering the math content. Second, a difficulty balancing the teaching of math and the teaching of language occurred, in part, because the teacher was new to teaching L2 learners. She tended to prioritize math concepts without explicitly addressing math language. At the beginning of the study she felt that students could use any language variety with which they were comfortable to talk about math. Third, implementation of some commonly used best practices in the classroom (e.g., pair work, conceptual curriculum using manipulatives), based on the teacher's belief about good teaching and learning, conflicted with student perceptions of the practices. Students believed the manipulatives were childish and frustrating. The students who had previously been instructed with a procedural approach to performing operations with fractions struggled because they could not use their previous knowledge. Instead of creating a positive change in the activity system, as some tensions can do if they are addressed, these three main unresolved tensions created a barrier to academic language production, and perhaps to the learning of math content as well.

Chapter 7 summarizes the key findings of Chapters four through six and relates them to the literatures. Ways to create a change that could support greater use of academic language are proposed.

# CHAPTER 7: CONCLUSIONS

In this final chapter I first reexamine my original research questions and summarize key findings for each question individually. After the summaries, I discuss how the findings relate to what we know from other research on academic language, prioritizing the research on K-12 ELLs in U.S. schools where possible and supplementing with findings from research on other types of L2 learners. Next, based on the case study findings and related literature, I make a limited set of recommendations regarding ways to establish conditions conducive to academic language instruction in content areas. As my observations in Ms. Grant's classroom confirmed, the issues around defining and developing academic language in her pre-algebra course were complex, and the specific factors that influence how academic language took shape may have been unique to her situation. For that reason, I believe that individuals closer to the classroom level have the best chance of recommending in-depth changes that will improve actual instructional delivery. Therefore, instead of creating a lengthy list of recommendations for the teacher to improve L2 instruction in content classes, I make broad recommendations for ways administrators can establish some of the basic conditions needed for effective language instruction in this type of setting.

## Summary of Findings

*Research Question 1: In what ways is the mathematical communication of ELLs shaped by the classroom context in which it is embedded (e.g., classroom structures, policies, resources, rules, shared language routines, mediating artifacts)?*

As mentioned in Chapter 4, the activity system of Ms. Grant's classroom contained a number of elements that shaped the expectations for, and opportunity to use, academic language. The third generation Activity Theory model developed by Engestrom (2001) suggests that these elements included: (a) classroom rules; (b) the classroom community; (c) the division of labor between community members, and; (d) the presence of potential mediating artifacts that could support, or detract from, the desired outcome of academic language production.

Ms. Grant provided a highly structured classroom that attempted to blend both traditional teacher-centered, large-group instruction with pair work where students could play a more active role in the conversation. Despite the opportunity for collaborative discussion, Ms. Grant still directed most of the activities and made most of the decisions about how students would participate in them (e.g., seating assignments, opportunities to read aloud or demonstrate solutions to problems, partners for the pair work, homework assignments). Her explicit and implicit classroom rules emphasized the few factors students could control: attendance and classroom participation, adherence to rules, and the need to do individual work on assignments. The cooperative, hardworking students were allowed some flexibility in the application of the rules, but those who were not cooperative were removed from class. The rules appeared to increase the efficiency of classroom routines, as noted when substitute teachers did not follow them. At the same time, the teacher-controlled classroom may have reinforced students' perceptions that they were "made" to take ELL courses against their wills and that they had little say in their own education.

The composition of the classroom community changed daily, and these changes influenced the students' instructional time, participation opportunities and language production. The presence or absence of two particularly vocal students could affect the tone of the entire classroom and the amount of content covered on a given day. On days when the class was off topic and math instruction time was limited, little content-related language occurred. Ms. Grant's absence, combined with the presence of a substitute teacher who was often unfamiliar with math, also meant that little content instruction or content-related language occurred. Finally, Ms. Johnson, the ELL aide who attended class a few days a week, provided a great deal of individualized content and language support to struggling students. When she was absent there were limited opportunities for students to have one-on-one conversations with an adult about math concepts.

In this classroom the four key potential mediators of academic language learning were: (a) the conceptually-based curriculum that incorporated a number of manipulatives and models while controlling language complexity; (b) the consistent opening routine that included language objectives; (c) the teacher's use of language (e.g., modeling, prompting, questioning and rephrasing student speech) to support content comprehension, and; (d) collaborative student language that could be used to build a more sophisticated explanation of a solution process or a justification for a solution. Each of these classroom features was a potential mediator, because in many cases the mediator offered limited support or the students could not, or did not, take advantage of the mediation offered. Students sometimes resisted the mediators that were available as their way of resisting being in a lower-level ELL math class generally, or specifically as their way of resisting instructional practices with which they disagreed. It is important to note that the teacher and school, whether intentionally or not, put in place these mediating tools through instructional choices. In cases where students tried to use their own mediating tools, the teacher sometimes resisted the ones that the students' chose.

The first key potential mediator of language learning was the conceptually-based curriculum written for young learners. This curriculum de-emphasized procedures for performing operations with fractions and focused instead on building students' understanding of what a fraction represented. Mrs. Grant's students had all made errors on a pretest that indicated they did not fully understand what a fraction represented. In theory, this curricular emphasis on basic concepts could have helped students address those misconceptions while learning to represent fractions in multiple formats, including words. However, the curriculum had no explicit language learning goals and it minimized the need to use math terms like "numerator" or "denominator". Thus, while students were talking about fractions ideas, there was not an explicit focus on how to talk about them. There was very little curricular emphasis on developing math reading and writing skills that would have been appropriate for high school students. Further, it contained no specific direction to teachers on how to adapt the curriculum for older learners, particularly for ELLs, even though the developers state on the curriculum website that it has been used successfully in remedial instruction. This curriculum was used out of great need, in a context in which there was no perfect textbook, but it clearly did not support the teacher in meeting students' second language development needs.

Second, each class that Ms. Grant taught began with the same opening routine that, in theory, had the potential to reinforce previously learned content concepts and to address key language that students needed to learn. During this time students interacted with the math and language objectives and Instructional Focus (IF) problem in multiple modalities (reading, writing, listening and speaking). The objectives and IF exposed students to a slightly more formal and sophisticated language register than the students might have used independently. Ms. Grant faithfully adhered to this opening sequence each day that she taught and on most days the routine appeared to set the stage for quiet, focused work throughout the class period. The opening routine, however, did not support much of a focus on academic language because Ms. Grant, a new ELL pre-algebra teacher, had difficulty knowing what aspects of language to target in the language objectives. She believed that supporting academic language use in her classroom was best achieved by creating opportunities for students to produce more language. To that end, her language objectives for the fractions unit emphasized activities students would do with language (e.g. Students will write fractions in word form) rather than specific features of language that students needed to use for those activities. As a result, there was usually a cursory oral reading of the language objective without any direct instruction on the topic.

Third, another potential mediator was the teacher's use of language to shape students' language production. Ms. Grant used her words to prompt students for more complete explanations of math ideas, to model the correct way to do tasks, and to paraphrase student language that did not convey accurate mathematical understandings. The teacher could have provided this type of support to encourage complex academic language production as well. However, her focus was almost entirely on expressing correct mathematical understandings, except in the cases where she corrected an occasional pronunciation error or use of an incorrect math term. Thus, the teacher's language sometimes appeared to support her goal of maximizing student output. However, her frequent use of low-level display questions actually limited the amount and complexity of language the students were required to use in their responses. For example, in some cases instead of asking students to compare two fractions to determine which one was larger, the teacher made the comparison in her question (e.g., Is the answer larger or smaller than ½?). Students only needed to think about the comparison, rather than using words to express it, and then give a one-word answer (e.g., larger).

Finally, during large group instruction time, some students could build collaborative utterances to express more complicated constructions than they could produce alone. In such cases the students showed remarkable skill at timing their piece of the complete utterance appropriately, and using compatible language structures. However, sometimes the highly collaborative discussion had the effect of cutting off another student's cognitive processing time and ending that student's chance to speak. This situation occurred most frequently for the student who was the newest arrival to the U.S. and who seemed to have lower oral fluency levels than other students who had been in the country longer.

*Research Question 2: What do focal ELLs do with mathematical/academic English in the classroom?*

After examining the academic language use for four focal students over five separate class periods it is possible to describe students' oral language performance given a particular set of contextual factors (e.g., activities, students present, teacher language, opportunities for interaction, student motivation and engagement). It is not possible to describe a more stable underlying level of "proficiency" in oral English because of the variability in what students produced across days (see Chapter 5 for a complete discussion of this topic). This variation in oral language production was, at least in part, due to factors such as students' mood, personal situations that preoccupied them, familiarity with the lesson topic, the structure of tasks, who was present in class on a given day, relationships with an assigned partner for pair work, etc. Variability also related to whether students felt that their individual, long-term learning goals were being fulfilled by classroom activities. They were less likely to verbally participate in activities that did no support those goals.

Despite the variability in language production, what is clear is that these four focal students were usually "doing" math, with varying degrees of success, using the most basic every day vocabulary and relatively short and simple syntactical structures. Utterances were typically a phrase long, but for some students they were as short as three or four words in length. When students produced only brief answers to the teacher's questions, their grammar was often correct. However, when an occasion arose for them to speak longer, and to produce a more complex utterance, grammar and fluency difficulties became more evident for some students. The four focal students did not frequently use the more complex and sophisticated language functions of explaining, justifying or comparing/contrasting that might have required more complex syntax, grammar and vocabulary. These language functions were a part of the curricular content, but as previously mentioned, the teacher sometimes structured her own language in ways that reduced language production requirements for students. During CAF analyses I noted that students needed to use logical connectors to indicate the order of steps or a cause and effect relationship required for some language functions. The focal students appeared to have only partial knowledge of the logical connectors needed to perform these language functions, and tended to repeat the same limited range of connectors.

**Tensions influencing academic language support.** Despite the presence of some potential supports for academic language learning that were present in the classroom, there were three key tensions in the activity system that minimized academic language expectations and opportunities for students to use such language. These tensions were: (a) providing remedial versus grade level instruction; (b) balancing the teaching of math and the teaching of language, and; (c) following adult versus students' preferences for instructional approaches and activities.

First, remedial instruction that incorporated a curriculum designed for elementary-aged learners contained lower language expectations than typical grade-level math courses might. These below-grade level materials and limited language expectations were in conflict with the state math standards which, in theory, should have dictated that ninth grade students learn algebraic functions using functional notation. There were no concrete academic language standards in place at the time of the study, and the language standards that did exist did not link to mathematics. Vocabulary suggested in the curriculum teacher's guide was basic, everyday language, and the curriculum encouraged teachers to accept a variety of ways of talking about key math concepts as long as the answers were mathematically correct. As previously mentioned, there were minimal requirements for students to read or write text. Drawing pictures, instead of answering with words, was allowed on some assignments. Pair work activities were fairly simple, in keeping with the curriculum's target audience of elementary students, and did not require extended conversations. During large group discussions when longer utterances were sometimes noted, extensive use of manipulatives created a highly contextualized situation in which students could merely refer to the color of a fraction circle piece to answer the teacher's question. The curriculum did not require elaborated answers that would be clear to a non-participant in the classroom. Students were aware that the content and language of the curriculum were well below grade level, and some were frustrated by the low-level and slow pace of the instruction in spite of the fact that they struggled with material developed for much younger learners.

Second, a difficulty balancing the teaching of math and the teaching of language occurred, in part, because the teacher was new to L2 learners and was learning on the job without a great deal of targeted support to strengthen her skills. She prioritized the teaching of math concepts the teaching of appropriate math language for two reasons. First, accepting any language variety that students used to talk about math concepts, so long as the math concepts were correct, fit with her personal values relating to welcoming diverse students in the math classroom. Second, she had difficulty identifying specific aspects of math language to teach. As previously mentioned, she thought about supporting academic language as providing more opportunities for students to produce language rather than about teaching them the features of that language.

Third, implementation of some commonly used best practices in the classroom (e.g., a conceptual curriculum using manipulatives, pair work), based on the teacher's belief about good teaching and learning, conflicted with student perceptions of the practices. Over time, some students openly resisted participating in these practices despite their potential to support their learning and academic language use. One illustration of this type of conflict over best-practices versus student preferences occurred around the curriculum. Conceptually-based math curricula and the use of hands-on materials are highly recommended in the professional literature on teaching content to ELLs (Ketterlin-Geller, Chard & Fien, 2008). However, many students preferred the paper and pencil approach to solving mathematical operations with fractions and, as mentioned earlier, they believed the manipulatives were childish and frustrating. After a time, many students stopped using the manipulatives when the teacher made them optional. A few students tried to explain ways they had learned fractions operations in other countries, but the class periods were short and there simply was not time for the teacher to try to comprehend the cultural and linguistic differences in the way fractions had been taught. Some students who had previously learned fractions operations using a procedural approach to instruction stopped participating in the group discussions when they could not use the knowledge they already had.

A similar type of conflict occurred around the use of pair work to practice math concepts. Again, the literature on teaching content to ELLs highly recommends this practice as a way for students to consolidate their understanding of concepts, and practice their academic language in a setting more adapted to an individual learner's need than large group discussion (e.g., Long & Porter, 1985). However, in Ms. Grant's math class, factors such as the simple nature of pair tasks, students' unwillingness to work with certain partners, and their limited academic L2 skills all restricted the amount and kind of language produced in pair tasks. When complex syntax, grammar or vocabulary did occur, it was primarily during large group discussion led by the teacher, or occasionally in one-on-one conversation with her, rather than in conversation with a peer.

Instead of creating a positive change in the activity system, as some tensions can do if they are addressed, these three key unresolved tensions created a barrier to academic language production, and to the teaching and learning of math content as well.

## Discussion

**Student language use.** To date, there are few studies of K-12 students' academic language production in math classes to which the results of this study can be compared (for one example see Hansen-Thomas, 2009). Much of the small body of literature examining classroom language use occurs in the context of other subjects, such as history, science, language arts or foreign languages (Bailey, Butler, LaFramenta & Ong, 2004; Bunch, 2009; Gibbons 2003; Jacob, Rottenberg, Patrick, & Wheeler, 2011; Nussbaum, 2002; Reppen, 1994/95; Short, 2002, 1994; Zwiers, 2008, 2007, 2006, 2005). The smaller number of studies conducted on features of academic language in math classrooms may reflect a common misperception that math is a relatively language-reduced subject that is easier for L2 learners (Lager, 2006; Janzen 2008). In addition, most of the available studies on content-area language use focus on the teacher's role in establishing the necessary conditions for L2 learning to occur (Achugar, Schleppegrell, & Oteiza, 2007; Bailey, et al., 2004; Gibbons, 2003; Short, 2002, 1994; Staples & Truxaw, 2010; Zwiers, 2008, 2007, 2006, 2005). The literature largely does not incorporate a focus on the role of the entire classroom context, and the way in which classroom factors are interrelated, in supporting or inhibiting academic language use.

However, if we examine a broader selection of relevant studies from the SLA, immersion education, and L2 instruction literature, it is clear that the results of this study are strikingly similar to the findings from the larger body of work on students' classroom language use in other subject areas. The findings are similar both in terms of the amount and features of academic language students often produce during typical instruction, and in the types of classroom factors influencing language production.

First, both this study and the other, related studies establish that L2 students, including ELLs, do not produce elaborated academic language unless there is a specific requirement for them to do so (Fazio & Lyster, 1998; Zwiers 2008, 2006).[36] In general, L2 students in traditional, input-based content and language classrooms tend to produce short utterances in response to teacher questions (Bailey, et al., 2004; Swain, 1988), use simple grammar and syntax (Swain, 1988), and use a restricted vocabulary range (Golberg, Paradis & Cargo, 2008) with little active acquisition of academic vocabulary (Bailey et al., 2004), unless the conditions are set up to encourage a different kind of language production. Students in these traditional classes, as observed in my study, may have few opportunities for sustained oral or written L2 production (see Genesee 1991; Llinares & Morton, 2010; Short, 2002), and thus, their productive L2 skills may not grow over time. In traditional instruction, students' use of language functions such as describing, justifying, or persuading seems to vary across studies depending on the content area investigated (Bailey et al., 2004; Dalton-Puffer, 2007; Zwiers, 2008, 2007, 2006, 2005). In this study of a pre-algebra classroom, ELLs were not found to be frequently using the higher level cognitive skills associated with complex math language functions such as describing a solution, justifying an answer, or comparing two quantities. Other studies have found that language in non-math classrooms tends to include other types of language functions such as evaluating opinions about historical events, supporting statements with evidence, and so on (Bailey et al., 2004; Dalton-Puffer, 2007; Zwiers, 2008, 2007, 2006, 2005). However, despite the difference in the

[36] Some differences in the typical amount of academic language production may occur across content areas (Fazio & Lyster, 1998).

type of language functions produced in a content area, students may still not use complex language functions frequently.

When students do produce a particular complex language function, a single function may be distributed across multiple speakers rather than uttered by just one speaker (Dalton-Puffer,  2007). Explaining, which is a relatively low-level function, may be the most common language function used by students in some L2 classrooms (Dalton-Puffer, 2007). Hansen-Thomas (2009) found that one student-related variable influencing the production of language functions is an individual student's content knowledge and skills. She determined that students with limited content comprehensions and skills spoke less often than students with her skills, and they also used simpler language functions. In this study, students who were confident that they had something to contribute to the conversation, whether that contribution was correct or not, tended to participate more frequently. However, in Ms. Grant's classroom there did not appear to be substantial variations in the amount of math language functions produced by different students, since there generally was only a limited need for students to produce such language.

Finally, in the related literature, some L2 learners had limited oral participation (DiNitto, 2000; Naughton, 2006; Pica & Doughty, 1985; Storch, 2002) and little negotiation of meaning (Foster, 1998), in pair and small group work. Thus, these students used relatively little academic language during activities that could have strengthened their L2 production ability. Again, this finding is similar to what I observed in Ms. Grant's classroom where the least amount of academic language use was observed during pair and small group work when students were interacting (or in some cases not interacting) with each other. The greatest use of these language functions occurred during one-on-one or large group interaction with a native-English speaking teacher.

**Factors related to academic language use.** Given that a lack of complex, elaborated L2 production in content classrooms is not an uncommon finding in the research literature, which contextual factors seem to have a relationship to the lack of elaborated language production? This study relates the de-emphasis of academic language during instruction to a variety of interconnected contextual factors that were present in Ms. Grant's classroom. These factors included the course design, the lack of grade-appropriate rigor in the curriculum, relationships between members of the class community, student values and motivation to participate in instruction, teacher L2 instruction experience and skills, and teacher beliefs. However, for the most part, the related literature reviewed here largely examines the key role played by the teacher in creating conditions that support or inhibit academic language use (see Bunch, 2010). These studies provide a lengthy list of findings that are critical of teachers' skills in promoting academic language use in content classrooms. The critiques of teachers include the following findings:

- segregation, rather than integration, of content and language teaching (Lyster, 2007);
- prioritization of content instruction over language instruction when both should occur in the same class (Fortune, Tedick & Walker, 2008; Lyster, 1998; Short, 2002);
- lack of explicit language objectives in lesson plans (Short, 2002);
- overemphasis on techniques to make content comprehensible at the expense of fostering students' ability to process, as well as produce, complex language (Short, 2002);
- missed opportunities for intentional language instruction combined with reliance on unsystematic, incidental language instruction (Genesee, 1987; Jacob et al., 2011; Short, 2002);
- use of whole class discussions in order retain control of the pacing and flow of instruction (Dalton-Puffer, 2007; Fazio & Lyster, 1997; Lyster & Mori, 2006; Short, 2002);[37]
- minimal explicit error correction with, instead, an emphasis on indirect repetition and rephrasing of students' speech (Swain, 1988; Zwiers, 2008, 2006), and;
- "linguistic enabling" behaviors such as asking low-level questions, reducing linguistic complexity, simplifying vocabulary, and accepting student responses even if incorrect, incomplete or without detail or elaboration (Zwiers, 2008, 2006).

[37] Note that whole class instruction can support academic language development if the group discourse quality is good (Gibbons, 2003; Haneda, 2005).

What the literature does, in presenting L2 content teachers in a negative light, is to oversimplify a complex and overlapping set of classroom variables that, together, create a push and pull on teachers' instructional decision-making regarding the balance of language and content. Furthermore, delegating to relatively untrained teachers the primary responsibility for the challenges of effectively integrating content and language instruction ignores the vital role of school and district administrators in creating the conditions for effective content instruction with ELLs. Bunch, Abram, Lotan and Valdes (2001) describe the difficulty inherent in sheltered content instruction and suggest the need for teachers to have extensive support and guidance in order to be effective:

> Teachers trying to meet the needs of these learners in sheltered content classes face extreme challenges. The obvious need to simplify difficult academic language and content to make it accessible to ELLs comes with the concurrent danger of reducing opportunities for students to develop increasingly advanced language and content skills. In addition, although the primary concern is to provide access to content knowledge in sheltered classes, this concern may overshadow a specific focus on developing academic English skills. Furthermore, ELLs in sheltered content are often isolated from mainstream classmates, thereby reducing opportunities for them to interact with English-speaking students who may be more academically prepared and, thus, denying them potential academic and linguistic resources. Finally, teachers may lack necessary preparation and continued support…mainstream content-area teachers may have minimal training in L2 teaching methodology or experience in supporting L2 development. (p. 29)

While it might be possible for individual teachers to learn to set their own classroom language learning goals, a disjointed approach to content and language-related goal setting in each individual classroom and subject in a school, and across schools within a district, allows ELLs to fall farther behind their non-ELL peers. What is needed is for leaders to promote a clear, shared vision of ELLs as capable of academic achievement, and a systematic emphasis on teaching language and content together.

## Recommendations

It is easy, but perhaps not very helpful, to develop a long list of recommendations for a variety of educators and administrators based on the result of one study's findings.

In this case, however, I make one or two central recommendations for each level within the school system that, if implemented, would set the stage for a clearer and more focused emphasis on developing secondary ELLs' academic language in math classrooms. Once these recommendations are in place, other work could be done to strengthen academic language teaching and learning given the unique set of local contextual variables present in an individual classroom and school. However, the conditions for establishing sustained attention to academic language learning must be put in place before such work can be done effectively. To create sustained growth and reach accountability targets for English language proficiency, academic language instruction must be systematic rather than left to the discretion of individual teachers. Systematic attention to how academic language should be taught, and the articulation of language across grade-levels in each subject area, requires substantial involvement from school and district administrators.

To develop a greater focus on intentional, systematic teaching of content-area language, there are key steps that can be taken at each level of the school system.

**District administration.** District administration can…

*Recommendation 1. Create district-level guidance on specific academic language skills needed for students in math (and all content) classes at each level in the K-12 system, attending to how these skills need to progress as math content becomes more difficult.*

State standards are often used for a variety of purposes. These standards may never be as precise or detailed about features of content-area academic language as individual teachers require for planning instruction using a particular curriculum that may have its own language emphases. In the absence of state-level guidance, the district can play a major role in providing such supports for teachers. One possible format that such guidance could take is learning progressions. Learning progressions are "a clearly defined progression in [content] skills along the sequence in which they typically develop" (Bailey & Heritage, 2008, p. 346). In math, for example, Hess and Kearns (2010) developed research-based learning progressions for use with the Common Core State Standards that have recently been adopted by Ms. Grant's state. These progressions show fractions knowledge and skills integrated into a strand called "Symbolic Expression". At the youngest grades, K-4, students "Build flexibility using whole numbers, fractions and decimals to understand the nature of numbers and number systems" (Hess & Kearns, 2010, p. 10). They do so by: (a) counting, modeling and estimating amounts, (b) comparing, representing and putting numbers in order, and (c) applying place value and expanded notation to create and break down whole numbers. As the grade levels progress, Hess and Kearns (2010) show that students should be able to estimate and compare the size of numbers written in different ways, including fractions. Finally, in high school, students should be able to demonstrate flexibility in using both rational and irrational numbers and number systems, including complex numbers and matrices.

Bailey and Heritage (2008) argue that to strengthen the education of ELLs, math progressions like the one found in Hess and Kearns (2010) should have a description of corresponding language features, such as how students' progress in learning more complex English syntax or how they develop in oral fluency. Bailey and Heritage (2008) call these academic language skills "enabling skills" that are needed to perform the math skills described in the math learning progressions. The New Zealand Ministry of Education (2008) has created academic language learning progressions at each of 13 grade levels, and these learning progressions can serve as an example of what a district could create. According to this document, in high school oral language production students at the foundational stage can say single words, echo phrases they hear and respond in the native language. Students at each of four successive stages of oral language development use increasingly varied and complex structures, progressively follow Standard English language conventions, and have relatively few errors in their speech. At the highest stage students "use mostly high-frequency words and leave out structural words; use non-standard vocabulary and sentence structures; use the subject-verb-object structure if they have had a chance to plan what they are going to say (New Zealand Ministry of Education, 2008, p. 10)."

The combination of content learning progressions such as those described by Hess and Kearns (2010) and academic language learning progressions like those described by the New Zealand Ministry of Education (2008) allow teachers to plan formative assessments to show what students already know in math and language and to determine what individual students need to learn next (Bailey & Heritage, 2008). Having these types of learning progressions in Ms. Grant's classroom, and designing appropriate formative assessments, would have allowed Ms. Grant to better serve students like David, the student in this study who struggled with math despite sounding like a fluent English speaker, because she would have been able to separate his troubles with Standard English and with math.

Bailey and Heritage's work (2008) addresses learning progressions in English Language Arts and the associated academic language listening and speaking skills. However, the descriptions they provide could be used as models for creating such progressions relative to math. District-created math and academic language learning progressions could also add in features of language emphasized by particular district-endorsed math curricula at each level. The discussion among staff that would be required to incorporate curricular emphases could focus attention on which curricula are used by ELLs and how well those curricula align with grade-level math and English language proficiency standards.

If sheltered math teachers like Ms. Grant began the school year with this type of specific guidance on what academic language to prioritize, other long-term initiatives could be planned to build teacher skills in writing appropriate language objectives and creating relevant language learning tasks.

*Recommendation 2. Provide resources and opportunities for sheltered math (and other content) teachers to collaborate with a mentor, ELL coach, or to team teach with a language development specialist to develop his or her ability to notice the academic language of the discipline and effectively teach it.*

From the beginning of the study, Ms. Grant described her challenges determining what language to teach. At times she also expressed surprise that she had not noticed particular students having trouble articulating ideas in English until I asked her about them. For example, until I commented that Marie, a quiet focal student, often asked to come to the board and write answers to the teacher's questions instead of providing an oral explanation, Ms. Grant had not noticed that Marie struggled to express an idea verbally. Once she noticed Marie's difficulty with oral language production she quickly began to allow Marie more uninterrupted time to formulate her thoughts prior to speaking.

Rather than taking Ms. Grant out of her classroom to attend professional development opportunities related to language teaching, some of the most productive learning opportunities might occur in her own classroom while she is faced with teaching a particular curriculum to a group of students with unique learning needs. A mentor, coach or co-teacher could provide Ms. Grant with support in designing appropriate language objectives, creating language learning activities and assessing academic language development in ways that allow her to gradually assume greater and greater responsibility for these aspects of teaching as her L2 teaching skills develop.[38] During the study, Ms. Grant occasionally viewed video clips of students during and instruction and provided thoughtful commentary on what she was hoping to achieve, as well as student learning difficulties. Incorporating some kind of videotaping of her teaching and review of the videos with a mentor or co-teacher might provide increased opportunities for Ms. Grant to notice needed changes to instruction.

**School administrators.** Principals and other school administrators can…
*Recommendation 3. Develop a positive school-wide vision of academic success for ELLs that includes deliberate, sustained attention to academic language development.*

Recommendations from several works on effective school leadership have been adapted here to suggest ways that this vision might be accomplished (Alford & Nino, 2011; Brooks, Adams, & Morita-Mullaney, 2010; Smiley & Salsberry, 2007). School administrators should ensure that:

- academic goals for ELLs are the same as for other students;
- a collaborative school culture is developed that shares responsibility for the academic success of ELLs and ends the isolation of sheltered math (and other content) teachers as well as ESL teachers;
- educators understand the learning characteristics of ELLs, with special attention given to communicating the needs of speakers of African English varieties (e.g., Liberian Creole, Pidgin English, etc.);
- instructional strategies in math and other content classes promote both content and language learning. Language learning must be conceptualized

[38] See Dove & Honigsfeld (2010) for a list of possible models of collaborative language and content teaching.

comprehensively to include reading and writing, rather than eliminating these modalities from instruction because they may be among the more difficult aspects of language to teach in content areas;

- staff has time and access to ongoing training and resources on L2 development strategies. As mentioned in the district-level recommendations, access to mentor teachers, peer coaches, and opportunities to team teach with ESL teachers may be especially important ways for content teachers to learn about L2 instruction with a particular curriculum and a specific group of student needs;
- teachers are regularly observed when they are providing academic language instruction and they receive specific feedback on ways to strengthen their L2 instruction skills.[39] When giving this type of feedback, it is important to attend to ways in which teacher language either promotes or inhibits students' use of complex, extended academic language.

*Recommendation 4. Search for, and hire, new content teachers who have attended teacher preparation programs that incorporate a focus on teaching ELLs.*

Ms. Grant's state, along with 33 others, is participating in the edTPA teacher performance assessment for teacher education candidates.[40] Among other skills, the edTPA assesses a candidate's ability to differentiate instruction for ELLs. Identifying and teaching academic language is one key skill that is included in the assessment for all types of teaching licenses and school levels. New teachers who have been successful on the edTPA will possess at least a basic awareness of how students learn content in a L2 and how their discipline uses language. This type of teacher knowledge is a valuable asset to high schools offering content classes that include ELLs. Teachers who have completed the edTPA can support and encourage their colleagues who have not had the opportunity to develop the same level of knowledge and skills regarding teaching content to ELLs.

**Sheltered math teachers.** After the study, Ms. Grant moved on to a new teaching opportunity in another location. A new sheltered math teacher took over her classroom

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[39] Echevarria, Vogt & Short (2004) provide a teacher observation form that can be used to observe sheltered content teachers who implement the Sheltered Instruction Observation Protocol (SIOP) model.

[40] In some states there may be only one institution adopting the edTPA, while in others there is a statewide adoption for all institutes with teacher preparation programs.

the following year, making the new teacher the third ELL pre-algebra teacher in three years. The following recommendation is made in light of potentially high turnover rates in sheltered content teachers, and the lack of accumulated expertise that occurs with frequent staff turnover. Sheltered math (and other content) teachers need to…

*Recommendation 5. Be vocal about the supports needed to develop competence in teaching academic English. Teachers might ask for*

- written guidance on specific features of academic language that can help in creating appropriate short-term and long-term math and language objectives for the sheltered math (and other content) classrooms. Such guidance should address ways that students build competence in both math and language skills so that math teachers can easily assess what students already know, what they do not know, and plan appropriate next steps for instruction;
- guidance on choosing an appropriate math (or content) text, particularly in a remedial instruction setting, so that academic language emphases are not too simple for the students' age and grade-level;
- guidance on appropriate pacing of remedial instruction so that students have the opportunity to learn grade-level math (or other content) and the associated language;
- support in strengthening academic language instruction skills, particularly those that can occur in the context of the sheltered math (or other content) classroom. Ask school and district administrators about the possibility of engaging a mentor teacher, peer coach, or team teaching math with an ESL teacher as you strengthen L2 instruction knowledge and skills;
- flexible grouping opportunities and creative use of school time to maximize opportunities to teach both math and language. Teaching both areas during a 45 minute class period is challenging when students require time to settle in to class and become engaged with material;
- guidance on developing small group and pair work skills in ELLs, as well as in handling social challenges that may prevent effective group work, so that students can have greater opportunities to produce complex ideas about math topics in ways that require academic language. One suggestion is for the school to make

teaching small group and pair work skills a priority for all students in all content areas, given the unique possibilities for language production and comprehension that exist during these types of interaction;[41]

- specific feedback on academic language teaching strengths and weaknesses as part of classroom observations by school or district administrators. As previously mentioned, the SIOP model materials (see Echevarria, Vogt & Short, 2004) contain for those conducting evaluations of experienced sheltered content teachers. One important area for feedback would be on ways that individual teachers' language use either promotes or inhibits complex, extended responses from students.

*Recommendation 6. Attend to student motivation issues over which classroom teachers have some control so that ELLs are engaged in academic language and math instruction.*

High school students have their own desires for their future, and unique social factors that influence how they behave in a classroom. It is not possible for teachers to make every lesson or every class motivating to young adults. However, there appeared to be a set of issues affecting ELLs in Ms. Grant's classroom that educators could address to influence student motivation to some degree. In short, sheltered math (and other content) teachers could provide students with more choice in how they participate in class work, create an interesting and engaging context for applying key concepts that would be respectful of teenagers' interests and past experiences, select a curriculum and teaching methods that do not feel childish to students, and move at a faster speed through remedial material.

One way that the literature recommends for engaging ELLs is through designing instructional activities that are informed by Culturally Relevant Pedagogy or CRP (see Ladson-Billings, 1995; Leonard, Napp, & Adeleke, 2009). With CRP, content lessons become meaningful to students because they are connected directly to their culture, home language and prior experiences. Valuing ELLs' perspectives and experiences in this way, rather than seeing students in terms of the mainstream linguistic or cultural knowledge that they lack, can be motivating in ways that traditional knowledge transmission

[41] See Zwiers & Crawford, 2011 for suggestions on ways to teach group skills to ELLs.

activities may not be. However, Leonard et al. (2009) caution that it can be challenging to use CRP in math classes because of educators' tendency to see math as a universal subject that is conceptualized in similar ways across cultures and languages. Enactment of CRP relies on mainstream teachers examining their own views of the role of race, culture and language in teaching mathematics first. Once teachers are aware of how their views influence the way math instruction is typically presented, they can then design rich, engaging lessons that will allow for multiple answers based on students' varying perspectives. Leonard et al. (2009) provide the caveat that to design motivating instructional experiences based on CRP teachers must know their students well and not make assumptions about students' experiences. Teachers must also monitor instructional tasks closely to ensure that the tasks remain cognitively challenging while still being engaging, and they must provide extensive scaffolding to ensure that activities are not too cognitively demanding.

**Study Limitations**

There are three primary limitations to this study that are important to acknowledge. First, deciding how to operationalize and measure academic language was one of the most challenging aspects of the study's data collection and analysis, and it was a key decision that influenced all of the study findings. Originally I intended to analyze academic language data using methods established by Jeff Zwiers for his analysis of classroom conversation (Zwiers, 2006). However, I quickly found that his definitions of the components measured were not explained in detail in his work, making it difficult to determine how he coded and counted features of language in messy oral language data that has frequent false starts, repetitions, overlapping speech, etc. With my particular language sample of naturalistic classroom conversation, I had greater success using CAF definitions from the SLA research literature because these linguistic features were typically well defined and there were easily available measures I could use to calculate them. Nonetheless, it is impossible to calculate every possible CAF measure that exists due to the time-consuming and labor-intensive nature of counting linguistic features in oral language data. Therefore, I had to choose which CAF measures to use, given the unique features of my data. I adapted those measures to the language samples I obtained. For example, I initially measured type-token ratios (TTRs), which provide an indication of oral language variety. However, I found that students were uttering such short phrases with so much repetitive, basic vocabulary that the TTR calculation varied little across students and days, making the data of comparatively less interest than other CAF features.

Making these types of adjustments to academic language measurements was possible, and perhaps desirable, in order to be able to say something about the types of language students produced. Yet, this exact set of CAF measures has not been used in any other L2 study, and any measures that have been used in other research may have been defined differently, depending on the features of the data. Ultimately, the variability in the way CAF measures are chosen and applied to language data makes it challenging to relate this study's findings directly to the findings of other, similar studies. The field of SLA would benefit greatly from having an identified set of basic CAF measures recommended, and clearly defined, for research studies. In this way, at least some components of language would be comparable across new studies. Research on features of academic language use in mathematics classrooms is particularly important to conduct, since there are currently so few studies of this type.

A second limitation of this study is that the classroom observed was a sheltered math class in which ELLs were segregated from their non-ELL peers. Because there were no fluent-English speaking students in the room it was difficult to get a sense of how much different language expectations might have been for non-ELLs taking the same type of remedial class. Further, the CAF data for the four focal ELLs lacked a reference point because there was no corresponding data on fluent English speakers to use to determine the adequacy or appropriateness of the language ELLs produced.

Finally, the third limitation was that focal students' records contained limited and inconsistent data about important background variables which could have informed data analysis and interpretation. English proficiency test scores were often outdated or missing some components. School records typically did not contain information on students' literacy levels in their home language or language of previous schooling. Understanding the strengths students had in their other languages might have led to additional insights about resources on which the teacher could build academic English instruction. In addition, there was no information about the amount of prior schooling the focal students had received. If students had not had a sustained period of consistent instruction in any language, they may have been missing some basic concepts and skills that played a role in how they interacted with both the content and the language of Ms. Grant's classroom. Further, for those students who had already studied the same math topic in another country, there was no information available about the nature of that instruction. Having at least a basic understanding of students' instructional experiences in other countries might have enhanced my understanding of the ways they used language in class. For example, Marie used a set of formal math terms (e.g., greatest common factor or GCF) that she had learned in some other setting outside of Ms. Grant's classroom. Jesse and the other Nigerian student tended to represent written fraction problems in an unfamiliar style that would have been helpful to understand when they were interacting with the teacher about a solution process.

**Recommendations for Future Research**

This study suggests a number of possible avenues for future research that would help U.S. educators and schools effectively integrate content and academic language instruction for secondary ELLs. By doing so, schools would increase students' opportunity to learn challenging academic content.

First, the literature reviewed in Chapter 2 highlights a clear need for a unified and comprehensive definition of academic language that can be applied to instruction across content areas. Some recent work on a comprehensive definition (e.g., Bailey, 2007; Bailey, Butler, Laframenta, & Ong, 2004; Bailey, Butler, Stevens, & Lord, 2007, Bailey & Heritage, 2008) has been done to support the development of state English proficiency assessments, but if instruction does not align with the content of assessments, these efforts will have minimal effects on student outcomes. The research on academic language to date has typically been conducted from a L2 perspective, and does not incorporate diverse perspectives that may be held be content-area specialists. Greater involvement of all types of educators in crafting a definition of academic language would help to ensure that teachers are applying similar definitions in their own classrooms. A starting point for research on this topic might be to investigate how educators' conceptualizations of academic language vary by discipline and which theories inform their ideas. A better understanding of the diverse perspectives on language would help teacher trainers and professional development experts design courses on Culturally Relevant Pedagogy for content teachers.

Second, CAF measures provided extremely useful ways to describe student language production in this study. However, as mentioned in the limitations section, there is no common set of CAF measures that has been applied across studies of this type, making comparisons of results challenging. Research examining which measures would be most appropriate for studies of natural oral language use in classrooms is greatly needed so that a body of research can be developed on academic English use by ELLs.

Third, students' oral language frequently contained a large percentage of vocabulary (16%-41% of all words) that was not found in the GSL or AWL corpora. Neither list contains math content words unless those words happen to have another, more general, meaning. Therefore, an analysis of these unlisted words could identify a set of math terms and linguistic phrases to include in language instruction. It would be particularly beneficial to compare these unlisted math words and phrases to similar data for fluent-English speakers in a corresponding remedial math course so that a more complete range of useful words and phrases could be compiled.

Fourth, this study demonstrated a clear need for educators and researchers to know more about how to effectively design remedial content instruction for ELLs. In my search of the literature for studies on this topic I noted that there were very few addressing ways to transition ELLs out of remedial instruction and into grade-level, standards-based classrooms. Future studies could address the optimal structure of remedial programs and pacing of lessons so that ELLs can be included in grade-level teaching as quickly as possible. Studies on best practices in remedial content instruction for these students could then be integrated into educator professional development courses and teacher training programs.

Fifth, comparative studies of fluent English speakers in remedial math (or other content) classrooms would help to establish some native speaker language targets that could inform the development of academic language objectives for ELLs. Without a sense of how fluent speakers use the language in a similar setting, it is difficult to determine whether ELLs' language use is adequate or appropriate for the context. Future studies of this type might also support teacher decision-making about integrating ELL and non-ELL sections of the same content course to provide ELLs with greater exposure to fluent English speakers.

Sixth, research describing the components and outcomes of long-term, in-class professional development for content teachers of ELLs (e.g., work with mentor teachers, peer coaches, or ESL co-teachers) is recommended to enhance the existing literature on out-of-class professional development such as district-sponsored SIOP training (Echevarria, Short, et al., 2006; Echevarria, Vogt, et al., 2004, 2010). Ms. Grant's school did not appear to offer any of these types of opportunities that were specifically aimed at improving teachers' academic language instruction. She and I informally exchanged observations of student language use that she used to help shape her instructional decision making. However, there are schools and districts across the country that have formal mentoring, coaching or co-teaching models in place. These models should be studied to determine characteristics of effective collaboration and its effect on teaching and learning. These types of programs may require a significant allocation of staff and financial resources, but if they are successful at strengthening teachers' skills and improving student outcomes they are well worth the cost.

Finally, Ms. Grant and the ELL aide, Ms. J., were aware that several members of the ELL pre-algebra class had previous fractions instruction experiences in other countries. However, they did not have the time or the resources to explore how those previous experiences shaped students' understanding of the conceptually oriented curriculum used in Ms. Grant's room. There is an urgent need for research addressing how ELLs, particularly students from newly emerging language groups, have learned particular math concepts, how they have been taught to write math formulas and problems, the terminology that was used during previous instruction, and the strengths and weaknesses students display with math concepts in their first language. This kind of information would be extremely timely and relevant for educators who want to better incorporate student experiences into instructional activities. Interviews in the students' native language or language of previous instruction could elicit prior experiences. Additional cognitive laboratory or think aloud sessions while students solve math problems or review video or audiotapes of instruction would also be an important area for further research. When I conducted think aloud sessions with students in English I found that I sometimes could not understand the ideas they were trying to describe, and thus, the data were of limited use. However, if think alouds were conducted with native-speaking educators, or community members, the resulting data could be extremely informative for teacher training and teachers' lesson planning.

**Conclusion**

Despite the Franklin school district's promotion of sheltered math instruction for ELLs, students in Ms. Grant's pre-algebra classroom at Lincoln High School were found to be producing little complex, elaborated academic language. They would need these language skills to be successful on standards-based graduation assessments and to be mainstreamed into grade-level math classes in the future. Students did not produce this type of language, at least in part, because there were no concrete academic language outcomes identified for the course and students were studying content several years below their enrolled grade.

The lack of access to grade-level content and the associated academic language has been identified in the literature as constituting a serious lack of opportunity to learn that schools must urgently address if all students are to succeed academically (Abedi & Herman, 2010; Aguirre-Munoz & Amabisca, 2010; Bailey & Butler, 2009; Bigelow, 2010; Herman & Abedi, 2004; Wang & Goldschmidt, 1999). This study provides critical evidence that educational leaders in particular need to do more to ensure that content teachers who must do the difficult work of integrating academic language and content instruction are provided with clearly defined language learning goals, and that they are well-trained and fully supported in the classroom so that they can do their job effectively.

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## Appendix A

## UNIVERSITY OF MINNESOTA IRB APPROVAL

### Internal Review Board Approval to Conduct Research

February 22, 2010
Kristin K Liu
Inst on Community Integrat 4201
Room 207 PtH
150 Pillsbury Dr S E
Minneapolis, MN 55455

RE: "Academic Language and English Language Learners in the Mathematics Classroom"
IRB Code Number: **0912P75475**

Dear Ms. Liu
The Institutional Review Board (IRB) received your response to its stipulations. Since this information satisfies the federal criteria for approval at 45CFR46.111 and the requirements set by the IRB, final approval for the project is noted in our files. Upon receipt of this letter, you may begin your research.

IRB approval of this study includes the primary parent consent forms and assent forms (audio and video) received December 20, 2009 and the teacher consent forms (audio and video), secondary assent forms, parent consent forms and adult support staff consent forms (audio and video), dated February 8, 2010.

**The IRB committee notes that approval is granted upon the condition that the researcher submits letters of approval from the schools and the school district where the proposed research will be conducted. The committee notes that no recruitment of study subjects or collection of research data can begin until these letters are obtained and submitted for committee review.**

**Provide the IRB office with the translated consent forms once it is determined which set of forms will be used.**

The IRB determined that children could be included in this research under 45CFR46.404; research not involving greater than minimal risk.

The IRB would like to stress that subjects who go through the consent process are considered enrolled participants and are counted toward the total number of subjects, even if they have no further participation in the study. Please keep this in mind when calculating the number of subjects you request. This study is currently approved for 35 subjects. If you desire an increase in the number of approved subjects, you will need to make a formal request to the IRB.

For your records and for grant certification purposes, the approval date for the referenced project is January 8, 2010 and the Assurance of Compliance number is FWA00000312 (Fairview Health Systems Research FWA00000325, Gillette Children's Specialty Healthcare FWA00004003). Research projects are subject to continuing review and renewal; approval will expire one year from that date. You will receive a report form two months before the expiration date. If you would like us to send certification of approval to a funding agency, please tell us the name and address of your contact person at the agency.
As Principal Investigator of this project, you are required by federal regulations to:

*Inform the IRB of any proposed changes in your research that will affect human subjects, changes should not be initiated until written IRB approval is received.
*Report to the IRB subject complaints and unanticipated problems involving risks to subjects or others as they occur.
*Respond to notices for continuing review prior to the study's expiration date.
*Cooperate with post-approval monitoring activities.

Information on the IRB process is available in the form of a guide for researchers entitled, What Every Researcher Needs to Know, found at http://www.research.umn.edu/irb/WERNK/ index.cfm The IRB wishes you success with this research. If you have questions, please call the IRB office at 612-626-5654.

We have created a short survey that will only take a couple of minutes to complete. The questions are basic, but will give us guidance on what areas are showing improvement and what areas we need to focus on:
https://umsurvey.umn.edu/index.php?sid=36122&lang=um

Sincerely,

Jeffery Perkey, MLS, CIP
Research Compliance Supervisor
JP/bw

**CC: Diane Tedick**

**Appendix B**
**ELL MATH 1**

**SYLLABUS FOR SEMESTER 2 FALL 2010**

**-Class Overview-**
During this semester, we will look at various Pre-Algebra/Algebra topics such as fractions, polynomials, graphing (points and lines) and solving equations. There will be a strong emphasis on the vocabulary surrounding these topics.

**-Instructional Focus-**
This class will focus on mathematical concepts and vocabulary that are related to the math curriculum and the [state] Graduation Standards.

**-Expectations of Student Work-**
You need to bring the following materials to class **every day**:

- Pencil—I prefer that work is done in pencil
- Notebook and Folder
- Textbook--*Access—Building Literacy Through Learning Math*

**-Attendance/Tardies-**

- <u>If you are absent, you must complete the work that you missed.</u> You are responsible for obtaining any missed work due to an absence.
- All make-up work needs to be completed before the end of the unit.
- If your absence is **unexcused**, you <u>will not receive credit</u> for the day's *participation points*.
  Being tardy to class can affect your *participation points*.
- We will follow [school]'s attendance and tardy policy.
- For extended absences, parents can send a request for missing work to be collected for you to pick up in the counseling office. Parents will contact the guidance secretary at 763-504-8520 to make this request.

**-Grading-**

**Assignments/Quizzes/Tests (60%)**

- Most assignments will be started in class. If the work is not finished in class, students may need to bring it home to finish.
- Quizzes can be given at any time.
- Tests will be given at the end of a unit. You will be given notice several days before the test. We will be reviewing in class to help you study for the test.

**Participation (40%)**

- Points will be given per day as participation points. You will get all your points if you are doing what you should be doing.
- You could lose points if you are not working, you are not following directions, you are tardy to class or have unexcused absences.

**Grading scale**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 93 -100% | A | 87-89% | B+ | 77-79% | C+ | 67-69% | D+ | | |
| 90 -92% | A- | 83-86% | B | 73-76% | C | 63-66% | D | | |
| 80-82% | B- | 70-72% | C- | 60-62% | D- | 0-59% | NC | | |

**-Late Work Policy-**

Missing assignments may be turned in for up to half credit up until the end of the chapter. In order to receive the half credit, the following criteria must be met: all problems attempted, all work clearly shown, and any corrections clearly shown.

**-Resources for Extra Help-**

- If you need individual help outside of class, please schedule a time to meet with me before/after school. I am available before and after school on most days in my office (383A). Please let me know in advance if you would like to meet with me.
- Math Resource Room – for individualized help with a math teacher - will be available from periods 1 through 8 during the school day.

| Per 1 | Per 2 | Per 3 | Per 4 | Per 5 | Per 6 | Per 7 | Per 8 |
|---|---|---|---|---|---|---|---|
| 385 | 385 | 384 | 380 | 380 | 380 | 347 | 344 |

- MATH PARTY – will occur most Thursdays after school in room 388, 2:15-3:30.
- ASAP, FIT, etc – see your counselor for more information about these programs.

**-Hall Passes-**

- Hall passes will be given out **only** during class work time.
- One pass per person per quarter.
- No passes during the first 10 minutes or last 10 minutes of class.
- No passes except pre-scheduled counselor meetings when there is a substitute teacher.

**-Behavior-**

All students are expected to come to class on time, to be prepared, to follow school rules, and to show respect for themselves and all others in the classroom. District and school policies will be enforced. This means headphones, cell phones, ipods, MP3 players, backpacks, hats and jackets or any other nuisance items do not belong in the classroom, and may be confiscated.

**-Academic Honesty-**

Any work that a student completes for credit must be their own work.
The goal of this class is to LEARN the math, not copy someone else's work. Please do not copy and do not allow other students to copy your work. Please help your classmates LEARN the math.
Scholastic dishonesty includes, but is not limited to, cheating on school assignments or tests, plagiarism or collusion. It is prohibited. Academic consequences could result in a grade of 0 for the full assignment. Disciplinary action will also be assigned by the administration. This could include detention, suspension, and/or recommendation for expulsion. Please see your Discipline Policy handbook, item #27, for further information.

## Appendix C
## CONSENT/ASSENT FORMS

### Academic Language and English Language Learners in the Mathematics Classroom Study

Dear Teacher,

You are invited to participate in a research study on language learning in math classrooms. You were selected as a possible participant because you are interested in improving math instruction for English language learners (ELLs).

This research project is being conducted by Kristin Liu, a Ph.D. candidate at the University of Minnesota in Second Languages and Cultures Education. Your school district and school have approved this study. This study will help teachers and researchers know more about how ELLs comprehend and use academic English in the math classrooms. It will examine how students use language productively. It will also address areas where educators can support students in using language differently to develop students' content knowledge and skills. This information can help improve teaching and learning practices because understanding and using academic language is crucial to learning math content.

**Study Activities:** If you agree to participate in this study, I will ask you to do the following things:

- **Recommend up to four ELLs who might make good study participants** based on your experiences so far.

- **Provide me with information about those students are doing in math and how well they speak English**. I will ask you for a recent state and/or district math test score, a recent state English proficiency test score, the length of time the student has been U.S. schools, and their native language.

- **Talk to me briefly about your language learning goals for the class and any efforts you have made to address language as part of math instruction**.

- **Be present in the classroom when I'm making audiotapes.**

- **Listen to segments of the students' audiotapes with me**. Based on what we hear, I will invite you to talk about your own observations, insights and thoughts about academic English use in the math classroom.

- **Provide me with copies of key homework assignments (including quizzes or tests)** for the focal ELLs to see how their language skills support, or do not support, their understanding of math content.

**Risks & Benefits:** There are no personal or professional risks associated with your participation in this study.

**Privacy:** The records of this study will be private. All audiotapes will be confidential. At no time will I identify you, the students, or any supporting teachers or classroom volunteers in the reporting of this information. Research records will be kept in a locked file in my house. Names will not appear on this information. Only I will have access to these records. I will keep the audio recordings until three years after the study is finished, and then I will erase them.

**Payment**: I will give you a $150 gift card to a store where you can buy classroom supplies (e.g., Office Depot, Target, a bookstore) as a thank you for participating in this research study.

**If you have questions:** Your decision about participating in this study will not affect your current or future relationships with the University of Minnesota or with your school. If you decide to participate, you are free to withdraw at any time without affecting those relationships. You may ask me, or my advisor, questions about the research now or at a later time.

| | |
|---|---|
| **Kristin Liu** | **Dr. Diane Tedick** (Kristi's advisor) |
| 612-626-9061 | 612-625-1081 |
| Kline010@umn.edu | djtedick@umn.edu |

If you want to talk to someone other than me or my advisor, please contact: Research Subjects' Advocate Line, D528 Mayo Building, 420 Delaware St. Southeast, Minneapolis, Minnesota 55455. Telephone: (612) 625-1650.

Sincerely,

Kristin K. Liu, Ph.D. Candidate in Second Languages and Cultures Education
College of Education, University of Minnesota
============================================================

**Statement of Consent:**
I have read the information on this paper. I have asked questions and my questions have been answered. I agree to participate in the study.
Teacher Signature:________________________________Date: _________________
Signature of Researcher:____________________________Date: _________________

***You will get a copy of this form***

**Academic Language for English Language Learners in the Mathematics Classroom Study**

Dear Parent or Guardian,

I am asking if you are willing for your child to be in a research study. The study is about language learning in math classrooms. I invite your child to be in this study because he or she is in [***teacher name***]’s math class. Your child has also been an English as a Second Language (ESL) student. In math class students have to use English in some special ways to understand their teacher and the textbook. Students also have to use special language to explain solutions to math problems. I want to understand more about how students like your child learn this special kind of English. The information I find out will help teachers figure out better ways to teach students.

If you agree for your child to be part of this study we will do several things: (1) Your child will answer some written questions that tell me what he or she thinks about learning math; (2) I will videotape and audiotape your child during math class one or two times each week for about 8-10 weeks between January and May. I will make recordings during two math units selected by the teacher. I will do the recording so that it does not interfere with your child’s class work; (3) I will take notes about what is happening in class; (4) Your child and I will listen to and watch parts of the recordings together. I will ask your child to talk about what he or she was thinking and doing on the recordings. I am very interested in learning what *your child* thinks about using English in math class; (5) The math teacher and I will review parts of the tapes. We will talk about the ways students need to use English in math class; (6) I will look at your child’s homework. I will also ask the teacher for some information about your child’s progress in math class, your child’s math test scores and English proficiency test scores. This information will help me understand how your child uses English to learn math.

Your child may miss about 20 minutes of class each time we meet to review the tapes and talk about them. I will try to talk with your child during lunch or some other free time so that he or she does not miss class time. However, if we need to talk during math class, I will help your child get any information that he or she missed from class.

**Payment:** Your child will receive a $25 Target gift card for participating in this study. I will give your child the gift card at the end of the study. I will also give the class a pizza party at the end of the year to say thank you for allowing me to be in the classroom every day. All students in the class will attend the party.

**Privacy:** The information that I collect during this study, including the videotapes and audiotapes, will be private. Only your child, your child’s math teacher, and I will see the information. I will keep all of the information I collect in a locked file cabinet in my house. The information will not have your child’s name on it. When I share information about this study with other people I will not give your child’s name, the teacher’s name or the school’s name. I will erase the tapes three years after the study is finished so no one can listen to or look at them again.

**You Decide:** Your decision about allowing your child to participate will not affect your relationships with the University of Minnesota or with [school name]. If you decide it is ok for your child to participate, you can change your mind at any time. If you change your mind, tell me or tell the teacher.

**If you have questions:** You may ask me questions about the research. You can also talk with my professor.


**Kristin Liu**
612-626-9061
Kline010@umn.edu

**Dr. Diane Tedick** (Kristi's professor)
612-625-1081
djtedick@umn.edu


If you want to talk to someone other than me or my professor, please contact: Research Subjects' Advocate Line, D528 Mayo Building, 420 Delaware St. Southeast, Minneapolis, Minnesota 55455. Telephone: (612) 625-1650.

**Thank you!**
Kristin Liu, Ph.D. Candidate, Second Languages and Cultures Education,
College of Education, University of Minnesota

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RETURN THIS PART OF THE PAPER TO YOUR CHILD'S TEACHER

I have read the information on this paper. I have asked questions. My questions have been answered. I give my permission for my child to participate in this study.

Parent or Guardian
Signature:_______________________________________________Date: ___________
Child's name: ___________________________________________________________
Signature of Researcher:________________________________Date: ________________

*You will get a copy of this form*

**Academic Language and English Language Learners in the Mathematics Classroom Study**

I invite you to be in a research study about language learning in math classrooms. I invite you to be in this study because you are in [*teacher name*]'s math class and you have been an English as a Second Language (ESL) student. The math teacher and the textbook use English in some special ways. Students also have to use special language to explain solutions to math problems. I want to understand more about how students like you learn this special kind of English. The information I find out will help teachers figure out better ways to teach students.

If you agree to be part of this study you and I will do several things: (1) You will answer some written questions that tell me what you think about learning math; (2) I will videotape the class every day; (3) I will audiotape you during math class for about 8-10 weeks between January and May. I will make recordings during two math units selected by your teacher. I will do the recording so that it does not interfere with your class work; (4) I will take notes about what is happening in class; (5) You and I will listen to parts of the recordings together. I will ask you to talk about what you were thinking and doing on the recordings. I am very interested in learning what *you* think about using English in math class; (6) Your teacher and I will review parts of the tapes. We will talk about the ways students need to use English in math class; (7) I will look at your homework. I will also ask your teacher for some information about your progress in math class, your math test scores and your English test scores. This information will help me understand how you use English to learn and talk about math.

You may miss about 20 minutes of class each time we meet to review the tapes and talk about them. I will try to talk with you during lunch or some other free time so that you do not miss class time. If you do need to miss some class time, I will help you get the information you missed from class.

**Payment:** You will receive a $25 Target gift card for participating in this study. I will give you the gift card at the end of the study. I will also give your teacher money for a class pizza party at the end of the year to say thank you for allowing me to be in the classroom every day. All students in the class will be part of the party.

**Privacy:** The information that I collect during this study, including the audiotapes, will be private. Only you, your math teacher, and I will see the information. I will keep all the information I collect in a locked file cabinet in my house. I will not keep your name on the information. When I share information about this study with other people I will not give your name, your teacher's name or the school's name. I will erase the audio and videotapes three years after the study is finished so no one can listen to or look at them again.

**Your Decision:** You can ask me questions about the study. You can also ask your teacher. You do not have to be part of the study. If you say you will participate, you can change your mind later. Tell me or tell your teacher. No one will be angry if you decide not to be in the study or if you first decide to be in the study and then change your mind.

**Thank you!**
Kristin Liu, Ph.D. Candidate in Second Languages and Cultures Education
College of Education, University of Minnesota

**What to Do:** Signing this form means that you have read it and you agree to participate in this study. RETURN THIS PART OF THE FORM TO YOUR TEACHER. If you do not want to be in this study, do not sign. Remember, being in this study is up to you. No one will be mad at you if you don't sign this or if you change your mind later.

Student's Name (please print): ______________________________________________

Signature:_______________________________________Date: __________________
Signature of Researcher:____________________________Date: __________________

***You will get a copy of this form***

## Appendix D

## GUIDING QUESTIONS FOR FIELD NOTES

*The following guiding questions from Goetz & Lecompte (1984, pp. 112-113) will be adapted to the context of the specific classroom in which I work and will serve as the structure for field notes.*

1. Who is in the group or scene? How many people are there, and what are their kinds, identities, and relevant characteristics? How is membership in the group or scene acquired?

2. What is happening here? What are the people in the group or scene doing and saying to one another?

   a. What behaviors are repetitive, and which are irregular? In what events, activities, or routines are people engaged? What resources are used in these activities, and how are they allocated? How are activities organized, labeled, explained, and justified? What differing social contexts can be identified?

   b. How do the people in the group behave toward one another? What is the nature of this participation and interaction? How are the people connected or related to one another? What status and rules are evident in the interaction? Who makes what decisions for whom? How do the people organize themselves for interactions?

   c. What is the content of their conversations? What subjects are common, and which are rare? What stories, anecdotes, and homilies do they exchange? What languages do they use for communication, verbal and nonverbal? What beliefs do the content of their conversations demonstrate? What formats do the conversations follow? What processes do they reflect? Who talks and who listens?

3. Where is the group or scene located? What physical settings and environments form their contexts? What natural resources are evident, and what technologies are created or used? How does the group allocate and use space and physical objects? What is consumed, and what is produced? What sights, sounds, smells, tastes, and feeling sensations are found in the contexts that the group uses?

4. When does the group meet and interact? How often are these meetings, and how lengthy are they? How does the group conceptualize, use, and distribute time? How do participants view their past and future?

5. How are the identified elements connected or interrelated--either from the participants' points of view or from the researcher's perspective? How is stability maintained? How does change originate, and how is it managed? How are the identified elements organized? What rules, norms, or mores govern this social organization? How is this group related to other groups, organizations, or institutions?

6. Why does the group operate as it does? What meanings do participants attribute to what they do? What is the group's history? What symbols, traditions, values, and world views can be found in the group?

## Appendix E
## INSTRUCTIONS FOR STIMULATED RECALL

**<u>For research participants (Read aloud):</u>**
What we're going to do now is listen to an audio recording. You will hear yourself during a math lesson in class. I want to know what you were thinking at the time you were doing this activity. I can hear what you are saying on the audiotape, but I don't know what you were thinking. Please tell me what was in your mind.

I will put the remote control on the table here. You can pause the tape any time you want. If you want to tell me what you were thinking, push pause. If I have a question, I will push pause and ask you to talk about that part of the tape.
==============================================================

**<u>For the researcher:</u>**
After reading the instructions to the student, model stopping the tape and asking a question. If the student stops the tape, ask general probes like:

- What were you thinking here?
- Can you tell me what you were thinking at this point?
- I hear you are laughing/sounding confused/having trouble/staying silent etc. there. What were you thinking?

If the student says "I don't know", accept the comment and continue. Try not to encourage answers about things other than the action in question.
It may be useful to direct students' attention to the speech or actions of other people on the tape by saying:

- Do you remember what you were thinking when he/she said those words?
- Do you remember what you were thinking when he/she did that?

Do not give concrete reactions to students' responses and avoid extended responses that might change the student's comments. Back channeling or non-responses are preferred:

- Oh
- I see
- Mhm
- Uh-huh
- Ok

## Appendix F
## TRANSCRIPTION NOTATION
**(**Wood & Kroger, 2000, modification of Jefferson System)

| | |
|---|---|
| [W98;SI;25] | Extract headings refer to the parts of the data as identified in the collection of the researcher who gathered the material |
| Some [talk]<br><br>[overlap] | Square brackets between lines or bracketing two lines of talk indicate the onset ([) and end (]) of overlapping talk |
| End of line=<br><br>=start of line | Equal signs indicate latching (no interval) between utterances |
| (.) | Untimed pause (just hearable; <.2 sec) |
| (1.2) | Pause timed to the nearest tenth of a second |
| Bu- | A dash shows a sharp cutoff of speech |
| Under; pie | Underlining indicates emphasis |
| CAPITALS | Capital letters indicate talk that is noticeably louder than surrounding talk |
| ˚soft˚ | Degree signs indicate talk that is noticeably more quiet than surrounding talk |
| >fast<<br><br><slow> | "Less than" and "greater than" signs indicate talk that is noticeably faster or slower than the surrounding talk |
| Ho:me | A colon indicate an extension of the sound or syllable that it follows |
| ⇧word<br>⇧word | Upward and downward pointing arrows indicate marked rising and falling shifts in intonation in the talk immediately following |
| .,?! | Punctuation marks are used to mark speech delivery rather than grammar. A period indicates a stopping fall in tone; a comma indicates a continuing intonation; a question mark indicates a rising inflection; an exclamation point indicates an animated or emphatic tone |
| Wghord | "gh" within a word indicates guttural pronunciation |
| Heh or hah | Indicates laughter |
| .hh | Audible inbreath |
| Hh | Audible outbreath (sometimes associated with laughter) |
| Wo(h)rd | An "h" in parentheses denotes laughter within words |
| Rilly | Modified spelling is to suggest pronunciation |
| (word) | Transcribers guess at unclear material |
| ( ) | Unclear speech or noise |
| ((coughs)) | Double parentheses enclose transcriber's descriptions of nonspeech sounds or other features of the talk ((whispered)) or scene ((telephone rings)) |
| [a local pub] | Brackets enclose contextual or explanatory information |
| … | Horizontal ellipses indicate talk omitted from the data segment |
| .<br>. | Vertical ellipses indicate intervening turns omitted from the data segment |
| ⇨ | A horizontal arrow in the left margin points to an utterance discussed in the text |

*Note: repeated symbols, for example, :::, ˚˚, and hhhh, indicate, respectively, greater elongation, quiet, outbreaths, and so on. Speakers may be identified by letter, pseudonym, or role (e.g., counselor). Lines are usually numbered, particularly in long excerpts.*

## SAMPLE TRANSCRIPT

5-6-10
Lesson Presentation

MS. GRANT: [Walking back toward her desk and facing away from Hope] That's not the deal that we made.[To class] ((Louder)) ALL RIGHT. [She picks up items on her desk] What I need you to have <u>no:w</u> is some strips of paper. So if you'll pass some of these back.[She goes to the first person in each row and hands out a set of paper strips.]

[Students look for their worksheet or write on their worksheet. David yawns loudly and chats with Luis next to him about how many strips of paper the teacher gave him.]

MS. GRANT: Hand some to James. (Do you need some more?) ((Quietly to student)). All right.

[James starts reading a math problem aloud. Ms. Grant erases board while students chat. Jesse says that he keeps losing his strips of paper.]

NAOMI: Michael is at the door. Michael is at the door.

JESSE: Michael is at the door!

[Luis gets up to let Michael in]

JESSE: You're welcome.

MS. GRANT: Thank you Luis. [She walks back to her desk.]

JESSE: You're welcome.

[Students talk loudly. James and Michael bicker back and forth about one of them gossiping about the other.]

MICHAEL: [To Ms. Grant] Please miss, can you give me the work that I missed?

MS. GRANT: It's right there.

JAMES: xxx

MS. GRANT: Ah, I just had that one. [Walks back to her desk]

*[Videotape stopped here due to a dead battery. From here on the transcript is based on the audiotape.]*

MS. GRANT: ((Talking over the students' voices)) All right. All right, here we go. I need you to take a strip. Take one strip plea:se. If you're working on something else, if you would you put that away.

[James continues talking to another student]

MS. GRANT:  [To a student] Can you give a strip to Michael please?

[Hope mutters a complaint about needing to go to the bathroom. Naomi drops her strip on the floor and Mrs. L. points it out. Naomi leans over and picks it up.]

MS. GRANT:  Hold onto your, hold up your strip. Let me see that you've got one strip ready. Luis, I need you to get one strip ready. One strip.

HOPE: Can I have some more paper?

[The other students are chatting loudly.]

MS. GRANT: Shh. Shhh. I need you to (get that piece of paper). What we're going to do. The first thing. The first thing I want you to do is fold this into <u>thirds</u>. So thirds remember is the S curve?  And we don't want to just guess and start folding, we want three equal pieces. So if you make an S, and then try to bring it down and so the folds are at the ends, try to make those even-

NAOMI:  I can't make it.

MS. GRANT: This is the hardest one.

VICTORIA: The hardest one! Hah hah.

[Students chat]

MS. GRANT: [To Hope] Hope would you make your thirds please?

HOPE: I don't know (what to do).

MS. GRANT: We're making an S. Jorge can help you. [To group] All right, and then I want to unfold it and show me that you have thirds. Luis?

LUIS: I got this.

MICHAEL: Don't look at me.

VICTORIA: (I don't need) dumbing down.

JORGE: You didn't do your homework.

VICTORIA: Hah hah.

JAMES: I don't want to do that thing no more now.

[Michael is talking to Hope and James while he's working.]

HOPE:  [To Ms. Grant] You want me to take like that with me?

MS. GRANT: Yep. [A moment later]  I'm still waiting for you to, right, do your folding.

MICHAEL: I already did. Look.

MS. GRANT: No, you're fine, I'm talking to Luis. We're folding into thirds. So you make that S curve. Not ha-, not fourths. You did fourths.

VICTORIA: Hah hah.

[Several students are chatting while they are folding paper.]

MS. GRANT: Yep. And then try to make it equal pieces.

[Students talk more.]

MS. GRANT: All right. Those are fourths.

[There is more conversation among students. Naomi complains that she's tired of seeing unhappy people. It's unclear to whom she is referring.]

MS. GRANT: [To the class] All right. So now that you have this, good, let me see your thirds. I want to make sure everybody has got thirds. Nice!  Ana, good. Good!  Good! I gave you all a colored pencil.

VICTORIA: You didn't give me one.

MS. GRANT: Ah, Jesse is going to pass them back to you. [She pauses] Jesse is going to pass one back to you.

JESSE: What?

MS. GRANT: The colored pencils?

JESSE: Oh.

MS. GRANT: I want you to take your colored pencil and I want you to <u>shade</u> two-thirds. So color in two-thirds.

[Students talk among themselves.]

JAMES: Can I get a colored pencil?

MS. GRANT: [To James] Did I forget to give you a colored pencil?  [To group] Two-thirds, shade two-thirds.

VICTORIA:  ((Mumbling)) Two-thirds.

NAOMI: Do it two-thirds?

[James and Victoria are teasing each other and laughing. Michael joins in.]

VICTORIA: Can you get me another?

[Jesse laughs at Victoria and teases her. Victoria tells him he's not being nice and Ms. Grant reminds Jesse to behave. Jesse complains, jokingly, that Victoria is always mean to him and Michael. Ms. Grant asks Victoria if Jesse's words are true and Victoria denies that she's mean to him. Michael chimes in that Victoria is often mean. Victoria says she is mad. Jesse thinks Victoria is mad at them. Michael laughs and responds that Victoria is using words he doesn't know.]

MS. GRANT: All right. Once you have your two-thirds shaded I want you to write on there two-thirds.

NAOMI: Man, why do we have to do this bogus stuff for?!

[Students mutter]

VICTORIA: This is kindergarten.

MS. GRANT: This is what?

JESSE: Kindergarten work.

[Students laugh and chat more.]

MS. GRANT: I don't care, I don't care if a kindergartener could do this. If it helps you learn fractions that's fine. That's all we care about.

FEMALE STUDENT: Yeah!

MS. GRANT: We just want to learn fractions.

[Michael responds that what a female student, either Naomi or Victoria, just said isn't correct behavior in Africa. Other students laugh and comment on Michael's words. There is more conversation about Africa. Victoria and Michael giggle. Ms. Grant has a side conversation with another student quietly]

MS. GRANT: (The part we're going to shade) is two-thirds. The shaded part is two-thirds.

[Michael teases Naomi about something and she tells him to be quiet. Laughing, Michael agrees to stop teasing her.]

MS. GRANT: All right. So I've got my pieces shaded.

[Naomi, Michael and Jesse continue arguing in a good natured tone.]

MS. GRANT: Two-thirds.

VICTORIA: Two-thirds.

MICHAEL: Miss! One out of four?

MS. GRANT: [To group] All right. So let me see your shaded two-thirds please. I want everybody's hands up. Nice! James you got yours shaded?

[Michael jokes that his shaded strip is more beautiful than everyone else's. Victoria retorts that it’s ugly.].

MS. GRANT: [To group] Beautiful. Beautiful. Nice. All right. So now, here’s the tricky part. The tricky part is I want you to, instead of having thirds, I want you to fold this into the same piece. How can I fold this into <u>six</u> equal pieces?

MICHAEL: Oh right here!

NAOMI: Oh that’s easy!

MICHAEL: Just fold it in half.

NAOMI: In half.

MS. GRANT: Fold it in half? When. Right now I should fold it in half?

MICHAEL: No, no. Put it back the same way.

MS. GRANT: Put it back?

MICHAEL: Yes.

NAOMI: You mean that same paper?

MICHAEL: Yes. And then put it in half.

MS. GRANT: That same paper. And then fold it in half?

MICHAEL: How did you know Miss? We got to teach you.

VICTORIA: (Let me see). Let me see you do it again.

MS. GRANT: Thank you.

MICHAEL: That should be a ticket you know. [Referring to prize tickets that Ms. Grant hands out to students who are on task] Right here.

MS. GRANT: So I put it back the way it was. Right. In thirds. And then fold it in half.

JAMES: Right here. Right here.

VICTORIA: You mean like this?

MS. GRANT: Mhm. And then when you unfold it are there six equal pieces?

STUDENTS: ((In unison)) Yes!

JESSE: You should, you should have four (parts).

MS. GRANT: ⇧Oh!⇩ How many was the shaded now. The two-thirds? How much is the two-thirds?

JAMES: It’s four-sixths.

MS. GRANT: ⇧Oh!⇩ So two-thirds=

JAMES: Four-sixths

MS. GRANT: =is the same as four-sixths. All right.

MICHAEL: And four-sixths the same as xxx.

JAMES: Did you see that? Did you see that? That's almost multiply it by two.

MS. GRANT: Yes! So if you multiply two times two is four. Three times two is six. Michael!

MICHAEL: Aw, you're not going to give me a ticket for the IF?

JESSE: Just put it again.

VICTORIA: Hah hah. [She makes a joke about the IF]

MICHAEL: I did get the IF though [referring to the instructional focus].

MS. GRANT: All right so the next thing, next thing. Next thing I want you to fold this piece into twelve equal pieces. How would you do that?

VICTORIA: Easy!

MS. GRANT: Easy?

JAMES: The same thing.

NAOMI: No.

VICTORIA: So do what?

MS. GRANT: How would I make this into twelve equal pieces.

MICHAEL: All right Miss, look. You do this.

MS. GRANT: (To Michael) What, what's do this mean?

MICHAEL: All right. Go back the same way. Go-

MS. GRANT: So go back the same way, so I go back to my thirds? Oops.

MICHAEL: Yes. And then go back to your sixths.

JESSE: Go back to your sixths again.

MS. GRANT: Go back to my thirds, go back to my sixths.

DAVID: ((Echoes quietly)) Go back to your thirds. Go back to your sixths. [To Ms. Grant] Bend it in.

JESSE: Bend that again.

MICHAEL: Bend it? Xxx

MS. GRANT: Bend it in. What's the word?

MICHAEL: Yeah bend it.

MS. GRANT:  Bend it in?

MICHAEL: Bend it into two?

MS. GRANT: So that each piece would be, half.

JESSE: Half.

MS. GRANT: Bend it in half. So you fold it in half.

MICHAEL: Yeah. And then you bend it in another half again.

MS. GRANT:  Another half? I don't know about that.

STUDENT: Oh yeah!

MICHAEL: I was just joking Miss.

MS. GRANT: Oh, ok.

MICHAEL: I was just joking!

JESSE: Yeah, I know that.

MICHAEL: You know I'm joking, right? Then thank you.

MS. GRANT: All right, so if you unfold it you should have twelve pieces. <u>Now</u> how many pieces are shaded?

[Students chat.]

HOPE: I have eleven.

DAVID: Eight.

MICHAEL: Eight.

MS. GRANT: Is it eights?

MICHAEL: No. We're just (playing) ((Counting pieces)) 1, 2, 3, 4.

MS. GRANT: ((Counting pieces)) 5, 6, 7, 8. That eight.

MICHAEL: Eight!

MS. GRANT: Eight what?

NAOMI: Eight-twelfths.

[Michael comments that another student is smart.]

MS. GRANT: All right are you seeing the pattern like James pointed out for the first one?

[There are murmurs of agreement]

MS. GRANT: Ok. Then I want to do this one more time, but a different piece of paper.

NAOMI: Aw, man!

MS. GRANT: So set that one down. New paper.

[Students grumble and chat.]

MS. GRANT: Take a new paper. Does anybody need a new paper?

[Laughing and chatting]

JAMES: Paper, paper, paper, paper.

MS. GRANT: [To a student] That one's a little bit longer than the first one. That's ok. [To the class] All right. First thing I want you to do is fold it in <u>ha:lf</u>. Fold it in ha:lf.

MICHAEL: Fold it in half you said?

MS. GRANT: Fold it in <u>ha:lf</u>.

MICHAEL: Then fold it in another half.

MS. GRANT: And then I want you to shade half. Shade <u>one</u> half.

MICHAEL: But I don't want to.

MS. GRANT: Please.

MICHAEL: Ok. I'm going to do it.

NAOMI: You don't wanna. But you gotta.

[Michael and Jesse chat with each other while they work.]

MS. GRANT: It can just be a quick shade. It doesn't have to take a long time. A quick shade.

[Students are still laughing and chatting. Michael starts a long spell of laughter. Jesse tells him to take it easy.]

MS. GRANT: So once you have your half. One half shaded. I want you to try to fold this same piece into, <u>fourths</u>.

NAOMI: Can we write one-half on it?

MS. GRANT: You can write one-half. I forgot that part. So one-half. [To herself] Oops, this marker doesn't work well. One-half. I think I got it.

MICHAEL: So you put one two?

MS. GRANT: [To Michael] Yep. One half.

MICHAEL: You gotta say (a number), don't say one half.

JESSE: You fold it again.

MS. GRANT: One half.

VICTORIA: Fold it again?

MS. GRANT: All right, so after you have your one-half I want you to fold it into, <u>fourths</u>. How do you fold this into fourths?

MICHAEL: Go back to one half. Go back to one half.

JESSE: Then you: fold it-

MICHAEL: ((Echoing Jesse)) Then you fold it into half. Hah hah.

JESSE: ((Echoes Michael)) Into half . Hah hah.

[Jesse and Michael tease each other about being smart because they finished each other's words.]

MS. GRANT: So an equivalent fraction. One half equa:ls?

MICHAEL: Two halves.

JESSE: Two-fourths.

MS. GRANT: [Responding to Michael] Two halves?

JESSE: Two-fourths!

MS. GRANT: Two?

JESSE: Fourths.

MS. GRANT: Fourths.

[Victoria starts to sing.]

JESSE: One more time!

[Students chat.]

MICHAEL: ((Quietly))[to Jesse] We're so smart we should get a ticket. You understand what I'm saying?

MS. GRANT: All right then. All right so two-fourths is the same as one-half. Fold this <u>same</u> strip into <u>ei:ghths</u>. What do you have to do? How do I fold this into eighths.

VICTORIA: You go back again.

MS. GRANT: You go back again to the fourths?

VICTORIA: Mhm.

MS. GRANT: And then what do you do Victoria?

VICTORIA: You bend it. Hah hah.

MS. GRANT: Just bend it in how many pieces?

[Naomi teases Victoria for using the word "bend" like Michael did.]

VICTORIA: Hah hah. Two.

VICTORIA: Hah hah.

MS. GRANT: Two pieces. So fold it in half.

VICTORIA: Mhm. That would be seven. Hah hah.

NAOMI: No, eight.

MS. GRANT: And how many pieces will that make?

NAOMI: Eight.

MS. GRANT: Eight. So tell us, one half is the same as how many eighths?

MICHAEL: Four, my bad. [To Jesse] Sorry about that.

JESSE: Four-eight(hs). [To Michael] Oh, sorry.

MICHAEL: [To Jesse] I already forgot what you said.

MS. GRANT: Do you agree that it's four-eighths?

JESSE: Yeah.

MS. GRANT: All right. Could we have done this with the circles too?

NAOMI: ⇧Yaah⇩.

MS. GRANT: ((Mimicking Naomi)) ⇧Yaah⇧. So we can do this with the papers,=

NAOMI: Duh.

MS. GRANT: =we can do this with the circles.

[Michael comments that in Africa Naomi shouldn't answer "Yah" the way she did or she would get beaten for being disrespectful. Naomi laughs and says she's not in Africa. Ms. Grant replies that she says "Yah" often herself.

MS. GRANT: All right. Michael, will you collect the pencils from everyone please?

MICHAEL: (Do I) get ticket? I'll do anything for a ticket!

VICTORIA: You're not getting ticket for that! Hah hah.

STUDENT: Yes he is.

MICHAEL: What do you want me to do for ticket?

MS. GRANT: Jesse, will you collect all the yellow strips?

MICHAEL: I can do it Miss, I can do it. I can do it for a ticket.

MS. GRANT: If you want to keep your yellow strips you can. Otherwise Jesse is going to come around, pick them up and toss them in the recycling bin.

VICTORIA: Yeah.

[Students chat.]

VICTORIA: Wow!

[Naomi makes a comment in Liberian Creole. Victoria and Michael laugh and make some inside joke that they all understand. There is frequent use of Liberian Creole by the girls. The Liberian speakers continue laughing and joking.]

MS. GRANT: Thank you Jesse.

VICTORIA: He's not finished!

[Michael makes a joke about tickets that is hard to hear. There is a lot of chatting as Jesse picks up the paper strips. The teacher thanks Jesse for helping and Victoria protests that Jesse isn't finished yet.]

MS. GRANT: All right, here is your worksheet. I want you to start on this side, the side that has your name on it. So fill in your name on it. This is your homework, if you can finish this today you can hand it in. Otherwise please take it home to finish it. So, we can work through this a little bit. First question says what fraction is <u>shaded?</u>

NAOMI: Two-thirds. It's easy!

MS. GRANT: Two-thirds. (Thank you) Naomi. Then it says <u>make</u> it into six equal size parts.

NAOMI: That would be four-sixths. Isn't that right? Four-sixths. Four-sixths?

MS. GRANT: Yes.

NAOMI: I always get everything.

MS. GRANT: Hmm.

[Students chat.]

VICTORIA: I need a pencil. Ms. Grant (I need a pencil).

MS. GRANT: You need a pencil? You've got a pencil but it doesn't stay in your binder.

NAOMI: Ms. Grant? This one's not going to work. The second one, make it into fifteen equal parts?

MS. GRANT: Why not?

NAOMI: How you gonna make it into fifteen?

MS. GRANT: You can.

NAOMI: How?

MS. GRANT: Jorge, you make it work?

JESSE: I don't understand, it's just so-

NAOMI: [To Jorge] Can you help me?

MS. GRANT: [To Naomi] How many pieces are there right now?

NAOMI: ((Counting)) One, two, three, four.

[Students chat.]

MS. GRANT: What do you mean two?

JORGE: You gotta make across. Make it two.

NAOMI: See this is what I did but it's not fifteen still.

MS. GRANT: She took each box and drew a line and made two out of one.

JORGE: Like two in each box. I don't know how to do that right here. ((To himself)) One, two, three, four, five, six, seven, eight, nine, ten, eleven, twelve-

MS. GRANT: 'Cause if you have five and you want to make 15, how much do you need in each box?

NAOMI: Nine?

MS. GRANT: You need three. Three pieces. Right? That's one, then it's one, two, three-

[Multiple people talk at the same time.]

MARIE: [To another student] What are you doing here? You didn't turn it.

MICHAEL: Miss, can you help me real quick? Ms. Grant, can you?

JESSE: I don't understand.

MS. GRANT: So what's the frac-, before you do anything, what's the fraction that's shaded?

MICHAEL: It's two-thirds. Making six equal sides, and that would be: six-fourths.

MS. GRANT: Six-fourths? How many pieces are there total?

[Silence.]

MS. GRANT: So where is the six?

MICHAEL: On the bottom. O:h, it's gotta be four-sixths.

MS. GRANT: So you're right, that's four, but you've gotta write it as a <u>fraction</u> still. David I'll be right there.

JESSE: Yeah, it's four-sixths.

MS. GRANT: What's the fraction that's shaded, there's one box, it's two out of-

VICTORIA: Three

MS. GRANT: Three. So that's two-thirds. So in this blank the fraction shaded was two-thirds.

[Silence.]

MS. GRANT: [And it says make it into six equal sized parts, drawing in lines. This is three. I want it in six parts. [After a moment] Mhm. But are these equal parts? Are these little parts the same as this part? I see six parts. Good.

VICTORIA: Mhm. ((Counting sections of the paper strip)) One, two, three, four, five, six.

MS. GRANT:  So what's the fraction that's shaded now?

VICTORIA: Four.

MS. GRANT: All right.

VICTORIA: Six

MS. GRANT: Six. Four-sixths. So that one's right. Ok?

NAOMI: Ms. Grant?

MS. GRANT: [To a student] Three out of? What's that one.

NAOMI: [To another student] Are you on the back side? Ms. G? Can you help me really quick?

MS. GRANT: Yep. I said I would help David, so I'll help David first.

NAOMI: Oh, ok.

[Students chat.]

MS. GRANT: Three out of-

JAMES [to Mrs. L]:  Does she mean here that (six) into four, into eight equal parts, that's one, two, three, four, five, six, seven, eight, right?

MRS. L: I think she means all of that in eight equal parts. The whole strip.

JAMES: Mmmm.

MRS. L: And you cut one of the pieces into eight-

JAMES: She said A.

MRS. L.: Strip A. Oh, you're right! You're right!

JAMES:  So eight equal parts. ((Reading)) "*Write the new fraction for the shaded-*"

MRS. L.: So that's divided into eight. Can you assume that these are divided into eight also?

JAMES: Yeah.

MRS. L: So then you have to give your fraction for these-

JAMES: Yes.

MRS. L: Yep, you got it.

JAMES: ((Counting)) four, five, six, seven, eight. Eight plus eight, right?

MRS. L: Eight times one, two, three, four? There's eight in each?

JAMES: Eight times four.

MRS. L: Do you know that one?

JAMES: Twenty, four? Yeah, twenty four.

MRS. L: Eight times three is twenty four.

JAMES: Twenty eight?

[Mrs. L. points toward the ceiling to indicate that the answer is higher.]

JAMES: Thirty?

MRS. L: Hah hah. Thirty two.

MS. GRANT: [To the group] On the back side when I say equivalence statement I want an <u>equals</u> equation. So <u>something</u> equals <u>something</u>. So ¾ equals-

MRS. L: [Still talking to James] What would the fraction be when you have these shaded. So what fraction would that be out of thirty two?

JAMES: Four?

MRS. L: Um. If you have eight.=

MRS. L: If you have eight in each of these [referring to sections of a shape drawn on paper] it would be eight times one, two, three-

JAMES: That would be xxx minus eight.

MRS. L: Yeah. Not just this box. Sorry.

MRS. L: [to James] Yes. I think so.

JAMES: "*Write an equi-, equi-*"

MRS. L: An equivalence statement. So you

MS. GRANT: ((In the background)) So this is your strip A. Cut it. Right now you have one, two, three-

MS. GRANT: [To a student] So this is your strip [pointing to picture]. Not just this box, sorry. So right now you have one, two, three, four, I want it to be a total of eight. Cut it into eight equal parts.

[There is more conversation here that is difficult to hear.]

MS. GRANT: So erase those. Erase those. Yes!

MS. GRANT: So strip A is the whole thing. What's the fraction for this? Write a fraction. A fraction for the shaded amount.

can start with this and say three-fourths equals, [she pauses] mm, yep.
JAMES: Oh, if fourteen divided by two.
MRS. L: Yeah four times eight equals thirty two. Three times eight is twenty four. Yep.

Mhm. How many pieces? What's the total?
MS. GRANT: So three-fourths equals.
MICHAEL: (That's what I should put in the blank]
MS. GRANT: Mhm. What does three-fourths equal?
MICHAEL: Six eighths.
MS. GRANT: All right, so you've got four xx and you want to make eight pieces. I want you to make it eight equal. Mhm. So can you draw that in. There's one, yep. Then you've got to do it to all the pieces. Right.
[Ms. Grant whispers quietly to a student about something else.]

DAVID: Cut it into how many pieces, eight. So it's xx. That's four, four. XXX.
MS. GRANT: [To David's partner] If you did it this way you want them all that way. So you decide do you want to take out David's line or do you want to take out your line?
[More task-related chatting.]
MS. GRANT: [To another student] So. Ok, one, two, three, four. And you did this. Fraction. And they have to be equal. There's two parts. This part is the same as ((talk gets really quiet here)) All right, you can use the equals sign so three-fourths, equals what?
[The student mumbles an answer.]
MS. GRANT: Nice. You keep moving around. [To a different student] You have three parts here. You want to cut it into twelve so one, two, three, four, five. One, two, three, four, five. So if you have three and you want to make it into twelve, how much does each one have to be?
STUDENT: Four.
MS. GRANT: So then you've got three, three, three?
[There is a lot of chatting. Some of it is task-related and some is not.]

MS. GRANT: [To James] So I want, ‘cause I want A. A is one, two, three, four. This whole thing is strip A.

JAMES: Oh, I didn’t know that.

MS. GRANT: So if I want eight pieces I have to cut it in half, in half, in half. One, two, three, four, five, six, seven, eight, nine-

[The bell rings while students are working. There is a lot of noise as students get up and leave the room.]

# Appendix G

## Sample MDA Analysis

| Page # | Actions/Context | Talk at Each Turn | Classroom Structures influencing language use | Mediators |
|---|---|---|---|---|
| 1 | Students are talking loudly about an incident that happened outside of school. Hope is speaking in Liberian Creole and laughing. | MS. GRANT: All right. Timer's on. | | Kitchen timer mediates attention needed to copy objectives |
| 1 | Students keep talking in animated voices. Ms. Grant walks around handing out tickets to students who are sitting down with binders open copying the objectives for the day without talking. | MS. GRANT: All right. Timer's se:t. | Written math and language objectives on board for students to copy into planner. (RDG & WRITING)<br>Individual work | Tickets mediate participation in routine (copying objectives) |
| 1 | Timer rings. Some students keep talking. | NAOMI: I didn't get a ticket. | Individual work | |
| 1 | Speaking to Naomi first, then to group. | MS. GRANT: Because you were talking. Time's up. | Individual work | Timer |
| 1 | Students quiet down but there is still some chatting. Ms. Grant shakes the name sticks in the can twice. | MS. GRANT: All right. Jorge will you take a seat please? Hope will you take a seat please? Luis, wanna take a seat please? | routine of drawing name to choose who reads<br>Large group | Name sticks |

## Appendix H
## MEASUREMENT DEFINITIONS AND EXAMPLES OF CAF MEASURES

### A. Total number of words

Word count of all of the words in all the student's utterances for one day. From this subtract the number of false starts, instances of repetition excluding whole sentence repetition, and interjections (see Items B, C and D below). If there are words that are marked as unclear (xxx), do not count them in the total number of words.

## FLUENCY MEASURES

### B. Interjections

Count the number of words used to fill pauses or in a cry (e.g., Oh!). In the case of an inarticulate utterance, count it as one word. Count this broadly. If there is a 'yeah' that could be an answer to a question, don't exclude it.

**Exclude:**

(1) Words used to fill pauses (e.g., um, er, ah) – Don't count words that could be an answer to a question

Ex: I forgot the, ah, fraction bar.

Ex: (Don't count this)

Teacher: Left, less than, right?

Student: Yeah. Greater than, right.

Ex: (Do count this as filler words)

Teacher: You can see the=

Student: ~~Yeah. Yeah.~~

Teacher= fraction is bigger than one-half.

(2) Words used A cry or inarticulate utterance (e.g., Ugh, aagh, oh, shh)

Ex: James: I'll show you.

Teacher: Show me at your desk.

James: Aagh.

James: ~~Oh~~, one.

Teacher: James is that ok with you?

James: ~~Hmm?~~

**Don't exclude:**
Teacher: James, say it one more time? James: Yeah, over four, yeah.

Do this step first before counting false starts and repetitions.

**C. Repetitions**

Words or phrases that a student repeats without modification. Exclude repetition of entire sentences. Count the part of the utterance that is repeated verbatim as one instance. Do this step second after eliminating interjections. If, after an interjection gets removed, two adjacent words are the same, exclude one as repetition

Ex: (Count this as two repetitions) We change, change the, the, the, the two over three to three times six.

(Don't count this) Who's gonna move? Who's gonna move?

**D. False Starts**

Utterances that are not finished (i.e., a fragment). If an utterance is finished across speaking turns, do not count the first (unfinished) one as a false start.

Count the utterance as one instance of a false start and then indicate the number of words contained in all of the instances of false starts for that student. If, in the false start, there is an unclear word or words represented with xxxx, exclude the xx from the count of the number of words involved. Subtract the number of words in false starts from the word count to calculate Item A (Total Number of Words).

Ex: I divide it by –

We can use, um---

## COMPLEXITY MEASURES

**E. A-S unit (text length)**

A single speaker's utterance made up of an independent clause or subclausal unit and any related subordinate clause.

- Independent clause has a subject and verb and can stand alone as a sentence
- Independent subclausal unit could be a "minor utterance" like 'Oh dear', 'Poor girl', 'Thank you very much' – these carry lexical meaning even if they don't have a complete subject and verb.

- Typically, but not always, the subclausal unit can be expanded into a full clause by replacing omitted elements. Sometimes subclausal units that can't be expanded still carry lexical meaning & if so count them.

In some cases you will need to rely on the punctuation in the transcript to make a decision about what words to include in an A-S unit. For example, you would mark A-S unit boundaries differently for these two utterances because one has a period after 'yeah':

Student 1: //Yeah, like this.//

Student 2: //Yeah.// Like this.//

If an utterance appears to have two parts that could each form an A-S unit if the second one were complete, then count as two A-S units.

Ex: My favorite person in the whole world, Marie. [I interpreted as 'My favorite person in the whole world, it is Marie.] **2 A-S units.**

Ex: Cut it into how many pieces, eight. [I interpreted as 'Cut it into how many pieces, that is eight] **2 A-S units**

<u>Factor these things into an A-S unit:</u>

i. False starts– Exclude the words from the A-S unit. Cross them out.
ii. Repetition of a word(s) – If they are disfluencies, and occur when a person repeats a word or phrase, exclude all except the last one from the A-S unit. Cross them out.
iii. Self-correction – if the student self-corrects, count the final version of the utterance in the A-S unit. Cross-out the corrected section and exclude it from the A-S unit. Do not count repetition of entire sentence as a disfluency.
iv. Exclude minor one word minor utterances like backchannelling (uh huh, ok, yeah, right) that do not convey meaning. Cross out these words and exclude them from the A-S unit.
v. If a student's statement is unclear and you can't reconstruct the full clause, do not count it as an A-S unit.
vi. If there is a period in the transcription, assume that is the end of a unit and put the A-S unit marker after it. E.G. /Yeah, like this./ versus /Yeah./ Like this./ If there is a comma in the sentence, include it as part of an A.S. unit, do not put the marker at the comma.

Include these things in an A-S unit:

i. If a second speaker interrupts the first speaker's utterance before it is completed and finishes enough of their utterance to meet the criteria for an A-S unit count it as part of the A-S unit from the first speaker.
ii. If a speaker finishes an A-S unit across speaking turns.

***Examples:***

JAMES: ||Yeah, like this. || [1 A-S unit]

JAMES: ||Will give you four, right? || [1-AS unit]

JAMES: "*Write an equi-, equi-*

MRS. LIU: An equivalence statement. So you can start with this and say three-fourths equals, mm, yep.

JAMES: ~~Oh, if fourteen divided by two.~~ [Don't have context needed to reconstruct full clause.]

JESSE: ||That's six times three. Is eighteen. ||~~And you have to take, um-~~ And ~~we have to put, um~~, we have to put, three here, six here, six here, three here. || And we have to times the top one by one. ||That's, ~~um~~, plus, eighteen. ||Six times two, (equals) twelve. || One times three. Three. ||And we have to add it together|| that's fifteen, eighteen. || ~~Ah,~~ we have to look for ~~the, um,~~ what can still divide them together. ||~~We can use, um-~~|| [9 A-S units]

**F. Mean number of verbs per A-S Unit**

Count the number of auxiliaries, modal verbs, finite verbs, infinitives, etc. Divide this number by the number of A-S units.

**G. Percentage of A-S Units with More Than One Main Verb**

Calculate the number of A-S units with more than one main verb. If there are two part verbs (e.g., have to + verb, want to+ verb, need to+ verb) do not count this as having more than one verb. Also do not count yes/no questions that must have be+ verb or do+verb.

Ex: I <u>need</u> to get out of here. (1 main verb)

**H. Number of Turns**

Total number of speaking turns performed by the speaker in one class period. Count a turn as one continuous line(s) of text uttered by the same speaker that are uninterrupted by another speaker. Do not count interjections and false starts that are, by themselves, turns.

[Here, Michael has two turns.]

Ex: Michael: We could, all he needed to do was probably, was to change one of them=

Naomi: Yah.

Michael: =we change, change the, the, the, the two over three to three times six.

## I. Mean Turn Length

Total number of words after false starts, repetitions and interjections have been removed (See Items B-D) divided by the student's total number of turns (see item F). If there are past, present and future tenses of the same verb, count them as one word.

## J. Type-Token Ratio

Put brackets around the first 100 words excluding interjections (see D), false starts, and repetitions of words or phrases. The words do not have to be all in one turn. These are the tokens. Then count the number of unique (i.e. not repeated) words (the types) and divide by 100. Count contractions a separate word from either of the component parts (e.g., count its separately from it and is). Count names such as Ms. Johnson as two words. Count past, present and future tense forms of the same verb as one word.

## K. Number of Verb Forms Used

Count the number of different verb forms used. Count past, present or future tenses of the same verb as one form. Include infinitives and auxiliary verbs <u>but exclude modals.</u>

Ex: It is. It was more. (1 verb form)

Ex: So that would <u>mean</u> we'd still <u>have</u> one-sixth plus here we ~~would have~~ four-sixths, when we <u>add</u> we <u>get</u> five-sixths. [4 verb forms – mean, have, add, get]

## L. Instances of Solving Problems Function

Count the total number of separate occasions (could be across turns if the student has a lengthy exchange) on which the student explains or narrates the process of solving a math problem. This might occur in answer to a teacher's prompt for the student to share their work.

Ex:

Michael: Ok, first you gotta found which one in there can go, what number it can multiply by so which is both of them go into twelve. So this, you could just replace the number and put three up ahead. Then you gonna put four right here.

### M. Instances of Justifying Function

Count the total number of separate occasions (could be across turns if the student has a lengthy exchange) on which the student justifies why their thinking or their solution to a problem is correct or why someone else's thinking is incorrect. To be counted as justifying, the utterance must include a reason.

Ex:

Teacher: That's way more. Because if you get it into ten pieces, twenty-tenths would be two full circles. That's way more than a half.

### N. Instances of Comparing/Contrasting Function

Count the total number of separate occasions (could be across turns if the student has a lengthy exchange) during which the student describes how two quantities, shapes, objects, ideas are alike and/or different. Note that in this math class often the teacher phrases her questions in such a way that a student has to do a mental comparison in order to answer it, but not a verbal comparison. Do not count the mental comparison as an example of the compare/contrast linguistic function. However, if the teacher asks the student to make a comparison and the student can construct a full clause on his/her own that contains a comparison, count it.

Ex: (Count)

Teacher: How does ½ compare to ¼?

Student: One-half is bigger than ¼.

Ex: (Don't count) Teacher: Is ½ bigger or smaller than ¼? Student: Bigger.

## ACCURACY MEASURES

### O. Percentage of A-S units with self-corrections

Count the A-S units with self-corrections as a percentage of the total number of A-S units. If the student repeats an entire sentence with one word changed, do not count as a self-correction.

*Include*

Ex: First you gotta find which one in there can go, what number it can multiply by.

*Exclude:*

When you take eleven pieces of, eleven reds, when you arrange them here….

I can draw it. I can write it, but I can't say it.

Renata spent one-eighth on repairing a, her bicycle.

## P. Percentage of Accurate Verb Phrases

Locate all finite verb phrases in the student's utterances. Do not count verbs or verb phrases in false starts. If the student repeats a verb or part of a phrase multiple times, only count the last version. Exclude consideration of whether the tense the student chooses to use is appropriate, and analyze the following aspects of the verb phrase:

a. All the obligatory auxiliary verbs are present. Include (1) modal auxiliaries like will, can, must, shall, may; (2) Periphrastic modals like be going to, have to, be able to, and; (3) Be and have (E.g., I am walking. I have seen the teacher.)

b. Where appropriate, there is appropriate tense marking for the tense the student chose. (E.g., I was going to the store (correct). I goed to the store (incorrect).)

d. There is subject-verb agreement where needed (E.g., She goes to math class on Thursdays (obligatory agreement). vs. She should go to math class today (verb 'go' not required to agree with subject here).

e. Periphrastic modals have a to infinitive before the main verb (He has to finish his homework.)

Calculate the number of correct finite verb phrases divided by the total number of verb phrases and then multiply this number by 100.

Ex: We have to look for, ~~um,~~ ~~the~~ what can divided or subtracted ~~the,~~ the nominator [sic]. And it's gonna give us, ~~like~~, ~~um~~, (these numbers). ~~That's um~~, that's eighteen. ~~We can do-~~ [2 accurate verb phrases out of 3 = 67% correct)

## Q. Percentage of Target-like plurals

Count the number of correct plurals and divide by the number of times a plural was required in the student's utterances, then multiply by 100.

## R. Math Vocabulary Use

Count the number and percentage of words on the General Service Word List, parts 1 and 2, and the Academic Word List

## Appendix I
## FOCAL STUDENTS' COMPLETE CAF AND VOCABULARY DATA

Table I.1

*David's Complete CAF Data*

| | Date of Transcript | | | | |
|---|---|---|---|---|---|
| | 5-6-10 | 5-11-10 (F) | 5-20-10 (F) | 5-25-10 | 6-7-10 |
| **Total Number of Words Spoken** | 26.0 | 306.00 | 371.0 | 191.0 | 86.0 |
| **Fluency** | | | | | |
| False Starts | 0.0 | 3.0 | 11.0 | 3.0 | 0.0 |
| Repetitions | 1.0 | 5.0 | 6.0 | 5.0 | 1.0 |
| Interjections | 0.0 | 1.0 | 7.0 | 5.0 | 0.0 |
| **Complexity** | | | | | |
| A-S Units | 8.0 | 87.0 | 79.0 | 50.0 | 16.0 |
| Mean number of Verbs per A-S unit | 0.7 | 0.9 | 1.3 | 0.9 | 1.4 |
| A-S units with 2+ verbs | 0.0 | 11.4% | 10.1% | 5.0% | 0.2% |
| Number of Turns | 4.0 | 48.0 | 54.0 | 41.0 | 11.0 |
| Mean Turn of Length (words per turn) | 6.5 | 6.4 | 6.9 | 4.6 | 7.8 |
| Type-Token Ratio | n/a | 0.5 | 0.5 | 0.7 | *0.5 |
| Number of Verb Forms Used | 4.0 | 21.0 | 27.0 | 19.0 | 13.0 |
| Instances of Explaining Function | 1.0 | 0.0 | 0.0 | 1.0 | 1.0 |
| Instances of Justifying Function | 0.0 | 1.0 | 0.0 | 2.0 | 0.0 |
| Instances of Comparing/Contrasting Function | 0.0 | 0.0 | 1.0 | 1.0 | 0.0 |
| **Accuracy** | | | | | |
| Percent of A-S Units with Self-Corrections | 0.0% (0/8) | 0.0% (0/87) | 3.8% (3/79) | 0.0% (1/50) | 6.2% (1/16) |
| Percent of Accurate Verb Phrases | 100.0% (6/6) | 96.8% (61/63) | 96.3% (78/81) | 94.1% (32/34) | 99.9% (15/16) |
| Percent of Target-Like Plurals | 100.0% (3/3) | 100.0% (6/6) | 70.6% (12/17) | 100% (3/3) | 50% (1/2) |

TTR on this day was calculated with fewer than 100 (but more than 75) words; reliability may be affected

**David's GSL 1 Vocabulary**

| | | | |
|---|---|---|---|
| **a** | caring | **following** | **in** |
| **about** | **circle** | for | **inch** |
| **add** | clean | get | **increase** |
| **again** | color | go | into |
| **amount** | come | god | is |
| **an** | **compare** | good | **it** |
| **and** | cover | got | just |
| **another** | cut | green | **know** |
| answer | **day** | grey | **largest** |
| **are** | **describe** | **half** | last |
| ask | divide | have | left |
| at | **do** | he | let |
| back | dollars | **help** | **level** |
| **be** | door | her | like |
| **because** | double | here | listen |
| biggest | down | **high** | look |
| blue | **each** | hold | lot |
| **both** | easy | hours | **many** |
| but | **equal** | **how** | me |
| by | **explain** | I | mean |
| call | **find** | if | mind |
| **can** | **first** | impossible | mine |
| minute | **repair** | **the** | welcome |
| money | right | then | well |
| **more** | **rise** | there | what |
| **much** | **same** | **they** | when |
| my | **say** | thing | which |
| next | see | thinking | while |
| no | **sentence** | third | why |

| | | | |
|---|---|---|---|
| not | she | **this** | **will** |
| number | shoot | though | **with** |
| one | should | **to** | word |
| open | **show** | trust | would |
| over | so | trying | **write** |
| person | **spend** | understand | yeah |
| pick | **step** | up | yellow |
| pieces | still | **use** | yesterday |
| put | store | wait | **you** |
| read | storm | **wants** | **your** |
| real | take | **water** | |
| **receive** | **than** | way | |
| red | **that** | we | |

Note: Words in bold print were read aloud

**David's GSL 2 Vocabulary (n=17)**

| | | |
|---|---|---|
| ahead | **exact** | **swimming** |
| bend | **list** | thank |
| **bicycle** | pink | tomorrow |
| brown | **pool** | whole |
| check | quick | zero |
| **correct** | **rain** | |

**David's AWL Vocabulary (n=8)**

| | | |
|---|---|---|
| challenge | grade | positive |
| definitely | partner | sum |
| **equivalent** | plus | |

Note: Words in bold font were read aloud

Table I.2

*Naomi's Complete CAF Data*

| | Date of Transcript | | | | |
|---|---|---|---|---|---|
| | **5-6-10** | **5-7-10** | **5-25-10** | **5-26-10** | **6-7-10** |
| **Total Number of Words Spoken** | 171.0 | 181.0 | 59.0 | 55.0 | 170.0 |
| **Fluency** | | | | | |
| False Starts | 0.0 | 4.0 | 0.0 | 0.0 | 3.0 |
| Repetitions | 1.0 | 1.0 | 0.0 | 0.0 | 2.0 |
| Interjections | 3.0 | 8.0 | 3.0 | 0.0 | 6.0 |
| **Complexity** | | | | | |
| A-S Units | 48.0 | 40.0 | 20.0 | 14.0 | 39.0 |
| Mean number of Verbs per A-S unit | 0.9 | 1.3 | .55 | 1.3 | 1.1 |
| A-S units with 2+ verbs | 6.2% (3/48) | 10.0% (4/40) | 5.0% (1/20) | 0.0% (0/14) | 10.0% (4/39) |
| Number of Turns | 36.0 | 36.0 | 16.0 | 13.0 | 27.0 |
| Mean Turn Length (words per turn) | 4.7 | 5.0 | 3.7 | 4.2 | 6.3 |
| Type-Token Ratio | 0.6 | 0.6 | *0.4 | *0.4 | 0.6 |
| Number of Verb Forms Used | 13.0 | 14.0 | 5.0 | 7.0 | 17.0 |
| Instances of Solving Problems Function | 0.0 | 0.0 | 0.0 | 0.0 | 2.0 |
| Instances of Justifying Function | 1.0 | 4.0 | 0.0 | 0.0 | 0.0 |
| Instances of Comparing/Contrasting Function | 0.0 | 2.0 | 0.0 | 0.0 | 1.0 |
| **Accuracy** | | | | | |
| Percent of A-S Units with Self-Corrections | 0.0% | 0.0% | 0.0% | 0.0% | 2.5% (1/39) |
| Percent of Accurate Verb Phrases** | 100.0% (28/29) | 96.9% (31/32) | 100.0% (7/7) | 100.0% (10/10) | 100.0% (31/31) |
| Percent of Target-Like Plurals | 75.0% (6/8) | 100% ( 1/1) | 0.0% ( 0/1) | n/a (0/0) | 100.0% ( 2/2) |

*TTR on these days was calculated with fewer than 100 words; reliability may be affected

**Naomi's GSL 1 Vocabulary**

a
add
also
always
**and**
are
at
back
be
because
blue
both
but
by
can
common
count
divide
do
draw
due
them
then
**they**
this
to
today
top

easy
equal
eyes
feel
finish
first
**for**
from
get
go
good
half
have
help
here
how
I
in
it
know
less
true
turn
**use**
want
we
what
when

like
line
look
make
man
me
mean
mine
more
my
names
no
not
now
number
one
other
our
over
**own**
paper
which
white
why
**will**
with
**word**
work

parts
**problem**
put
red
right
same
say
second
see
she
should
side
smaller
so
square
start
still
**story**
than
that
the
would
**write**
yellow
yes/yeah
yesterday
you

**Naomi's GSL 2 Vocabulary (n=9)**

| | | |
|---|---|---|
| bottom | hungry | sorry |
| check | pink | stuff |
| excuse | quick | ticket |

**Naomi's AWL Vocabulary (n=2)**

| | |
|---|---|
| equivalent | symbol |

Note: Words in bold print were read aloud

Table I.3

*Jesse's Complete CAF Data*

| | Date of Transcript | | | | |
|---|---|---|---|---|---|
| | **5-6-10** | **5-19-10** | **5-21-10 (F)** | **5-26-10** | **6-7-10 (F)** |
| **Total Number of Words Spoken** | 143.0 | 178.0 | 530.0 | 342.0 | 43.0 |
| **Fluency** | | | | | |
| False Starts | 3.0 | 1.0 | 19.0 | 10.0 | 0.0 |
| Repetitions | 6.0 | 0.0 | 16.0 | 8.0 | 0.0 |
| Interjections | 4.0 | 3.0 | 19.0 | 24.0 | 1.0 |
| **Complexity** | | | | | |
| A-S Units | 53.0 | 66.0 | 185.0 | 129.0 | 15.0 |
| Mean number of Verbs per A-S unit | 0.6 | 0.5 | 0.6 | 0.5 | 0.7 |
| A-S units with 2+ verbs | 5.7% | 0.0% | 0.1% | 3.1% | 6.7% |
| Number of Turns | 48.0 | 56.0 | 151.0 | 117.0 | 14.0 |
| Mean Turn Length (words per turn) | 3.0 (143/48) | 3.2 (178/56) | 3.5 (530/151) | 2.9 (342/117) | 3.0 (43/14) |
| Type-Token Ratio | 0.5 | 0.5 | 0.5 | 0.6 | n/a |
| Number of Verb Forms Used | 13.0 | 12.0 | 29.0 | 11.0 | 8.0 |
| Instances of Solving Problems Function | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 |
| Instances of Justifying Function | 0.0 | 0.0 | 3.0 | 0.0 | 0.0 |
| Instances of Comparing/Contrasting Function | 0.0 | 1.0 | 1.0 | 0.0 | 0.0 |
| **Accuracy** | | | | | |
| Percent of A-S Units with Self-Corrections | 0.0 | 0.0% | 0.0 | 0.0% | 6.7% |
| Percent of Accurate Verb Phrases** | 100.0 (23/23) | 100.0% (27/27) | 98.0% (99/101) | 96.4% (53/55) | 100.0% (11/11) |
| Percent of Target-Like Plurals | 89.0% ( 8/9) | 36.0% (4/11) | 75.0% (21/28) | 27.3% ( 3/11) | n/a (0) |

**Jesse’s GSL 1 Vocabulary**

a
add
**after**
again
agree
all
already
and
another
answer
as
at
**away**
back
bar
be
because
before
better
blue
boy
but
can
change
**circle**
color
come
could
difference
divide
do
door
**draw**
each
easy
**eat**
equal
even
except
**explain**
find
first
for
**from**
game
get
give
go
God
**great**
half
hard
hardly
have
he
head
her
here
history
**how**
I
in
it
just
know
large
leave
**left**
**less**
let
light
like
**live**
look
make
man
many
me
**mile**
mine
Miss
**more**
most
**much**
my
need
no
not
**notice**
now
number
of
**one**
**or**
other
our
out
over
part
**party**
**picture**
piece
place
please
put
red
right
same
say
**school**
see
should
**show**
**size**
so
stop

| | | | |
|---|---|---|---|
| take | this | use | will |
| **than** | time | wait | with |
| that | to | we | word |
| the | today | welcome | work |
| their | together | well | would |
| then | too | **what** | yellow |
| there | top | when | yes |
| they | understand | **which** | yesterday |
| think | up | why | **you** |

**Jesse's GSL 2 Vocabulary (n=20)**

| | | |
|---|---|---|
| bend | lesson | sorry |
| brown | orange | stupid |
| correct | **pencil** | thank |
| far | pink | ticket |
| **farther** | purple | **tomorrow** |
| fold | question | **whole** |
| grey | shade | |

**Jesse's AWL Vocabulary (n=3)**

| | | |
|---|---|---|
| estimate | participate | partner |

Note: Words in bold print were read aloud

Table I.4

*Marie's Complete CAF Data*

| | Date of Transcript 5-6-10 (F) | 5-18-10 (F) | 5-21-10 (F) | 5-26-10 | 6-7-10 |
|---|---|---|---|---|---|
| **Total Number of Words Spoken** | 51.0 | 30.0 | 84.0 | 78.0 | 55.0 |
| **Fluency** | | | | | |
| False Starts | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 |
| Repetitions | 2.0 | 0.0 | 3.0 | 0.0 | 0.0 |
| Interjections | 0.0 | 0.0 | 1.0 | 0.0 | 1.0 |
| **Complexity** | | | | | |
| A-S Units | 11.0 | 8.0 | 25.0 | 17.0 | 9.0 |
| Mean number of Verbs per A-S unit | 1.0 | 0.7 | 0.9 | 0.7 | 1.1 |
| A-S units with 2+ verbs | 0.0 | 0.0 | 2.0 | 0.0 | 2.0 |
| Number of Turns | 7.0 | 4.0 | 25.0 | 14.0 | 9.0 |
| Mean Turn Length (words per turn) | 7.3 | 7.5 | 3.4 | 5.6 | 6.1 |
| Type-Token Ratio | *0.3 | n/a | *0.6 | *0.3 | *0.6 |
| Number of Verb Forms Used | 6.0 | 2.0 | 15.0 | 5.0 | 6.0 |
| Instances of Solving Problems Function | 1.0 | 2.0 | 0.0 | 1.0 | 2.0 |
| Instances of Justifying Function | 1.0 | 2.0 | 1.0 | 0.0 | 0.0 |
| Instances of Comparing/Contrasting Function | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Accuracy** | | | | | |
| Percent of A-S Units with Self-Corrections | 0.0% | 0.0% | 4.0 | 0.0 | 0.0 |
| Percent of Accurate Verb Phrases** | 100.0% (7/7) | 50.0% (3/6) | 91.7% (11/12) | 100.0% (9/9) | 100.0% (7/7) |
| Percent of Target-Like Plurals | 100.0% (1/1) | 100.0% (6/6) | 100.0% (8/8) | 100.0% (2 /2) | 100.0% (1/1) |

*TTR on these days was calculated with fewer than 100 words (but more than 50); reliability may be affected

**Marie’s GSL 1 Vocabulary**

| | | | |
|---|---|---|---|
| a | difference | how | point |
| actual | **divide** | I | red |
| add | **do** | is | remain |
| also | draw | it | sign |
| **an** | each | just | so |
| and | **eat** | know | space |
| **answer** | equal | **least** | take |
| at | explain | like | **that** |
| away | farther | look | **the** |
| **be** | find | **more** | then |
| because | **first** | **much** | thing |
| board | fit | need | this |
| both | for | next | to |
| but | from | no | use |
| **by** | **get** | not | we |
| **can** | go | number | what |
| change | good | **of** | when |
| color | half | one | which |
| come | have | over | yes |
| **common** | help | **party** | you |
| cover | here | piece | |

**Marie's GSL 2 Vocabulary (n=6)**

| | | |
|---|---|---|
| arrange | farther | multiply |
| empty | grey | pink |

**Marie's AWL Vocabulary (n=1)**

factor

Note: Words in bold print were read aloud

## Appendix J

## SOCIAL AND ACADEMIC LANGUAGE EXPECTATIONS OF STATE ELP LISTENING AND SPEAKING STANDARDS (GRADES 9-12)

*Social and Academic Language Expectations of State English Proficiency Standards (Gr. 9-12) for Listening and Speaking*

| | **Listening** | | **Speaking** | |
|---|---|---|---|---|
| | **Social** | **Academic** | **Social** | **Academic** |
| **Purpose, Audience & Genre** | Understand highly contextualized conversations on familiar topics | Understand main idea of academic content | Participate in highly predictable conversations on familiar topics with peers and teachers | Participate in limited guided discussions<br><br>Give simple oral reports related to self or topics of high personal interest |
| **Communicative Functions** | Follow simple, familiar directions<br><br>Understand familiar questions and commands | Perform familiar class tasks with prompting<br><br>Understand familiar questions and commands | Express many needs and preferences<br><br>Ask and answer simple questions<br><br>Describe | Express many needs and preferences<br><br>Ask and answer factual questions<br><br>Describe |
| **Language Features** | Understand, with repetition and rephrasing, simple speech delivered slowly | Understand, with repetition and rephrasing, simple speech delivered slowly<br><br>Distinguish present, past and future time | Produce phrases and simple sentences<br><br>Recombine learned material<br><br>Speak with enough accuracy that listeners used to language learners comprehend some of the message | Produce phrases and simple sentences<br><br>Recombine learned material<br><br>Speak with enough accuracy that listeners used to language learners comprehend some of the message |
| **Word Knowledge and Use** | Understand vocabulary related to personal interests and familiar topics | Understand target vocabulary in sentence-level discourse | Use familiar, general vocabulary | Use general target vocabulary in class activities |

## Appendix K

## Social and Academic Language Expectations of State English Proficiency Standards (Gr. 9-12) for Reading and Writing at the Intermediate Level

| | Reading | | Writing | |
|---|---|---|---|---|
| | **Social** | **Academic** | **Social** | **Academic** |
| **Purpose, Audience & Genre** | Understand environmental print<br><br>Understand simplified personal communications | Understand parts of simplified content-area texts<br><br>Understand simple narrative text<br><br>Understand simple story elements<br><br>Understand simple poetry concepts<br><br>Identify topic | Follow a model to write journal entries, notes, messages and friendly letters | Write about familiar content-area topics in guided tasks<br><br>Edit own work for grammar, mechanics, and spelling, with guidance |
| **Communicative Functions** | Read to obtain simple literal information | Interpret text by:<br><br>-Answering factual questions about simple, familiar text<br>-Drawing a picture<br>Acting out a story<br>-Filling in a graphic organizer<br>-Taking simple notes<br>-Recognize that background and cultural knowledge help to understand a text<br>-Make simple inferences | Exchange simple information with peers | Fill in graphic organizers<br><br>Write stories<br><br>With extensive classroom support, perform academic functions in writing, such as:<br><br>-make simple hypotheses<br>-compare and contrast<br>convey a main idea<br>organize ideas logically |

| | | | | |
|---|---|---|---|---|
| **Language Features** | Understand basic conventions of text<br><br>Comprehend at the sentence level | Understand basic conventions of text<br><br>Comprehend at the sentence level | Write simple sentences in standard word order<br><br>Spell and combine words with sufficient accuracy that readers accustomed to the writing of language learners comprehend some of the message | Write simple sentences in standard word order<br><br>Spell and combine words with sufficient accuracy that readers accustomed to the writing of language learners comprehend some of the message |
| **Word Knowledge and Use** | Understand enough vocabulary to comprehend isolated parts of a text | Understand enough grade-level vocabulary to comprehend portions of a text<br><br>Use knowledge of letter patterns, affixes, roots and compound word parts<br><br>Understand cognates | Use general vocabulary | Use a limited amount of target vocabulary<br><br>Use general vocabulary |

## Appendix L

## Social and Academic Language Expectations of State ELP Reading and Writing Standards at the Intermediate Level (Grades 9-12)

*Selected Achievement Level Descriptors for Content Area Proficiency Relating to Fractions*

| | **Does Not Meet the Standards** | **Partially Meets the Standards** | **Meets the Standards** | **Exceeds the Standards** |
|---|---|---|---|---|
| 3rd Grade | Matches fractions with correct area model. | Writes fractions for a given representation, including number line. | Compares and orders fractions with common denominators. | Understands that the size of a fractional part is relative to the size of the whole. |
| 4th Grade | Uses models to represent fractions. | Knows decimal and fraction equivalents for halves and fourths; uses models to compute with fractions. | Uses fraction models to determine equivalent fractions | Develops a rule for addition and subtraction of fractions with common denominators; |
| 5th Grade | Recognizes fractions and decimals in familiar context. | Knows benchmark decimal and fraction equivalents (e.g., ½ = 0.5, ¼ = 0.25). | Orders and compares common fractions and decimals; adds and subtracts fractions; | Adds and subtracts fluently with fractions and decimals. |
| 6th Grade | [Only mentions decimals, not fractions] | Recognizes equivalences among common fractions, decimals, and percents; | Determines equivalences among fractions, decimals, and percents but reverts to one | Efficiently translates between fraction, decimal, and percent forms of positive rational number to solve problems; compares ratios and understands their relationship to fractions; |
| 7th Grade | Changes numbers in fractional form to decimal form by dividing; recognizes that short terminating decimals, fractions, | Changes numbers in fractional form to decimal form and uses to compare; | [Fractions not explicitly mentioned; focus on multiple forms of rational numbers] | [Fractions not explicitly mentioned; focus on multiple forms of rational numbers] |

| | | | | |
|---|---|---|---|---|
| | and whole numbers are rational… | | | |
| 8th Grade | Recognizes fractions and terminating decimals as rational numbers. | *[Fractions not explicitly mentioned; focus on multiple forms of rational numbers]* | *[Fractions not explicitly mentioned; focus on multiple forms of rational numbers]* | *[Fractions not explicitly mentioned; focus on real numbers]* |