Fostering Engaged Academic Literacy for Adolescents Through Literacy Apprenticeships in the Disciplines

Cynthia Greenleaf
Strategic Literacy Initiative
www.wested.org/strategicliteracy
Strategic Literacy Initiative at WestEd

A program of research and development focusing on improving adolescent literacy across subject areas

Mission: To work with communities of educators to support the development of high level academic literacy skills among diverse populations of students, especially academically underperforming youth
Plan for Today

- Review past and current research on adolescent and academic literacies
- Argue that high level literacy for all means inquiry based professional development for all
- Describe the work of the Strategic Literacy Initiative
- Engage you in literacy inquiries (doing “pilates”)
- Share emerging findings from studies in high school content area classes
Taking Aim, Raising our Sights

The nation must reach for high level literacy skills (Heller & Greenleaf, 2007)

We need to move beyond a generalist notion of literacy learning, to identify and explore how to teach high level literacies in the disciplines (Shanahan & Shanahan, 2008)
The argument...

- High level, advanced literacies are discipline-shaped inquiry engagements with texts.
- For students to acquire these literacies, they must be engaged in metacognitive inquiry as a mode of learning
  - (meta-affective, meta-linguistic, meta-discursive)
- For subject area teachers to create such learning environments, they must themselves be engaged in metacognitive inquiry
  - (into their disciplines, texts, reading and discourse processes, student learning, their own teaching)
A Vision of Discipline Shaped Inquiry Engagement with Text
www.wested.org/sli
## Students are Unprepared

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<th>National Assessment of Educational Progress, 2005</th>
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<td>8%</td>
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Students are Unprepared

- Only 30% of high school students graduate as proficient readers who are college-ready (Greene & Forster, 2003)
- Less than 50% of youth who take the ACT are prepared for the demands of college reading (ACT, 2006)
- 35 - 40% of high school graduates lack the reading and writing skills that employers seek (Achieve, Inc., 2005; Kaestle et al., 2001; National Commission on Writing, 2004)
The Literacy Gap Persists

Ethnic and racial minority students and children who live in poverty continue to score disproportionately in the *below basic* category.

In urban schools, about half of incoming ninth grade students read at a sixth or seventh grade level or below (Balfanz et al, 2002)
Vulnerable Students have Restricted Opportunities to Learn

Recent studies indicate that schools and districts are responding to NCLB imperatives by reducing instructional time for social studies, history, and science, particularly for low scoring students (Center for Education Policy, 2006; 2008).
Restricted Opportunity to Learn

• Differences in track assignments and instruction contribute significantly to the literacy achievement gap in middle and high schools (Gamoran & Kelly, 2003; Oakes, 1995)

• Not surprisingly, research evidence suggests that students’ academic achievement is closely related to the rigor of the curriculum (Barton, 2003; Langer, et al., 2005).
A Matter of Equity

The downward spiral...

If students do not have the opportunity to learn subject area knowledge, concepts and vocabulary, their capacity to read a broader range of texts will be further diminished (Alexander & Jesson, 2000; Cunningham & Stanovich, 1998; Hirsch, 2007; Stanovich, 1986).
Reading as Literate Social Practice
### History of Reading Instruction for Older Students (Jacobs, 2008)

#### Skill Instruction 1800s – 1970s
- **What**: sequential, remedial skills: decoding, fluency, reading speed, vocabulary, comprehension, and study skills
- **Who**: Reading specialists, Supplementary instruction through Title I

#### Reading Process Models 1960s – 1990s
- **What**: Meaning making activity: linguistic, psychological, cognitive, affective processes – “high level” and “critical” reading
- **Who**: Content area reading, reading across the curriculum as a means to access content (middle and high school content area teachers)

#### Reading as Literacy 1980s - present
- **What**: Multiple literacies used for social purposes, shift to content literacy
- **Who**: Middle and high school content area teachers
Recent Conceptions of Reading as Literacy Practice

- Literacy is a social, cultural, and cognitive activity shaped by situation and context of use (e.g. Scribner & Cole, 1983, Street, 1995).

- Academic literacy can be described as the reading, writing, and discussion practices that support participation in discipline-based work (Bazerman & Russell, 1994, 2003; Bereiter & Scardamalia, 1987; Hynd, 1998).

- Explicitness about school-based literacy practices is necessary to help diverse students participate successfully in these practices (Delpit, 1995; Lee, 1995).
Recent Views of Adolescent Literacy

• Diversity is the norm; interpretive practices vary across communities and disciplines (Heath, 1983; Gee, 1996)

• Adolescents bring aesthetic, cognitive, cultural, and linguistic knowledge and experiences to the work of literacy (Alvermann, 2002; Heath & McLaughlin, 1995; Jimenez, 2000; Lee, 1995; Moje, et al., 2008; Moll, 1992; Tatum, 2008)

• Tapping into the literacies in adolescents’ lives and inquiry-based instruction can engage students in active learning (Bean, Bean, & Bean, 1999; Guthrie, et, al, 2000; Moje, et al, 2000; Tatum, 2008)
Recent Conceptions of Learning as Socially Mediated Participation

• Advanced psychological processes are acquired through socially and culturally mediated activity (Vygotsky, 1978)

• Learning can be understood as the increasing capacity to participate in communities of practice (Lave & Wenger, 1998)
  – To learn science is … to learn how each new generation of scientists re-makes our view of the world. Ultimately it is to learn how to have some degree of participation in this process of invention and discovery. (Lemke, 1999)
  – [Subject-matter] knowledge includes an ability to transform disciplinary knowledge so that novice learners can participate in discipline-specific ways of understanding the world around them. (Holt-Reynolds, 1999)
Academic Disciplines Participate in Distinct Literacy “Practices”

Specialized ways of reading, writing, speaking and reasoning that are specific to an intellectual discipline

– Particular reasons to read and write

– Conventional forms of text & means of representation

Valued reasoning processes

– Traditions of argumentation: What counts as a good question, evidence, problem, or solution
Distinct Literacy Practices Support Discipline-Based Tasks

- Proof in algebra or geometry
- Document analysis in history
- Hypothesis generation and inquiry design in science
- Thematic and symbolic analysis in literature
Preparing Students for Advanced Literacies

Students are [profoundly] inexperienced and unprepared to engage in academic literacies, but they are not beginning readers.
Strategic Literacy Initiative Program of Research and Development

How can we provide diverse adolescents with the means to participate successfully in the complex literacy practices they encounter in school and beyond?
Findings from Case Studies of Literacy Learners

- Students hold powerful misconceptions of reading and learning that do not serve them well
  
  “Good readers read fast and know what all the words mean.”
  “Some people can just read the paragraph and know what it means. I can’t do that. I’m just not a reader.”

- Students engage in challenging literacy activities outside school that are not tapped in the classroom
  
  “I be up reading the dictionary... I need some words for my poetry... My mind should be more focused on school than on my reading and stuff.”

- Students are profoundly inexperienced with advanced academic literacy tasks
Findings from Case Studies of Literacy Learners

- Students have abundant experience with low level literacy tasks that do not engage them in disciplinary reading and reasoning.

  “I know the teacher will go over it and tell us what it means, so I don’t have to read it.”

  “I don’t know if they care, but no one reads the textbook. You just look for the answer to the questions at the end of the section. You can slide by without them knowing.”

  “I’m going to be honest with you: I don’t read the stuff, I just go back to the question…It’ll tell me this word and I’ll be like, ‘Let me go back and find the word.’”
Findings from Case Studies of Literacy Learners

- Teachers misread students’ literacy performances as evidence of inability (Hull & Rose, 1989; Greenleaf, Hull, & Reilly, 1994).

- Teachers reduce expectations, “teach around the text” and resort to “telling” students what texts say and mean (Schoenbach & Greenleaf, 1999).

- Teachers do not have the resources they need to support diverse learner needs (Heller & Greenleaf, 2007).

- Students have increasingly limited opportunities to read and gain advanced literacy proficiencies.
Findings from Case Studies of Literacy Learners

• With support, underachieving students learn to read complex texts and successfully tackle comprehension problems.

• Mentoring these students in the reading and reasoning processes of the discipline can change their beliefs about learning and increase their engagement in school.
<table>
<thead>
<tr>
<th>Cognitive Strategy Instruction for Adolescents (Conley, 2008)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Dominance of cognitive strategy instruction in adolescent literacy reform</td>
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<tr>
<td>• Under-prepared students need tools for reasoning with complex texts</td>
</tr>
<tr>
<td>• Distinction between using cognitive strategies as a “teaching tool” versus helping students acquire strategies as “learning tools”</td>
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<tr>
<td>– Doing graphic organizers versus doing historical inquiry</td>
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Classroom Literacy Practices Shape Student Conceptions

• What we ask students to read, how we ask them to read, and to what ends, shapes not only their conceptions of reading, but also their conceptions of the disciplines (Greenleaf, et al., 2001; Schoenbach & Greenleaf, in press)

• The tasks teachers ask students to do as they work with subject area texts powerfully influence students’ beliefs about their capacities and identities as learners (Committee on Increasing High School Students’ Engagement, 2004).
Fostering Engaged Academic Literacy for Adolescents

- Dispositions for engagement in academic tasks
  - Curiosity, tolerance for ambiguity, persistence, stamina, confidence
- Text-based problem solving capacities
- Discipline-based literacy practices
- Resilient learner identities
  - *Code breaker* stance
  - When we ask students to learn something new, we ask them to become someone new (Feldman, 2004)
Reading Apprenticeship

A partnership of expertise between teacher and students

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The Reading Apprenticeship Instructional Framework

**Social Dimension**
- Creating safety to support collaborative problem solving in science & reading
- Investigating relationships between literacy, science learning and power
- Sharing science-related book talk
- Sharing science reading processes, problems, and solutions
- Noticing and appropriating others' ways of reading in science

**Personal Dimension**
- Developing science reader identity
- Developing metacognition in science reading
- Developing fluency and stamina for science reading
- Developing confidence with a range of written science materials
- Assessing science reading performance and setting goals

**Cognitive Dimension**
- Getting the big picture
- Breaking down science reading
- Monitoring comprehension with written science materials
- Using science-specific problem-solving strategies to assist and restore comprehension
- Setting science-specific reading purposes and adjusting reading processes

**Knowledge-Building Dimension**
- Mobilizing and building on prior science knowledge structures
- Developing science knowledge
- Developing knowledge of science vocabulary
- Developing knowledge and use of the text structures of science curriculum materials
- Developing scientific discourse
- Developing scientific reasoning

Metacognitive routines make normally invisible disciplinary reasoning processes visible and available for assessment, modeling, and coaching during reading, problem solving, and inquiry activities.
The Reading Apprenticeship Instructional Framework

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<th>PERSONAL DIMENSION</th>
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Goals for Students In Reading Apprenticeship Classrooms

- Engage in more reading with instructional support
- Gain insight into and take control of their own reading processes
- Practice problem solving to overcome obstacles in their reading of subject area texts
- Develop their own motivations for reading ~ even of very challenging materials
Preparing Teachers

My students can’t, don’t, won’t read
I don’t know how to teach reading
I have too much to cover to add anything else
Besides, it’s not my job
Raising our Sights: Expert Teaching for Diverse Students

- Responding with insight into students’ thinking (Cazden & Mehan, 1989)
- Deep subject matter knowledge (Alvermann, 2002)
- Complex and responsive interactions with learners in the dynamic flow of teaching (Ball & Cohen, 1999)
- Understanding tasks from the point of view of learners (PCK - Shulman, 1986)
- Interaction of texts, tasks, and learners (Darling-Hammond & Sykes, 1999)
Content Area Teachers Feel Unprepared

- don’t have training to be “reading teachers”
- don’t have time to “stop and teach reading” in addition to their subject areas (Jacobs, 1999; Jacobs & Wade, 1981)
- are not necessarily members of disciplinary discourses (Draper, 2008)
- don’t know how to help students who struggle with their classroom materials (Dupuis, 1984)
Content Area Teachers Have Untapped Knowledge and Expertise

- may not be cognizant of the literacy demands of their subject areas (Heller & Greenleaf, 2007; Shanahan & Shanahan, 2008)
- are largely unaware of their own specialized literacy expertise (Greenleaf & Schoenbach, 2004; Greenleaf & Katz, 2004).
- need to learn to see past their “expert blind spots” (Braunger, et al., 2006; Nathan & Petrosino, 2003)
Preparing Secondary Teachers to Teach Content Literacies

- All secondary school teachers should receive initial and ongoing professional development in the literacy of their own content areas (Heller & Greenleaf, 2007).
- Research is needed to clarify how cognitive strategies operate in content-area classrooms, how teachers can effectively integrate these strategies in complex domains (Conway, 2008).
- Pre-service and in-service efforts do not provide teachers with the means to examine why and how reading strategies can facilitate learning (Jacobs, 2008).
Model of Knowledge Development in Diverse Communities of Practice

- Data Collection
- Research and Analysis
- Theory, Model, and Tool Development
- Documentation

Feedback

Engagement with Communities of Practice

Dissemination

Engagement with Broader (Distal) Communities

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An Inquiry Approach to Professional Development

• Supported opportunities to engage in challenging (advanced) literacies within disciplines
• Collaborative problem solving to make meaning
• Metacognitive inquiry and conversation

“The primary question was not what do we know, but how do we know it.” – Aristotle
Inquiry Models for Building Insight into Literacy and Learning

- Teacher Self Study (Florio-Ruane & DeTar, 1995)
- Literacy Inquiry (Graves, 1989; Wells, 2002)
- National Writing Project Institutes (Smith, 1996; Lieberman & Wood, 2001)
- Task Analysis (Hillocks, 1995)
- Genre Study (Luke, 1999; Rabinowitz, 1987; Rabinowitz & Smith, 1998)
Inquiry Models for Building Insight into Literacy and Learning

- Teacher Action Research (Cochran-Smith & Lytle, 1992)
- Practical Argumentation (Fenstermacher & Richardson, 1993; Richardson, 1994)
- Problem-Solving Case Methods (Barnett, 1991; Moje & Wade, 1997; Risko, 1995)
- Cognitively Guided Instruction (Franke, et al., 2001)
- Collaborative Student Assessment (Wilson & Sloane, 2000)
- Japanese Lesson Study (Lewis, Perry & Hurd, 2004)
Reading Process Inquiries

Turning insights into assets for instruction
Preparing Secondary Teachers to Teach Content Literacies

“You must experience it in your own body before you can help others.” Pilates Training Institute, 2008

Teaching takes place on the ‘outside,’ and learning mostly goes on ‘inside.’ So much professional development is focused on the outside, yet it needs to be focused on the inside.” Teacher leader, 9/2002

Inquiry into reading processes, the demands of disciplinary texts, and student reading helps teachers develop generative knowledge of reading that can transform classroom practice from within (Greenleaf & Schoenbach, 2004).
Practicing Pilates: Building the Core Strength of the Profession

• Bringing automatic processes under deliberate control
• Role of metacognition in new learning
  – Awareness
  – Ability to monitor and assess task performance
  – Ability to orchestrate problem solving processes
• Role of coaching/mentoring in performance
• Role of frequency in generating new habits
# Practicing Metacognitive Inquiry

- Bringing automatic reading and reasoning processes under deliberate control (Bransford, Brown & Cocking, 2000; Pressley, 2002)
- Role of metacognition in making expertise available for teaching
  - Awareness of reading and reasoning processes
  - Ability to monitor and assess comprehension
  - Ability to identify, name, and orchestrate problem solving processes
Personal Science Reading History

Write about some key moments or events in your development as a thinker, reader, learner, and “do-er” of science:

– What experiences, materials, reading, activities stand out for you? High points? Low points?
– Were there times when your experiences made you feel like an insider? Like an outsider? What happened?
– What supported your development as a learner of science? What discouraged it?
Personal Science Reading History

Pair Share and Discussion:

– Share some highlights of your science history with your partner. [Take 2 min. each]
– Discuss: What were some commonalities? What were some surprises?
– What kinds of experiences supported your development as a learner of science? What kinds of experiences discouraged it?
– What are some implications for the classroom?
Reading Process Inquiry with a High School Biology Textbook

How do you read a science illustration?

What are the meaningful text signals and conventions?

Ex.: Here, what does an arrow mean?

FIGURE 6-5
The light reactions take place in the thylakoid membrane and involve several steps. Step 1: Light excites electrons in chlorophyll a molecules of photosystem II. Step 2: These electrons move to a primary electron acceptor. Step 3: The electrons are then transferred along a series of molecules called an electron transport chain. Step 4: Light excites electrons in chlorophyll a molecules of photosystem I. As these electrons move to another primary electron acceptor, they are replaced by electrons from photosystem II. Step 5: The electrons from photosystem I are transferred along a second electron transport chain. At the end of this chain, they combine with NADP⁺ and H⁺ to make NADPH.
Capturing Your Reading Process

• Even if you weren’t explicitly aware of them while you were reading, what strategies did you use?
• What got in the way of your reading?
• What comprehension problems did you solve?
• What problems, if any, remain unsolved?
What Does Discipline-Based Literacy Instruction Look Like?

- Underperforming high school, Title 1
- ~ Half of the class scored below 10th percentile on standardized reading tests
- Only two students scored above 25th percentile
- Introduction to Chemistry, midway through the academic year
What Does Discipline-Based Literacy Instruction Look Like?

- What are these students learning about the subject?
- What are these students reading?
- What are these students learning about reading and writing in particular content areas?
- What supports them in doing this work?
Toward the Responsive Teaching of Discipline Specific Literacies
Design Principles in Professional Development

- Connections to teachers’ experience, disciplinary commitments, and expertise
- Practice “making thinking visible” with varied subject area texts and investigations
- Collaborative, metacognitive learning experiences embedded in content that model target classroom practices
- Opportunities to explore student reading and thinking in the context of content learning
Designing Literacy Inquiries

Capturing Your Reading Process (Graves, 1989)
Think-Aloud with Disciplinary Texts (Pressley, 2002)
  Open-ended Problem-Solving, Strategic

Close Readings
  What do I know? How do I know it? (Bransford, Pearson)

Discipline-Based Interpretive Strategies
  Rules of notice, significance, coherence, configuration (Rabinowitz, 1989)

Text and Task Analysis (Hillocks 1995; McKeown, et al., 1997)
  Assumed knowledge, language and text features, audience, purpose, function
Goals: Reading Process Analyses

- Experiencing the struggle to comprehend: complexity of literacy tasks, empathy, collegial support
- Building awareness of strategic problem-solving: identifying a repertoire and reservoir for teaching
- Fostering ownership: identifying and embracing discipline-specific literacy practices
Goals: Using and Evaluating Reading Comprehension Strategies

- Experiencing specific instructional approaches and/or comprehension strategies while reading disciplinary texts
- Evaluating the utility of these approaches and/or strategies for particular types of reading
- Refining strategies to meet subject area needs
Goals: Investigating Students’ Literacy Performances

- Developing teachers’ insights into teaching and student learning through case inquiry and assessment protocols
- Recognizing students’ strengths and resources: disrupting deficit views
- Identifying instructional needs and taking responsibility
Close Reading Study: Inquiry-Based PD Results in Teacher Learning

- Teachers transform and enrich their conceptions of reading, reading processes, and texts – often becoming stronger academic readers themselves!
- Teachers shift their thinking about student reading resources, capacity, and difficulty
- Teachers develop a professional identity that embraces their discipline-based literacy expertise
- Teachers develop a language and classroom routines for mentoring students in reading and thinking processes
Close Reading Study: Inquiry-Based PD Results in Teacher Learning

• Teachers gain experience with a repertoire of teaching strategies
• Teachers become facilitators of subject area learning and literacy mentors to students
• Teachers adaptively generate a variety of ways to integrate comprehension instruction into content area teaching, even “on the fly”
• Teachers positively impact student reading achievement
RA Classroom Study: Differential Uptake

- Reading Opportunities in Subject Areas
  - Role of text, volume of text, range of text
- Degree of Integration of Literacy and Discipline
  - Up-front instruction, “metacognitive Mondays”, seamless
- Degree and Nature of Support
  - Mentioning mental tools, didactic strategy instruction, mentoring in disciplinary thinking
RA Classroom Study: Features of High Implementation

- More frequent opportunities for supported reading experiences in class
- Explicit teaching of problem solving with a wide range of discipline-based texts
- Abundant and explicit coaching in effective, discipline-based, strategic thinking processes
- Collaborative, inquiry-oriented learning environment
- Fostering of student engagement in worthy, discipline-based tasks
New Discipline-Specific Resources and Tools for Teacher Learning

- Literacy instruction integrated in content
  - Rich text sets
  - Discipline-specific inquiries
- Videotapes of classroom teaching in varied content areas
- Case studies of students learning in varied content areas
- Foregrounding Routines
  - Making Thinking Visible
  - Metacognitive Conversation
NSF and IES Funded Randomized Controlled Studies Underway

- Treatment (PD) aims to integrate literacy instruction into biology or US history teaching through collaborative, metacognitive inquiry.
- Attempts to build and measure science teachers’ implementation integrating literacy and content.
- Targets schools serving African American, Latino, English Learner, and Low SES students.
- Investigates the effects on student learning in both literacy and content.
Hypotheses

**Intervention:** Professional Development in Reading Apprenticeship

- **Increased Teacher Knowledge and Classroom Practice**
- **Integrating Biology or US History and Literacy Teaching**
- **Increased Student Engagement and Achievement in Biology or US History and Literacy**
Reading Apprenticeship Professional Development in Biology - Intervention

5 Day Professional Development Institute
Integrating RA Routines into Biology Content

- Rich biology text sets
- Science investigations
- Cell biology, evolution and genetics
- Metacognitive Routines
- Comprehension Strategies
- Classroom Videos
- Student Case Studies

Ongoing Support

- 5 Additional institute days
  2 in February, 2006
  3 in August, 2006
- Curriculum embedded reading assessment
- Classroom libraries linked to biology curriculum
- List serve with professional community and ongoing mentoring from RA coach
Multiple Measures of Classroom Practice, Student Learning

- Teacher survey of instructional beliefs and practices [T0, T1, T2]
- Teacher assignments/student work in genetics and cell biology; industrialization and WWII
- Teacher interviews
- Classroom observations (subset)
- Student survey of opportunity to learn
- State standardized tests in ELA, biology, and history; DRP
- Integrated Learning Assessment in genetics and cell biology; domestic issues during WWII
Constructs Drawn from Reading Apprenticeship Classroom Study

Content area reading opportunities
Collaborative activities with content area reading
Metacognitive inquiry into reading comprehension and problem solving
Specific comprehension routines, tools, strategies, and processes
Negotiating success
Teaching philosophy
### Biology Teacher Surveys (T0 - T2)

#### T-Tests by Control/Intervention Group

<table>
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<tr>
<th>Construct</th>
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<th>df</th>
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<th>Effect Size</th>
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<td>-1.9</td>
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<td>.06</td>
<td>-.26</td>
<td></td>
</tr>
<tr>
<td>12. Teaching Philosophy: Reading</td>
<td>-2.9</td>
<td>54</td>
<td>.00</td>
<td>-.28</td>
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<tr>
<td>13. Teaching Philosophy: Learning</td>
<td>-1.2</td>
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<td>.27</td>
<td>-.14</td>
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</tr>
<tr>
<td>14. Teaching Philosophy: Diversity</td>
<td>.79</td>
<td>54</td>
<td>.44</td>
<td>.11</td>
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</tr>
</tbody>
</table>
### Biology Teaching Assignments

<table>
<thead>
<tr>
<th>Rubric Dimensions</th>
<th>NSF Genetics Assignments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Intervention, N = 30</td>
</tr>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>Content</strong></td>
<td></td>
</tr>
<tr>
<td>Quality of Goals</td>
<td>7%</td>
</tr>
<tr>
<td>Cognitive Challenge</td>
<td>3%</td>
</tr>
<tr>
<td>Support for Cognitive Challenge</td>
<td>3%</td>
</tr>
<tr>
<td><strong>Literacy</strong></td>
<td></td>
</tr>
<tr>
<td>Quality of Goals</td>
<td>10%</td>
</tr>
<tr>
<td>Literacy Challenge</td>
<td>0%</td>
</tr>
<tr>
<td>Support for Literacy</td>
<td>0%</td>
</tr>
</tbody>
</table>
## Biology Teacher Interviews

<table>
<thead>
<tr>
<th>Construct</th>
<th>Intervention (N=32)</th>
<th>Control (N=25)</th>
<th>p-value</th>
<th>Effect Size (Cohen’s D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading opportunities</td>
<td>2.84 SD = 0.64</td>
<td>2.64 SD = 0.59</td>
<td>NS</td>
<td>0.33</td>
</tr>
<tr>
<td>Support for student reading engagement</td>
<td>2.92 SD = 0.86</td>
<td>2.10 SD = 0.63</td>
<td>&lt;.001</td>
<td>0.95</td>
</tr>
<tr>
<td><em>Metacognitive Inquiry</em></td>
<td>2.55 SD = 0.66</td>
<td>1.68 SD = 0.51</td>
<td>&lt;.001</td>
<td>1.28</td>
</tr>
<tr>
<td>Reading comprehension routines</td>
<td>2.98 SD = 0.75</td>
<td>2.02 SD = 0.80</td>
<td>&lt;.001</td>
<td>1.06</td>
</tr>
<tr>
<td>Collaboration</td>
<td>2.97 SD = 0.62</td>
<td>2.14 SD = 0.44</td>
<td>&lt;.001</td>
<td>1.21</td>
</tr>
</tbody>
</table>
Integrating Literacy and Biology: Changes in Classroom Practice

- Teacher Surveys, Teaching Assignments, and Teacher Interviews show significant differences in instruction for the intervention group, compared to controls
  - Increased teacher support for reading engagement
  - Less lecture
  - More collaborative group work
  - More discussion of science readings
  - More metacognitive inquiry
  - More modeling and guided practice in comprehension routines and strategies
Integrating Literacy and Biology: Student Opportunity to Learn Surveys

<table>
<thead>
<tr>
<th>Treatment/Control Differences in OTL Constructs Based on Full Sample</th>
<th>Treatment Coefficient</th>
<th>S.E.</th>
<th>Z-value</th>
<th>p-value</th>
<th>Treatment Coef/SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emphasis on Reading in Biology</td>
<td>0.234*</td>
<td>0.087</td>
<td>2.71</td>
<td>0.007</td>
<td>0.431</td>
</tr>
<tr>
<td>Student Integration of Biology &amp; Literacy</td>
<td>0.218*</td>
<td>0.075</td>
<td>2.91</td>
<td>0.004</td>
<td>0.340</td>
</tr>
<tr>
<td>Motivation and Effort</td>
<td>0.169*</td>
<td>0.070</td>
<td>2.43</td>
<td>0.015</td>
<td>0.266</td>
</tr>
<tr>
<td>Academic Identity</td>
<td>0.142</td>
<td>0.119</td>
<td>1.20</td>
<td>0.231</td>
<td>0.214</td>
</tr>
</tbody>
</table>

Analytic samples consists of 42 schools and 957 students. Random intercept regression model with fixed effects for strata and teachers, and covariates for Hispanic and other language spoken before starting school.
## Integrating Literacy in Biology: Student Opportunity to Learn Surveys

### Treatment/Control Differences in OTL Constructs Based on Partial Sample

<table>
<thead>
<tr>
<th>Treatment/Control Differences in OTL Constructs Based on Partial Sample</th>
<th>Treatment Coefficient</th>
<th>S.E.</th>
<th>Z-value</th>
<th>p-value</th>
<th>Treatment Coef/SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emphasis on Reading in Biology</td>
<td>0.228*</td>
<td>0.089</td>
<td>2.56</td>
<td>0.010</td>
<td>0.418</td>
</tr>
<tr>
<td>Student Integration of Biology &amp; Literacy</td>
<td>0.209*</td>
<td>0.076</td>
<td>2.76</td>
<td>0.006</td>
<td>0.329</td>
</tr>
<tr>
<td>Motivation and Effort</td>
<td>0.154*</td>
<td>0.075</td>
<td>2.06</td>
<td>0.039</td>
<td>0.237</td>
</tr>
<tr>
<td>Academic Identity</td>
<td>0.140</td>
<td>0.106</td>
<td>1.33</td>
<td>0.185</td>
<td>0.208</td>
</tr>
</tbody>
</table>

Analytic samples consists of 23 schools and 616 students. Random intercept regression model with fixed effects for strata and teachers. Strata with only one (or zero) schools remaining were excluded from the analytic sample to account for school-level selection biases resulting from attrition/non-return of consent forms.
Integrated Learning Assessments

In this part of the test, you will read an article on biotechnology. As you read to comprehend the article, mark up the text and add notes to show your thinking.

Examples of marks and notes you might use to show your thinking and help you understand this article:

- Make connections to things you know about
- Write questions on the page
- Connect parts of the text to other parts or to instructions
- Add commentary to explain what you are reading
- Circle things you do not understand
- Summarize what you are reading

When you have finished reading, continue to Part III of the booklet.
### History Teaching Assignments

#### Preliminary Analysis (Summary Statistics, N = 27)

<table>
<thead>
<tr>
<th>Construct</th>
<th>Condition</th>
<th>N</th>
<th>Mean</th>
<th>Std.Dev.</th>
<th>Cohen’s D (Effect Size)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading Comprehension Strategies</td>
<td>Control</td>
<td>20</td>
<td>2.30</td>
<td>1.261</td>
<td>1.08</td>
</tr>
<tr>
<td></td>
<td>Treatment</td>
<td>7</td>
<td>3.43</td>
<td>.787</td>
<td></td>
</tr>
<tr>
<td>Metacognitive Processes</td>
<td>Control</td>
<td>20</td>
<td>1.70</td>
<td>1.081</td>
<td>.84</td>
</tr>
<tr>
<td></td>
<td>Treatment</td>
<td>7</td>
<td>2.57</td>
<td>.976</td>
<td></td>
</tr>
<tr>
<td>Collaborative Meaning Making</td>
<td>Control</td>
<td>20</td>
<td>1.90</td>
<td>1.071</td>
<td>1.63</td>
</tr>
<tr>
<td></td>
<td>Treatment</td>
<td>7</td>
<td>3.43</td>
<td>.787</td>
<td></td>
</tr>
<tr>
<td>Teacher Instruction: Support for Reading Engagement</td>
<td>Control</td>
<td>20</td>
<td>2.40</td>
<td>1.142</td>
<td>1.05</td>
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<tr>
<td></td>
<td>Treatment</td>
<td>7</td>
<td>3.43</td>
<td>.787</td>
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</table>