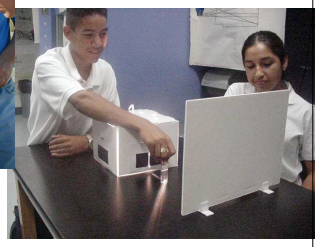
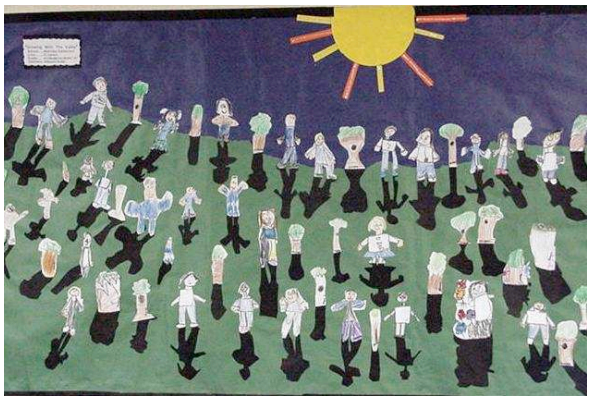
Effective Classroom Practices – English Learner Development Strategies in Science

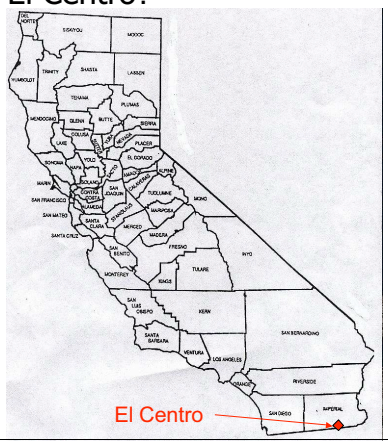


CREATE Conference
Oakbrook, IL
October 2, 2007

A Field Trip to El Centro, California



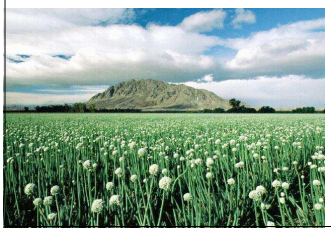
Where is El Centro?



Our Community and Students

In Imperial County

- **Mean income $16,322**
- **Poorest of all 58 counties in California**
- **30% unemployment rate**
- **22,500 students in 14 Districts**



In El Centro

- **13,200 K-12 students**
- **9 elementary, 2 middle, 2 high school**
- **All Title I, School-wide Project Schools**
- **77% Free/Reduced Lunch**
- **61% English Language Learners**
- **10% Migrant**
- **81% Hispanic, 12% Caucasian, 4% African-American, 3% Asian**

Valle Imperial Project in Science

In partnership with

CALTECH

SDSU IMPERIAL VALLEY CAMPUS

CSP Imperial Valley Science Project

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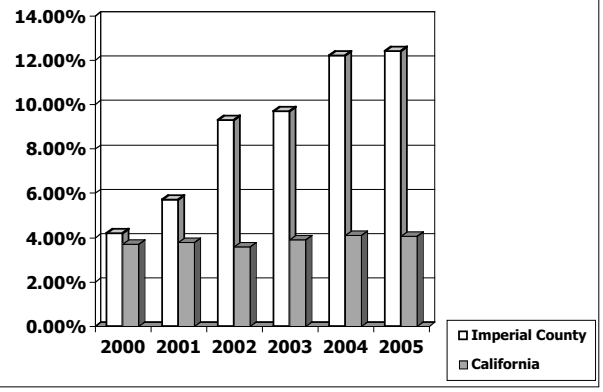
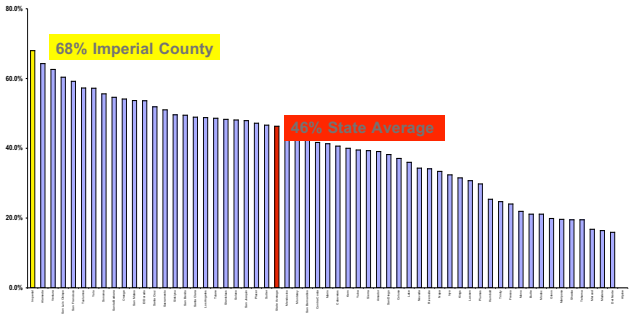
UC Eligibility Rate for Underrepresented Students



College going rate to any California College from known high schools in California 2003



Recent Evidence

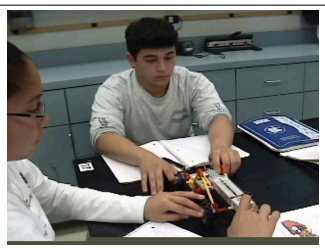
In a study with more than 1200 5th graders using a process of scaffolded guided inquiry with embedded writing strategies experimental group students significantly outperformed the control group who received regular instruction using just kits and just testbooks on posttest, state science standards scores and writing scores.

EL closed achievement gap with EO students in experimental group

At a middle school with 288 8th graders (99.7% Free and Reduced Lunch, 77.8% EL), a similar method was used. 63% of the students scored Proficient or Advanced on the 2006 administration of the California Science Standards Test.

(Vanosdall, Klentschy, Hedges and Weisbaum, 2007)

For additional information on this research

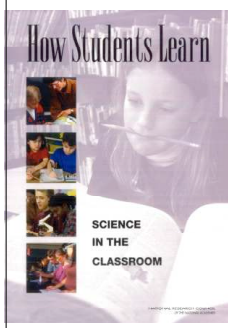


Amaral, O., Garrison, L. and Klentschy, M. (Summer 2002). Helping english learners increase achievement through inquiry-based science instruction. Bilingual Research Journal, 26:2, 213-239.

http://brj.asu.edu/content/vol26_no2/pdf/ART2.PDF

How Students Learn Science

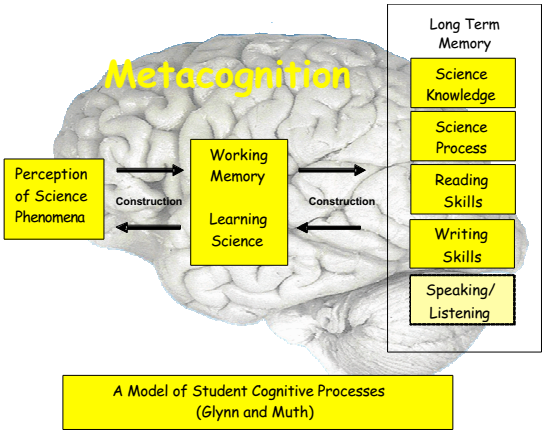
National Research Council (2005)



Engage to activate prior knowledge

Develop competence
- Deep foundation of factual knowledge
- Understand facts in the context of big ideas
- Organize knowledge to facilitate retrieval and application

Utilize metacognitive approaches to instruction



A Model of Student Cognitive Processes (Glynn and Muth)

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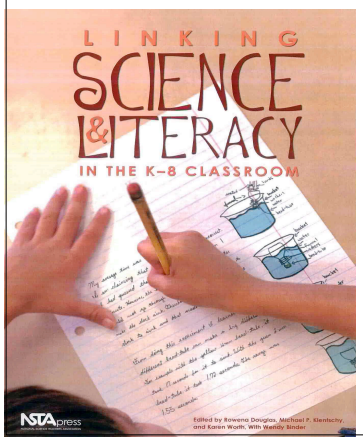
Science-Literacy Connection



- Best Practices
- Research-Based Strategies
- Lessons Learned

Key Issues:

Teachers of Science are Teachers of Language

- **Are the special challenges of scientific oral and written discourse and vocabulary, included in instructional design?**
- **Is the rigor of academic language increased incrementally as students progress to higher levels of English Language Development?**
- **What are the efficient and supportive ways to provide feedback to students on their written and oral work within the context of science instruction?**

Strategies in Science and Literacy

Literacy

1. **Word wall**
2. **Graphic organizers**
3. **Questioning strategies**
4. **Text structure**
5. **Academic Language**
6. **Dialogues and conversations (scientific discourse)**
7. **Reading Comprehension (focus on informational text)**
8. **Writing strategies (scientific method)**

Best Practices in Science

Questioning Strategies

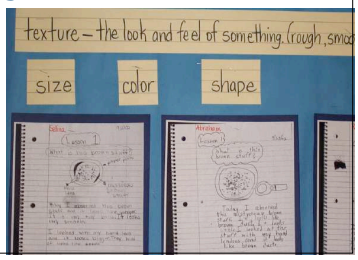
- **Prior knowledge activation (inference strategies)**
- **Exposure to critical vocabulary that is contextualized in pedagogy**
- **Reflection on hands-on experiences**
- **Ensure intellectual rigor of inquiry**
- **Nurture collaboration among students**
- **Share authority for answers**
- **Facilitate student thinking**

Opportunity to Learn

- ELD Strategies
- Academic Content Language Development

Vocabulary Building

- **It is important for teachers to build vocabulary and conceptual knowledge at the same time they provide instruction in the skills of word recognition**



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Vocabulary Building

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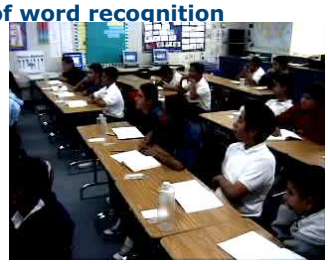
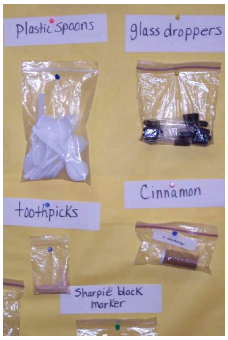


Working Word Walls and Charts

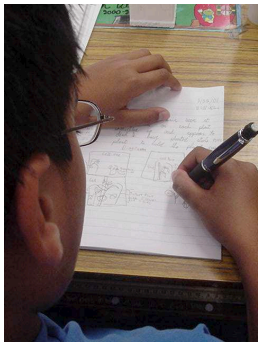
- Comprehensible input
- Scientific vocabulary
- Kit vocabulary
- Facilitates notebook entries



Kit Inventory

Kit Inventory Objectives

- Vocabulary development
- Oral language practice
- Active experiences



Kit Inventory "Big Idea"

- Introduction to unit
- E.L.D./Science/Language Arts integration
- Develop "working word wall":
  - Emphasis on descriptive vocabulary
- Adaptable to student's needs

Kit Inventory

- **Prediction**
  - Student/Teacher pull out one item at a time. Students predict what they think it might be used for.
- **Classifying**
  - Teacher distributes items. Students match items they feel are used together or fall under the same category. Students may identify properties of items.

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Kit Inventory

- **Prior Knowledge**
  - **Students discuss which items they've previously used and how**
- **Description**
  - **Students take an item from kit and describe it by using their senses. They can play a guessing game with class/partner.**

Making Connections

- **It is important for instruction to focus on connecting new words with what students already know.**

California Science Project Grade 6 SEI Classroom Example

What is it?	Material	Color	Size	Shape	Measurement	Weight	Living Thing?
It is a cup	It is made of styrofoam	It is white.	It is small.	It is the shape of a cylinder.	It measures 4 centimeters	It is light	It is a non-living thing.

What can you tell me about the cup?

Maria, the cup is…

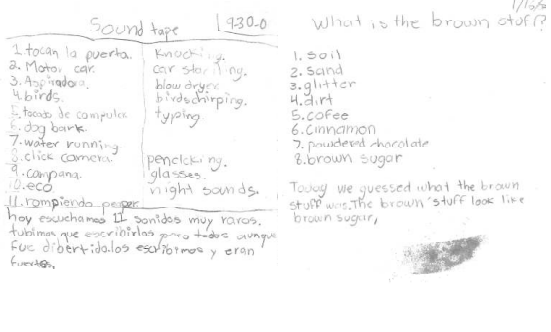
What shape is the cup?

(Amaral, 2001)

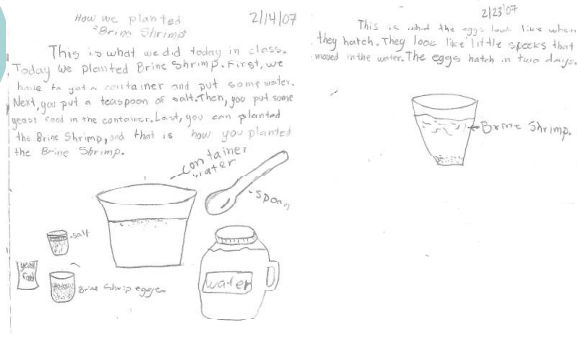
KWLH Chart

What We Know	What We Want to Find Out	What We Learned	How Can We Learn More
Soil is dirt Soil is all around us Plants grow in soil Soil is wet	What's in soil? Are there different colors of soil? Do all plants grow in soil?	Soil is made of different minerals. There are different types of soil Some seeds can grow in soil and humus Some seeds cannot grow in sand and clay	Research Museums Field Trips Videos Internet computer search

Writing



Writing



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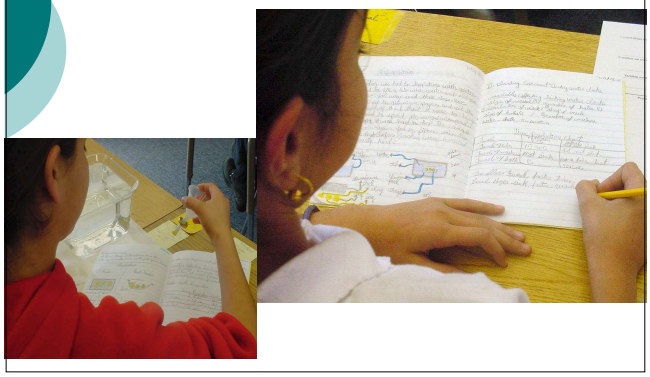
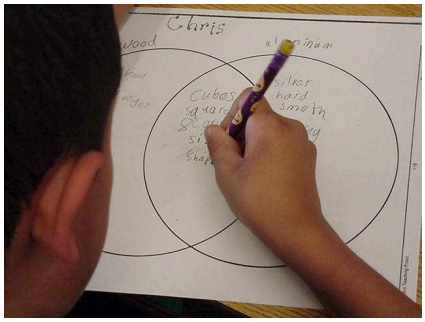
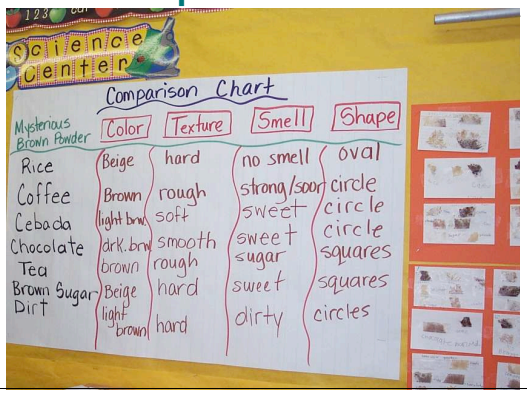
Writing



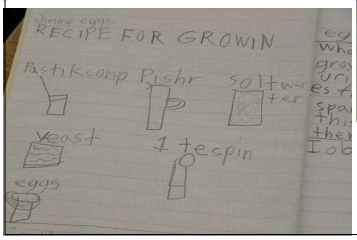
Venn Diagram

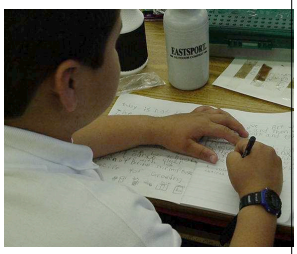


Comparison Charts

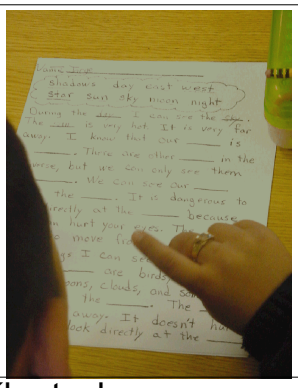


Labeling





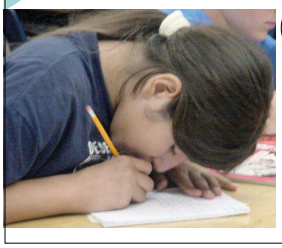
Cloze Paragraph

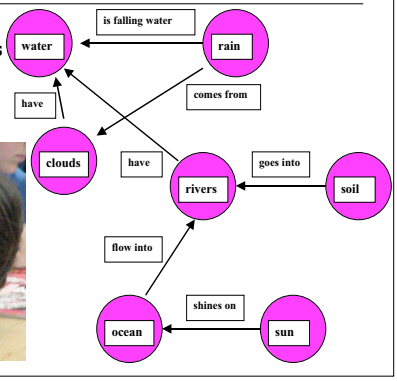


Concept Mapping – Declarative Knowledge

SEI Classroom

- **10 or fewer terms**
- **relationships**
- **misconceptions**





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Benefits
Oral Development

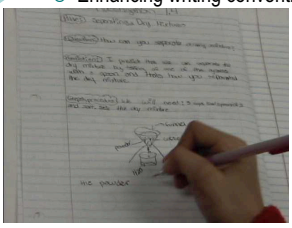
- Precise science terminology, Academic Content Language Development (ACLD)
- Introduction and repetition of vocabulary
- Word walls
- Oral presentations
- Posing questions
- Appropriate framing in grammar structures
- Association of vocabulary to items in real world context

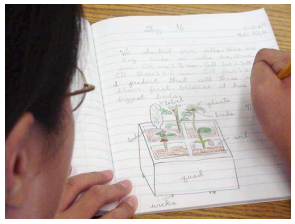
Benefits - Reading

- Repeating
- Sequencing
- Predicting
- Comparing
- Contrasting
- Inferring
- Analyzing
- Summarizing

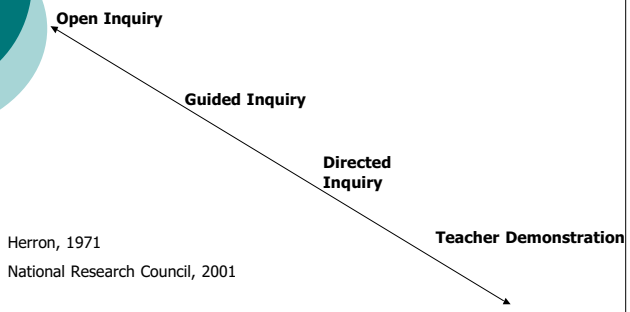
Benefits - Writing

- Expository genre is reinforced
- Use of precise language
- Language is connected to students' immediate experiences
- Enhancing writing conventions





Scaffolded Inquiry



Herron, 1971

National Research Council, 2001

National Research Council (2001)

"Investigations can be highly structured by the teacher so that students proceed toward known outcomes, such as discovering regularities in the movement of pendulums. Or investigations can be free-ranging explorations of unexplained phenomena… The form that inquiry takes depends largely on the educational goals for students, and because these goals are diverse, highly structured and more open ended inquires both have their place in science classrooms" (NRC, 2001, p. 10-11).

More Research to Consider

- Students benefit from strong scaffolding with respect to building explanations from evidence (Songer and Lee, 2003)
- Questioning, predicting, clarifying, and summarizing are strengthened through scaffolding. Clarifying promotes comprehension monitoring. Students benefit from scaffolding when analyzing data and building explanations from evidence. (Hug, Krajcik and Marx, 2005)
- A process of scaffolded inquiry, reflection and generalization developed students' metacognitive knowledge. (White and Fredrickson, 1998)

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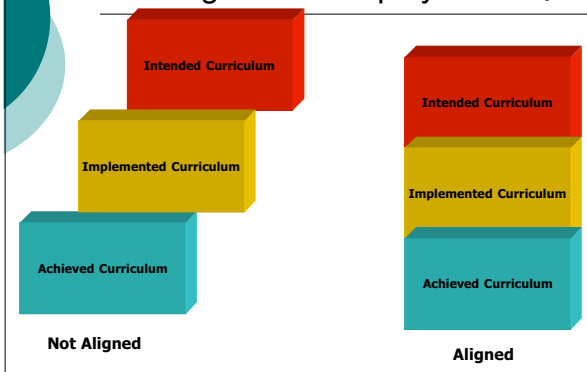
- Writing may force the integration of new ideas and relationships with prior knowledge and encourage personal involvement with the new information (Kleinsasser, et al, 1992)
- Written and oral language opportunities to explain, describe, predict and integrate new information allow students to make conceptual shifts and facilitate retention (Fellows, 1994)

Effect of Talk and Writing on Learning Science

(Rivard and Straw, 2000)

- Talk is important for sharing, clarifying, and distributing knowledge among peers.
- Asking questions, hypothesizing, explaining, and formulating ideas together are all important mechanisms during peer discussions.
- Writing is an important tool for transforming claims and evidence into knowledge that is more coherent and structured.
- Talk combined with writing appears to enhance the retention of science learning over time.

Scaffolding Guided Inquiry **Marzano (2001)**



STUDY 1: Scaffolded Guided Inquiry Instruction and Text-based Instruction

This randomized experiment was designed to provide a test of the strongest treatment-control contrast

That is, to compare achievement results for:

- Scaffolded Guided Inquiry Instruction: kits enhanced with scaffolded lessons, versus
- Text-based Instruction with conventional materials

Tennessee State University Center of Excellence for Learning Sciences

STUDY 1: Scaffolded Guided Inquiry Instruction and Text-based Instruction

This experiment involved
N = 20 teachers and *N* = 563 students

None of the teachers had experience with kit-based instruction

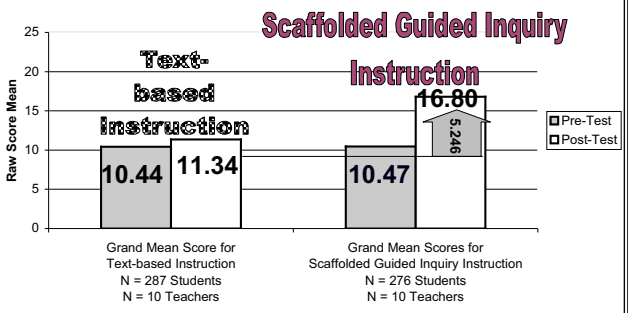
Teachers were randomly assigned to:

- Scaffolded Guided Inquiry Instruction
- Text-based Instruction

Tennessee State University Center of Excellence for Learning Sciences

Study 1: Scaffolded Guided Inquiry Instruction v. Text-based Instruction

Pre-Test / Post-Test Mixtures and Solutions (Grade 5)



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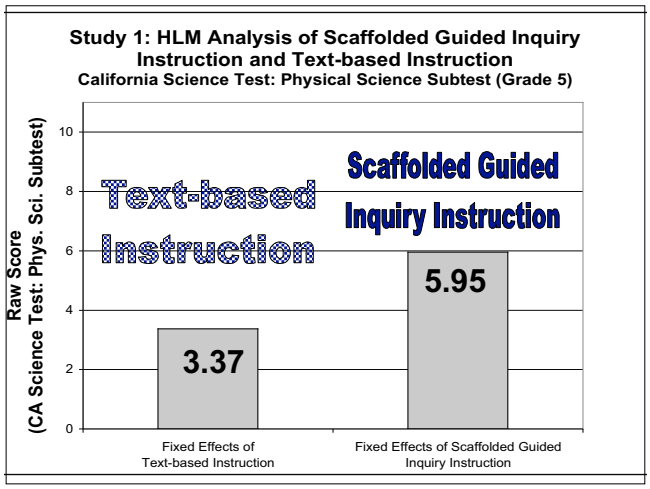


STUDY 1:
Scaffolded Guided Inquiry Instruction and Text-based Instruction

Effect Sizes	
Standardized Test	1.392
Post test	1.095

A gain of 42 percentile points on the California Standards Test: 5th Grade Physical Science Section

STUDY 2:
Scaffolded Guided Inquiry Instruction and Kit-based Instruction

This randomized experiment was designed to test whether Scaffolded Guided Inquiry Instruction leads to greater science achievement than kit-based instruction alone.

That is, to compare achievement results for:

- Scaffolded Guided Inquiry Instruction: kits enhanced with scaffolded lessons, versus
- Kit-based Instruction: kits and the manufacturers' professional development and teacher materials

STUDY 2:
Scaffolded Guided Inquiry Instruction and Kit-based Instruction

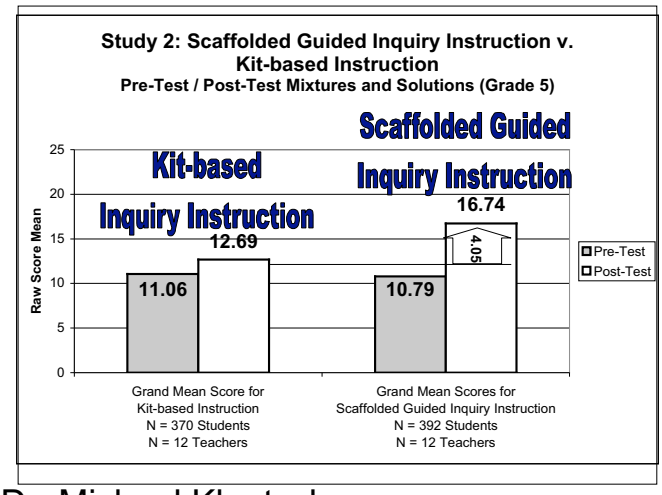
This experiment involved

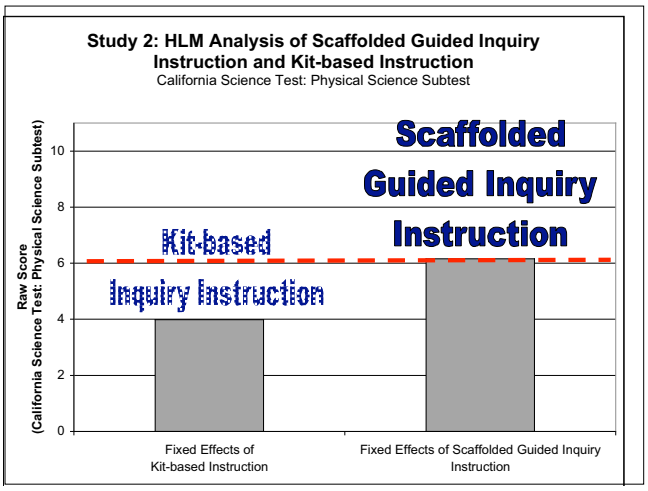
N = 24 teachers and *N* = 762 students

All of the teachers had prior Kit-based science teaching

Teachers were matched on background and then randomly assigned to:

- Scaffolded Guided Inquiry Instruction (kits + scaffolded lessons)
- Kit-based Instruction (kits + kit materials)





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STUDY 2:
Scaffolded Guided Inquiry Instruction and Kit-based Instruction

Effect Sizes	
Standardized Test	1.137
Post test	1.043

A gain of 36 percentile points on the California Standards Test: 5th Grade Physical Science Section

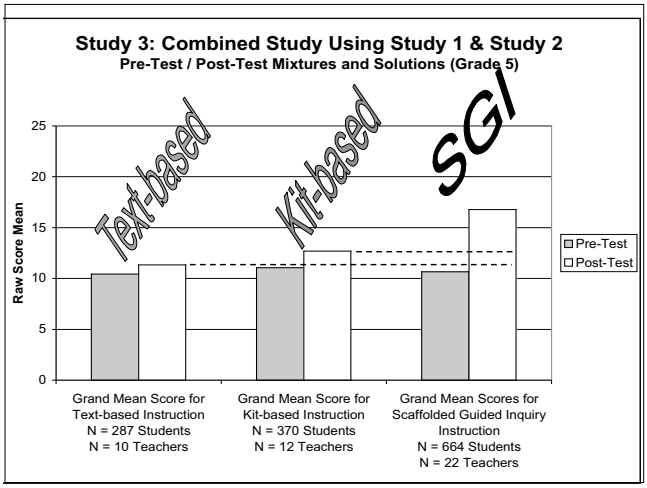
Study 3:
A Combined Study using Study 1 and Study 2

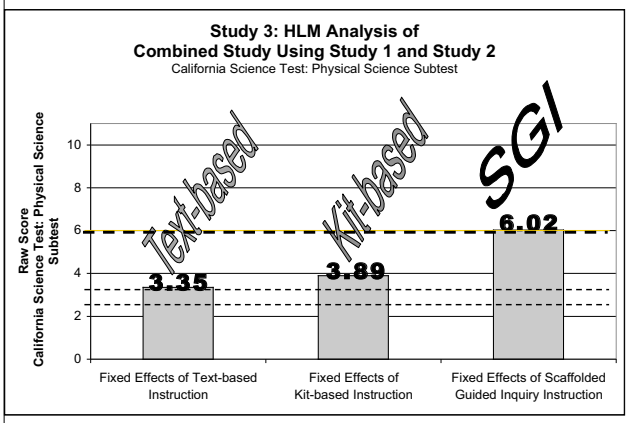
This quasi-experiment combines data from the two 5th grade experiments (Study 1 and Study 2) to develop the comparison between kit-based instruction and text-based instruction.

Study 3:
A Combined Study using Study 1 and Study 2

Groups include:

- Scaffolded Guided Inquiry Instruction: Treatment teachers from Study 1 and Study 2 (N=22)
- Kit-based instruction: Control teachers from Study 2 (N=12)
- Traditional instruction: Control teachers From Study 1 (N=10)





Study 3:
A Combined Study using Study 1 and Study 2

Effect Sizes	Kit-based v. Text-based Instruction
California Science Test	0.320
Mixtures and Solutions Test	0.408

A gain of 12 percentile points on the California Standards Test: 5th Grade Physical Science Section

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Conclusions

Study 3: A Quasi-experimental Study using Study 1 and Study 2

Kit-based Instruction over Text-based Instruction

Effect Size is 0.32

A gain of 12 percentile points on the California Standards Test: 5th Grade Physical Science Section

Conclusions

Study 2: Randomized Controlled Trial

Scaffolded Guided Inquiry Instruction over Kit-based Instruction

Effect Size is 1.1

A gain of 36 percentile points on the California Standards Test: 5th Grade Physical Science Section

Conclusions

Study 1: Randomized Controlled Trial

Scaffolded Guided Inquiry Instruction over Text-based Instruction

Effect Size is 1.4

A gain of 42 percentile points on the California Standards Test: 5th Grade Physical Science Section

Conclusions

- All of these findings were found in a set of school districts and schools who have very high ELL populations (70-85%)
- Students receiving scaffolded guided inquiry instruction in both grade 4 and 5 produced student notebooks that were significantly different than control group with respect to:
  - Quality of Communication
  - Science Conceptual Understanding
  - Use of scientific vocabulary

Next Steps

- Same studies were replicated in the same schools with the same teachers for 2005-2006 and 2006-2007
- Grade 4 students from 2004-2005 were tracked longitudinally to create a 2X2 design in grade 5 for 2005-2006 and repeated in 2006-2007.
- Entire study is being replicated in Wake County Public School System (North Carolina) in 2006 -2007.

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