



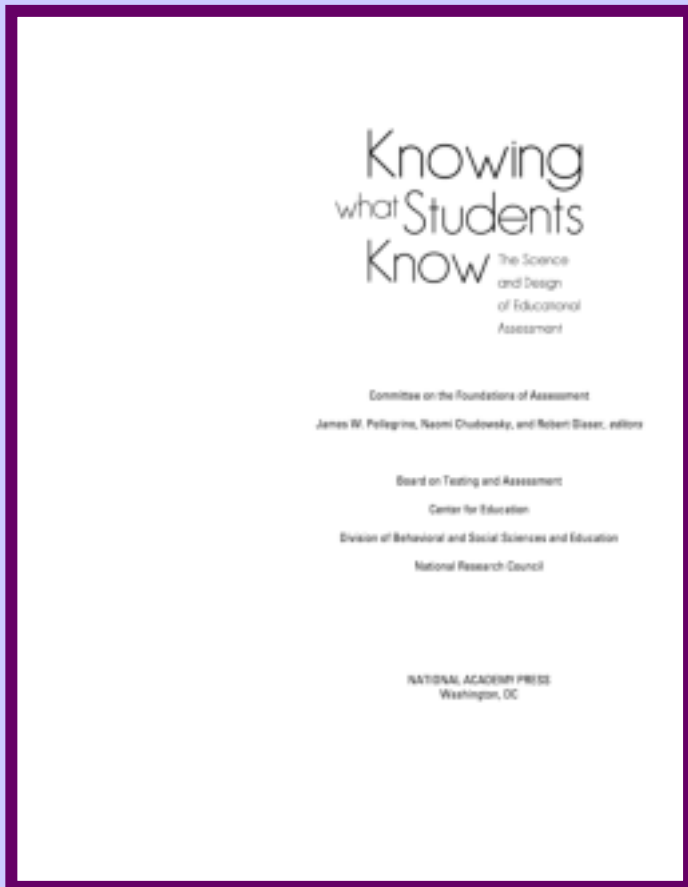
Assessment for Knowledge Integration



Marcia C. Linn
ICLS, October 25, 2002
Seattle, WA



Knowing What Students Know



- "A model of learning and cognition should serve as the cornerstone of assessment design."

Knowledge Integration Assessment and Instructional Design



- How do we make informed decisions about curriculum design?
- Knowledge integration perspective amalgamates current socio-cognitive research

Knowledge Integration Perspective

- Interpretive

Learners make sense of new information based on past experiences and courses

Cultural

Learners infer norm, standards, & epistemologies from media, peers, role models, activity structures, and grading rubrics

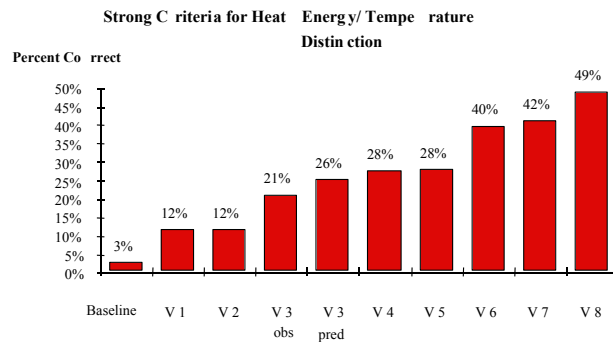
Deliberate

Learners personally guide their learning, select courses and careers, and choose to revisit ideas



Assessing Knowledge Integration

Eight Versions of the Computer as Learning Partner Curriculum

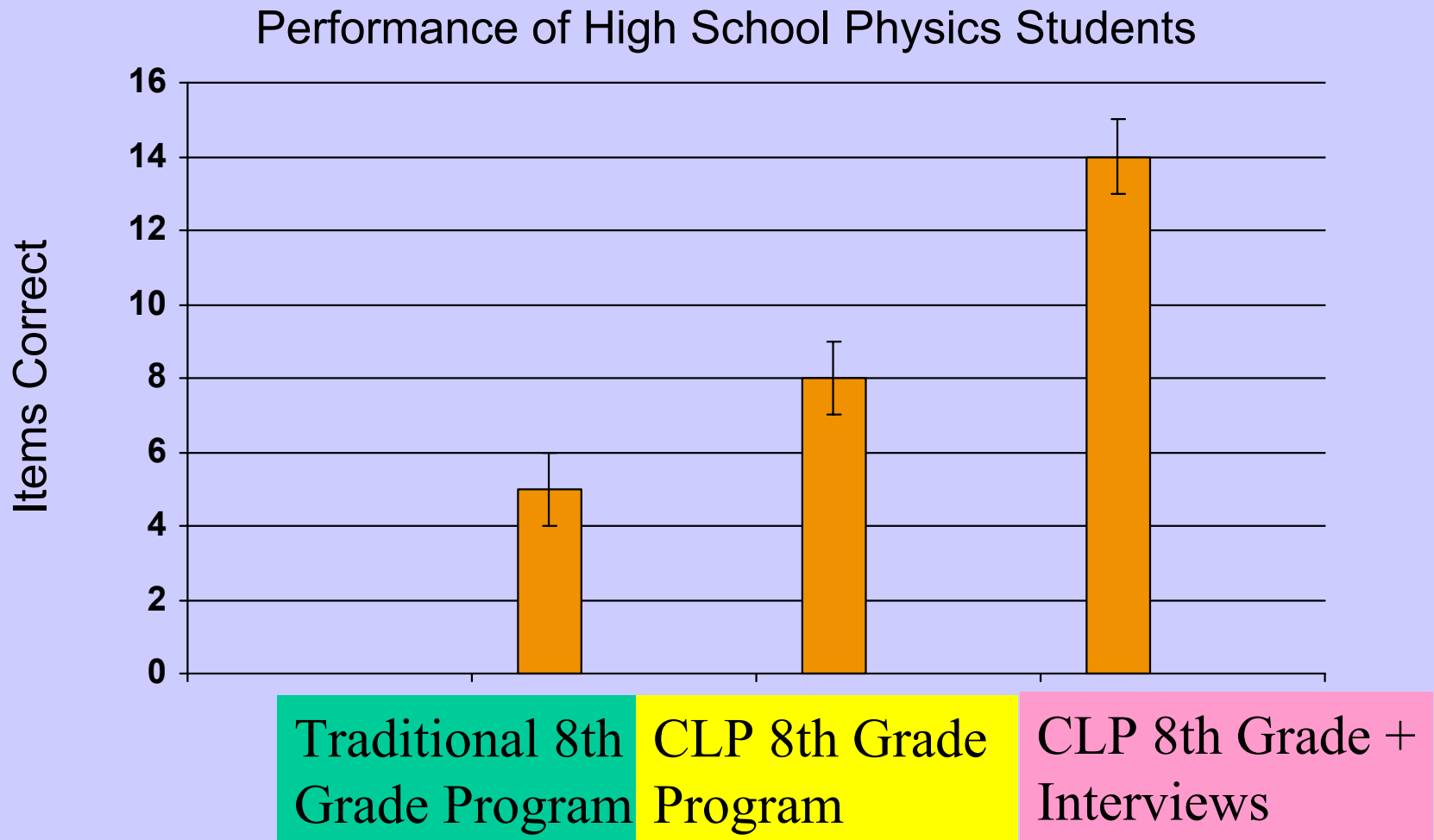


(Linn, M. C. & Songer, N. B. (1991). Teaching thermodynamics to middle school students: What are appropriate cognitive demands? *Journal of Research in Science Teaching*, 28(10), 885-918.)

Linn, NSF, 11-6-97 — Slide 1

- Interpretive
What is the difference between heat and temperature?
- Seven iterations of CLP led to a 400% improvement in student outcomes.

Longitudinal Impact of CLP Curriculum



$P < .0001$ All comparisons significant

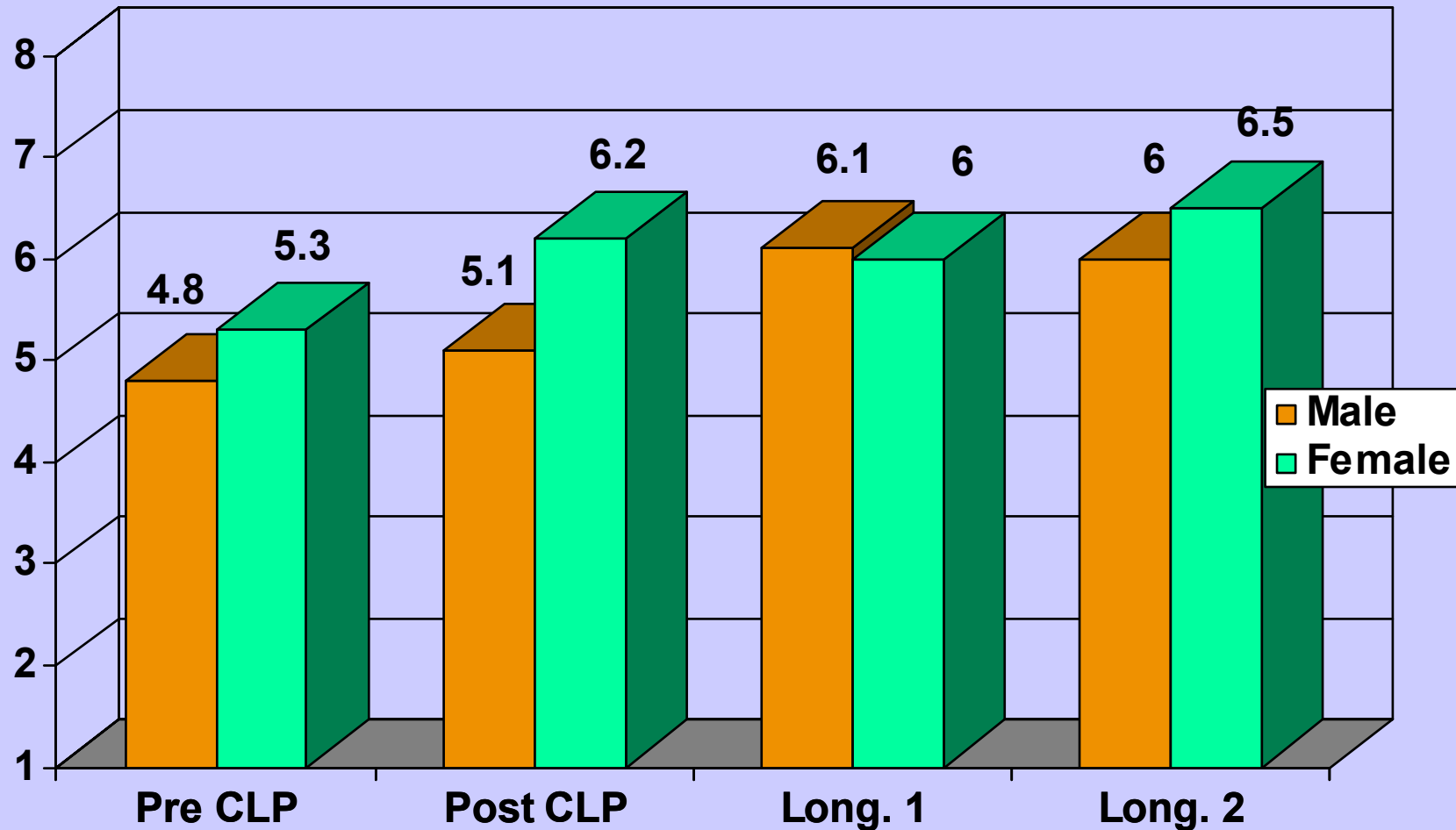
Assessing Knowledge Integration

Cultural

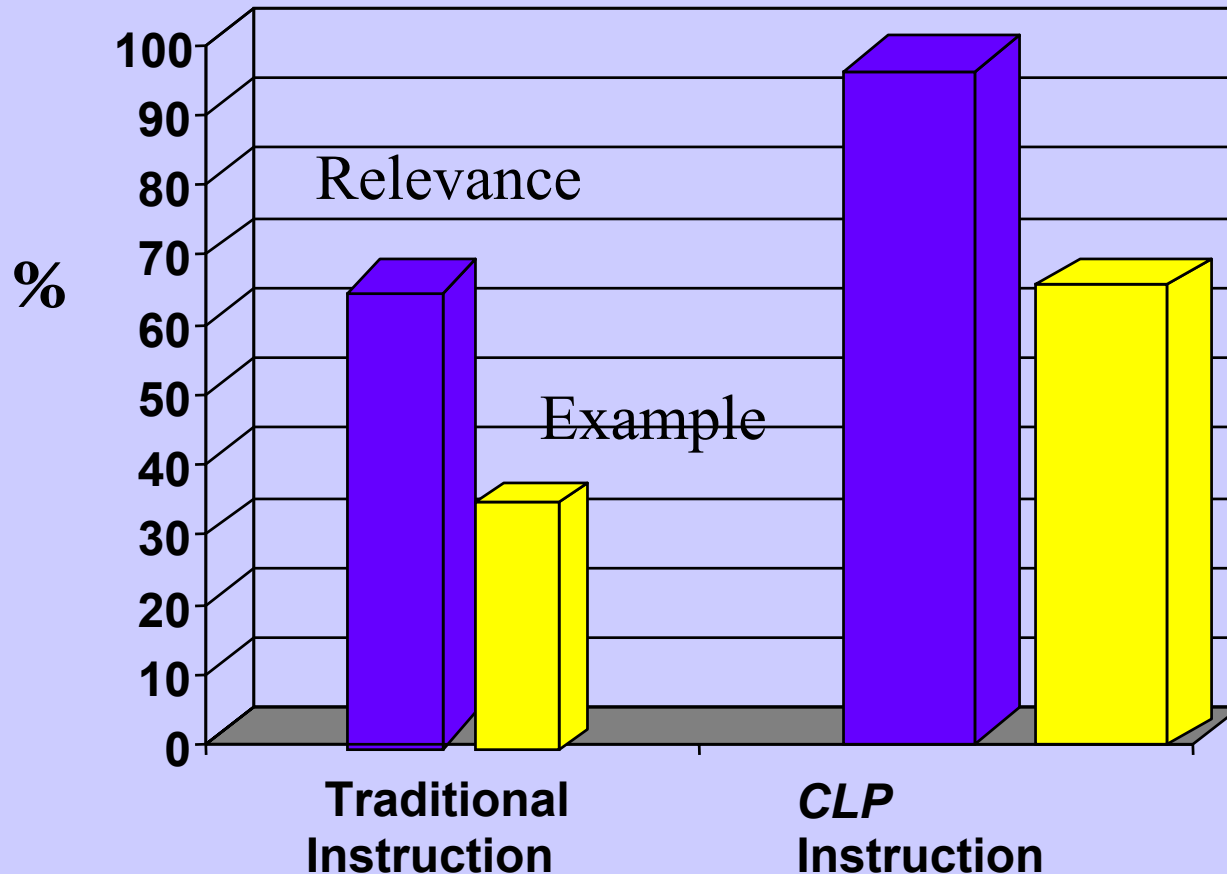
- **Relevance of Material Learned in Science**—
CLP curriculum emphasizes practical problems
- **Nature of science**—
Controversy projects improve understanding of role of debate in science



Relevance of Science Class before and after CLP

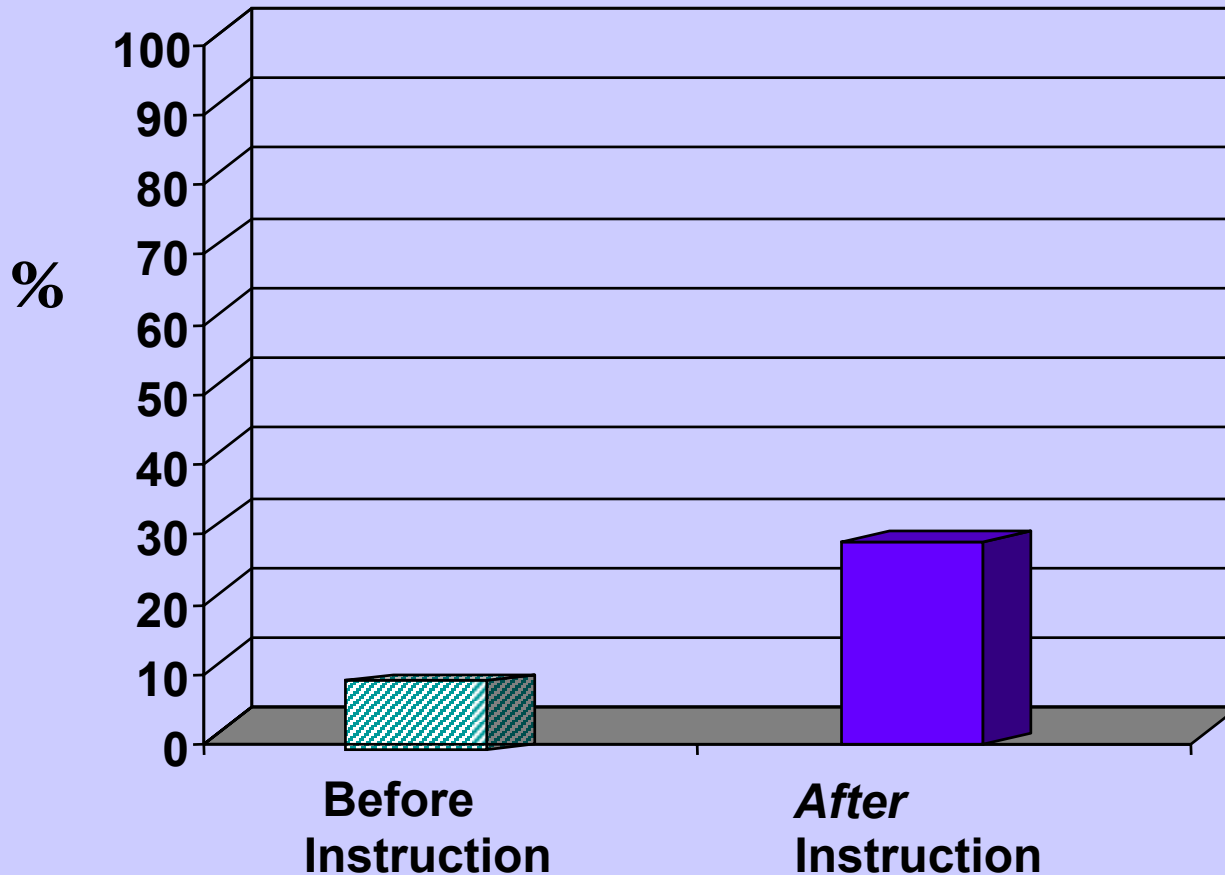


Longitudinal Comparison— Relevance of Science



Students in high school physics who studied CLP in middle school reported thinking science was more relevant and giving examples more often than those in traditional program

Student views— Scientists motivated by debate



Debate can
"encourage scientists
to produce the
evidence they need to
support their theory"
& "help them explain
their evidence more
thoroughly."

Bell, P. & Linn, M. C.(2000) Beliefs about science: How does science instruction contribute? In *Personal epistemology: The psychology of beliefs about knowledge and knowing*. Editors: Barbara K. Hofer and Paul R. Pintrich. Lawrence Erlbaum, Inc., New Jersey.

Assessing Knowledge Integration





Genetically Modified Foods In Perspective

Deliberate—Essay

What agricultural method you think should be used here in California, and why you think we should use this method?

- Scoring — Explain and provide evidence for tradeoffs.

Genetically Modified Food—Tradeoffs



SCOPE: Genetically Modified Foods in Perspective

[Exit](#) [Index](#)

ACTIVITY 5 OF 8

[Look at the Evidence](#)

[Select Evidence](#)

[View Evidence](#)

[Note](#)

[Select Evidence](#)


[Go to Next Activity](#)



Genetic Engineering Saves Papaya Crop.

Jamia is a scientist who has chosen to genetically modify papaya. She recognizes that we need to be careful and responsible and careful, genetically modified plants. Jamia thinks that if we are careful, we can save the crop.

Papaya image from [University of Illinois](#)



One piece of evidence can be used to show that genetic engineering can help farmers have had a virus. This virus has caused a loss of income for many farmers.

new type of fungus hit the potato crop, reduced entire potato crops to rot. The population of Ireland decreased from 1800 to 1850 due to starvation and emigration. As many famine-related death counts are confirmed at around 1 million.

Now, unlike potatoes in Ireland in the 1800s, papaya is not the main source of food for Hawaiians. However, growing papayas is an important source of income for many Hawaiian farmers, and these farmers were desperate to save their papaya groves. Maybe it would have been possible to develop disease resistant varieties of papaya using traditional crosses (remember, like the way corn was developed from Teosinte), but remember how long this can take! **Genetic**

Netscape: WISE Note

Notes

Why did scientists want to genetically modify papayas?

The purpose of genetically modifying the papayas was...

Explain how the evidence about papayas can be an argument for genetically modified food.

The evidence about genetically modified papayas is...

Netscape: WISE Hint

Hint 1 of 2

Crops are always at risk of being attacked by new diseases. Crosses can help to develop plants which are more disease resistant, but as you know, this can be slow.

[NEXT HINT](#) [CLOSE](#)

Curriculum Overview

Note Initial Ideas about
Genetically Engineered Food

History of Corn
What Products Contain Corn?
What is a Cross?

What is Genetic Engineering?

Jigsaw
1. Explore Arguments and Evidence

2. Class Presentations
Present Your Findings

Position Paper

Take Notes
|
Discuss

Pieces of the Jigsaw

Pro-GM

Papaya Virus	Reduce Allergens	β-Carotene Rice
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Anti-GM

Monarchs + bt-Corn	Introduce Allergens	Super-weeds
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Pro-Orgo

Crop Rotation	No Synthetic Chemicals	Certification + Regulation
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Anti-Orgo

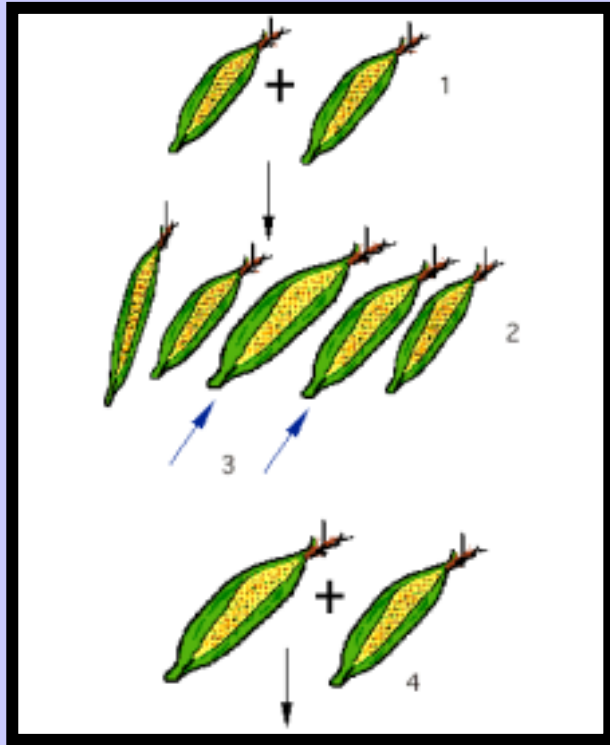
Insects + Weeds	Chemicals are used	Lower yields
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Changes to improve knowledge integration



- In pilot run students thought people could easily avoid genetically modified corn.
- Revisions included evidence and a note about people with corn allergies.
- Most students using the revised project explained that avoiding corn is difficult.

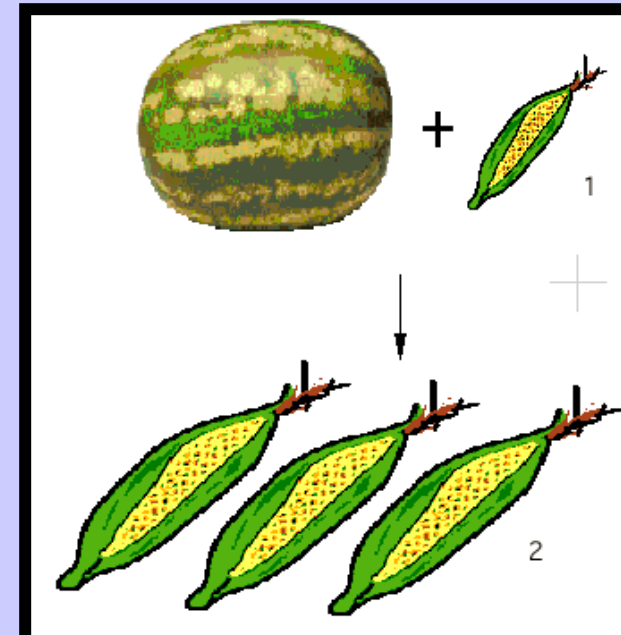
Changes to improve knowledge integration



Crosses

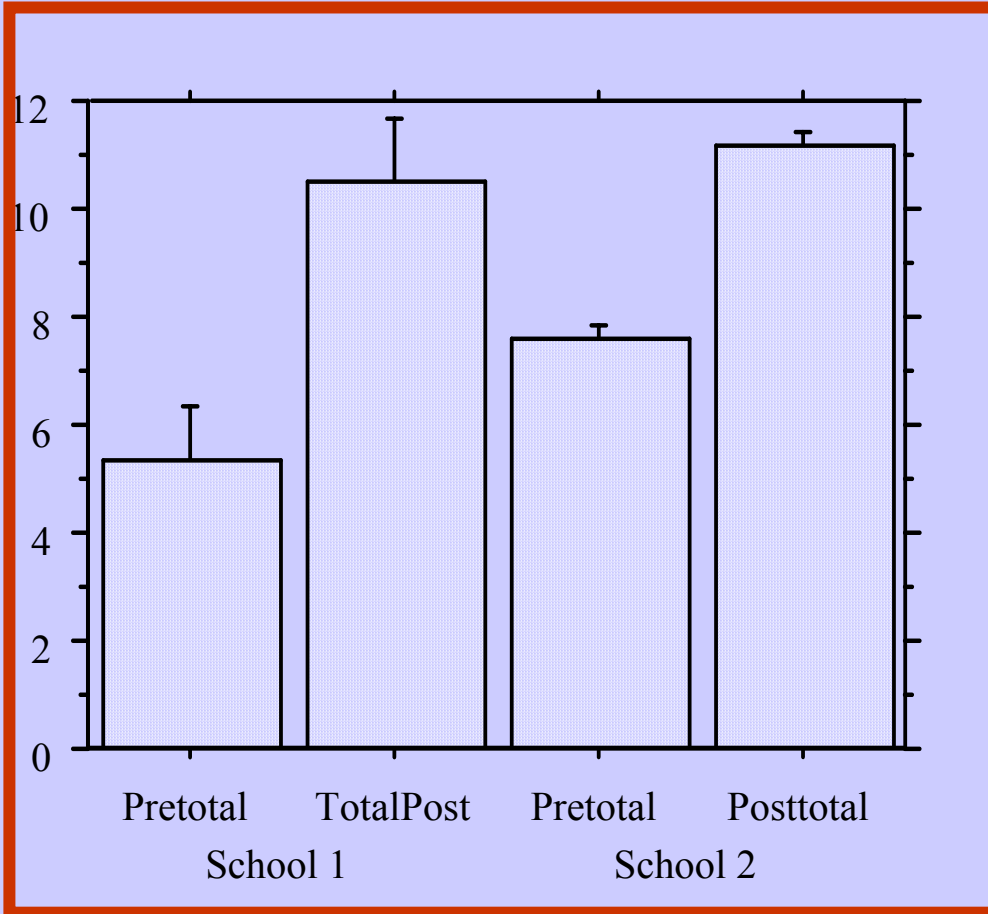
- In pilot run, students had difficulty distinguishing crosses from genetic engineering
- These diagrams helped students distinguish the ideas in revised project

Genetic engineering



Interpretative questions—both schools

Total Scores



Example Question—Why might a farmer planting genetically engineered seeds chose to grow genetically modified food?

Pretest: To make more money.

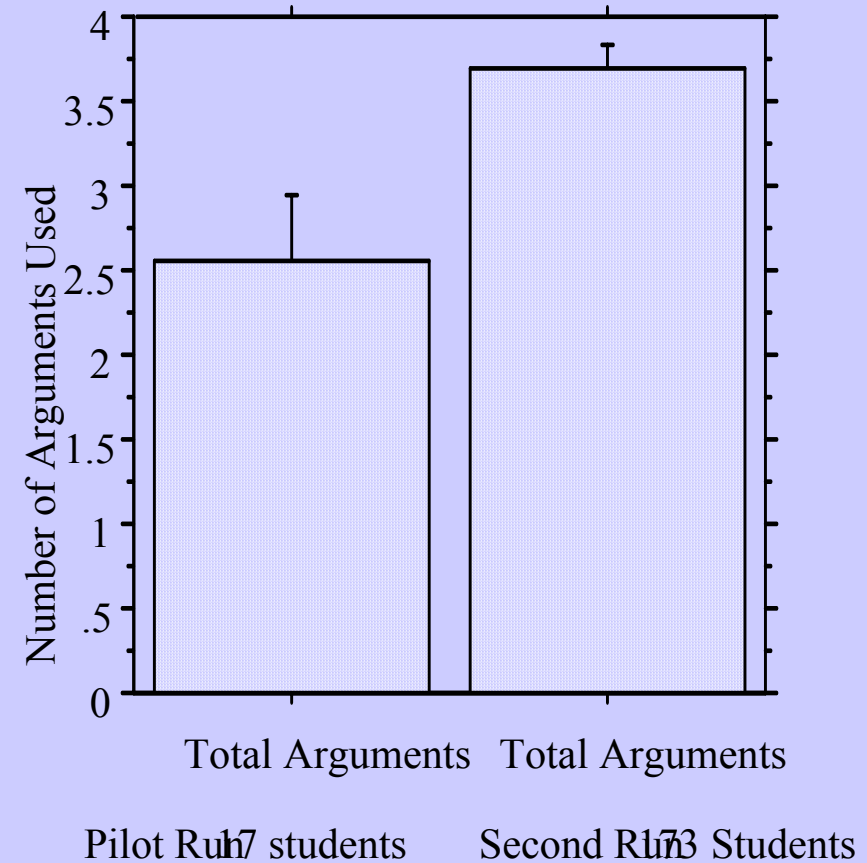
Posttest: He can produce 2 times the amount of food on the same amount of land. He can pick characteristics that will be easier to grow and make him more money. He can reuse his land by fertilizing it. He can control pests.

Deliberate question — both schools

Write a one-page essay to explain the agricultural method you think should be used here in California, and why you think we should use this method...”

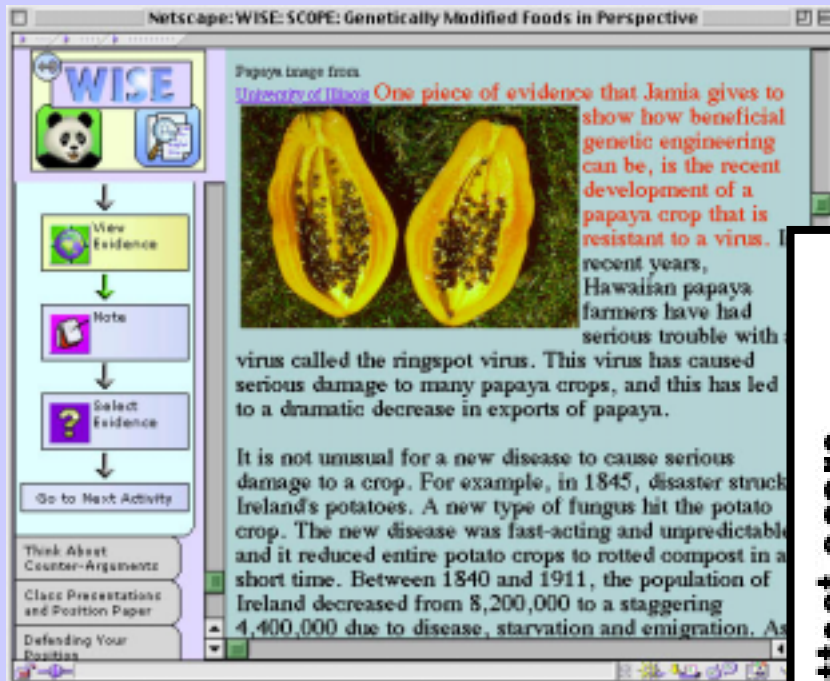
Tara: “A great conflict with genetically modified fruits and vegetables are allergies. If a gene is taken from one plant and transferred to another, the person that shall be eating the plant will not have the knowledge that the plant they are eating has a specific gene from another plant that they could possibly be allergic to. Although genetically engineering a plant could mean that they take out the allergenic gene, not genetically modifying plants could at least give people the assurance that they are eating something they are not allergic to...”

Arguments used in essays

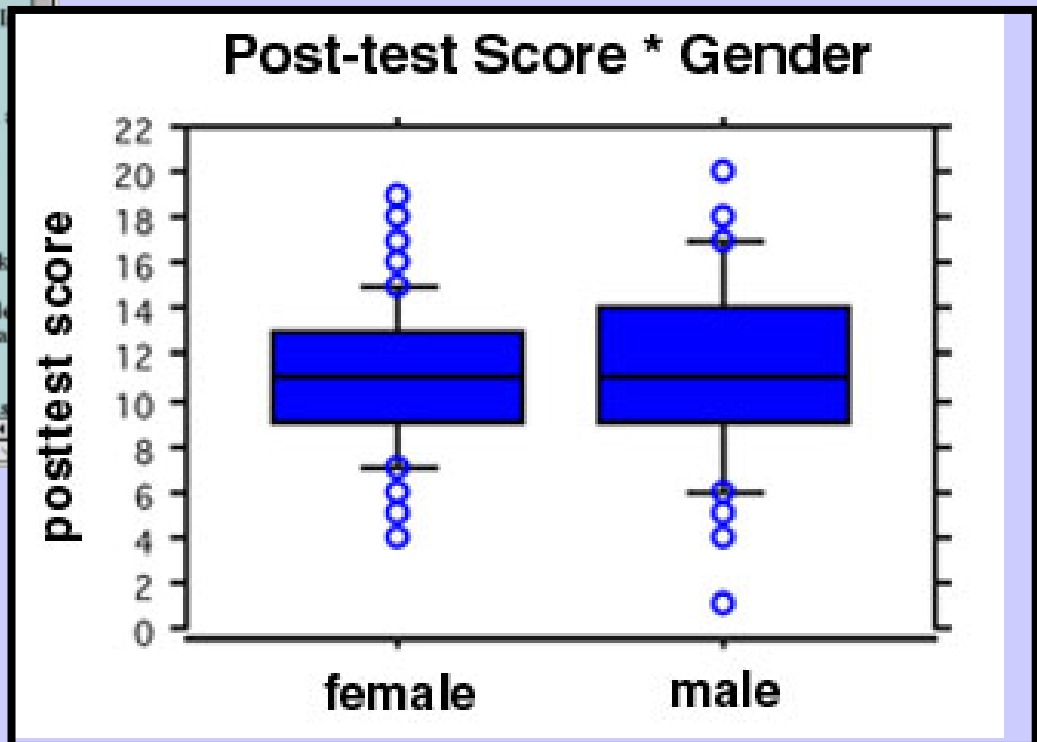


How do males and females respond to knowledge integration assessment?

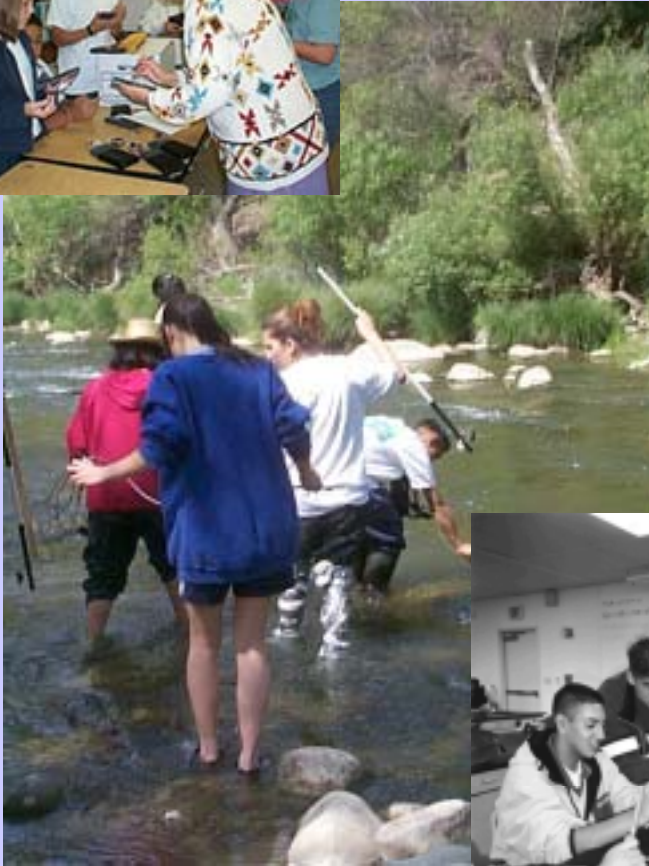
Genetically Modified Foods Study



Assessment research by
Sherry Seethaler,
University of California, Berkeley



Conclusions



- Knowledge integration perspective guides design and refinement of curriculum.
- Compelling comparisons — between versions designed to investigate aspects of knowledge integration—inform refinement of instruction

Why do we need better assessments?

"Schools caught in rash of cheating on tests"

Teachers say they're pressured to ensure good results on exams

Lack of training, materials cited"

Detroit News

"State Fears Cheating By Teachers - 51 schools left off cash award list"

San Francisco Chronicle

"Oakland school superintendent deploras possible cheating on state aptitude tests"

OAKLAND -- The head of the Oakland Unified School District says it is too soon to tell whether state aptitude tests were altered in three district classrooms, but if so he would not spare the rod."

Bay Insider

"Cheating teacher skews schools' test scores"

Eagle-Tribune