Maximizing the Academics in CTE: The NRCCTE Curriculum Integration Studies

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NRC CTE
National Research Center for Career and Technical Education

National Research Center for CTE

University of Louisville

College of Education & Human Development

NRCCTE Partners

Three Foci

- *Engagement* – Completing high school, completing programs
- *Achievement* – technical and academic
- *Transition* – to continued formal learning without the need for remediation; and to the workplace

Four Main Activities

- Research (Scientifically-based)
- Dissemination
- Technical Assistance
- Professional Development

www.nrccte.org

Curriculum Integration Research

- Math-in-CTE: complete
  - Math-in-CTE Technical Assistance—six years
- Literacy-in-CTE: complete
  - Launching technical assistance this year
- Science-in-CTE:
  - Study concluded; data analysis underway

Math-in-CTE

The Math-in-CTE Study

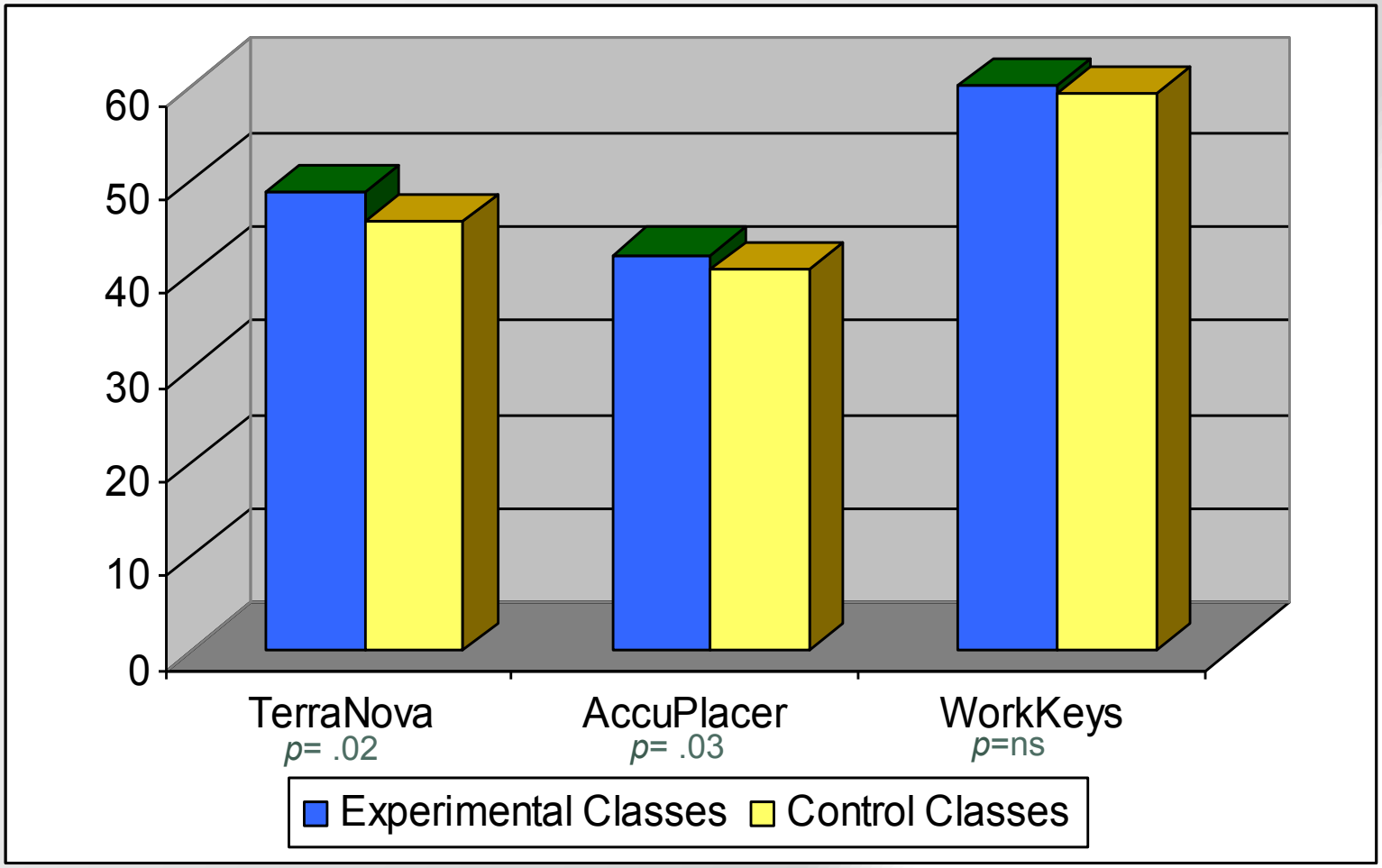
A study to test the possibility that enhancing the embedded mathematics in Technical Education coursework will build skills in this critical academic area without reducing technical skill development.

Math Study Questions

- Does enhancing the CTE curriculum with math increase math skills of CTE students?
- Can we infuse enough math into CTE curricula to meaningfully enhance the academic skills of CTE participants (Perkins III Core Indicator)
- . . . Without reducing technical skill development
- What works?

Math-in-CTE Findings

All CTEx vs. All CTEc
Post test % correct controlling for pre-test

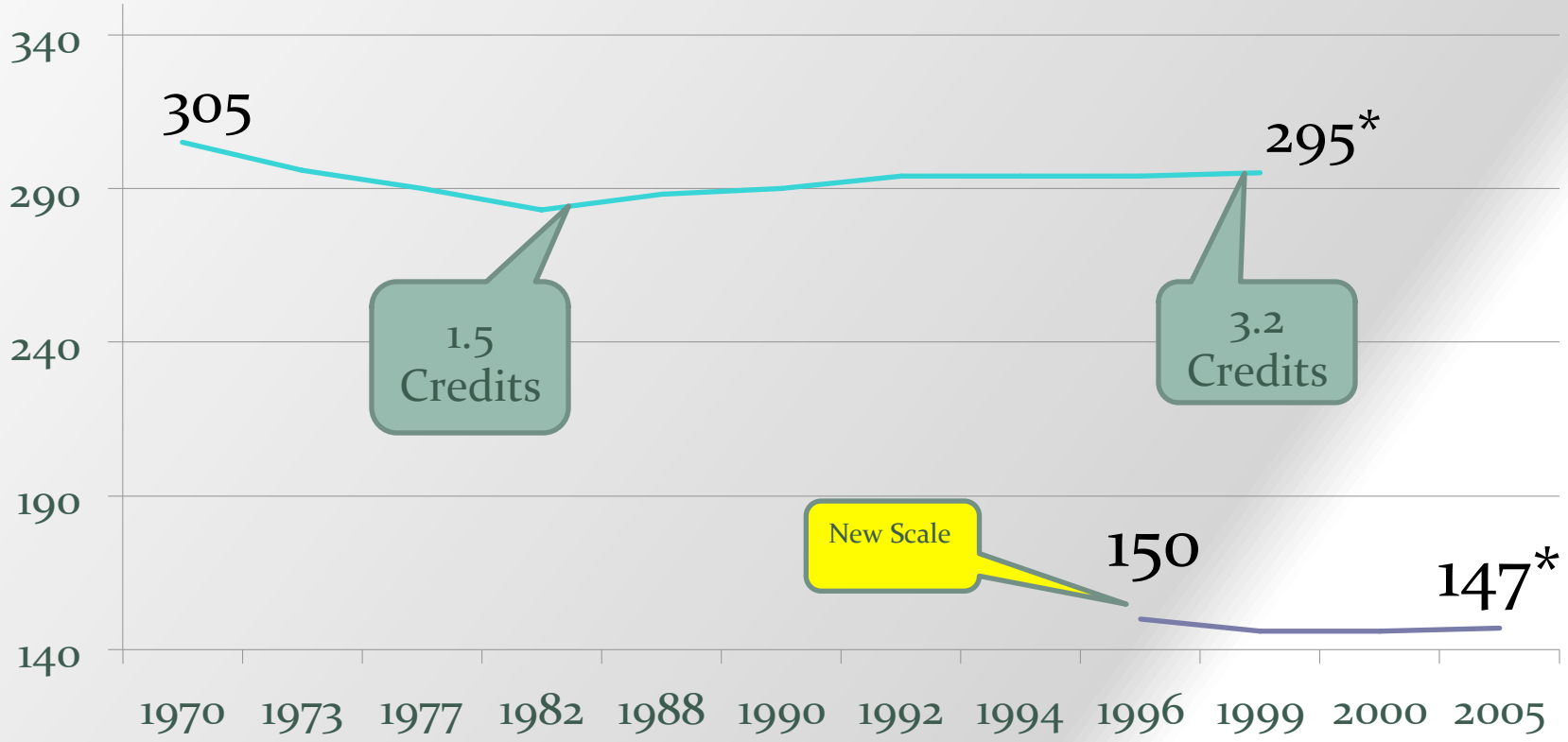


Science-in-CTE
Preliminary Findings

"Six Elements" Pedagogic Framework

1. Introduce the CTE lesson
2. Assess students' pre-understandings of CTE and the embedded science
3. Walk through the CTE content and the *embedded science* within it
4. Students participate in an *authentic application* of the CTE using inquiry
5. Students demonstrate what they have learned about the *explicit science*
6. Formal assessment of CTE and science knowledge and skills

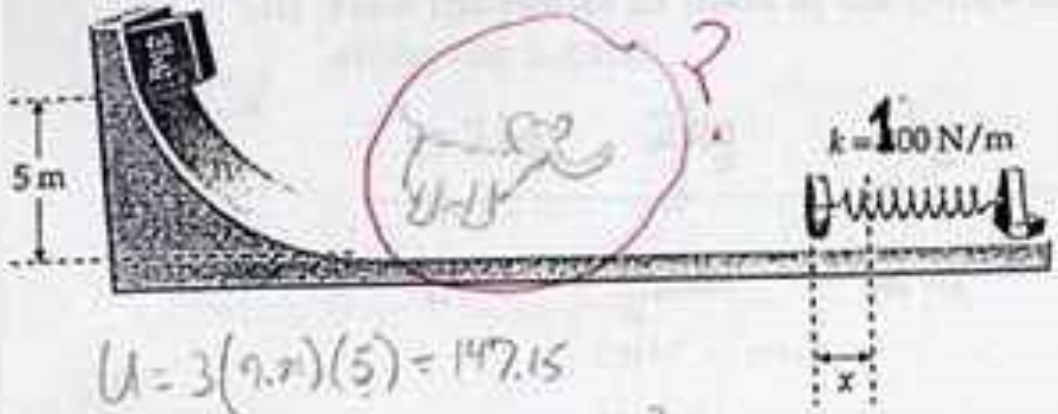
NAEP Science Scores – High School



2. A 3-kg object is released from rest at a height of 5m on a curved frictionless ramp. At the foot of the ramp is a spring of force constant k = 100 N/m. The object slides down the ramp and into the spring, compressing it a distance x before coming to rest.

10 (a) Find x.

5 (b) Does the object continue to move after it comes to rest? If yes, how high will it go up the slope before it comes to rest?



$U = 3(9.81)(5) = 147.15$

$U_s = \frac{1}{2}(100)x^2 = 50x^2$ ...?

NO. there is an elephant in the way.

The Science-in-CTE Study

An adaptation of the Math-in-CTE model.

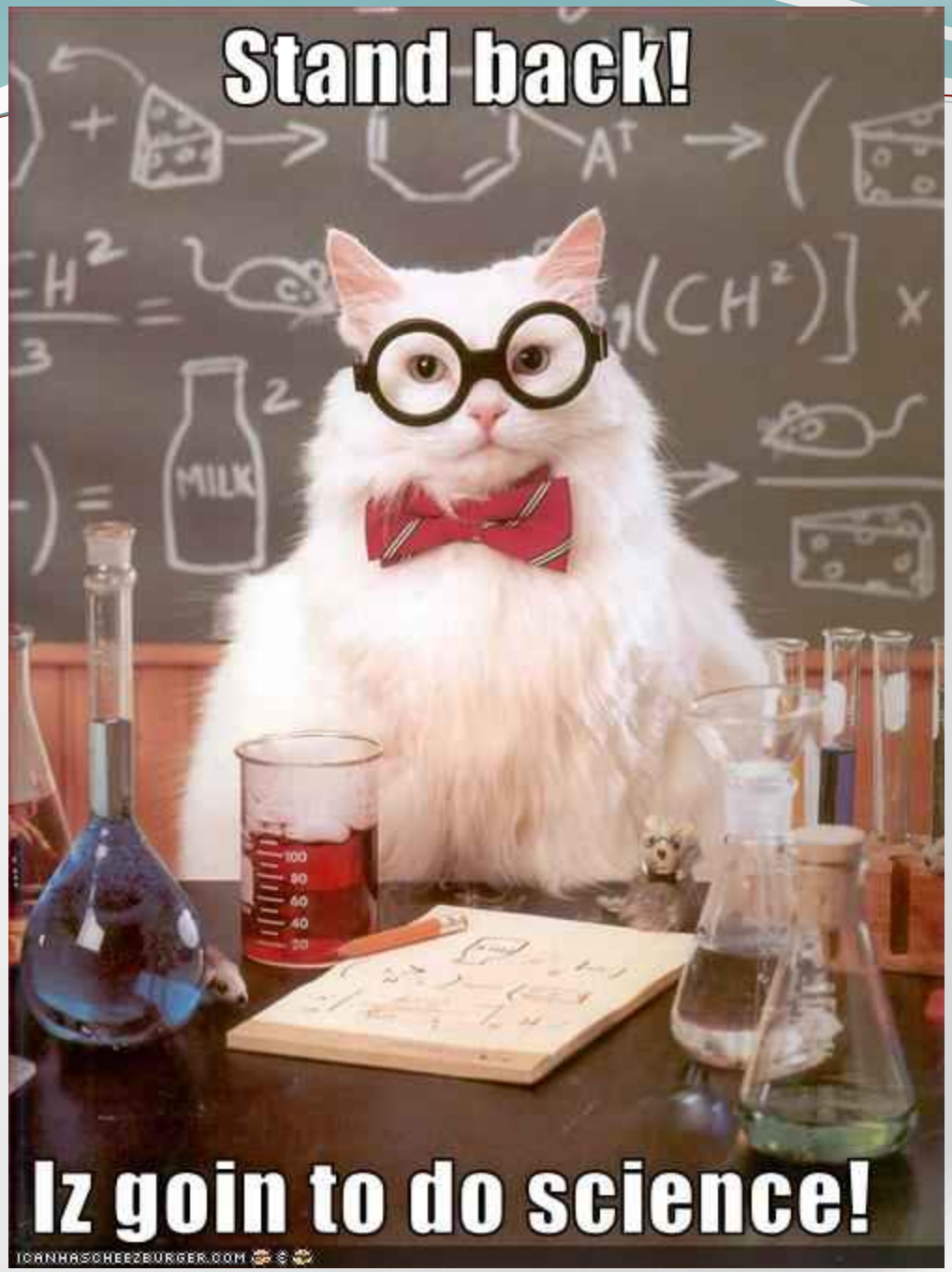
A study to test the possibility that enhancing the embedded science in Technical Education coursework will build skills in this critical academic area.

NRC Science-in-CTE

Science-in-CTE Study Questions

- Does enhancing the CTE curriculum with science increase science knowledge skills of CTE students?
- What works?

Science-in-CTE

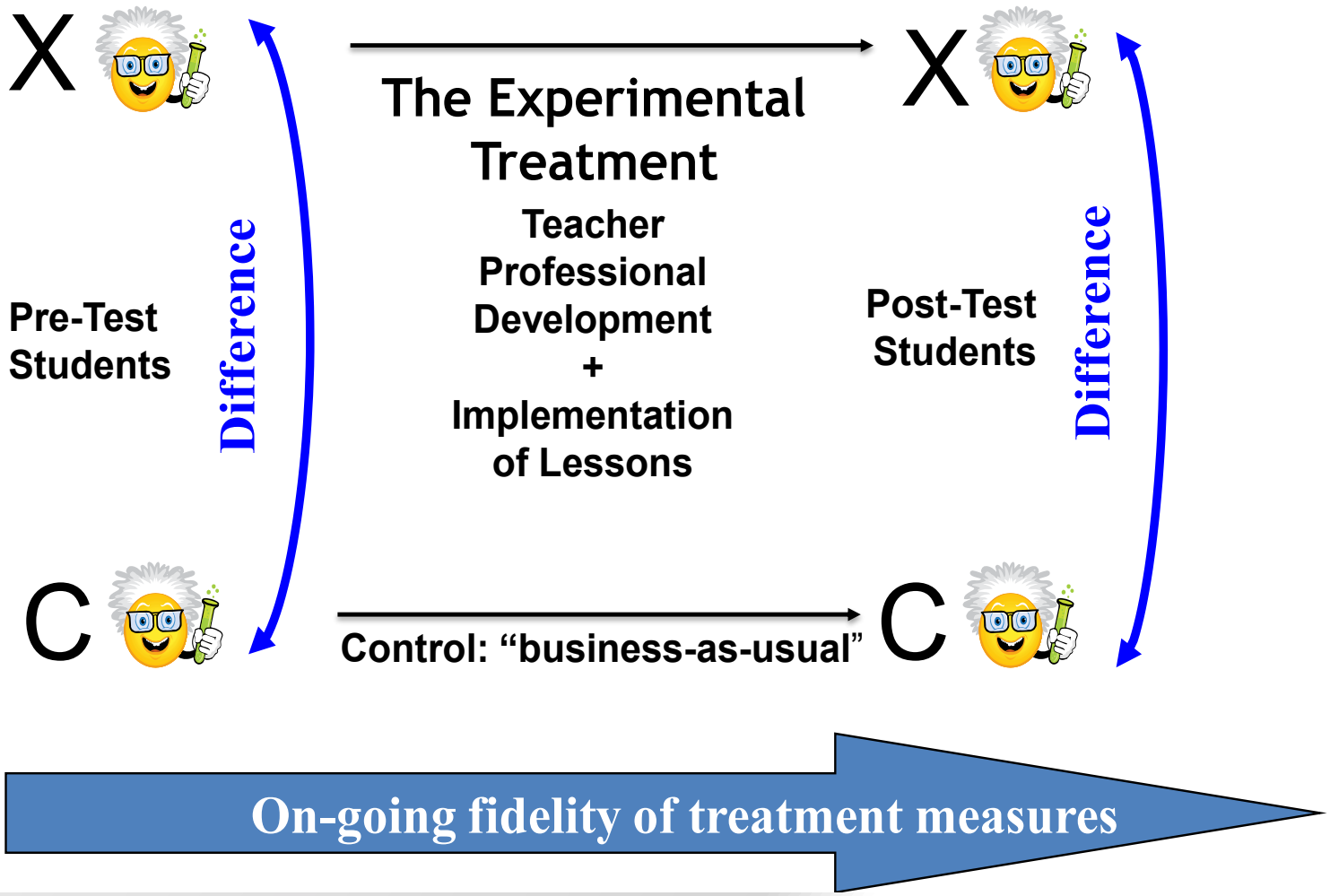


A study of national significance

Science Study Design

- Test a model of *Curriculum Integration*
- Random assignment of teachers to experimental or control conditions
- Two replications: agriculture, health science
- One semester test (spring 2011)
- Mixed-methods: quantitative and qualitative
- Focused on naturally occurring science (embedded in CTE curricula)
- Intense focus on *Fidelity of Treatment*

The Research Design



Science-in-CTE Experimental Treatment:

1. Professional Development—one semester
   - Dec PD (2 days) – Mapping and lesson creation
   - Jan PD (2 days) – Lesson creation; scope and sequence
   - Early Spring PD (2 days) – Lesson critique
   - Ongoing support; pre and post reports

2. Pedagogic framework
   6 Elements adapted for science

NRC Science-in-CTE

Fidelity of the Treatment

- Pre- and posttest teacher questionnaires
- Science teacher pre-teaching reports
- CTE teacher post-teaching reports
- Instructional artifacts
- Focus groups
- Video teaching tapes

NRC Science-in-CTE

Sample

- Initially, 1429 secondary students at both sites
- 3 cases removed due to absence of teacher codes
- 34 cases removed due to large number missing either pretest or posttest data in two classes
  - Could not be imputed because not missing at random
- 1392 participants were available for analysis
  - 737 Site 1
  - 655 Site 2

HLM

- Test effects of the intervention on science achievement
  - 2-level model that incorporated both student and classroom level predictors into a single analysis
- We chose HLM for 3 reasons:
  - testing data were from students nested in classrooms
  - allows us to treat the intervention as a characteristic of classrooms and test its effects at level 2, a more accurate statistical representation of our procedure.
  - allows us to control for the possibility that the

Model Characteristics

Student level predictors:		
Pretest quartile	Representing quartile on pretest science achievement for each student	1st quartile = 0, 2nd quartile = 1, 3rd quartile = 2, 4th quartile = 3
Classroom level predictors:		
Group	Representing the treatment condition for each classroom	Control group = 0, treatment group (1st treatment) = 1
Class mean pretest score	Representing average pretest science score for each classroom	

Equations:

The level-1 model including the within class variables listed above:

$$\text{Posttest math achievement}_{ij} = \beta_{0j} + \beta_{1j}\, \textit{pretest quartile}_{ij} + r_{ij}$$

The level-2 model including the between class variables listed above:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}\, \textit{group}_j + \gamma_{02}\, \textit{class mean pretest score}_j + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}\, \textit{group}_j + \gamma_{12}\, \textit{class mean pretest score}_j + u_{1j}$$

Note. Bolded predictors were grand mean centered.

Descriptives

	N	Mean	SD	Min	Max
		Site 1			
		Level 1 Variables			
Posttest Num Correct	737	23.45	6.11	4.00	38.00
Pretest Quartile	737	1.40	1.16	0.00	3.00
		Level 2 Variables			
Group	30	0.50	.51	0.00	1.00
Class Mean Pretest	30	14.18	1.77	10.50	18.21
		Site 2			
		Level 1 Variables			
Posttest Num Correct	655	20.66	6.42	5.00	38.00
Pretest Quart	655	1.31	1.10	0.00	3.00
		Level 2 Variables			
Group	30	.47	0.51	0.00	1.00
Class Mean Pretest	30	12.78	1.51	9.71	15.68

Every increase in pretest quartile corresponds to this increase in mean posttest score.

Being in a treatment classroom did not have a significant effect on mean posttest score.

For 7000's, every increase in classroom mean pretest score is associated with this increase in mean posttest score.

Level 2 Models

Student and Classroom-Level Predictors of Mean Posttest Science Achievement

Parameter	Site 1	Site 2
Student level predictors of mean science achievement:		
Intercept (γ_{00})	16.83(.47)***	15.72(1.44)***
Pretest quart (γ_{10})	4.06(.25)***	4.89(1.25)**
Classroom level predictors of pretest quartile slope (i.e., γ_{10}):		
Group (γ_{11})	-.28(.34)	-.32(.19)
Class mean pretest (γ_{12})	0.00(.10)	.34(.50)
Classroom level predictors of mean science achievement (i.e., γ_{00}) :		
Group (γ_{01})	.67(.65)	-.19(.66)
Class mean pretest (γ_{02})	.31(.20)	.82(.21)**
Variance Components:		
Var. in intercept (τ_{00})	1.39(1.18)**	1.40(1.18)**
Var. in pretest quartile slope (τ_{11})	.39(.62)**	1.09(1.04)
σ^2	13.57(3.68)	15.67(3.96)

Note. Standard errors for parameters are in parentheses. Standard deviations for variance components are in parentheses.
*p<.05 **p<.01 ***p<.001

Summary of Preliminary Analysis:

Treatment was associated with an effect that was not statistically significant.

- Outcome measure included many domains of science achievement.
- Not all domains were targeted by the intervention.
  - Thus, scores in non-targeted domains may wash out effects on targeted domains.
- In addition, there is a large amount of within groups variance remaining.
  - Controlling for demographic variables may reveal significant among some individuals.
- Future analyses will test for statistically significant effects in targeted science domains only and control for covariates.

Continuing Analyses

- Test sensitivity: *Did the test measure what students actually learned?*
  - Less than 50% match
  - Item analysis underway
- Teacher experience: *What were challenges, benefits, successes?*
- Fidelity: *To what extent did teacher implement?*
  - Teaching reports
  - Video teaching tapes
  - Focus groups
  - Artifacts

Teacher Experience: Challenges …

- Issues of time related to:
  - Changing the way/method of teaching
  - Time to teach using inquiry methods
  - Planning for laboratories
  - Should be a year-long intervention beginning in fall
  - Fit to existing curriculum--mismatch
- Affordability of/access to lab materials
- MN snow storm at a critical juncture

Teacher Experience: Benefits/success

- Opportunity to examine, think about what we teach
- Collaboration with other teachers
- Partnerships with science teachers
- Reinforcing science concepts from “both sides”
- Kids liked the laboratories -- the inquiry!
- Overall, a worthwhile experience

Science teacher comments:

- “Window into the CTE world…”
- Appreciation for what ag teachers do:
- The interconnectedness of CTE and science content
- Opportunities to interact with other science teachers
- Opportunities to learn CTE applications

Literacy-in-CTE

Research Purposes

- Purpose
  - Determine impact of reading strategies on comprehension and vocabulary for students enrolled in CTE
- Objective
  - Compare the effects of reading strategy instruction under a control condition and two models of content-area reading interventions: Ash Framework and MAX Teaching

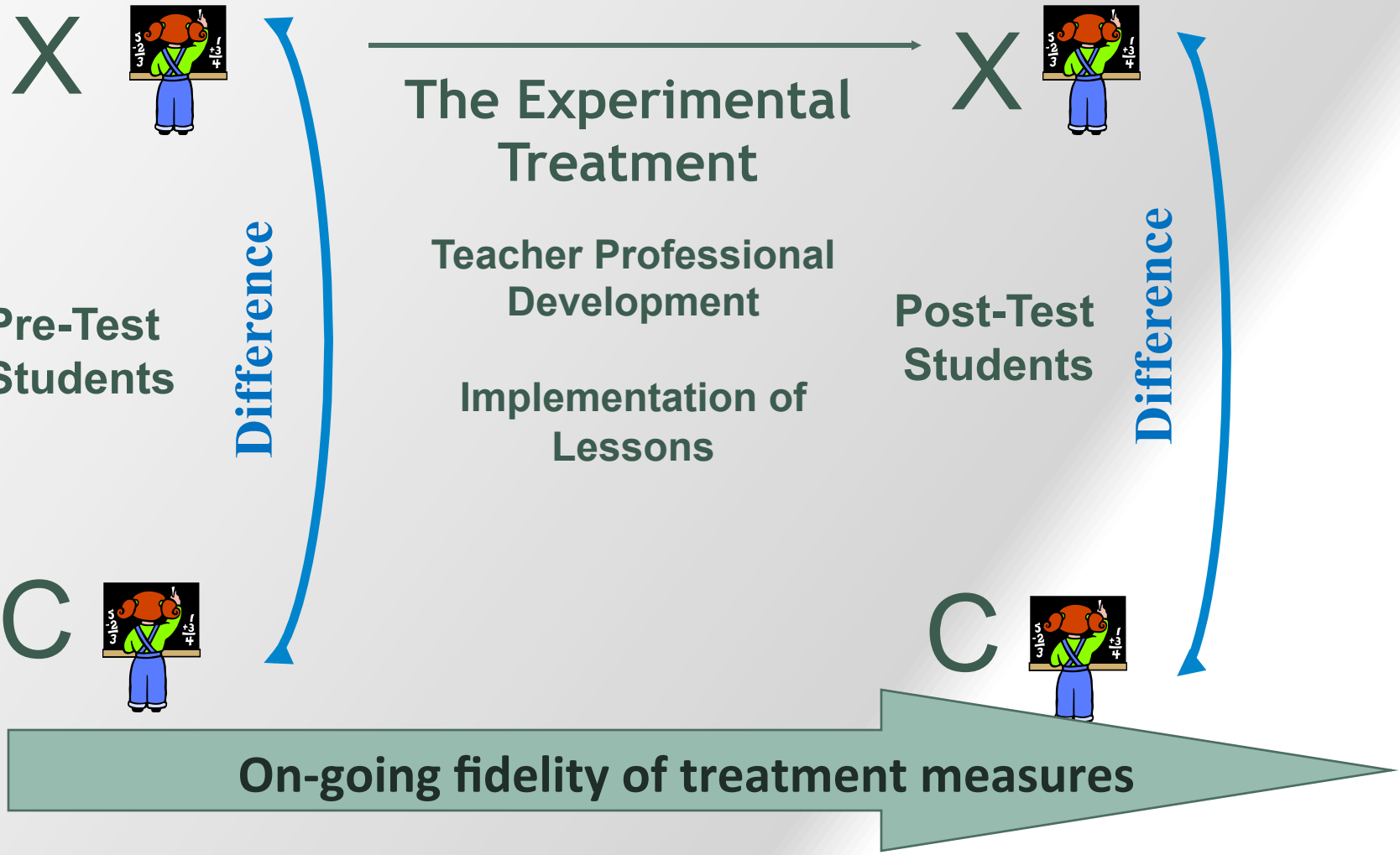
Literacy-in-CTE

- 96 teachers in 3 groups
  - 15 returning teachers
- Prof Dev: July - August 2009
  - 2.5+ days
- Treatment period: September 17 – April 9
- Weekly teacher reports of reading activities

Experimental design

- Random Assignment
- Pretest only
  - Demographic survey
- Pretest and posttest
  - Gates-MacGinitie Reading Test (~50 min)
    - Grade level 7-9
    - Forms S & T

The Research Design



Teachers

Group	NY	SC	Total
X 1. MAX	14	14	**28**
X 2. Ash	13	12	**25**
X 3. MAX Y2	15	---	**15**
X 4. Control	9	19	**28**
Total	**51**	**45**	**96**

Students

Demographic	Overall	Control	MAX	Ash	MAX Y2
NY	57.0	28.1	51.8	63.3	100.0
SC	43.0	71.9	48.2	36.7	---
Female	56.9	63.9	56.7	47.8	72.3
11-12th grade	69.6	67.9	58.9	62.7	97.5
White	61.1	55.2	58.3	55.1	84.3
FRPL	38.8	40.4	44.0	34.9	36.6
Mother $\leq$ HS	32.0	31.3	33.4	27.7	38.7
Father $\leq$ HS	35.6	33.0	36.6	32.7	43.7

Students

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FRPL	38.8	40.4	44.0	34.9	36.6
Mother $\leq$ HS	32.0	31.3	33.4	27.7	38.7
Father $\leq$ HS	35.6	33.0	36.6	32.7	43.7

Coop Learning & Skills Acquisition

	MAX	SAM	Coop Learning
Before Reading	**M**otivation Reducing the anxiety and improving the probability of success in reading	Introduction and modeling of the skill	Written commitment and small-group discussion
During Reading	**A**cquisition Individual silent reading for personal interpretation	Guided practice in learning skill	Individual gathering of data for discussion
After Reading	E**X**tension Cooperative construction of meaning through discussion, writing, etc.	Reflection on how the skill worked	Attempt to achieve small group and class consensus

6 Essential Elements for Adolescent Literacy Instruction (Ash)

1.) Guided Reading of Text
2.) Direct Instruction
3.) Peer-Led Discussion of Text
4.) Word Study
5.) Purposeful Oral Reading and Text Production
6.) Inquiry Learning

Strategies

- Think-Pair-Share
- Anticipation Guide
- List-Group Label
- Pre/Post Check
- Cube It!
- Focused Free-Write
- Guided Rdg Proc
- Preview NF Text
- PRep

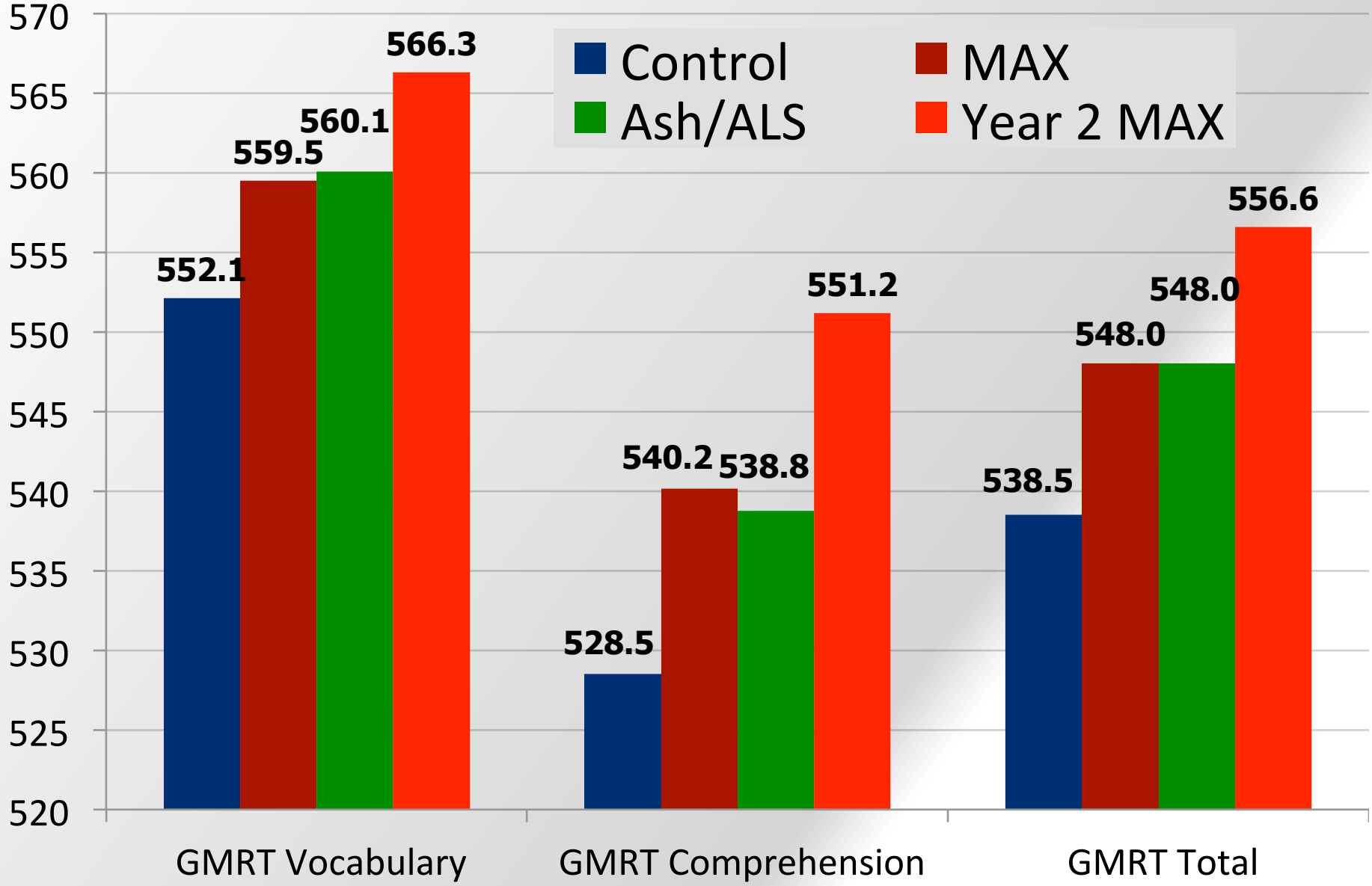
- DRTA
- 3-Level SG
- Cornell Notes
- Jigsaw
- Stump the Teacher
- GIST
- Paired Reading
- I-Charts
- Hunt for Main Ideas

- Think-Pair-Share
- Pre/Post Check
- Cube It!
- Focused Free-Write
- RAFT

Before Motivation → During Acquisition → After eXtension

	Pretest		Posttest	
Group	ESS Mean	Raw Mean	ESS Mean	Raw Mean
GMRT Vocabulary				
Control	554.48	30.31	552.10	29.28
MAX	554.94	30.55	559.48*	31.07
Ash	553.83	30.24	560.05*	31.09
MAX Y2	555.00	30.44	566.30*	32.56
GMRT Comprehension				
Control	537.06	29.94	528.52*	27.25
MAX	546.34	32.81	540.17*	30.73
Ash	539.38	30.82	538.76	30.24
MAX Y2	543.53	31.75	551.18*	33.40
GMRT Total				
Control	544.16	60.24	538.50*	56.53
MAX	549.02	63.36	548.04	61.80
Ash	545.04	61.07	548.02*	61.28

Posttest – ESS Means



Which strategies did teachers use?

MAX

- Cornell notes
- Hunt for main ideas
- Previewing nonfiction text
- Pre/Post learning concepts checks
- Focused free writes
- Paired reading
- Guided reading procedure
- Anticipation guide

Ash

- Anticipation guide
- Directed Reading-Thinking Activity
- Inquiry Charts
- Vocabulary from context
- List-Group-Label
- GIST

Teachers' use of strategies

How?

- Used strategies more early in week
- Asked students for feedback about which strategies worked best
- ↑ assigned reading: ↑ student engagement
- Adult learning approach
  - Learner feedback
  - Utility value

Why?

- Selected strategies that were easy to implement
- Strategies helped students learn
- Transitioned learning to students
- Teachers actually "taught" less

What Makes Integration Work?

Common Findings Among the NRCCTE Studies…

Core Principles

- Begin with the CTE curricula, not with academics
- Approach academics as essential workplace skills
- Maximize the academics in CTE
- Support CTE teachers as “teachers of academics-in-CTE”; not as academic teachers
- Foster and Sustain a Community of Practice

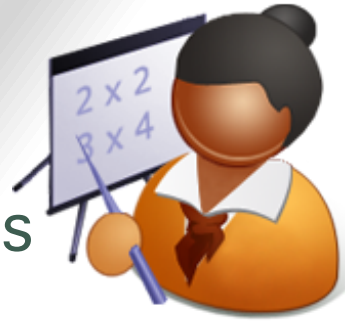
3 levels of integration

System

- Administrative commitmen
- Funding support
- Logistical support

Curricular

- Opportunities in courses
- Coherence through programs



Instructional

- Pedagogic framework
- Teacher skill/performance

A Process and A Pedagogy

a process and a pedagogy through which to enhance and teach the embedded academics within existing CTE curricula

Changing the Paradigm in Practice

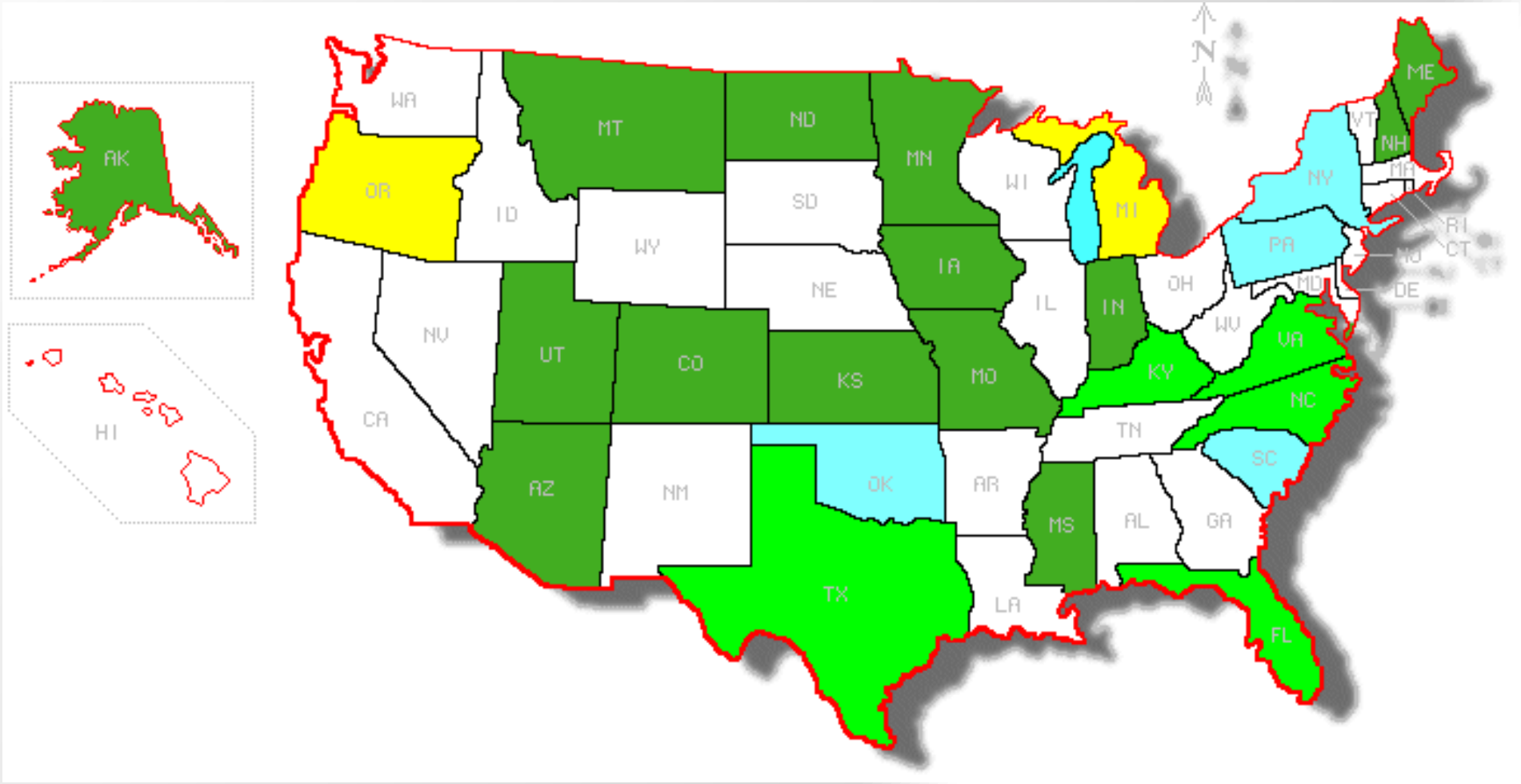
Old Models

- A *box* of curriculum
- Short term "training"
- Little or no support after the "sage on the stage" goes away
- Replicable by individual teachers (assumed)

New Models

- Process not an event
- Built on communities of practice
- On-going support – the learning curve
- Requires teams of committed teachers working together over time

Math and Literacy TA-PD



CI Professional Development

- 10 days (60+ hours)
  - Summer = 5 days
  - Fall = 2 days
  - Winter = 2 days
  - Spring = 1 day
- ≤ 40 teachers
- Variety of CTE areas, but clusters of 5+ teachers/area
- Bi-monthly accountability

Questions?

Thank you!!!

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NRCCTE Website
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Math

A. Contextual, situated
B. Exact
C. Systematic
D. CTE curriculum-driven
E. Concept-oriented
F. Math partner essential
G. Single CTE area
H. Stigmatizing
I. Fidelity/accountability reports after lessons
J. Transferrable

Literacy

a) Contextual, situated
b) Subjective, inferential
c) Continual, daily
d) CTE teacher-driven
e) Process-oriented
f) Literacy partner optional
g) Multiple CTE areas
h) More stigmatizing
i) Bi-monthly fidelity reports
j) Transferrable