



Mathematics and Latino/a, ELL Students: Some Findings from CEMELA

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What is CEMELA?

- Center for the Mathematics Education of Latinos/as (<http://cemela.math.arizona.edu>) is NSF-funded Center for Learning and Teaching (CLT).
- CEMELA aims to understand the interplay of mathematics education and the unique language, social, cultural, and political issues that affect Latino communities.

CEMELA PARTNERS

The University of Arizona –

Tucson Unified School District & Sunnyside Unified School District

University of California, Santa Cruz –

Pajaro Valley Unified School District & North Monterey County Unified School District

University of Illinois at Chicago –

Chicago Public Schools

The University of New Mexico –

Albuquerque Public Schools, Bernalillo Public Schools,
& Socorro Consolidated Schools

The Three Goals of CLTs

- Renew and diversify cadre of national leaders in Mathematics Education (Doctoral / Post-Doctoral)
→ 28 graduate students; 12 post-docs.
- Research → student learning; teacher education; parents.
- Outreach: teacher education and parents → courses and institutes, study groups, lesson study, workshops /mini-courses for parents.

What does CEMELA's work look like in Tucson?

CEMELA's outreach has involved:

- 76 Teachers from SUSD and TUSD schools:

SUSD: Drexel, Elvira, Ocotillo, Summit View, Apollo, Challenger, Chaparral, and Sierra

TUSD: Cavett, Howell, Lawrence, Manzo, Menlo Park, Mission View, Ochoa, Pueblo Gardens, Steele, Carson, Hohokam, Mansfeld, Pistor, Roskruge, Safford, and Wakefield

Local Outreach (cont.)

- 206 Students from these schools:

SUSD: Drexel, Apollo, and Chaparral

TUSD: Menlo Park, Ochoa, Pueblo Gardens,
Safford, and Wakefield

- 86 Parents from these schools:

SUSD: Ocotillo and Apollo

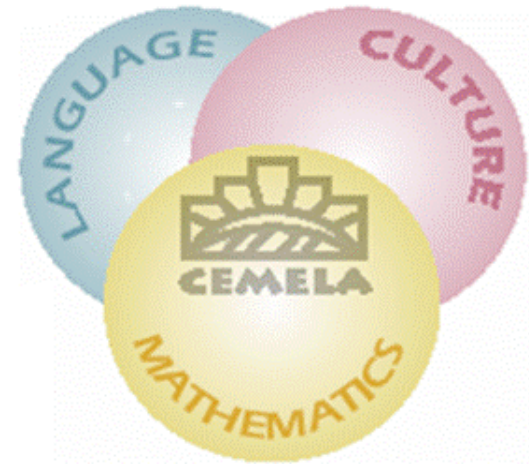
TUSD: Ochoa and Safford

In 2008-09 we have

- An After School Math Club (ASMC) at Drexel
- Follow-up to the ASMC from last year at Safford
- Math for Parents courses at Apollo and Safford
- A Teacher Study Group – Drexel & Apollo
- UA Mathematics Courses for SUSD and TUSD teachers (and other districts)
- Lesson Study at Myers / Ganoung school

RESEARCH

CEMELA conducts research in three areas: student learning; community and parents; teaching and teacher education.



Sample Research Questions

How do language, discourse practices, and everyday mathematics mediate mathematical reasoning, understanding, and learning for Latino/a learners?

What is the nature of Latino parents' perceptions of the teaching and learning of mathematics?

What are the issues of language and culture with which teachers grapple while engaged in reflecting on Latino children's thinking about mathematics?

Teacher Education

José María Menéndez Gómez

Teachers' reflections on their practices

What practices are more typical and important in their instruction and that seem to be more effective to promote Latino students' mathematical understanding?

1. Using appropriate mathematical vocabulary
2. Creating learning situations that foster peer interaction
3. Supporting students to become active thinkers and independent decision makers
4. Providing varied materials and resources to solve problems
5. Supporting student learning through the review of concepts, the validation of their responses and strategies, and using students' native language when needed

Using appropriate mathematical vocabulary

“I am thinking about the language. As I’m saying things I’m trying to think of the correct language, and to make sure I’m using the mathematical terms. . . . So I go slow because I’m always trying to think of how to say it correctly and using the vocabulary, so that they in turn will use it also.”

Using appropriate mathematical vocabulary and need for using students' native language

“A lot of the kids in here would need Spanish and it would help them. And because you just can't give it to them all in English because then it would hinder their learning. This way you explain both in English and Spanish and 'I can do that, I understand what she is talking about now.'”

Creating learning situations that encourage students to interact and learn from each other

“If the environment is set up correctly, the children will learn just as much or more from each other than they will from your instruction, ... in something like this, I remember there were a couple of places where kids were doing as well or better a job than I would be doing explaining to another child how they got the answer.”

Promoting learning situations that would support students to be active thinkers

“I want them to be able to think on their own. I’ve always told them, when you are solving a problem try and, I try and teach them different ways, different strategies to solve something. And I want them to be able to reason and think: ‘Okay here I have a problem, what can I do to figure this out?’”

Reflection of factors that influence practice

The most influential factor on what teachers teach, what they do in the classroom, and what they consider relevant for students learning are:

1. The adopted reform curriculum
2. Their knowledge of students in terms of dispositions for learning
3. Their previous personal and professional experiences as learners and teachers of mathematics
4. Their expectations or what they value for students to learn and understand
5. Professional development experiences

Working with Parents

Marta Civil

Through courses for parents, interviews, focus groups, classroom visits and debriefings, we have learned a lot from parents.

First, our experience is that parents enjoy the opportunity to come learn mathematics for themselves as well as to help their children:

- Personally it also fills me with excitement to come again...simply when you say “I’m going to school,” you get that feeling of excitement to remember [father]
- It is about being and learning together, and when your son or daughter sees that you learn, they get motivated. It motivates them to know that their parents get involved and interested in their children’s education [mother].

- There are many parents that want to get to know each other, interact ... more than anything, this has showed us to mingle with teachers and parents. [father]

→ We encourage activities such as the math for parents courses or workshops in which parents and teachers “mingle” to do and talk about mathematics together.

Now we turn to some key findings and implications from our research with parents

Latino parents' perceptions of the teaching and learning of mathematics

Our focus here is mostly on Mexican immigrant parents' views on the teaching and learning of mathematics.

- Parental involvement takes on very different forms, some of which may not be along the lines of what schools “expect.”
- Parents in our studies are very interested in their children's education and comment on different ways they engage in their education (through advice, informal interactions, everyday uses of mathematics).

- Parents are quite open about the differences they notice between how they were taught and how their children are being taught, as well as between education in México and in the U.S.
- These differences encompass:
 - Level (“higher there than here”)
 - Approaches (“they are not required to memorize the multiplication facts here”)
 - Resources (“here they give them everything”)
 - Concept of caring (“teachers / schools care more about students here”)



There are many things...

- Parents are appreciative of the resources (“they give them everything at school”) (though in some cases, they question issue of responsibility)
- Parents are appreciative of the attention their children are given:
 - Magdalena identifies with quote: “I like how they are taught here in the United States. It seems that teachers give children more personal attention.”

And she says,

My son has speech problems, he has auditory problems, and in Mexico they would always say he was dumb. And in Mexico they would offend him a lot. In Mexico, I fought a lot for my son, I would pay for special teachers, I would pay for therapists, I would pay for psychologists, I would pay for everything. But they never helped me at school. [After his first day of school here in the U.S.] he told me, “Mom I never want to leave this country. I never want to leave.” And it was such personal attention that they gave him, they gave him, they gave him what he needed, that attention that in Mexico I wasn’t able to get for him, they gave it to him here. And up until now I can say that my son is not dumb because he gets straight A’s on his report card and that my son is a very intelligent boy even though he has speech problems.

What parents want: a conversation with parents of middle school students

Marcos: Give them homework so that they bring it home, so that we can see what kinds of mathematics they are doing; because there are many children who don't bring any; my daughter doesn't bring any, they don't give her any

Iliana: Mine neither, I always ask her

Mila: Besides giving them homework, they need to demand more [from the children], because what I see, with my daughter and school here and school in Mexico, they should demand more, because for her it's very easy here and then she just kind of glosses over... and in addition to more demanding, the school should be stricter with them... they are too lax.

[Tertulia, 2/20/08]

- Parents underscore the importance of academics: they want more homework, they want their children to learn “the basics,” they express some concern about calculators. Parents, like everybody else, bring their values and beliefs to the conversation.
- What our findings show is a need for more communication between parents and teachers → even with the parents we work with, misinformation is present.

Why should we care?

- Ultimately, children are caught in the middle:
Last night my son said to me that school from Mexico was not valued the same as school here, that is, it doesn't count. What I studied there doesn't count here He knows that what is taught here is different from what is taught there and so he says, 'why would I ask my Mom for help if she's not going to know.' So, there is a barrier.

Student Learning

Liana Dawson

Student Learning Research Group

The Student Learning Research group has performed a series of task-based interviews with 3rd and 6th graders.

- Tasks were modified from the 4th and 8th grade level National Assessment of Educational Progress (NAEP) items
- Some items were written in English with Spanish translations
- Student work was collected and interviews were video taped and transcribed.

Student Learning Findings

Although we are in the preliminary stage of analysis, we have noticed several interesting trends:

1. Challenges with language appear at different levels
2. Word problem relevancy affects students' strategies
3. Some prompts seemed to be helpful
4. Students bring their own context to the problem

Language Challenges

Challenges with the language within problems can occur on many different levels

- Terms that have both mathematical definitions and standard definitions can be confusing

Problem: Write an expression to show the product of r and t

Interviewer: “When we talk about a product, what does that usually mean?”

Student: “Like in the world?...Or in a math problem?”

- Having Spanish translations may assist ELLs with understanding word problems
- The word “expression” consistently appeared as one that the students did not fully understand

Word Problem Relevancy

It often helps students when word problems are relevant to their lives

- However, arbitrary “real-world” context may not be helpful for students

Interviewer: “Now at looking at those [problems] that have that connection to outside of school, do those make doing those types of problems easier?” ...

Student: “Kinda. Because...some of them I’ve went through. But some I have to wait, like, until adulthood.”

Effective Prompts

Effective prompts in helping students solve word problems include:

- Replacing variables with numbers.
- Asking students to reread each sentence in the problem slowly.

Interviewer: “And what do you think about this problem?”

Student: “It was hard to understand the first time, but the second one, that I read it slow...I understand it.”

- Asking the students to explain in their own words what they think the problem is asking.
- However the students we interviewed did not attempt these problem solving strategies without being prompted

Contextualizing Problems

Students use their own life experiences to their approaches to mathematical problem solving.

This can occur in several forms

- Applying context to problems when none is provided

Problem: Write an expression to show the product of r and t

Student: “I want to say r was radiation, but it’s not”

- Replacing given context with one more relevant to their lives

Monthly Pay Task Example

If m represents the total number of months that Jill worked and p represents Jill's average monthly pay, which of the following expressions represents Jill's total pay for the months she worked?

- A) $m + p$
- B) $m \div p$
- C) $m \times p$
- D) $p \div m$
- E) $m - p$

Handwritten notes and calculations:

5 (written above the word "average" in the question)

$= 1000$ (written above the word "expressions" in the question)

1000

$\times \quad 5$

5000

Monthly Pay Task Example



Monthly Pay Task Example

- In this case, the student used her own life experiences in her approaches to mathematical problem solving.
 - E.g., using hours in monthly pay problem.
- These approaches may lead to incorrect responses, however, do not necessarily reflect the students' *mathematical content* knowledge.
- Has brought forth cultural and linguistic assumptions in world problems.

Some Implications for Practice

- Need to be aware of possible word confusion, especially with terms that have multiple meanings (mathematics and everyday life; English and Spanish).
- Need to teach students effective problem solving strategies so that they become part of their repertoire.
- Need to understand how students may or may not relate to word problems and how they may bring their own contextualization to these problems.

Bilingual After School Math Club

Tal Sutton

Semester one: focus on cryptography

Directions: This cryptogram is a phrase or sentence where each letter used in the original text has been substituted with another (for example, G could become A, F could become P, etc.). The substitution of letters does NOT follow a pattern. Every time a letter appears, it always stands for the same letter. Make sure your answer fits the story.

Ms. Cripto, a seventh grade teacher was trying to encode something that she comes across everyday in school, but did not have time to encode the last half of the alphabet. So the letters N through Z are the actual letters; and only the first half of the alphabet, A through M, stand for different letters. What everyday thing did she try to encode?

T̄ J̄ C̄ P̄ B̄ C̄ Ī Ā C̄ Ō K̄ H̄ B̄ B̄ C̄ Ā M̄ H̄ N̄ F̄ C̄

Semester two: focus on using math to investigate issues in school and community

Survey: School safety

This survey is anonymous (we won't know who you are). You have the choice to write your name.

Please Read the question carefully.

What grade are you in? _____

Are you a boy or a girl? Circle one.

1. Who would you go to with a problem?

Administrators (principal, counselors, vice principal)

Teachers

Monitors

None of the above

5. How often are you the victim of physically bullying (fighting, pushing, shoving, aggression)?

Often (everyday)

Once in a while (every 2-3 weeks)

Not at all

6. How often do you physically bully someone else (fighting, pushing, shoving, aggression)

Often (everyday)

Once in a while (every 2-3 weeks)

Not at all

7. On a scale of 1-10, how safe do you feel at school? (1-not safe, 10-very safe)

Purpose of the math club

(from a research perspective)

- Create an informal learning environment which minimizes possible pressures and maximizes students' opportunities to work on challenging, non-traditional tasks
- Explore the nature of Latino/a students' beliefs and perceptions of themselves as doers of mathematics, learners of mathematics, and agents of (social) change

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(from a research perspective)

- Willingness to Struggle
- Mathematical Identity and Agency
- If a student solved a problem in 5 seconds, it wasn't a problem- it was practice.

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(from a research perspective)

- Willingness to Struggle
- Mathematical Identity and Agency
- If a student solved a problem in 5 seconds, it wasn't a problem- it was practice.
- To what extent do students' willingness to struggle with challenging tasks change over time? What factors support students' willingness to struggle?

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- Mathematical identity is the student's perception of themselves as learners and doers of mathematics.

Purpose of the math club

(from a research perspective)

- Willingness to Struggle
- **Mathematical Identity and Agency**
- Mathematical identity is the student's perception of themselves as learners and doers of mathematics.
- What is the nature of students' mathematical identity, their mathematical learning, and sense of socio-political agency?

Directed Perseverance

- **Circle versus Helix**
- The solution path of a student exhibiting DP would look like a helix, moving along different strategies and revisiting old strategies- all the while headed towards a solution.

Directed Perseverance

- **Circle versus Helix**
- The solution path of a student exhibiting DP would look like a helix, moving along different strategies and revisiting old strategies- all the while headed towards a solution.

Students spiraling upwards towards a solution will take notes to prevent them from reinventing the wheel.

Students stuck in a cycle will focus on superficial aspects of the strategy (e.g. meticulously crafting a table)

Risk Taking

- Hedging risks
- Students develop methods of introducing ideas in such a manner that they can divorce themselves from the idea, in case it is wrong.

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-“Well, I wasn’t here last time...”

-Introduce ideas by “talking to the air”

(Possible) Classroom Implications I

- Students often employ multiple strategies when working on complex mathematical tasks
- Differentiating between a “circular” approach versus a “helix” approach is difficult
- Building a culture of note taking and record keeping may induce more “helix” like approaches to these tasks.

(Possible) Classroom Implications II

- Students will hedge their ideas when taking risks in situations where they can be wrong.
- Taking risks can help get students started on non-traditional, non-procedural, challenging tasks.

Beliefs about being good at math

- Good behavior
- Speed
- Effort
- External Evaluation

Interviewer: How would you describe yourself as a math student?

...

Student: I'll just do it. I won't smart-mouth or anything, just go- like just don't...

Beliefs about being good at math

- Good behavior
- **Speed**
- Effort
- External
Evaluation

Student: “Okay...Person who can look at a problem, get it right in a matter of five seconds is really really smart. The person who can look at it and get it, in an hour, needs a lot of help. The person who's gonna get it done in like, in between those times is mostly average.”

Contradiction about being “good at math”

- Students tied good behavior, speed, or memorization to being “good at math”
- Despite identifying themselves as being problem solvers, and describing how they used problem solving strategies to solve “hard” tasks, only a few students tied being “good at math” to the capacity to solve hard problems.

Beliefs about being good at math

- Good behavior
- Speed
- **Effort**
- External Evaluation
- Success in math is not static.

Students see themselves as having the capacity to be good at math (i.e., get a better grade). Improving in math is linked to effort/practice and “getting it”.

Beliefs about being good at math

- Good behavior
- Speed
- Effort
- External Evaluation
- Many of these students still felt that they could “get it” even though they “get marked wrong”.
- Students often indicate that tests, grades, etc. are what evaluate math ability, but often feel it is arbitrary.

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“When I do it right, I know I did it right, and yet I cannot find the answer and then I'll get really mad. And then I'll get a F on that assignment.”

Beliefs about Importance of Math

- Vague notion of importance

-There is a general sense that math is important for access to school and jobs, vague/general understanding that certain jobs use math, not a lot of specific ideas about how that job involves math.

-Students seem to have a more specific sense of how math is important when talking about consumer finance issues or the mathematics used by their parents in their jobs.

(Possible) Classroom Implications III

- Students can have an idea that being good at math is related to speed, good behavior, or memorization
- It may help to impress upon students counter-examples to these notions about being good at math
 - For example: It took Andrew Wiles over seven years to prove ONE theorem (he did get knighted for it, but that's another story)

(Possible) Classroom Implications IV

- Students can perceive evaluation systems as arbitrary, so developing such a system which students place value in can be very important
- Having conversations with the students that will help them “look behind the curtain” and remove the mystery of their grades may teach the students how they can improve their performance.

(Possible) Classroom Implications V

- Students have a vague notion of why math is important.
- This could be made more explicit through examples, or building on their out-of-school experiences with mathematics.