



Preservice Practices Framework for Math Education

Developed by the

Angelo State University MELL Initiative Team

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The Checklist of Guiding Principles

Introduction

The Checklist of Guiding Principles is an instrument that was developed specifically to improve teacher preparation for teaching mathematics to the English Language Learner (ELL) and other special needs populations. However, it could be used to evaluate specific experiences good for all teachers of all students, assist in shaping courses and field experiences to better prepare teachers, and provide employers with valuable information concerning actual teacher experiences.

- **Preservice Teachers:** A student preparing to be a teacher can use this instrument to ascertain their strengths and weaknesses and augment teacher preparation experiences.
- **Teacher Educators:** Those who prepare teachers can use this instrument to assist in shaping their courses and/or required experiences to equip preservice teachers with appropriate content and methodologies to provide high quality instruction.
- **Teacher Employers:** Those who employ teachers can use this instrument to evaluate strengths and weaknesses of the teacher applicant for appropriate placement.
- **In-service Teachers:** The checklist is currently being adapted to create an instrument that will assist in-service teachers in ascertaining their strengths and weaknesses in their classroom teaching and will assist administrators and service center personnel in determining what professional development is needed.

Items from the Checklist of Guiding Principles are based on the suggestions from research. The Written Review of Research and Annotated Bibliography of Scholarly Literature Pertaining to Teacher Preparation and Mathematics Instruction for English Language Learners can be found at the end of this document.



Suggestions from Research

A wide variety of teacher preparation pathways exist in the attempt to provide high quality mathematics instruction for a highly diverse student population. Although the paths vary, research suggests specific preparation experiences related to teaching and learning mathematics which all paths should include.

Review of research suggests the following are the best methods for reaching ELL students:

- Raise awareness of language used in the classroom.
- Encourage empathy for learning language.
- Use synonyms and avoid homonyms.
- Employ consistent math vocabulary.
- Avoid more than three phrases for basic operations.
- Speak slowly, enunciate clearly, and repeat often.
- Use short sentences.
- Employ active voice and present tense.
- Require journaling.
- Encourage student-to-student interaction.
- Provide explicit guidance in grammar and pronunciation.
- Use clear, legible handwriting.

Review of research suggests the following strategies:

- Emphasize problem solving in authentic contexts.
- Encourage development of critical thinking skills.
- Teach the language of mathematics (vocabulary and syntax).
- Create language supportive classrooms (i.e. journaling).
- Teach reading skills specifically for mathematics content.
- Connect mathematics to students' background and experiences.
- Vary instructional methods.
- Utilize an authentic and meaningful assessment plan.

Review of research suggests helping teachers of ELL students to:

- Develop cultural understanding.
- Develop a repertoire of methods and skills for adapting instruction to the needs of ELL students.
- Distinguish between language difficulties and learning problems.
- Utilize cooperative learning strategies to encourage interaction between ELL students and native English-speaking students.



Checklist of Guiding Principles: Preservice Preparation Components

Section A: This section is to be completed by preservice teachers only. Employers should have applicants complete this section. Teacher educators proceed to section B.

Content: Mathematics Courses				
Circle the number that best describes your familiarity with the content from these courses.	Proficient (good)	Familiar (uncomfortable) (comfortable)		No Experience (clueless)
Algebra				
Abstract Algebra	4	3	2	1
College Algebra	4	3	2	1
Linear Algebra	4	3	2	1
Pre-Calculus				
Trigonometry	4	3	2	1
Analytic Geometry	4	3	2	1
Calculus				
Calculus I	4	3	2	1
Calculus II	4	3	2	1
Calculus III	4	3	2	1
Advanced Calculus (Analysis)	4	3	2	1
Foundations of Mathematics				
Elementary Math I	4	3	2	1
Elementary Math II	4	3	2	1
Elementary Math III	4	3	2	1
Geometry				
Euclidean	4	3	2	1
Informal	4	3	2	1
Other				
Probability - Statistics	4	3	2	1
Problem Solving	4	3	2	1
Number Theory	4	3	2	1
Math Modeling	4	3	2	1
History of Mathematics	4	3	2	1



Section B: This section is to be completed by preservice teachers and math content teacher educators. Employers should have applicants complete this section. Education content teacher educators proceed to section C.

Instructional Methods and Field Experiences: Mathematics Content Courses

Check the box for each instructional method you have experienced in your mathematics courses.

Modeling

- hands-on manipulatives
- technology
- visual demonstrations
- kinesthetic activities
- real-life (authentic) problems -- connect math to student's background and experiences
- discovery learning
- observation

Communicating

- lecturing
- writing
- developing reading skills specifically for mathematical content
- building math vocabulary
- translating vocabulary to mathematical notation (syntax)

Teaching/Learning Techniques

- independent learning
- peer-to-peer
- small groups
- whole class

Assessment Techniques

- written
- portfolios
- journaling
- oral
- rubrics
- alternative assessments

Field Experience

- observing
- lesson planning
- teacher mentoring
- working with students
- teaching lessons



Section C: This section is to be completed by preservice teachers and education content teacher educators. Employers should have applicants complete this section. Math content teacher educators proceed to section D.

Instructional Methods and Field Experiences: Education Courses

Check the box for each instructional method you have experienced in your education courses.

Modeling

- hands-on manipulatives
- technology
- visual demonstrations
- kinesthetic activities
- real-life (authentic) problems -- connect content to student's background and experiences
- discovery learning
- observation

Communicating

- lecturing
- writing
- developing reading skills specifically for content
- building appropriate vocabulary
- translating vocabulary into conversational language

Teaching/Learning Techniques

- individual learning
- peer-to-peer
- small groups
- whole class

Assessment Techniques

- written
- portfolios
- oral
- rubrics
- alternative assessments

Field Experience

- observing
- lesson planning
- teacher mentoring
- working with students
- teaching lessons



Field Experience: Special Populations Courses (ELL, LEP, Bilingual, Special Ed, etc.)

- observing
- lesson planning - adjusting lessons for diverse populations
- teacher mentoring
- working with students
- teaching lessons

Preservice teachers should indicate their level of preparation.

Teacher educators should indicate the degree of preparation provided by their program.

Support Systems in Relation to ELL Students

- | | | |
|------------------------------------|---------------------------------------|-----------------------------------|
| classroom management | <input type="checkbox"/> ill-prepared | <input type="checkbox"/> prepared |
| discipline management | <input type="checkbox"/> ill-prepared | <input type="checkbox"/> prepared |
| parental involvement/communicating | <input type="checkbox"/> ill-prepared | <input type="checkbox"/> prepared |
| working with administrators | <input type="checkbox"/> ill-prepared | <input type="checkbox"/> prepared |
| grading procedures | <input type="checkbox"/> ill-prepared | <input type="checkbox"/> prepared |

Section D: This section is to be completed by preservice teachers and teacher educators. Employers should have applicants complete this section.

Special Populations' Modifications

Preservice teachers should indicate their level of preparation.

Teacher educators should indicate the degree of preparation provided by their program.

- | | | |
|---|---------------------------------------|-----------------------------------|
| diagnostics -- distinguishing language difficulties from learning problems | <input type="checkbox"/> ill-prepared | <input type="checkbox"/> prepared |
| assessment -- adapting assessments to eliminate language barriers | <input type="checkbox"/> ill-prepared | <input type="checkbox"/> prepared |
| lesson plan adaptations -- designing lessons to meet special needs and talents | <input type="checkbox"/> ill-prepared | <input type="checkbox"/> prepared |
| cultural understanding -- tackling cultural differences in the classroom | <input type="checkbox"/> ill-prepared | <input type="checkbox"/> prepared |
| student interactions -- facilitating interactions between ELL students and native English-speaking students | <input type="checkbox"/> ill-prepared | <input type="checkbox"/> prepared |



The Checklist of Guiding Principles Analysis

Preservice Teachers

A. Content: Mathematics Courses

- Describe how you feel about your math content preparation?
- Do you feel you need more instruction in math content? In what area(s)?
- Do you feel prepared to teach in your certification areas? Why or why not?
- List your concerns about your mathematics preparation?

B. Instructional Methods and Field Experiences: Mathematics Content Courses

Research suggests a wide variety of instructional methods and field experiences are beneficial in teaching mathematics to ELL students, special populations, and, in general, all students.

- Review your checklist and indicate your strengths and weaknesses in employing a variety of strategies.
- Prioritize additional training needed.
- What field experiences did you benefit from?
- What experiences would you like to have readily available to you?

C. Instructional Methods and Field Experiences: Education Courses

Research suggests a wide variety of instructional methods and field experiences are beneficial in teaching ELL students, special populations, and, in general, all students.

- Review your checklist and indicate your strengths and weaknesses in employing a variety of strategies.
- Prioritize additional training needed.
- What field experiences did you benefit from?
- What experiences would you like to have readily available to you?
- Prioritize additional support systems training needed in dealing with ELL students.

D. Special Populations Modifications

- Review your checklist and indicate your strengths and weaknesses in your ability to handle special populations modifications.
- Prioritize additional training needed.

E. Suggestions from Research (page 3)

Reaching ELL students can be enhanced by employing particular methods and strategies.

- Review the methods and strategies and be aware of the need to include these in your teaching.



Math Content Teacher Educators

- A. Content: Mathematics Courses (not applicable)
- B. Instructional Methods and Field Experiences: Mathematics Content Courses
Research suggests a wide variety of instructional methods and field experiences are beneficial in teaching mathematics to ELL students, special populations, and, in general, all students.
 - Review your checklist and indicate your strengths and weaknesses in employing a variety of strategies.
 - Prioritize additional training needed.
 - What field experiences do you provide?
 - What field experiences could you add?
- C. Instructional Methods and Field Experiences: Education Courses (not applicable)
- D. Special Populations Modifications
 - Review your checklist and indicate the strengths and weaknesses in how your program handles special populations modifications.
 - Prioritize additional instruction needed.
- E. Suggestions from Research (page 3)
Reaching ELL students can be enhanced by employing particular methods and strategies. Review the methods and strategies and identify the ones that you are currently using and the ones that need to be emphasized.

Education Content Teacher Educators

- A. Content: Mathematics Courses (not applicable)
- B. Instructional Methods and Field Experiences: Mathematics Content Courses (not applicable)
- C. Instructional Methods and Field Experiences: Education Courses
Research suggests a wide variety of instructional methods and field experiences are beneficial in teaching mathematics to ELL students, special populations, and, in general, all students.
 - Review your checklist and indicate your strengths and weaknesses in employing a variety of strategies.
 - Prioritize additional training needed.
 - What field experiences do you provide?
 - What field experiences could you add?
 - Review your checklist and indicate the strengths and weaknesses in how your program addresses support systems in relation to ELL students.
- D. Special Populations Modifications
 - Review your checklist and indicate the strengths and weaknesses in how your program handles special populations modifications.
 - Prioritize additional instruction needed.



E. Suggestions from Research (page 3)

Reaching ELL students can be enhanced by employing particular methods and strategies. Review the methods and strategies and identify the ones that you are currently using and the ones that need to be emphasized.

Teacher Employers

Review the teacher applicants' checklist and analysis to determine possible placement and need for future in-service training.



**Written Review of Research and Annotated Bibliography of Scholarly Literature
Pertaining to Teacher Preparation and Mathematics Instruction for
English Language Learners**

By Jennifer McEwan

**Prepared for Angelo State University in conjunction with the
Texas State University System Mathematics for
English Language Learners Project
(TSUS MELL)**

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Jennifer McEwan has a Bachelor of Arts in Political Science with a minor in English from Texas A&M University. As a result of teaching 4 years in public schools, she was awarded the James Madison Fellowship for outstanding secondary education teachers by the Federal Government to pursue her masters degree. She completed her Masters of Arts in Political Science from Texas State University. She is pursuing a Ph.D. in Government at the University of Texas in Austin. She has also taught at Blinn Community College and has been a research assistant for Lieutenant Governor Rick Perry.

Jennifer's mission was to collect and summarize information pertaining to teacher preparation and mathematics instruction for English Language Learners. Some of her professional opinions are included in the Literature Overview and Summary of Debates in Teacher Preparation and Classroom Pedagogy in Mathematics Instruction for English Language Learners and the Annotated Bibliography. The collection of literature and other articles are on file at Angelo State University.



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Literature Overview and Summary of Debates in Teacher Preparation and Classroom Pedagogy in Mathematics Instruction for English Language Learners

The existing scholarly literature pertaining to teacher preparation in mathematics instruction for English language learners is sparse at best. In fact, the only relevant literature in this specific inquiry is a 1999 report by the National Council of Bilingual Education titled “Preparing Secondary Education Teachers to Work with English Language Learners: Mathematics.” In this work, the best practices for mathematics classroom instruction for ELL learners identified the following strategies: emphasize problem solving in authentic contexts, encourage development of critical thinking skills, teach the language of mathematics (vocabulary and syntax), create language supportive classrooms i.e. journaling, reading, connect mathematics to students’ background and experiences, vary instructional methods, and utilize an authentic and meaningful assessment plan. Most insightful in this list are teaching the language of mathematics and creating a language supportive classroom, for the rest seem to be a reiteration of general best practices. In the preparation of teachers to work with ELL students, the report suggests helping preservice teachers to: develop cultural understanding, develop a repertoire of methods and skills for adapting instruction to the needs of ELL students, distinguish between language difficulties and learning problems, and utilize cooperative learning strategies to encourage interaction between ELL’s and native English speaking students. No strategies for the implementation of such suggestions are given, rendering the practical application of such suggestions lacking for a teacher preparation program seeking advice.

Inadvertently, this work touches on a more central debate in the existing body of literature pertaining to general classroom pedagogy for ELL students. Is the best way to reach such students through “just good teaching?” Do “Best Practices” for the classroom apply to all students or do ELL students have special needs that are not supported by general Best Practices? The literature is mixed, divided into the “Just Good Teaching”¹ camp headed by Jarrett, which asserts that the use of good content teaching methods will serve all students in the classroom, and the counter-camp headed by De Jong, which asserts that mainstream teachers of ELL students must focus on *language* instruction as much as content instruction. In addition to content Best Practices, therefore, De Jong advocates the training of mainstream teachers in the process of learning a second language, in the role of language and culture as a medium in teaching and learning, and in helping ELL students to set explicit linguistic oriented within the particular content of the classroom.

This debate assumes that ELL students are and ought to be in the mainstream English-speaking classroom. However, there is no consensus within the literature that this is the appropriate means of ELL instruction. A larger debate in the literature centers on this question: Should ELL students be taught in their native language when possible to help them acquire

¹ Phrase used by Jarrett, Densie, “Teaching Mathematics and Science to English-Language Learners: It’s Just Good Teaching.” Northwest Regional Educational Laboratory, November 1999.



content-specific skills (bilingual v. ESL education models)? Again, several camps represent a range of views including the “California model”² that advocates instruction in native languages as English-only instruction represents a cultural and linguistic supremacy bias, the less extreme Guzman model which advocates bilingualism as it has positive effects on cognitive functioning but recognizes the importance of English education, particularly in mathematics instruction, to the Secada et al. model that advocates instruction in English with some materials rewritten in Spanish, to the Jarrett who again advocates the “just good teaching” method. No empirical evidence is provided to suggest the superiority of one method over another; thus, we are left with an array of normative preferences. However in Texas, pragmatism requires that not all educators be bilingual and therefore it seems we must focus on ELL students within mainstream English-only instruction.

What therefore are the best pedagogical methods for reaching ELL students in mainstream classrooms? The following suggestions represent a synthesis of the literature:

- 1) Have an overall awareness of language within the classroom. In other words, recognize the language you employ in the classroom. Use synonyms and avoid homonyms in instruction.
- 2) Use appropriate vocabulary, including in mathematics classroom teaching and using the vocabulary of math (syntax, structure, etc.) Be consistent in how this vocabulary is used, i.e., have three ways for asking students to perform subtracting but no more than three.
- 3) When possible, in the mathematics classroom phrase problems in short sentences with active voice and in present tense. Complicated vocabulary takes time away from problem solving for ELLs.
- 4) Implement language activities such as journaling that reinforce language education.
- 5) Speak slowly and clearly, allowing time for all to process questioning before soliciting responses from students.
- 6) Encourage student to student interaction to improve communication skills.
- 7) Develop a sense of understanding and empathy for learning a second language.

Unfortunately, empirical evidence is weak in demonstrating which methods provide the most “bang for the buck” in reaching ELL students, suggesting the need for further research in this area.

² Endorsed in work put forth by the California Council on the Education of Teachers, the California Association of Colleges of Teacher Education, the State of California Association of Teacher Educators, and the Independent California Colleges and Universities Council on the Education of Teachers. “Success for English language learners: teacher preparation policies and practices.” *Teacher Education Quarterly* v28 no1 199-208 Winter 2001.



Annotated Bibliography

I. Best practices of teacher preparation in the area of mathematics for English language learners

Anstrom, Kris, "Preparing Secondary Language Teachers to Work with English Language Learners: Mathematics." Center for the Study of Language and Education, Graduate School of Education and Human Development, The George Washington University, December 1999.

While the name of this report suggests a good fit for this project, its substance is a bit lacking. Best practices for mathematics classroom instruction for ELLs identified by the study are: emphasize problem solving in authentic contexts, encourage development of critical thinking skills, teach the language of mathematics (vocabulary and syntax), create language supportive classrooms i.e. journaling, reading, connect mathematics to students' background and experiences, vary instructional methods, and utilize an authentic and meaningful assessment plan. Most insightful in this list are teaching the language of mathematics and creating a language supportive classroom, for the rest seem to be a reiteration of general best practices. In the preparation of teachers to work with ELL students the report suggests helping preservice teachers to: develop cultural understanding, develop a repertoire of methods and skills for adapting instruction to the needs of ELL students, distinguish between language difficulties and learning problems, and utilize cooperative learning strategies to encourage interaction between ELLs and native English speaking students. No strategies for the implementation of such suggestions are given.

II. Best Practices of teacher preparation for all content areas for English language learners.

Costa, J., et. al., "Faculty First: The Challenge of Infusing the Teacher Education Curriculum with Scholarship on English Language Learners." *Journal of Teacher Education* v. 56 no2 104-18 March/April 2005.

This article describes the first year results from The Faculty Institute on ELLs, a project funded by the U.S. Department of Education. The purpose of the institute is, "to change the teacher education curriculum to better prepare teachers for work with linguistically and culturally different (LCD) students." After attending the institute, faculty participants reported incorporating the following revisions in syllabi in their respective teacher preparation programs: the inclusion of culturally diverse guest speakers, readings that incorporate diversity issues, oral lessons in foreign languages to promote empathy, sections on problematic vocabulary, and the incorporation of the Sheltered Instruction Observation Protocol (SIOP) model (Echevarra, Vogt, & Short 2000), a model with the purpose of helping teachers adapt their instruction to better



serve ELLs through the use of sheltered instruction (instruction in English as well as the native language of the student).

De Jong, E.J., et. al., “Preparing Mainstream Teachers for English-Language Learners: Is Being a Good Teacher Good Enough?” *Teacher Education Quarterly* v32 no2 101-24 Spring 2005.

This paper offers a well formulated conceptual model for preparing mainstream teachers for ELL students. Rather than focus on “just good teaching” strategies for all students, the authors suggest that mainstream teachers must develop the knowledge, skills, and dispositions that reflect an awareness of three dimensions: the process of learning a second language, the role of language and culture as a medium in teaching and learning, and the need to set explicit linguistic and cultural goals. Moreover, “What distinguishes a classroom that explicitly addresses the needs of ELLs from the just good teaching” classroom is that “English is very much present and accounted for... teachers extend practices of good teaching to incorporate techniques that teach language as well as content” (Diaz-Rico & Weed, 2002, p. 117). Examples of such techniques include providing a variety of question forms appropriate to ELLs' proficiency levels (e.g., requiring non-verbal, one-word, or extended responses), while keeping the cognitive demand challenging, using more explicit scaffolding techniques, and developing an understanding of what is developmentally “normal” for bilingual students so teachers will not confuse language barriers with learning disabilities.

Note: this article is responding to The Inclusive Classroom’s “It’s Just Good Teaching Model” by Jarrett.

Dong, Y.R. “Preparing Secondary Subject Area Teachers to Teach Linguistically and Culturally Diverse Students.” *The Clearing House* v77 no5 202-6 May/June 2004.

This paper summarizes the research in second language education as identifying four major areas of teacher preparation: “building empathy toward second language learners' language difficulties and cultural differences, increasing understanding of the process of second language acquisition, adapting the curriculum and instruction to these students' cultural and language needs, and integrating discipline specific language and literacy skills into area of instruction (Genesee 1993; Meyer 2000; Mora 2000; Teemant et al. 1996).” In reporting anecdotal evidence for a teacher preparation class, the author advocates the following strategies to reach the above mentioned areas: providing language sensitivity exercises, setting up language objectives along with content curricular objectives, anticipating ESL-related difficulties, and providing cultural background information.



Lenski, Susan, Crumpler, Thomas, Staliworth, Corsandra, and Kathleen Crawford,
“Preparing Culturally Responsive Preservice Teachers.” *Teacher Education Quarterly* 32
no2 85-100 Spring 2005.

This report focuses on findings from the Beyond Awareness Research Project, a project designed to develop more effective ways to prepare preservice and inservice teachers to tackle cultural differences in the classroom. The methodology of the project required preservice teachers in an urban professional development school to observe interactions at predetermined locations in the

community and describe their observations without focusing on the race or ethnicity of those being observed. By practicing this ethnographically informed approach, preservice teachers began to understand perspectives different from their own. The authors argue that from this interaction teachers can move beyond just cultural awareness to effectively reach all students in their classrooms. Findings from the study based on participant responses revealed initial reluctance to the assignment, but that the observational skills learned through ethnography were valuable in relating to students from different cultures.

Pewewardy, Cornel, “Shared Journaling: A Methodology for Engaging White Preservice Students into Multicultural Education Discourse.” *Teacher Education Quarterly* 32 no1 41-60 Winter 2005.

In attempt to increase awareness of personal biases in preservice teachers, the author advocates the utilization of shared journaling, a practice in which a student participates in a written exchange of ideas with another classmate. The author argues that such an exchange will help students think reflexively about their own experiences and backgrounds and how they may influence their teaching.

“Success for English language learners: teacher preparation policies and practices.”
Teacher Education Quarterly v28 no1 199-208 Winter 2001.

This work is a position paper representing the views of the California Council on the Education of Teachers, the California Association of Colleges of Teacher Education, the State of California Association of Teacher Educators, and the Independent California Colleges and Universities Council on the Education of Teachers. The purpose of this paper is to establish the position of the three organizations on educational policy and regulations affecting English language learners and to recommend a course of action relative to teaching English language learners. This course of action and subsequent committee recommendations are based on the California Standards for the Teaching Profession (CSTP) and the premise that these standards will guide future policies relating to the training of teachers and the teaching of California's students.



Tellez, K, "Preparing Teachers for Latino Children and Youth: Policies and Practice."
The High School Journal v88 no2 43-54 December 2004/January 2005.

This paper explores three avenues of improving the preparation of teachers to work with Latino students: preservice teachers' acquisition of cultural knowledge, preservice teachers' knowledge of second language teaching, and the value of targeted recruitment. In order to better address the needs of Latino students, this paper advocates that teacher educators implement curricular reforms that assist preservice teachers in understanding Latino culture, in particular immigrant culture, aid in the understanding of linguistics in a way that directly affects their work with Latino students, and recognize the limits and narrowness of targeted recruitment.

III. Research-based best practice pedagogy in existing mathematics classrooms with English language learner students.

Abedi, Jamal, "Examining the Effectiveness of Accommodation on Math Performance of English Language Learners." Paper Presented at the Annual Meeting of the National Council on Measurement in Education (Montreal, Quebec, Canada, April 19-23, 1999).

This study examines the use of various accommodations on ELL students in mathematics. Four accommodation strategies were used: modified (simplified) English of the test items, glossary, original English with extra time, and glossary with extra time. Generally, ELLs performed better on the modified versions with the glossary combined with extra time having the greatest effect and glossary only having the least amount of effect. Drawing my own conclusions from this study, it may be that ELLs understand words individually, but require more time in processing words together to understand what tasks they are to perform.

Basurto, Imelda, "Conditions of Reading Comprehension which Facilitate Word Problems for Second Language Learners." *Reading Improvement* 36 no 3 143-8 Fall 1999.

This paper reports on strategies used by three elementary math teachers to help ELLs better understand mathematical word problems and problem solving skills. Rather than focus solely on computational skills, these teachers focused on ELLs experiencing a situation with role playing or story telling. Through these strategies, these teachers were better able to communicate with ELLs as opposed to relying only on written instruction.



Bielenberg, Brian, “The English They Need for the Test.” *Educational Leadership* 62 no 4 45-9 December 2004/January 2005.

This paper does a good job explaining what difficulties ELLs encounter when faced with mathematical word problems. The author deconstructs word problems and shows how what appears to be straight forward to native English speakers, can be very difficult for ELLs. The author examined techniques used by Project Challenge teachers in Boston, Massachusetts to aid ELL students in math instruction. Using strategies such as revoicing and restating, Project Challenge teachers were able to raise language awareness in the math classroom and ultimately raise state standardized test scores of ELL participants.

Bresser, Rusty, “Helping English-Language Learners Develop Computational Fluency.” *Teaching Children Mathematics*, February 2003 v9 i6 p. 294.

This article focuses on communication as an instructional feature to promote English fluency in the math classroom. The author asserts that teachers must make sure language in the classroom does not result in inequity for ELLs. For example, the word “left” in “how many are left” has several meanings in common English and may confuse ELLs. Teachers should be aware of their math vocabulary at all times. From experience as a classroom teacher, the author offers 10 strategies for ELLs in the mathematics classroom: ask questions and use prompts, practice wait time to allow ELLs time to process the question, modify teacher talk (slow and articulate), recast mathematical ideas and terms, pose problems with familiar contexts, connect symbols with words, reduce stress in the classroom, use “Think Pair Shares,” use English experts, encourage students to “retell” their strategies.

Carrasquillo, Angela and Vivian Rodriguez, “Integrating Language and Mathematics Learning,” Chapter 9 in Language Minority Students in the Mainstream Classroom. 2nd Edition. Bilingual Education and Bilingualism 33, 2002.

This chapter begins by raising awareness of the language of mathematics including its unique vocabulary, syntax, and semantics that may present difficulty for ELL. Strategies used to mitigate these difficulties for ELLs include group work, open discussions, presentations, the utilization of culturally relevant problems, hands on activities with manipulatives, the use of essay prompts to relate personal experiences that have a mathematical component.

Cuevas, Gilberto, “Mathematics Learning in English as a Second Language.” *Journal for Research in Mathematics Education*, vol 15, no 2, Minorities in Mathematics (March, 1984), 134-144.

This article (a bit outdated) presents a theoretical model, Secondary Language Approach to Mathematics Skills (SLAMS), for instructing ELL students in mathematics. Combining the notional/functional syllabus developed in Europe in which language skills necessary to perform



objectives are incorporated into the lesson (i.e. an emphasis on specific language skills rather than general communicative ability) and Cummins's idea of cognitive academic language proficiency, the author presents an esoteric approach without empirical or anecdotal evidence. Perhaps well suited for academic journals, this article does not transcend well to classroom practices.

Gutierrez, Rochelle, "Beyond Essentialism: The Complexity of Language in Teaching Mathematics to Latina/o Students." *American Educational Research Journal* 39 no 4 1047-88 Winter 2002.

This paper argues that ELL strategies may also prove to be useful on English dominant Latina/o students. Based on anecdotal evidence of three high school teachers in one high school math department, the study endorsed the following strategies for English-dominant Latina/o math students: group work, allowing students to work in their primary language, building on prior knowledge, and using supplemental texts including primary language (Spanish) texts to place students in a natural mathematics context rather than word for word translations that sometimes mislead students. No empirical evidence is provided as to student performance when such strategies are implemented.

Guzman, Joseph M, "Learning English: Strange as it may seem, new evidence shows it's better to know two languages but be taught math in English." *Education Next*, Fall 2002 v2 i3 p 58.

This paper examines the competing pedagogies of Bilingual v ESL instruction as approaches to language programming for LEP students. The main findings of the paper corroborate linguistic research that bilingualism has a positive effect on cognitive functioning across disciplines. Students in bilingual programs tended to fare better according to data reported by The High School and Beyond survey while students exposed to both methodologies fared the worst, possibly due to confusion stemming from exposure to very different pedagogies. Regarding mathematics, time on task differences between LEP and non-LEP students had the most effect on test scores since non-LEP students had more time to do the required computations because of their language ability.

Jarrett, Densie, "Teaching Mathematics and Science to English-Language Learners: It's Just Good Teaching." Northwest Regional Educational Laboratory, November 1999.

This handbook advocates "just good teaching" practices to reach ELLs in the mathematics classroom. Strategies include: thematic instruction in the context of students' everyday lives, cooperative learning, inquiry and problem solving activities, vocabulary development, and classroom discourse that employs controlled vocabulary, simple language structures, and few idiomatic expression. In addition, teachers ought to speak slowly, enunciate, and repeat main



points to aid in the language comprehension of ELL students. Moreover, the author advocates family involvement and collaboration with other teachers. This work has been criticized by De Jong for not addressing the “special needs” of ELL students. Rather, Jarrett argues that “good teaching” on the part of mainstream teachers will serve the needs of all students.

Secada, Walter and Deborah Carey, “Teaching Mathematics with Understanding to Limited English Proficiency Students.” Urban Diversity Series No. 101, ERIC Clearinghouse on Urban Education, Institute of Urban and Minority Education, October 1990.

After summarizing current problems with ELLs in the math classroom, this paper offers the following ten recommendations:

- Select content for LEP students based on mathematically relevant criteria
- Do not water down content for LEP students in mathematics courses
- Use mathematical language that students understand or can relate to
- Allow students to create meaningful problem solving situations from their own background
- Combine as many objectives as possible into single activities that meet both mathematics and linguistic instructional goals
- Determine whether the primary purpose of a lesson is for math or language competence
- Avoid superficial attention to mathematical language i.e. refrain from emphasizing key words as they may change meaning in word problems
- Be aware of district changes in mathematics curriculum
- Encourage LEP students to try to understand what they are doing and why they are doing it
- Encourage students to persevere in mathematics courses

This work also advocated the use of Active Mathematics Teaching (Good and Grouws, 1979) for reaching ELL students. In conclusion, this report’s claims seem to be in line with good teaching practices that are appropriate for all students, and it is unclear how such recommendations specifically fit with the special needs of ELLs.

Secada, Walter and Yolanda Cruz, “Teaching Mathematics for Understanding to Bilingual Students.” National Center for Research in Mathematical Sciences Education

This paper advocates a “teach for understanding” approach to mathematics (as opposed to teaching for non-understanding?). This particular method suggests allowing children to participate in class discussions and in doing so give reasons for their answers to vocalize their thought processes. In addition, “teaching for understanding” includes activities that connect to one another and also connect to student’s prior experiences. For ELL students, the ideal situation according to the authors is to hire bilingual teachers who can support mathematical understanding in either language. They also suggest that English-only speaking teachers have some materials rewritten in Spanish and that teachers phrase English word problems with short



sentences in active voice and present tense. The insight of this article is minimal at best for it seems the author's solution to the challenges of ELL students is to just teach them in Spanish.

IV. Additional Resources - Research-based best practice pedagogy in general education existing classrooms with English language learner students.

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