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# Academic and Linguistic Support for ELLs

A review of literature on approaches to teaching English Language Learners

in a Secondary Mathematics Classroom

**APPROVED BY**

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by

**Melissa Ann May, B.A.**

**Report**

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A review of literature on approaches to teaching English Language Learners in a Secondary Mathematics Classroom

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Melissa Ann May, M.A.

The University of Texas at Austin, 2014

Supervisor: Rebecca Callahan

This report discusses the current climate within mainstream content–area classrooms for English language learners (ELLs), and how academic and linguistic supports can improve the success of ELLs in school endeavors. The first section of this paper highlights these four aspects of instruction: comprehensible instruction, academic rigor, culturally relevant pedagogy, and teacher/student relationships, in order to create an academically and linguistically supportive classroom. The second section translates research and theory into practice, providing activities that promote both academic and linguistic development for all students by involving listening, reading, writing and speaking instruction.

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In the current educational climate, educators are finding themselves teaching students from increasingly diverse linguistic, academic, and cultural backgrounds (De Jong & Harper, 2005). One main issue is how to provide academic and linguistic support to the rising population of students who speak languages other than English (LOTE) at home and are enrolled in mainstream content–area courses.

These students are commonly called language minorities (LM) identified as such by school-administered home language surveys (Durán, 2008). When a family enrolls a student in a U.S. public school and indicates the student speaks a LOTE at home, schools administer an English language assessment. If schools determine the student's level of English is insufficient, they are labeled as an English language learner (ELL) and are required to receive both academic and linguistic support while in school (Durán, 2008).

Teaching classes that include English language learners (ELLs) can present many obstacles for mainstream teachers in content–area classrooms who have not had experience instructing ELLs or ELL training in the past. While pre-service teachers have the option to take courses related to educating ELLs, many current practitioners have not had the opportunity to complete a specialized ESL (English as a Second Language) program or prepare for this kind of teaching climate (Gibbons, 2002).

This paper provides a comprehensive synthesis of the growing ELL population in the United States, who is responsible for teaching ELLs, and insight into current roadblocks to English acquisition and academic advancement for ELLs in current mainstream classrooms. This paper also proposes methods to take theory into practice within secondary mathematics classrooms in order to allow ELLs to acquire both English and content simultaneously.

## Literature Review

Classrooms today are composed of both native English speaking (NES) and LM students. ELLs are the LM subgroup identified by educators in the school as lacking sufficient English to benefit fully from mainstream instruction (Durán, 2008). Schools thus identify ELLs for linguistic and support services intended to facilitate English acquisition.

Under the NCLB Act of 2001, the federal government requires all states to assess ELL students' English proficiency in reading, writing, speaking, and listening (Umansky & Reardon, 2014). States are required to provide linguistic support services for ELL students, however the federal government does not mandate policies regarding the identification, assessment, placement, instruction, or exit from (reclassification) English language learning programs (Calderón et al., 2011; Crawford, 2004). Nor has the federal government provided a definition of English proficiency or how to measure the tested domains of reading, writing, speaking, and listening (Rolstad, 2014). These policies lead to many different types of students falling under the umbrella of an English language learner, which can cause problems when deciding on methods to educate them most effectively.

ELLs are the fastest growing segment of the student population, with their growth highest in grades 7 to 12 (Calderón et al., 2011). From 1995 to 2005, the number of ELL students enrolled in public schools rose 56% while the overall student population rose only 2.6% (Ballantyne et al, 2008; Boardman et al., 2012). In the 2010-2011 school year, the National Center for Educational Statistics reported that there were 4.7 million ELLs in schools, compromising 10% of the student population (Bunch, 2013; McKeon, 2005; U.S. Department of Education, 2013). In some states, the percentage of ELLs is even higher. For instance some urban districts in Texas report 35% of students labeled as ELLs (Austin Independent School District Factsheet, 2014) and California has districts reporting as many as 46.5% ELLs (Pajaro Valley Unified School District, 2014). This results in between 10 and 14 students in each classroom of 30 identified as ELL. From these statistics it is clear that the proportion of secondary ELL students is large, everywhere, and growing.

While the majority of ELLs in the United States speak Spanish as their native language (Calderón et al., 2011; Durán, 2008), there is considerable diversity within the ELL population, linguistically and socio-economically. ELLs include economic migrants from Mexico and the Caribbean, political exiles from Cuba, and war refugees from Vietnam, Cambodia, El Salvador, and Guatemala (Crawford, 2004). Immigrants from Eastern Europe, the Middle East, and Africa are educated alongside the children of professional workers from India, Korea, the Philippines, and Taiwan (Campbell et al., 2007; Crawford, 2004). Some ELLs are highly schooled and may be more academically prepared than NES students in the United States, but they lack proficiency in English. Others ELL students have gaps in their formal education and require both subject and literacy development (Freeman & Freeman, 2001). In addition, some students may have never attended school (Calderón et al., 2011). Callahan (2005) posits that there are three main categories of ELL students within the United States: recent immigrants with significant amounts of previous schooling, recent immigrants with limited schooling or gaps in education, and long-term English learners who have been schooled primarily in the United States. While new immigrants make up 20-30% of the secondary ELL population (Calderón et al., 2011), the remaining ELL students are native born, second-generation students in the United States that are still in English language learning programs. They remain ELL identified either due to academic or linguistic constraints (Calderón et al., 2011). These three groups of ELL students have differing needs with regards to language development and academic abilities, yet all are found in mainstream content–area classrooms.

The vast majority of secondary ELLs complete their coursework in mainstream content area classrooms, where teachers often struggle to balance instruction in both literacy and content (Bunch, 2013; Campbell et al. et al., 2007; Gibbons, 2002; Gutierrez, 1999). In a recent survey, more than 40% of all U.S. teachers report teaching students who were limited in their English proficiency, yet only 12% of those teachers had 8 or more hours of training in how to teach ELLs (Nieto, 2004; Zehler et al., 2003). Likewise, in 2008 only 20 states required new teachers to have some form of ELL preparation, and that those requirements vary considerably (Ballantyne et al., 2008). However, some ELLs are finding success in rigorous mathematics coursework, even when teachers do not have substantial ELL specific training, suggesting that other factors in ELL success beyond professional development might be at play (Gutierrez, 1999, 2002). Callahan

(2005) argues that the ELL educational disadvantage is complex, and that language instruction, as well as access to rigorous academic content are both needed for ELLs to find success in schools. Other research suggests that in addition to academic and linguistic support, culturally relevant pedagogy (CRP), and meaningful teacher-student (T/S) relationships are also associated with ELL classroom success (Secada et al., 1999). The first section of this paper highlights four aspects of instruction in order to create an academically and linguistically supportive classroom: making instruction comprehensible, providing academic rigor, CRP, and T/S relationships. The second section translates research and theory into practice, providing activities that promote both academic and linguistic development for all students.

## Comprehensible Instruction

Secada (1992) notes that when teachers do not understand the relationship between language and mathematics instruction, they can hold unreasonably high or low expectations of ELLs. Without support, ELLs struggle to benefit from high-level or academically rigorous content (Crawford, 2004). Assuming students already possess an oral and literacy base in English for learning academic content does not consider how students will actually learn to talk, read, write, and comprehend conversations in English (De Jong & Harper, 2005), making access to meaningful content difficult. ELLs need to be taught how to analyze and use content in mainstream courses.

Many mainstream teachers employ practices that have been proven successful with ELL students, i.e., activating prior knowledge, using cooperative learning, process writing, using graphic organizers, and hands-on activities (Coggins, 2014; Gibbons, 2002). However, teachers cannot assume that students have the necessary language abilities to complete these academic tasks. In fact, many ELLs who appear to be proficient in oral varieties of English demonstrate difficulty in school assignments that require abstract reasoning or formal writing (Gibbons, 2002; Horwitz, 2013). Many content area teachers assume that ELLs will be taught English in another class (De Jong & Harper, 2005), and language is not considered to be a focus of their professional practice (Bunch, 2013). This is unsettling because mainstream content–area courses have been shown to be the best location for ELLs to acquire both academic and linguistic proficiency. Mathematics is best viewed as a language of its own, and the English used in mathematics classrooms must be explicitly discussed.

***Mathematics as a language***. Mathematics is its own language of words and expressions with meanings specific to the mathematics context that differ from those of everyday language use (Secada, 1991). Both ELLs and NESs must process mathematics as a language, and the associated academic language requires explicit instruction to promote this acquisition for all students. Crawford (2004) states that school language and playground language are not the same, suggesting that while all students will acquire oral English skills with relative ease, academic English skills are considerably more challenging and take longer to acquire. Academic English is defined by Bailey & Butler (2003) as "language that stands in contrast to the everyday informal speech that students use outside the classroom environment" (p.9). It is important to note that academic

English is not just understanding content area vocabulary. It also includes classifying, synthesizing, evaluating, and inferring information from both textbooks and presentations from the teacher and other students (Bailey & Butler, 2002; Bunch, 2013). As students get older, academic language becomes more and more cognitively demanding as new ideas, concepts, and language are presented simultaneously in the classroom.

Research suggests that it takes many ELL students 4 to 10 years or more to be exited out of the program with one factor of reclassification being English proficiency (Echevarria, Vogt & Short, 2004; Gibbons 2002; Umansky & Reardon, 2014). ELLs who are still acquiring academic English and are transitioned into mainstream classrooms too early quickly fall behind the progress of their NES peers due to a lack of necessary tools to do grade-level academic work (Crawford, 2004; Durán, 2008). One of these tools is a mastery of academic English, and in order to provide successful and fair opportunities to ELLs in mainstream classrooms, explicit language development should be one focus.

There are many ways that researchers have found to incorporate English instruction in mainstream classrooms. Gutierrez (2002) suggests that engaging students in mathematical contexts help teachers to involve their ELLs in language experimentation so that the English and concepts of mathematics become more accessible. Language experimentation involves describing mathematics situations in a variety of different ways and using gestures and objects to clarify meaning. This type of experimentation provides access to the information for students who might normally have difficulty in making sense of the subject matter. Gutierrez (2002) also notes teachers restating concepts in various ways, and ask students to rephrase mathematical ideas, can help both NESs and ELLs relate key mathematical ideas of various linguistic structures.

***Semantics: Making Meaning.*** Restating problems and ideas can be helpful when language in mathematics does not mirror everyday conversational language. Teachers need to pay attention to and clarify vocabulary that has a different use in everyday language (Bay-Williams et al., 2009; Secada et al., 1999). Examples of everyday vocabulary that have different meanings in mathematics include categories such as homonyms, homophones, and false cognates, which are defined in Figure 1. ELL students have the added cognitive demand of determining which of these definitions is more appropriate, while native speakers of English can infer meanings quickly from context. In mathematics classrooms words such as *row*, *table*, *square*, and *integral* all have meanings different than their meanings in everyday English. ELLs can become confused if this distinction is not made clear, and the point of the teacher's presentation can be lost as ELLs struggle to make sense of the new vocabulary and words with multiple meanings (Secada et al., 1999).

| Classification | Description | Examples |
|---|---|---|
| Homonyms | Words with multiple definitions | *row, table, square, integral* |
| Homophones | Words that sound alike with different meanings | *sum/some, hour/our, to/two/too, ad/add* |
| False Cognates | Words with different meaning in different languages | *billion/billón (Spanish)* |

**Figure 1. Examples of Mathematics Vocabulary with Different Definitions**

Harklau (1994) completed a 3.5-year study that followed Chinese-speaking immigrants from ESL to mainstream classes. She found that mainstream classrooms employ predominantly teacher-led discussions where teachers dominate classroom communication. While much input is provided for second language (L2) listening practice, teachers primarily address native speakers of English and seldom adjust to make instruction more comprehensible to L2 learners. Additionally, ELL students report that the puns, sarcasm, and irony used by mainstream teachers were confusing and incomprehensible (Harklau, 1994). Off topic conversation as well as colloquial language use can be confusing to ELLs (De Jong & Harper, 2005; Harklau, 1994). For example, using phrases like *knock it off, hands up,* and *hang on* can initially be confusing to ELLs who are not familiar with everyday classroom sayings. Many teachers do not even recognize their own use of these types of sayings, as they are so commonplace within the classroom (Campbell et al., 2007). Thoughtful reflection of personal language use can alleviate many problems in ELL comprehension.

Reduction of speed, pausing, comprehension checks, and contextualizing abstract information are all methods of making input more useful to ELL learners (Harklau, 1994). Researchers also suggest that slower, natural, and more enunciated speech with fewer idiomatic expressions is more appropriate (Coggins, 2014; Echevarria, Vogt, & Short, 2008). Horwitz (2013) states that gestures, facial expressions, tone of voice, knowledge of the topic, setting, and context of the conversation all also contribute to ELL student understanding of what other people are saying. These should be used alongside visuals, demonstrations, repetitions, and paraphrasing to enhance linguistic understanding for ELLs so that academic content becomes more accessible. Harklau (1994) found that ESL instructors regularly looked at the faces of students when administering comprehension checks to verify that assignments were understood, and that this practice did not occur as regularly in mainstream classes.

Semantics also shapes English acquisition through the demands of metaphorical meanings, connotation and stylistic nuances, and synonymy (Hummel, 2014). For example, in mathematics, addition can be implied through various words such as *add*, *plus*, *and*, *increase*, *gain*, *more*, or *sum* (De Jong & Harper, 2005). Additionally, mathematical statements written symbolically (e.g. $2 - x = 7$) can be expressed verbally several different ways (e.g. " 2 take away $x$ is 7", "2 minus $x$ equals 7", "2 less $x$ is 7"), and teachers often unknowingly interchange verbal statements in instruction (Khisty, 1995). Often, ELL students become intently focused on language and spend an inordinate amount of time trying to figure out a word's meaning rather than focusing on solving the math problem (Campbell et al., 2007). Meaning specific to the math context makes providing linguistic support even more paramount for content–area teachers. Providing language that is comprehensible is essential when providing linguistic support to ELL students, and Gutierrez's (1999, 2002) suggestion of rephrasing concepts in multiple ways could be a helpful way to alleviate many language difficulties. However, beyond linguistic support, teachers also need to maintain the rigor of their courses.

## Academically Rigorous Instruction

Research shows that ELLs enrolled in more advanced math and science coursework have greater access to academic language and rigor than students in ESL coursework (Callahan et al., 2010). This finding highlights the importance of enrollment in rigorous coursework alongside their NES peers for ELLs. However, ELLs often are placed into low-track, non college-preparatory mainstream classrooms (Callahan, 2005; Callahan et al.,2010), where the courses make fewer cognitive demands and inhibit their English acquisition (Bunch, 2013). Placement in low-track classes occurs for many reasons: students may receive poor or little advising from teachers and counselors, choose courses to be with peers, or not know the consequences of taking one class over another. As a result, ELL students often fail to acquire basic grade-level academic and linguistic competencies necessary to exit ESL programs (Callahan, 2005). Low-track classes simplify content (Callahan, 2005), limiting ELLs' exposure to the academic language necessary for success. Instead of offering students the opportunity to develop critical and independent thinking, low-track classes often subject ELLs to vocabulary drills (Lee, 2012), leaving ELLs even more unprepared to handle rigorous coursework. Conversely, ELLs who enter into high-track classes can become skilled at complex discourse (Harklau, 1994), which is typically seen in more academically rigorous coursework.

It requires greater linguistic proficiencies to use a language for academic purposes than it does to use it in everyday conversation (Gibbons, 2002). Research shows that a lack of English proficiency should not preclude ELLs' enrollment in high-level classes.

Gutierrez (2002) completed a multi-year study investigating the teaching of three high school mathematics teachers. Although only two years of mathematics were required for graduation, 40% of the senior class at Union High School enrolled in Calculus, which Gutierrez argues is due to teacher encouragement and a rigorous mathematics curriculum (Gutierrez, 2002). The math classes at Union High School consisted of ELL, bilingual, and NES students who worked side by side in groups of varying language abilities. Gutierrez (2002) reports that Union High School teachers rejected the view that ELLs were not capable of doing well in mathematics, and that the teachers beliefs and value of student identity were the main reasons for success.

Similar success for ELLs has been found in the Internationals Network for Public Schools in New York, which provide newcomer immigrant English students with rigorous academic instruction (Lee, 2012). Lee and colleagues (2012) found that ELLs at these schools have graduation success rates almost 40% higher than similar ELL populations citywide. Again, success in high academic engagement and achievement resulted from teachers' values of drawing on student cultures, native languages, and communities all while involving students in academic discussions. The reliance on student identity to promote academic success leads to an emphasis on culturally relevant pedagogy, and how this can affect the success of ELLs in mainstream classrooms.

## Culturally Relevant Pedagogy

In order to provide appropriate academic and linguistic supports for ELLs, mainstream teachers need to be cognizant of the cultural relevance in the contexts used within the classroom. Teachers need to consider whether the information they present is in a known or unknown language, and also whether the concepts are known or unknown (Garrison and Mora, 1999). If new mathematical concepts are introduced in an unfamiliar language, ELLs will struggle with two unknowns: the language, and the concept (Gutierrez, 2002; Secada et al, 1999). Gutierrez (2002) notes "if everyday language is known, teachers can build on that language to help make math concepts meaningful. If a given mathematics concept is known, teachers can help develop students' knowledge of language by using language in that context" (p.1053). With her study on three high school mathematics teachers, Gutierrez (2002) found that they did just that. Teachers at Union High School rarely used the textbook to introduce new information because the material was suited for typical native English speaking students at a particular developmental or grade level (Campbell et al., 2007; Gutierrez, 2002). Connecting the words with the numbers and symbols in the textbook is difficult for ELLs and teacher-created worksheets helped the teachers draw on the experiences of students (Gutierrez, 2002). After the mathematical content was mastered, the teachers would use the textbook to familiarize students with the academic language and representations of mathematics problems. The introduction of the textbook and academic language after mathematical comprehension is a way that teachers can scaffold learning in a mathematics classroom to be more comprehensible and effective for ELLs.

Teachers can also make assumptions about prior knowledge and life experiences that may be implicit in the language or the situations used to contextualize problems. References to pop culture and experiences assumed to be universal are embedded in grade level textbooks, worksheets, and teacher talk and often confuse ELL students (Campbell et al., 2007). When the teacher and students do not share the same language, previous experience or culturally based assumptions about what it means to teach and learn mathematics, the teacher's resulting mental model of student learning may have little to do with the student's actual understanding and construction of mathematical concepts and processes (Campbell et al., 2007; Coggins, 2014). This mismatch between teacher and student can cause problems when assessing student progress in a classroom where language and cultural relevance are indicators of success over mathematical abilities.

Campbell et al. (2007) describes a conversation with an ELL university student where the student failed to answer a question correctly on a mandatory pre-service teaching exam. The Pythagorean theorem was used to solve a problem and stated for students to "find the distance a catcher needed to throw a ball in order to throw out a runner at second." When asked about this missed question, the student commented that while she was familiar with the shape of a baseball field, she knew nothing about how the game was played. Thus, she didn't know where the catcher or second was located. After this information was supplied the student was able to solve the problem without any further assistance. While she knew the appropriate mathematical procedures to solve the problem, without the necessary background knowledge, she was not able to create a mental model or picture to help her understand the context. This lack of information caused the question to become one of cultural awareness over mathematics. In order to alleviate this situation, the context of problems given in mathematics classrooms should be altered to align with cultural norms of students. Students can be asked to create their own word problems to share with the class on mathematical concepts, and student identities can be incorporated and valued within the classroom setting.

## Student-Teacher Relationships

The value of student identity has also been shown to have significant effects on students' achievement. Lewis et al. (2012) argue that other factors besides English proficiency are responsible for Hispanic underachievement. They find that Hispanics fluent in English, as well as ELLs, are performing well below national norms on achievement tests, and conducted a study on addressing the importance of teacher ability to communicate caring. Lewis et al. (2012 define caring as "the ability to listen to, empathize with, and be moved by the plight or feelings of the other person" (p. 3). They found that teachers who foster meaningful or caring relationships help students adapt to school environments and demands. Specifically, perceptions of teacher caring had the greatest impact among ELLs whose overall math performance was the lowest. Gains in both self-reports of math-self efficacy and scores of standardized tests improve for ELLs who report feeling a sense of caring from their teachers (Lewis et al., 2012).

These meaningful relationships occur when the teacher recognizes the students as both a mathematical learner and as a sociocultural being (Gutierrez, 1999). With respect to mathematics, teachers connect with their students in review sessions, tutoring sessions, and conversations both in and on campus. In order to be more in tune with students social and cultural lives, teachers can find success by attending student's extracurricular activities, being present in other teacher's classrooms during lunch, and having conversations between teachers about specific students.

Meaningful relationships between students can also be fostered in the classroom when students' own identities are seen as valued. Gutierrez (2002) found that placing students in groups of varying language abilities had positive outcomes for Latina/os who were ELLs. At Union High School, teachers would pair a NES, bilingual, and ELL student together in groups, so as not to isolate Spanish speakers from monolingual English speakers (Gutierrez, 2002). While students were encouraged to present their final work in English, teachers allowed students to speak any language, and never asked students to use specific languages for other group members. Gutierrez (2002) found that groups spoke in both English and Spanish freely to work on problems. In this setting, both NESs and ELLs found value in speaking in their native language to work with other students in mathematics. While ELLs made academic and linguistic gains, monolingual English speakers also reported that they were learning some Spanish as a result of being in calculus class and hearing group members speak (Gutierrez, 2002). The practice of encouraging students to speak in languages in which they feel comfortable, and grouping students accordingly to support full class communication reflects the understanding of teachers in valuing students' identities as well mathematics education. Teacher willingness to understand students in ways that respect their identities can open the door to effective instructional practices and genuine relationships with students.

## Theory into Practice

New standards involving language and literacy demands are challenging for all students, but especially challenging for ELLs (Bunch, 2013), who need to focus on both academic content and English language development. Much academic English is learned through student collaboration and conversation about mathematical ideas, where students take time speaking in groups (Coggins, 2014). However, sometimes it is difficult for practicing teachers to come up with ways to incorporate the ideas that they know are successful. Bunch (2013) states "teachers are dissatisfied with professional development that does not connect *what* to teach with *how* to teach it" (p. 312). Thus, this section takes the ideas of language development and culturally relevant pedagogy, and incorporates them into two activities used in high-level rigorous mathematics classrooms.

These activities offer opportunities for the development of language and literacy in mathematics classrooms by incorporating more student participation and group work. These activities will help teachers to extend instruction beyond just listening skills, and further develop speaking, reading, and writing skills in academic English, exposing ELLs to rigorous mathematics language that supports content–area understanding. By incorporating structures like these into a mainstream content–area classroom, ELL students can develop the skills necessary to find both academic and linguistic success in U.S. high schools.

## Method 1: Promoting Speech through Problem Presentations & Group Work

The use of student presentations and group work provides an opportunity to hear how others problem solve. Gillies (2004) finds that students teaching each other is helpful, as it allows students to clarify their own understandings, and learn the material better than before. Students get a chance to internalize their own methods, and reinforcement for correct procedures occurs. Student presentations and group work can also debunk common mistakes, and can be used as a quick way for teachers to formatively assess class understanding. Listening to other students speak about their ideas and ask questions can provide the necessary scaffolding for a student to get "unstuck" and understand new content (Coggins, 2014). Having student presentations also provides the opportunity for ELLs to practice using academic English and descriptive first and second person vocabulary along with practice in problem solving and communicating to an audience in English.

Problem solving presentations require in the moment speech and evaluation, which can be difficult for ELLs, and can easily result in a show of English proficiency rather than mathematical knowledge. ELL students need more time than their NES peers to process, plan, and produce the speech necessary to present a problem to the class (Horwitz, 2013). Thus, the ways in which presentations should occur must be structured in a way that helps promote successful communication for ELLs.

***Structuring Student Presentations.*** Structures should be put in place so that ELLs can successfully solve problems aloud to either the full class or a smaller group of peers. Hummel (2014) suggests explicitly teaching formulaic sequences, incorporating new vocabulary or ready-made chunks commonly seen in presentations, which can serve as building blocks in second language (L2) development. These sequences lighten the attention and processing burden of utterances enabling faster and more fluid communication. Figure 2 shows a potential presentation structure including formulaic sequences used in problem solving.

| | | |
|---|---|---|
| Step 1 | State the question | "The problem I am solving is…" |
| Step 2 | State method used to solve the problem | "In this problem I decided to … " |
| Step 3 | List steps used to solve the problem | "First, you…"<br>"Second…."<br>"Then, …"<br>"Once that is done…" |
| Step 4 | Provide the Answer | "The solution is… " |
| Step 5 | Verify the solution | "To check that the solution is correct, you can…" |

**Figure 2. Formulaic sequences in math problem solving**

Providing a list of discussion starters for different mathematical steps to solve a problem in class is helpful to both NES and ELL students. NES students will have a guide for the structure of problem solving with verbal cues, and ELLs will have an additional reference for language associated with problem solving. ELLs can add other formulaic sequences they hear from student presenters and create a list of phrases representative of the common language they hear in class. Winsor (2007) finds that ELLs learn mathematics and a new language more effectively when they write to communicate what they are learning, they learn in groups, and the learning is set in context. Creating a transcript of what to say prior to discussion between peers offers ELLs an opportunity to practice mathematics along with language for academic purposes.

Many ELLs are less likely to volunteer to speak in front of the whole class (Horwitz, 2013), and tend to speak more freely in small groups (Secada et al., 1999). Participant structures such as pair-shares, round robins, and jigsaws are ways for teachers to promote the connections between oral language proficiency and mathematics comprehension in order to prepare all students for language use for academic purposes (Bunch, 2013). Grouping students strategically with both NES and ELL students alongside bilingual students can help to break down superficial barriers within classrooms (Gutierrez, 2002). These mixed groups can also assist ELL students when the context of problems may not be understood. Having a NES peer explain a concept in a different way can provide the culturally relevant knowledge needed to understand a question.

Utilizing group work in the classroom helps students understand and contextualize class problems and discussions more than traditional lectures or class discussions (Galguera, 2011). The same formulaic sequences for presentations from Figure 2 can be used in smaller groups to facilitate discussion. Small-group settings allow all students practice in both receptive and expressive English, and allow ELLs to have access to peer guides and interpreters as they work through assignments (Secada et al., 1999). Working with peers both in full class presentations along with smaller groups is helpful, yet the heterogeneous group of ELLs consists of many students who are not yet ready to speak publicly.

***Student Accountability.*** Many language researchers believe in a "silent period" and that ELLs will speak aloud when they are ready in class (Crawford, 2004; Krashen, 1985). If a grade is given when students present problems to the class or in smaller groups, students who are less comfortable with public speaking should also be allowed to present a problem to the teacher outside of class. Studies show that ELLs who suffer from anxiety express "freezing in class" or "going blank" (p. 128) as commonly occurring in situations when asked to speak (Horwitz, 1986). Thus, while student presentations have many benefits both mathematically and linguistically, special care needs to be taken with regards to language learners. Initial presentations for some ELLs can also be submitted as their written logs using the formulaic sequences from Figure 2, or with pictures to reference certain steps in problem solving.

***Assessment.*** Creating a rubric, such as the one in Figure 3, can be a guide for students when preparing to present. Explaining this rubric in class and having students understand both the mathematical and communication requirements will prepare students for success.

Modeling a presentation is helpful for students to understand how to use the formulaic sequences and requirements in the rubric. Students can even use the rubric to assess the teacher during their example presentation so that the requirements are clearer.

This rubric promotes the use of communication and mathematics within the classroom and does not provide a grade lower than 70% so that students receive credit for participating in communicating in class. The teacher can grade students during a full class presentation, or have students assess their own presentations themselves. This rubric can also be used in smaller groups as an evaluation tool.

| **Problem Solving & Mathematical Reasoning:** *How well does the presenter use mathematical tools, procedures, and representations to explore and solve the problem?* | | | |
|---|---|---|---|
| **Emerging 7** | **Developing 8** | **Proficient 9** | **Advanced 10** |
| Student selects an incorrect approach.<br>-OR-<br>Student cannot display solving or exploration of the problem.<br>-OR-<br>Student requires an overabundance of prompting to proceed to a correct solution. | Student selects a reasonable strategy but has difficulties obtaining a correct solution.<br>-OR-<br>Student incorrectly executes a valid approach to problem.<br>-OR-<br>Student reaches a partially correct solution but is unable to identify errors with respect to context. | Student selects one or more appropriate strategies to arrive at a correct solution.<br>-AND-<br>Student used valid mathematical tools to solve the problem.<br>-AND-<br>Student states the correct conclusions with respect to the mathematical context of the problem. | Student meets ALL standards in Proficient.<br>-AND-<br>Student is able to present without heavy reliance on notes.<br>-AND-<br>Student exceeds the solution requirements. |

| **Communication:** *How clearly and accurately does the student communicate the thinking used to consider/select approaches, solve problems, and make decisions?* | | | |
|---|---|---|---|
| **Emerging 7** | **Developing 8** | **Proficient 9** | **Advanced 10** |
| Student is unable to answer questions.<br>-OR-<br>Student is limited in mathematical vocabulary crucial to explanation. | Student is able to explain their approach on a basic level.<br>-OR-<br>Student has some gaps in logic/organization.<br>-OR-<br>Students can answer questions on a limited scale. | Student able to explain their approach with particular detail.<br>-AND-<br>Student logically sequences strategy used to solve.<br>-AND<br>Student able to answer most questions. | Student meets ALL standards in Proficient.<br>-AND-<br>Student maintains eye contact, pacing, and proper volume. |

**Figure 3. Rubric for grading student presentations**

### Method 2: Promoting Writing through Math Journaling

Typically, math notebooks are used for taking notes, organizing tests and papers, and keeping homework. Having a math notebook helps students stay organized, yet there is so much more that can be done with a notebook. Focused journal writing with a variety of purposes, such as writing narratives, recounts, or procedures, helps ELLs improve their writing skills (Brisk & Zisselsberger, 2011).

List the steps you follow to…
How would you explain how to solve … to a new student in class?
List 3 questions you have about processes or terms we have learned recently
Explain common mistakes students make when performing…
Create a story problem or situation for …
Describe the type of problems in this unit that are the easiest/hardest for you to solve. Why do you think they are so difficult?
Describe the type of problems in this unit that are the easiest for you to solve. Why do you think they are so easy?
Define each vocabulary term and give a mathematical example
Give 2 ways to solve…
How do you feel about your last assignment?

**Figure 4. Prompts for Math Journaling**

Incorporating specific tasks for students to complete within their journals will help to promote advancement in student writing, which has a direct effect on other modes of communication (Horwitz, 2013). Topics to assign for writing prompts can vary greatly depending on the activities in class. Some topics are suggested in Figure 4 as examples, but are in no way a comprehensive list of ideas for writing. Most of the writing assignment prompts in Figure 4 allow students to access their metacognitive thinking skills and evaluate what they do in math class (Coggins, 2014). Journal writing about mathematics helps students determine what they do and do not know and put that information on paper (Winsor, 2007). Once problems in comprehension are clarified, this type of activity can act as a springboard for NES and ELL students to begin asking questions in class.

Students' home language, literacy, and cultural practices should be used as a resource for both learning and language development (Bunch, 2013). Allowing students to write in English or their home language helps ELLs develop mathematical discourse and allows ELLs to get their message across (Coggins, 2014; Moschkovich, 2012). Additional research shows that expressing ideas in the language of greatest fluency can mitigate the difficulty of expressing mathematical ideas that may already be cemented in their mind in their home language (Secada et al., 1999; Winsor, 2007).

Writing instruction is also student centered and process-oriented (De Jong & Harper, 2005) and can help develop ELLs confidence as communicators. Many ELLs rehearse and think in their first language (L1) before writing or speaking in their second language (L2). Math journaling provides the opportunity for students to use their L1 as a tool to help organize their thinking and as a scaffold for more advanced communication in English (De Jong & Harper, 2005). Active language use via journaling, as opposed to passive exposure of two language systems, causes children to compare and contrast aspects of the languages, strengthening their cognitive, linguistic, and metalinguistic abilities (Reyes & Vallone, 2007). Many speakers of different varieties of English, such as African American or Appalachian English, would also benefit from an explicit focus on language development in content classes (Horwitz, 2013).

***Student Accountability***. Students who choose to write in the same language can be grouped as partners to share their writing. For many Latina/os "Spanish is a defining aspect of identity", and the use of Spanish is more about cultural bonds with peers than a need for communication (Gutierrez, 2002, p. 1048). Many ELLs are known to code-switch between their two languages in order to communicate subtle nuances of meaning (Martínez, 2010). Research has also shown that code switching is often used to promote an ELLs social identity and create ties with one's community (Zentella, 1997). Thus, allowing students to choose a partner for their journaling provides students with the option of maintaining cultural relationships with peers while working in a mathematics classroom.

Many prompts listed above in Figure 4 allow students to reflect on their own learning. By creating journaling partners, each partner can share their journal response with another person who can be both a witness to completion of the activities, as well as an audience for written work. Thus, student's personal identities can be incorporated within class by providing a way for them to bond with peers through mathematics.

***Assessment.*** Assessment of writing can be difficult and time consuming. Many times graders will give very different scores to the same piece of work because they were focusing on different aspects of the writing (Williams, 2005). In order to keep grades objective, journals should be graded holistically on completion of tasks. If grading for accurateness, a rubric should be used so that only specific items are evaluated (Williams, 2005). For example, it would be difficult for a monolingual teacher to grade the journal entries written in different languages for specific points, but quite easy to grade on completeness and use of mathematical vocabulary terms in English.

| Score | Rationale |
|---|---|
| 0 | No work |
| 1 | Cannot understand entry |
| 2 | Some understanding of entry; Perhaps off topic |
| 3 | Complete understanding of entry, on topic |

**Figure 5. Three-point Journal Rubric (Winsor, 2007)**

Winsor (2007) suggests that students evaluate peer writing on the 3-point scale like the one shown in Figure 5. In his action-based research, Winsor's (2007) students would exchange journals at the end of the week, and assign a score to the journal with a written rationale. Journal writers then had the opportunity to read and respond to the journal evaluation using the same rubric, providing each student two scores. He found that students put more effort into their journal entries because they were peer reviewed. Students would also discuss each other's evaluations when they did not agree on the scores. These discussions were always mathematical in nature because students were explaining their own reasoning to their peers (Winsor, 2007). This process allows students to think about their learning and understanding and write about it. It also allows students to read other student's work and evaluate it with a written rationale, sparking student conversation. The act of journaling in this way promotes reading, writing, speaking, and listening with in depth discussions of mathematics in a small group setting, which is a benefit to all students. It also allows for students to connect their own identities into the work of the classroom.

## Conclusion

In the present climate, where the number of ELLs in U.S. classrooms requiring academic and linguistic supports is growing, one can argue that all teachers of ELLs are language and content–area teachers. Mainstream content–area teachers need to be advocates for their ELL students by providing necessary supports to make success in academic achievement a reality. ELLs, like all students, have tremendous potential, but need linguistic and academic support from their schools and teachers. By having educators who foster positive student-teacher relationships, value student identities, support academically challenging and integrated classrooms, and provide linguistic supports, ELLs can find success in mathematics classrooms and have opportunities for advancement. This report aimed to identify and discuss strategies that would be helpful for providing academic and linguistic supports that are proven by research within content area classrooms. Mainstream teachers can use these strategies (shown in Figure 6) as a quick reference tool when evaluating their teaching and supporting ELLs in their classrooms.

| |
|---|
| ***Allow students to use any language.*** The use of home language has been found to promote ELL student understanding in content-area classrooms and foster greater academic success and development of English[1]. Students should be allowed to communicate both verbally and in writing in their language of choice. |
| ***Facilitate Group Work.*** Group work has been shown to provide both academic supports as well as support in student identity[2]. Groups should be non-homogenous in language abilities so ELLs work with peers who can help scaffold both their language and academic learning. |
| ***Implement activities that promote reading, writing, speaking, and listening.*** ELLs need practice in all four modes of communication in order to develop higher-level competencies in both academics and English[3]. Incorporating multi-modal activities like group presentations and journaling help to provide this support. |
| ***Promote student identity.*** ELLs in classrooms exhibiting culturally relevant teaching have higher gains in both academics and language development[4]. Asking students to create their own problems and rephrase questions in their own words both provide opportunities for students to exhibit their own cultural identities within the classroom. |
| ***Build meaningful relationships.*** ELLs who have established meaningful relationships with their teachers are found to do better academically[5]. Meaningful relationships can be fostered by showing interest in student activities inside and outside of class and valuing student opinions. These relationships should be fostered both between student and teacher along with peers. |
| ***Provide rigorous academic content.*** ELLs have been found to have the largest academic and linguistic gains in high-level academic coursework[6]. Thus, ELLs should be encouraged to enroll in these courses by faculty, and both academic and linguistic supports need to be provided in order for ELLs to be successful. |
| ***Evaluate linguistic challenges in speech and text.*** ELLs are in the process of acquiring both language and content, and mathematics learning can be impeded when linguistic challenges occur[7]. To alleviate this, make sure that text resources are culturally relevant to ELLs, and explanations are given with discussion, summary, pictures, or gestures when the context is unclear. Spoken language should also be clarified so that ELLs are not confused with semantic features in speech such as homonyms, homophones, colloquial sayings, synonyms, etc. Be sure to check for understanding before proceeding to new concepts. |

**Figure 6. Tips for Mathematics Instructors of ELLs**

([1] Bunch, 2013; Coggins, 2014; Moschkovich, 2012; Secada et al., 1999; Winsor, 2007; [2] Coggins, 2014; Galguera, 2011; Gillies, 2004; Gutierrez, 202; Secada et al., 1999; [3] Bunch, 2013; Winsor, 2007; [4] Lewis et al., 2012; Gutierrez, 2002; [5] Gutierrez, 1999, 2002; Secada et al., 1999; [6] Callahan, 2005; Callahan et al., 2010; Crawford, 2004; Gutierrez, 1999, 2002; Lee, 2012; [7] Bay-Williams et al., 2002; Campell et al., 2007; Coggins, 2014; De Jong & Harper, 2005; Echevarria, Vogt, & Short, 2008; Gutierrez, 2002; Harklau, 1994; Horwitz, 2013; Hummel, 2014; Khisty, 1995; Secada et al., 1999)

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