The Invisible 10%
Preparing Teachers to Teach Mathematics to Students with Special Needs

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Overview of Session

1. What is the history behind the 10%?
2. What are the challenges for teachers of mathematics and for mathematics teacher educators?
3. How can mathematics teacher educators help teacher candidates to assess and teach effectively within a multi-tiered system of support?
4. What are the next action steps for mathematics teacher educators?
Why is this an equity issue?

When I was on the NCTM Board, there were people who, if you asked them, would define themselves as equity sensitive yet would question the extent to which the general membership of NCTM would embrace and value the focus on working with teachers to better teach special education students mathematics.

Overlapping Equity Issues

• Certain populations of students have been historically marginalized in mathematics
• Traditionally, many minority students and ELLs are over represented in the population of students with special needs
Challenge All Students

• Look to the work of critical theorists who suggest we create situations where teachers work in dialogue with students and where these students – while being taught – also teach

• Intellectual activity of those without power is frequently thought about as non-intellectual

Special Education by the Law

- **1975 - Public Law 94-142** – mandated free public education for students with disabilities
- **1997 - Public Law 105-17 (IDEA)** – mandated inclusion in state and district assessment programs
- **2004 – Reauthorization of IDEA** – mandated a change in how children with specific learning disabilities are identified – must show interventions attempted – suggested an RtI model as an option for identifying students
RtI or Multi-Tiered Systems of Support (MTSS)

Primary Prevention:
High quality engaging core instruction - UNIVERSAL

Secondary Prevention:
Supplementary strategies for students who do not respond to core instruction - TARGETED

Tertiary Prevention:
Specialized & individualized strategies for students who do not respond to Tier 2 supplementary support - INTENSIVE

~80% of Students

~15%

~5%
Components of a Strong RtI Model

- Uses a collaborative approach with general education and special education
- Includes research based teaching practices
- Instructs with a preventative approach
- Builds from students’ strengths
- Uses diagnostic assessment to align intervention

Are we doing any better? Let’s look at 4th grade NAEP scores

Figure 2. Trend in fourth-grade NAEP mathematics percentile scores

* Significantly different (p < .05) from 2011.
What about 8th grade NAEP scores?
What about RtI? Why isn’t it Helping?

- A recent study revealed that teachers providing Tier 2 mathematics instruction to elementary-aged students largely used worksheets (Swanson, Solis, Ciullo & McKenna, 2012)
- In my travels many others use a one-size-fits-all generic computer program.
Mathematics Performance on 2011

4th grade:
At or Above Proficient: 40% of all students and 17% of students with disabilities
Below Basic: 18% of all students and 45% of students with disabilities

8th grade:
- At or Above Proficient: 35% of all students and 9% of students with disabilities
- Below Basic: 27% of all students and 64% of students with disabilities

National Center for Education Statistics, 2011
What are some of the Issues in Teaching Mathematics to Students with Disabilities?

• What the problem isn’t: difficulty reading, paying attention, or following directions

• What the problem is: **Underdeveloped cognitive structures** which are the mental processes necessary to connect new information with prior knowledge.

What is Needed?

Explicitly develop prospective teacher competence (in both general education and special education) in developing children’s mathematical thinking about the big ideas in mathematics.
What goes in the Overlap in this Venn Diagram?

Special Education Teachers

Teachers of Mathematics

PreK-12 Students
Mathematics Pedagogy
Multi-tiered Systems of Support
Mathematics Content Knowledge
Two Worlds to One

• How do we develop a common vision?
• How do we bring together two worlds to create classrooms that support all students’ learning?
“When I was an undergraduate, I took two courses (special education methods and elementary education methods)... We were shown the same video in both courses, but to illustrate opposite points.”

Where do We Go to Learn More?

- Inattention to Teaching Mathematics to Students with Disabilities
  - Where can we find studies of interventions that work for students with disabilities?
  - Where can we find professional development that shares insights on how to teach mathematics to students with disabilities?
Extant Research

• Forty years ago the ratio of research on supporting students with reading disabilities to supporting students with mathematics disabilities studies was 100:1 (401 reading studies to 4 math studies)

• Collective education research from 1996-2005 – 14:1 (622 reading disability studies to 43 mathematics disability studies)

• When we add studies of in medical-related journals 18:1 (1736 reading to 95 math)

Where’s the research?

Research – Reading vs. Math

Gersten, Clarke, & Mazzocco (2007)
What Research is Out There?

Mathematics Components Addressed in Studies Completed with Students With Moderate/Severe Disabilities

<table>
<thead>
<tr>
<th>Numbers and Operations</th>
<th>Measurement</th>
<th>Algebra</th>
<th>Geometry</th>
<th>Data Analysis</th>
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<td>Match, 9</td>
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<tr>
<td>Calculate, 12</td>
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Touch Math
Where Can I get Professional Development?

Are annual conferences an option for learning more?
NCTM and CEC?

• Annual NCTM conference sessions on Special Ed:
  – 15 out of 753 sessions in 2010 (1.9%)
  – 7 out of 768 sessions in 2011 (0.9%)
  – 25 out of 704 sessions in 2012 (3.5%)
  – 26 out of 724 sessions in 2013 (3.6%)

• Annual CEC conference sessions on Math:
  – 64 out of 956 sessions in 2011 (6.7%)
  – 42 out of 868 sessions in 2012 (4.8%) (12% reading)
  – 81 out of 889 sessions in 2013 (9.0%)
TED and AMTE?

• Annual TED (Teacher Education Division of CEC) conferences:
  – 3 out of 150 sessions in 2009 (2.0%)
  – 6 out of 348 sessions in 2010 (1.7%)
  – 13 out of 401 sessions in 2011 (3.2%)
  – 34 out of 319 sessions in 2012 (10.7%) (developed a specific math strand)

• Annual AMTE conference sessions:
  – 0 out of 146 sessions in 2008 (0.0%)
  – 2 out of 141 sessions in 2009 (1.4%)
  – 2 out of 158 sessions in 2010 (1.2%)
  – 1 out of 149 sessions in 2011 (0.1%)
  – 3 out of 146 sessions in 2012 (2.1%)
  – 5 out of 196 sessions in 2013 (2.5%)
The Case for the Engagement of MTEs

- The message and vision of how to teach mathematics at special education conferences can be different from our message and vision.
- Students with disabilities spend approximately 80% of their time in the general education classroom.
- Therefore, it is the general education teacher - the teacher candidates in our classes – who need this information – and it is our responsibility to provide it in coursework AND related field experiences.
• Premise: Mathematics education and special education faculty should deliver university courses and professional development together.

• Response: Teaching a methods course for teacher candidates preparing to teach special education students.
Overview

- What makes such collaboration work well?
- Are there any factors that make collaboration between a special educator and general educator particularly difficult?
Teaching Mathematics to Students with Disabilities

- 51 hour course of which 15 hours were field work in an urban community center with K-8 children
- Children assigned to teacher candidates and “walk ins” were always welcome
- Commitment to building positive mathematics experiences for students and their families
# Recommendation

1. Universal screening (Tier 1)
2. Focus instruction on whole number for grades k-5 and rational number for grades 4-8
3. Systematic instruction
4. Solving word problems
5. Visual representations
6. Building fluency with basic arithmetic facts
7. Progress monitoring
8. Use of motivational strategies
Intervention Recommendations from Research

– Visual representations – including a Concrete--Semi-concrete--Abstract (CSA) approach
– Explicit instruction
– Underlying mathematical structures
– Examples (and counterexamples)
– Progress Monitoring - collecting students’ feedback to the teacher on what they know and don’t know
Selected Course Components

• Diagnostic Interviews
• Try Out Activities from the textbook – (ones that include adaptations for students with disabilities – or they must create their own adaptations)
• Family Math Event
IES Recommendation

Monitor the progress of students receiving supplemental instruction and other students who are at risk.

– Level of evidence: Moderate (for Tier 1)
Assessment Assumptions

• If assessments only measure skills, it is difficult to determine all that a student knows.
• If you cannot determine what a student knows, it’s difficult to plan an instructional sequence.

Dougherty, 2012 Access for All – Using Response to Intervention Techniques, NCTM Algebraic Thinking Institute
IES Recommendation

Instruction during the intervention should be **systematic and explicit**. This includes providing models of proficient problem-solving, verbalization of thought processes, guided practice, corrective feedback, and frequent cumulative review.

— Level of Evidence: **Strong**
Diagnostic Interviews

• Collects **in-depth** information about an individual student’s knowledge and mental strategies (strengths)

• Provides evidence of **students’ prior knowledge, naïve understandings and ways of thinking**

• Focuses on a task/problem where students are asked to verbalize their thinking and/or demonstrate ideas through **multiple representations**

• **Is not a teaching opportunity**

• Uses errors to **identify barriers to understanding** and to inform instructional decisions

IEES Recommendation

Intervention materials should include opportunities for the student to work with visual representations of mathematical ideas, and interventionists should be proficient in the use of visual representations of mathematical ideas.

- Level of evidence: Moderate
Follow Up to the Course

Observations using the RTOP (Reform Teaching Observation Protocol)

Small-group model teaching

For more on the RTOP instrument see Sawada, Piburn, Falconer, Turley, Benford and Bloom (2000)
Lessons Learned

• **Students with disabilities** – responsibility for their learning

• **Preservice teachers** – growth in their ability to focus on conceptual understanding

• **Our own work** – growth in our ability to work together to support teachers
Outcomes: Students with Disabilities

- Give students with disabilities choices and capitalize on their unique strengths
- Nurture traits of resilience – rather than learned helplessness
- Demonstrate an ethic of caring
- Make mathematics irresistible
- Give students with disabilities some leadership in their own learning – let them teach others

# Shifts in Teacher Candidates’ Thinking During the Class

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<tr>
<th>From</th>
<th>To</th>
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<tbody>
<tr>
<td>How to present a topic in a given way</td>
<td>How to use multiple representations</td>
</tr>
<tr>
<td>Talking about math anxiety</td>
<td>Sharing a passion for mathematics</td>
</tr>
<tr>
<td>Teaching procedures and basic facts by memorization</td>
<td>Teaching concepts and strategies working to know them by memory</td>
</tr>
<tr>
<td>Demonstrating with teacher use of manipulatives and having students copy</td>
<td>Embedding manipulatives in students’ problem solving</td>
</tr>
<tr>
<td>Leading students to use one way to get an answer</td>
<td>Allowing multiple strategies to get an answer</td>
</tr>
<tr>
<td>Asking factual questions as tasks are broken into small parts</td>
<td>Asking higher-order questions (reversibility, flexibility, generalization)</td>
</tr>
<tr>
<td>Focusing on how quickly a student can get an answer</td>
<td>Allowing time to respond</td>
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Outcome: The Essential Skills We Found We Needed as Collaborators

• Actively work on communication and negotiation skills (be an active listener)
• Encourage sharing of ideas
• Withhold judgment – be open minded
• Make sure language is understood
• Respect the other’s perspective and content expertise
• Find common ground
• Expect that 50/50 will not often be the right proportion so agree on all responsibilities in advance
• Find and create win-win situations
Challenges we Identified

• Co-teaching not rewarded at the university
• Different philosophies
• Distinctive Language (math content, special education terms)
• Time commitment
• Team teaching vs. Turn teaching
• Sharing control – sharing the bond with students
Task Analysis? Maybe Not?

• When the materials break skills down into small pieces, it requires students to put the pieces together to form the whole.
Insights for Mathematics Teacher Educators

Preservice teachers more readily embrace equity and social justice perspectives when these ideas are presented consistently across their courses.

Leaving this work solely to special education faculty will never match our working together as a team.

Think about it as a Marriage....

IN THE MARRIAGE OF GENERAL AND SPECIAL EDUCATION, BOTH PARTIES AGREE TO LEAVE THEIR BAGGAGE AT THE DOOR.
Recent NCTM – CEC Partnership

Beginning Substantive Collaboration between Mathematics Education and Special Education: Teaching Mathematics to Students with Disabilities

Project goals:
• To build a core community of researchers interested in research and professional development related to RtI
• To promote rigorous research on this topic, involving innovative concepts from mathematics education and cognitive psychology
• To promote dissemination of research to relevant practitioners
• To create professional development resources

Project was supported by funding from NSF and NCTM
Call to Action: Teacher Education Programs

Evaluate our teacher education programs:

– How much mathematics content knowledge and mathematics pedagogical content knowledge are special education teachers getting?
– How are assessments and strategies for working with special education students infused in our general education methods courses (including field experiences)?
– How might special education and general education programs include explicit work on co-teaching strategies?
Call to Action: Doctoral Programs

Evaluate doctoral programs:

– Do our doctoral candidates preparing to be mathematics teacher educators know about multi-tiered support systems and do they know about their role in helping teacher candidates operate successfully within that framework?

– Do doctoral candidates have a background in working with students with disabilities? If not, how can field work and experiences be built into their programs of study?
What are some of the interventions you present in your courses that your students test and find successful in their field placements?

What are some progress monitoring measures you are using and find successful?

How can you contribute to the research base and the PD opportunities for others?
A Concluding Thought

We expect that the very best doctors will treat the most grievously ill patients. It should be no different in education. Great teachers have the skills to help the students who struggle the most. (Larson, 2011)

Thank you

Contact Information:

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Resources

• Center on Instruction (COI) [http://www.centeroninstruction.org](http://www.centeroninstruction.org) On this site go to the RtI link on the left side under Hot Topics which will take you to 4 pages of resources.


