Maximizing the Academics in CTE: The NRCCTE Curriculum Integration Studies

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NRCCTE Partners

- University of Louisville
- University of Minnesota
- Clemson University
- Cornell University
- SREB
- NOCTI
- AED
- ACTEonline
- State Directors
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

- TerraNova: p = .02
- AccuPlacer: p = .03
- WorkKeys: p = ns

Experimental Classes: [Bar Color]
Control Classes: [Bar Color]
“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


305
295*
150
147*

1.5 Credits
3.2 Credits

New Scale
2. A 3-kg object is released from rest at a height of 5 m 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.

(a) Find $x$.

(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.
Science-in-CTE Study Questions

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

- **Pre-Test Students**
- **Post-Test Students**
- **Control: “business-as-usual”**

The Experimental Treatment

- Teacher Professional Development
- Implementation of Lessons

On-going fidelity of treatment measures
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
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
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 classrooms differed on pretest science.

# Model Characteristics

**Student level predictors:**

- **Pretest quartile**
  - Representing quartile on pretest science achievement for each student
  - 1\(^{st}\) quartile = 0, 2\(^{nd}\) quartile = 1, 3\(^{rd}\) quartile = 2, 4\(^{th}\) quartile = 3

**Classroom level predictors:**

- **Group**
  - Representing the treatment condition for each classroom
  - Control group = 0, treatment group (1\(^{st}\) 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:

\[
\text{Posttest math achievement}_{ij} = \beta_{0j} + \beta_{1j} \text{ pretest quartile}_{ij} + r_{ij}
\]

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

\[
\beta_{0j} = \gamma_{00} + \gamma_{01} \text{ group}_j + \gamma_{02} \text{ class mean pretest score}_j + u_{0j}
\]

\[
\beta_{1j} = \gamma_{10} + \gamma_{11} \text{ group}_j + \gamma_{12} \text{ class mean pretest score}_j + u_{1j}
\]

**Note.** Bolded predictors were grand mean centered.
## Descriptives

<table>
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<tr>
<th>Site 1</th>
<th>Level 1 Variables</th>
<th>N</th>
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<tr>
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<td>0.51</td>
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<td>9.71</td>
<td>15.68</td>
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</table>
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.

<table>
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<tr>
<th>Parameter</th>
<th>Site 1</th>
<th>Site 2</th>
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<tr>
<td>Intercept ( (γ_{00}) )</td>
<td>16.83(0.47)***</td>
<td>15.72(1.44)***</td>
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<tr>
<td>Pretest quart ( (γ_{10}) )</td>
<td>4.06(0.25)***</td>
<td>4.89(1.25)**</td>
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<tr>
<td>Group ( (γ_{11}) )</td>
<td>-.28(0.34)</td>
<td>-.32(0.19)</td>
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<td>Class mean pretest ( (γ_{12}) )</td>
<td>0.00(0.10)</td>
<td>.34(0.50)</td>
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<tr>
<td>Group ( (γ_{01}) )</td>
<td>.67(0.65)</td>
<td>-.19(0.66)</td>
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<tr>
<td>Class mean pretest ( (γ_{02}) )</td>
<td>.31(0.20)</td>
<td>.82(0.21)**</td>
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<tr>
<td>Var. in intercept ( (τ_{00}) )</td>
<td>1.39(1.18)**</td>
<td>1.40(1.18)**</td>
</tr>
<tr>
<td>Var. in pretest quartile slope ( (τ_{11}) )</td>
<td>.39(0.62)**</td>
<td>1.09(1.04)</td>
</tr>
<tr>
<td>( σ^2 )</td>
<td>13.57(3.68)</td>
<td>15.67(3.96)</td>
</tr>
</tbody>
</table>

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
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

- Pre-Test Students
- Post-Test Students

The Experimental Treatment
- Teacher Professional Development
- Implementation of Lessons

On-going fidelity of treatment measures
<table>
<thead>
<tr>
<th>Group</th>
<th>NY</th>
<th>SC</th>
<th>Total</th>
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<tr>
<td>1. MAX</td>
<td>14</td>
<td>14</td>
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</tr>
<tr>
<td>2. Ash</td>
<td>13</td>
<td>12</td>
<td>25</td>
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<tr>
<td>3. MAX Y2</td>
<td>15</td>
<td>---</td>
<td>15</td>
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<tr>
<td>4. Control</td>
<td>9</td>
<td>19</td>
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<td><strong>Total</strong></td>
<td>51</td>
<td>45</td>
<td>96</td>
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# Students

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<tr>
<th>Demographic</th>
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<th>MAX</th>
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<td>Female</td>
<td>56.9</td>
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<td>11-12&lt;sup&gt;th&lt;/sup&gt; grade</td>
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<td>58.9</td>
<td>62.7</td>
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<td>58.3</td>
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<td>FRPL</td>
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<td>Mother ≤ HS</td>
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<tr>
<td>Father ≤ HS</td>
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<td>32.7</td>
<td>43.7</td>
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## Students

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<th>Overall</th>
<th>Control</th>
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<th>Ash</th>
<th>MAX Y2</th>
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<td>58.9</td>
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## Coop Learning & Skills Acquisition

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<td><strong>M</strong>otivation</td>
<td>Introduction and modeling of the skill</td>
<td>Written commitment and small-group discussion</td>
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<tr>
<td></td>
<td>Reducing the anxiety and</td>
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<tr>
<td></td>
<td>improving the probability</td>
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<tr>
<td></td>
<td>of success in reading</td>
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<tr>
<td><strong>During Reading</strong></td>
<td><strong>A</strong>cquisition</td>
<td>Guided practice in learning skill</td>
<td>Individual gathering of data for discussion</td>
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<td>Individual silent reading</td>
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<tr>
<td></td>
<td>for personal interpretation</td>
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<tr>
<td><strong>After Reading</strong></td>
<td><strong>E</strong>Xtension</td>
<td>Reflection on how the skill worked</td>
<td>Attempt to achieve small group and class</td>
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<tr>
<td></td>
<td>Cooperative construction</td>
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<tr>
<td></td>
<td>of meaning through</td>
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</tr>
<tr>
<td></td>
<td>discussion, writing, etc.</td>
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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

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

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

After eXtension
- Think-Pair-Share
- Pre/Post Check
- Cube It!
- Focused Free-Write
- RAFT
- Paired Reading
- I-Charts
- Hunt for Main Ideas
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<td>62.19</td>
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Posttest – ESS Means

Control | MAX | Ash/ALS | Year 2 MAX

GMRT Vocabulary: 552.1 | 559.5 | 556.6
GMRT Comprehension: 528.5 | 538.8 | 538.5
GMRT Total: 540.2 | 548.0 | 556.6
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 commitment
- 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

<table>
<thead>
<tr>
<th><strong>Old Models</strong></th>
<th><strong>New Models</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>A <em>box</em> of curriculum</td>
<td>Process not an event</td>
</tr>
<tr>
<td>Short term “training”</td>
<td>Built on communities of practice</td>
</tr>
<tr>
<td>Little or no support after the “sage on the stage” goes away</td>
<td>On-going support – the learning curve</td>
</tr>
<tr>
<td>Replicable by individual teachers (assumed)</td>
<td>Requires teams of committed teachers working together over time</td>
</tr>
</tbody>
</table>
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
www.nrccte.org
<table>
<thead>
<tr>
<th>Math</th>
<th>Literacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Contextual, situated</td>
<td>a) Contextual, situated</td>
</tr>
<tr>
<td>B. Exact</td>
<td>b) Subjective, inferential</td>
</tr>
<tr>
<td>C. Systematic</td>
<td>c) Continual, daily</td>
</tr>
<tr>
<td>D. CTE curriculum-driven</td>
<td>d) CTE teacher-driven</td>
</tr>
<tr>
<td>E. Concept-oriented</td>
<td>e) Process-oriented</td>
</tr>
<tr>
<td>F. Math partner essential</td>
<td>f) Literacy partner optional</td>
</tr>
<tr>
<td>G. Single CTE area</td>
<td>g) Multiple CTE areas</td>
</tr>
<tr>
<td>H. Stigmatizing</td>
<td>h) More stigmatizing</td>
</tr>
<tr>
<td>I. Fidelity/accountability reports after lessons</td>
<td>i) Bi-monthly fidelity reports</td>
</tr>
<tr>
<td>J. Transferrable</td>
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