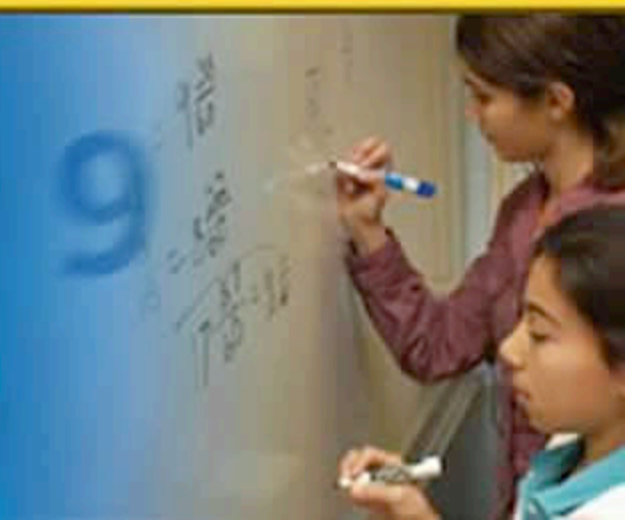
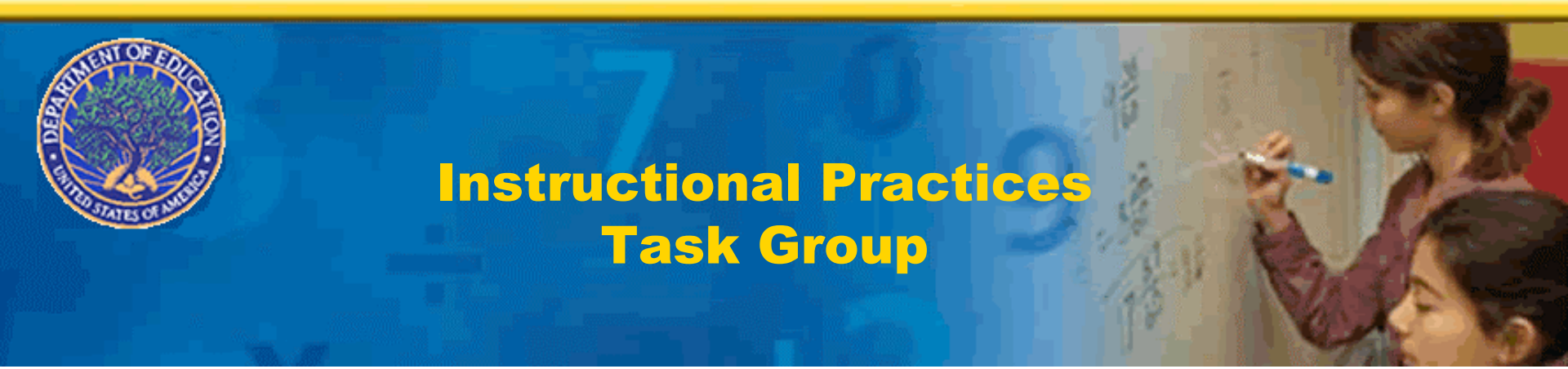
National Mathematics Advisory Panel

Instructional Practices Task Group

St. Louis Meeting
Progress Report
September 7, 2007

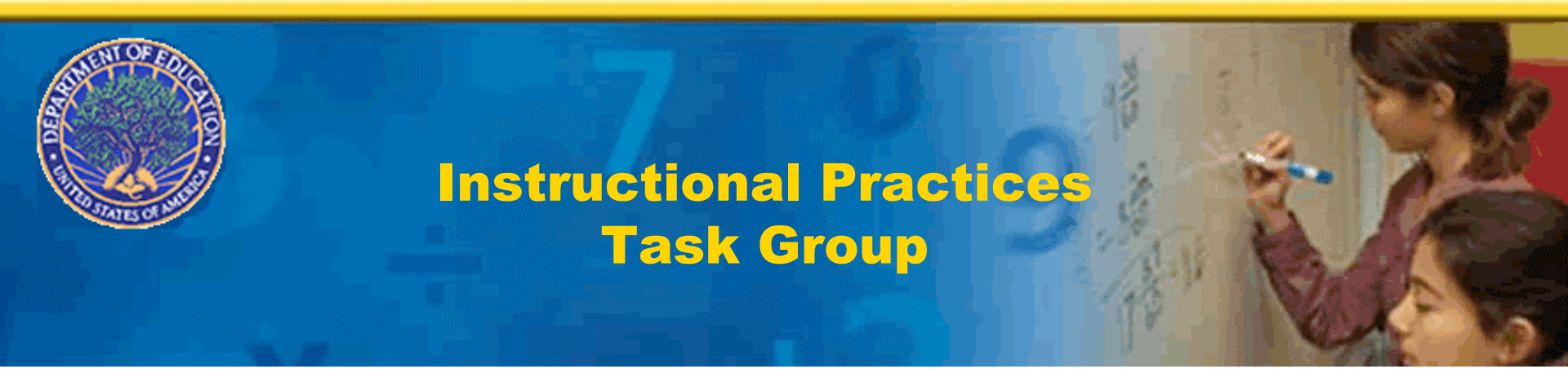




Instructional Practices Task Group

Members

- –Russell Gersten, Chair
- –Camilla Benbow
- –Douglas Clements
- –Bert Fristedt
- –Tom Loveless
- –Vern Williams
- –Joan Ferrini-Mundy, Ex Officio
- –Irma Arispe, Ex Officio
- –Marian Banfield, Staff



Instructional Practices Task Group

Methodological Approach: Meta-analysis

1. Used standards of What Works Clearinghouse (with two modifications)
2. Report focus: findings or patterns of findings from high quality RCTs or Quasi-experiments that are significant
3. Patterns of findings from methodologically troubled studies included (in one report) (provided the problems vary from study to study)
    - Ex: National Reading Panel: but more rigorous

Why these topics?

1. Wish to explore widely advocated practices to see if there is evidential basis:
   - Real world problems, guided inquiry, direct instruction, enrichment programs for gifted

2. Chose some topics because we knew there would be literature

Formative Assessment

1. Consistent replication of positive benefits for students in 12 studies.
2. Effect size .204 and approaches significance, p=.054 at the student level, g is .3 at class level.
3. Effect size doubled if enhancements added:

   ---Include using information to determine focus of tutoring, providing ideas from expert teachers, peer tutoring.

Formative: Limits

1. All studies but one done at elementary level
2. Enhancement studies typically done with special education students
3. Only one type of formative assessment used: proportional sampling from state standards, includes both concepts/problem solving and computational measures

Teacher-Directed vs. Student-Centered

1. Small number of studies that pit the two against each other.
2. No data to support student-centered instruction OR direct instruction OR any other instructional regime for average or high ability students.
3. Only clear finding: structured work in cooperative groups is productive in terms yielding positive effects on students' computation performance.

Using Special Strategies to Improve "Real-world" Problem Solving Questions:

1. Does the use of strategies to help students learn to solve "real-world" problems (e.g. situated cognition/anchored instruction) lead to improved mathematics proficiency?

2. Are there instructional strategies that really help students learn to transfer the mathematics they know to solving "real-world" problems, i.e. strategies for transfer?

Note: "real world problem" is defined differently by different researchers. Typically, these are complex word problems.

Findings From 5 High Quality Studies on the Impact of Use of Real World Problems As Part of Instruction

- Pooled g = .221 ($p<.05$) for all measures of mathematics proficiency, many of which include complex word problems.
- But Pooled ES on "typical" school math outcome measures (e.g. mathematics achievement tests or problem solving tests) not significant.
- This seems a promising practice although we are not sure of the overall impact on student mathematics performance.

Gifted

- Consistent finding: no known negative impact to acceleration in terms of long term interest and engagement in mathematics. No data available on long term social outcomes.
- Effects on mathematics achievement small and non significant.
- Paucity of research on impact of enrichment.
- Combining enrichment and acceleration may be promising.

Low Achieving Students

1. An ill defined group
2. Not a large number of studies that meet the criteria (more in the school wide reform research)
3. Categorized as Explicit Instruction or Other
4. Explicit instruction remains a construct to unpack

Explicit Instruction: Low Achieving

- ✓ 5 studies
- ✓ Pooled effect size of .97, which is significant
- ✓ Most studies focused on word problems
- ✓ Interventions ranged from direct instruction (scripted/unison response, Engelmann/Carnine model) to approaches which allowed for probing and encouraged student verbalization
- ✓ Careful sequencing of examples was key

Other Strategies: Low Achieving

Intensive Tier 2 intervention for at risk first graders:

- use of concrete-representational-abstract (CRA) in small group instruction (*g=.414 concepts, .441 for calculation, both significant)*

This is a promising practice in that N of 1 study.

There are other cases in our area.

Learning Disabilities

- More studies but similar findings
- Emerging trends
- More recent studies incorporate some findings from cognitive psychology and occasionally mix direct instruction with a more interactive follow-up phase
- Expeditious move from concrete to visual

Technology

1. Only rigorous studies on calculators from 1970s and 1980s
   - No evidence of harmful effects of technology use and some facilative effects on word problems.

2. Meta-analyses of technology use over the past 30 years show significant positive efffects for computer based instruction but depends on software and goals.

Cross cutting

1. In many cases, interventions are multifaceted (e.g. TAI involves formative assessment, both explicit instruction from teacher and cooperative learning, incentive structure).
2. Equally true in other topics.
3. Nature of control condition is often ill defined.
4. There are some practices that appear promising but we don't have confidence yet either due to statistical significant or paucity of studies.

Final Lap

- Three robust findings:
  1. Formative assessment enhances mathematics achievement (of only one type).
  2. Explicit instruction for lower third or so of students (in many instances, though construct remains ill defined).
  3. Real world problem solving on array of mathematics tasks-- not typical achievement but not on standard achievement measures.