REL SOUTHEAST
Regional Educational Laboratory
At Florida State University

Regional Educational Laboratory Southeast

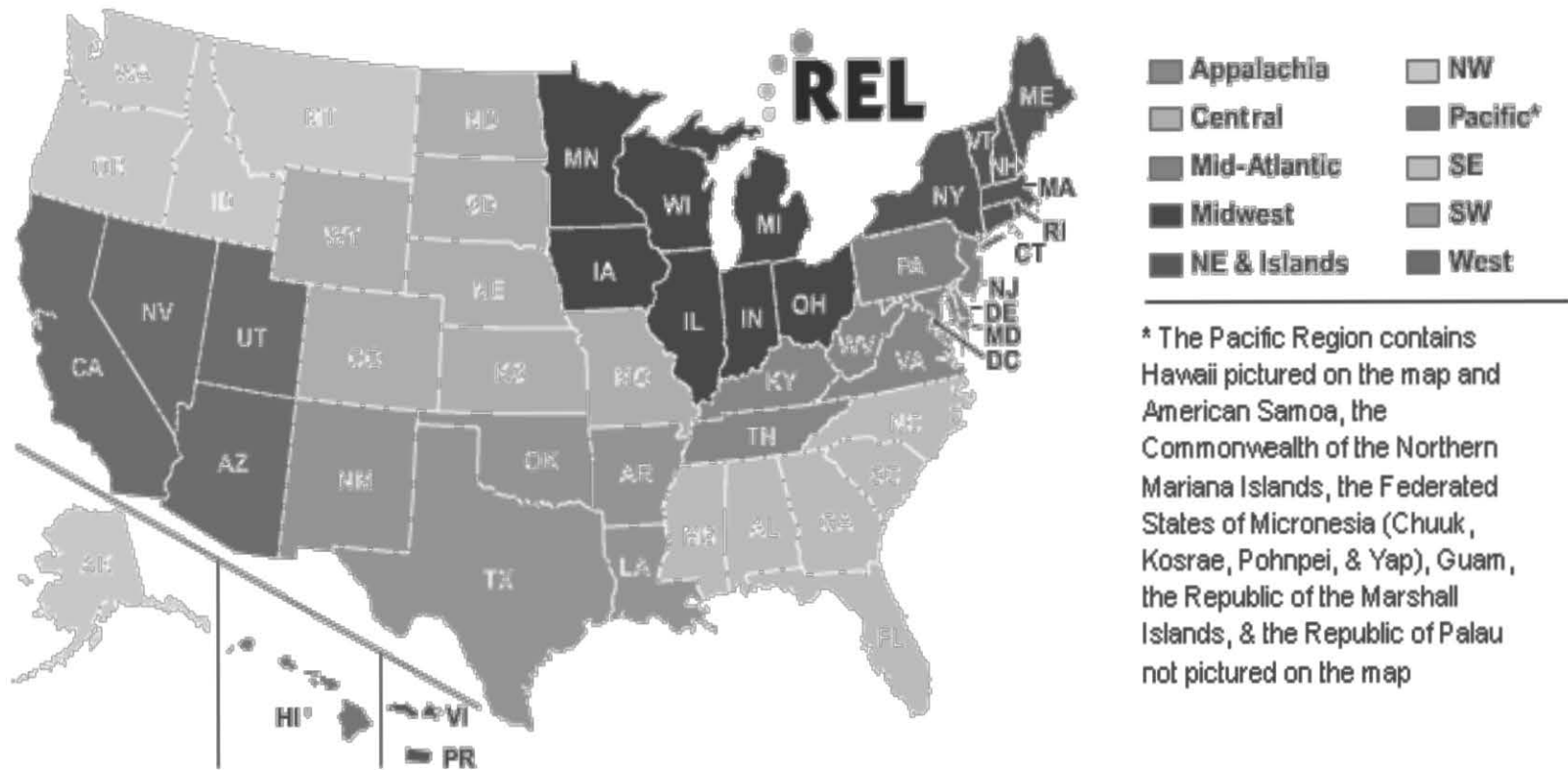**SELF-STUDY GUIDE FOR IMPLEMENTING LITERACY INTERVENTIONS IN GRADES 3-8**

IES PRACTICE GUIDE   **WHAT WORKS CLEARINGHOUSE**

Improving Adolescent Literacy: Effective Classroom and Intervention Practices

NCEE 2008 4027
U.S. DEPARTMENT OF EDUCATION

Launch into Literacy: 2.0 for Grades 6-8 REL Southeast Training on Literacy Tools

Acknowledgement and disclaimer

The Regional Educational Laboratories

REL

■	Appalachia	▢	NW
▢	Central	■	Pacific*
■	Mid-Atlantic	▢	SE
■	Midwest	■	SW
■	NE & Islands	■	West

* The Pacific Region contains Hawaii pictured on the map and American Samoa, the Commonwealth of the Northern Mariana Islands, the Federated States of Micronesia (Chuuk, Kosrae, Pohnpei, & Yap), Guam, the Republic of the Marshall Islands, & the Republic of Palau not pictured on the map

REL Southeast

REL Program Overview

- Establish priority areas within each region
- Provide access to high quality, scientifically valid education research through
  - applied research
  - developmental projects
  - studies
  - technical assistance

IES Practice Guides

Practice guides, published by the Institute of Education Sciences (IES), are developed by panels of nationally recognized experts. They offer actionable recommendations, strategies for overcoming potential roadblocks, and an indication of the strength of evidence supporting each recommendation.
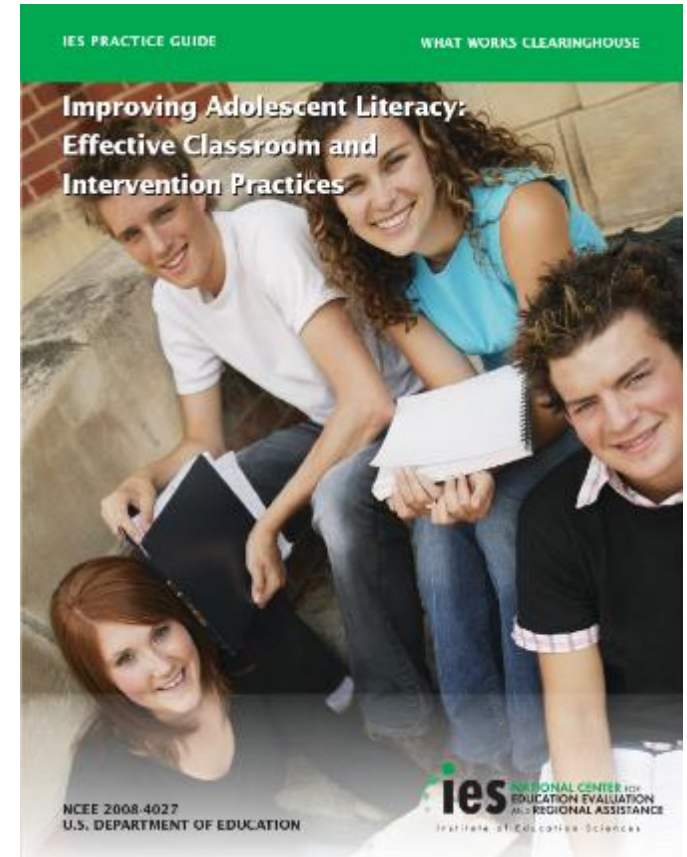
Ask A REL

- Free reference desk service

- Provides references and summaries of research tailored to your specific questions

- For more information and to submit a question visit http://ies.ed.gov/ncee/edlabs/askarel/index.asp?REL=southeast

Goal

To leave this professional learning feeling confident about using the self-study process to review academic intervention implementation including differentiation of instruction using literacy strategies with technical text.

Objectives

- Learn about the self-study process for reviewing the implementation of academic interventions
- Define and discuss the eight areas of the self-study guide as they relate to planning and implementing academic interventions
- Gain a deeper understanding of research-based teaching practices for literacy and how to differentiate instruction
- Gain a deeper understanding of examples of evidence-based instructional strategies and how to use these strategies to differentiate instruction

What are the ABCs of early warning indicators?

A

Attendance

Most students who do not regularly attend class fall behind in their coursework and consequently see their grades suffer.

B

Behavior incidents

Behavior incidents can indicate that a student is disengaged with the school environment.

C

Course performance

Number of course failures and overall grade point average obviously correlate with a student's probability of graduating in four years.

Early warning systems indicator: course performance

Course performance

Number of course failures and overall grade point average obviously correlate with a student's probability of graduating in four years. If a student fails a course, he or she will need to make up the credit outside the regularly scheduled school time to stay on track. Poor course performance can also indicate disengagement at the classroom level.

Frazelle, S. & Nagel, A. (2015). A practitioner's guide to implementing early warning systems (REL 2015–056). Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Northwest. Retrieved from http://ies.ed.gov/ncee/edlabs.

REPORT CARD

Introduction

Self-Study Guide for Implementing Literacy Interventions in Grades 3-8

- Purpose of guide
- Focus on grades 3-8

SELF-STUDY GUIDE FOR IMPLEMENTING LITERACY INTERVENTIONS IN GRADES 3-8

REL SOUTHEAST

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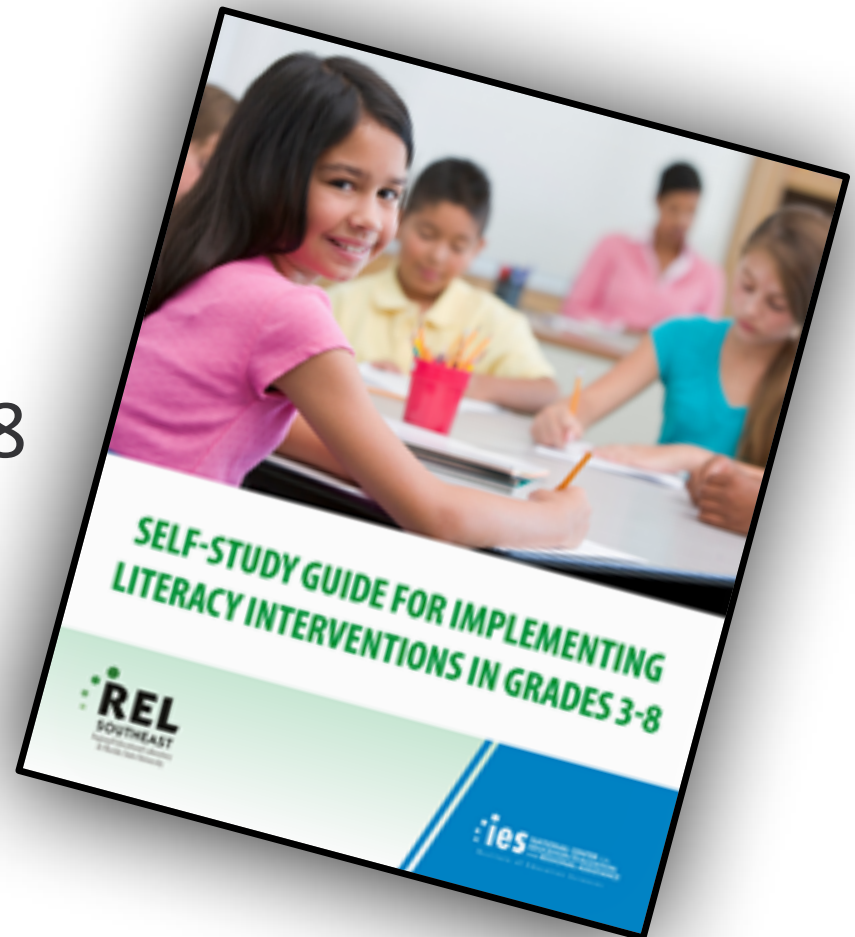
Introduction

The Self-study guide for implementing literacy interventions in Grades 3-8 focuses on the

following eight areas which research shows are associated with strong implementation of practice (p. ix):

Students in need of academic interventions are identified and scheduled in a timely manner.

Valid and reliable assessments focusing on vocabulary and algebra are selected.

Data-driven curriculum using empirically proven practices is used.

Sufficient time has been scheduled to facilitate intervention.

A plan is developed to identify, hire, develop, and retain the best possible interventionists

A system of ongoing professional development is established.

A system of communication is established between all parties.

A healthy and safe learning environment is established.

Introduction

Each of the Scoring Guide Areas provides possible sources of evidence and guiding questions. (p. 1)

Scoring Guide Area 1: Student Selection

A plan is developed and implemented to identify and serve struggling students with timely literacy interventions.

Circle the rating that best describes your program's implementation progress for each item.

1 = Important, but not feasible now
2 = Area to develop or improve
3 = Partially in place, under development
4 = Already in place

1.1 A plan is developed and implemented for timely (in close proximity to the student's first day of school) identification of students who are at risk or failing to meet grade-level literacy expectations.	Implementation progress			
	1	2	3	4

Possible sources of evidence
- District or school pupil progression plan. (Pupil or student progression plans are typically developed by local school districts and align with state policies to identify criteria, such as course mastery, attendance, and grade point average, that students must meet to be promoted to the next grade.)
- School improvement plan.
- District or school multitiered system of support or response to intervention plan.
- Documentation of assessments and other criteria used to identify students' academic skills (including attendance and prior grade retention).

Guiding questions
- Are students with literacy intervention needs identified through teacher nomination, previous grades, or existing assessment data in close proximity to the students' first day of school?
- Who ensures that all students with potential risks have been identified?
- Who administers literacy progress monitoring assessments?
- Who interprets the results of the literacy assessments and translates to instruction?
- Is there a more efficient way to identify students who are at risk?
- Is prior data available to prioritize placement of low-performing students in interventions?

Introduction

Appendix A provides support for each of the scoring guide areas, including an annotated bibliography. (p. 19)

Appendix A. Support for *Scoring Guide* areas

This appendix describes key references that provide additional support for each of the *Scoring Guide* areas.

Scoring Guide Area 1: Student Selection

Fuchs, L. S., Fuchs, D., & Compton, D. L. (2010). Rethinking response to intervention at middle and high school. *School Psychology Review, 39*(1), 22–28. http://eric.ed.gov/?id=EJ886408

The authors note important differences in student selection for academic interventions at secondary school settings. "At middle and high school, academic deficits are well established. Moreover, because a greater range of performance in the academic domain can be sampled than in the elementary grades, it is easier to design middle and high school tests whereby students do not cluster near the bottom of the scale, creating meaningful distinctions among students with deficits of larger and smaller magnitudes. For these reasons, at middle and high school, it no longer makes sense to allocate scarce resources to screening for the purpose of identifying students at risk for academic failure. It makes more sense to rely on teacher nomination or existing assessment data to identify students with manifested academic difficulties" (p. 24).

"Restricting participation in secondary prevention to students for whom the likelihood of success is good creates a better opportunity to serve this population more effectively, which in turn enhances schools' opportunity to provide appropriately intensive tertiary prevention. This is the case because when secondary prevention is offered to a mix of students, some of whom seem likely to respond and others of whom have such large deficits that secondary prevention's intensity is manifestly insufficient, a higher proportion of both subsets of students may fail to respond, thereby flooding tertiary prevention and watering down the intensity required at the tertiary level. This parallels the need for high-quality primary prevention to avoid overwhelming secondary prevention with inappropriate students and thereby decreasing the intensity available at secondary prevention. For these reasons, moving students with the greatest academic deficits directly to a well-conceptualized, most intensive tertiary prevention level may produce more reliable and substantial outcomes for both subpopulations of students" (p. 25).

Hamilton, L., Halverson, R., Jackson, S., Mandinach, E., Supovitz, J., & Wayman, J. (2009). *Using student achievement data to support instructional decision making* (NCEE No. 2009–4067). Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance. http://eric.ed.gov/?id=ED506645

This practice guide for using student data in decisionmaking recommends that "after triangulating data and considering the extent to which student learning did or did not improve in response to the intervention, teachers can decide whether to keep pursuing the approach in its current form, modify or extend the approach, or try a different approach altogether" (p. 16).

Scoring Guide Areas: Discussion

Using Handout 1 –
Discuss for each Scoring Guide Area:
How do districts and schools implement this strategy?
Are there issues or barriers to implementation?
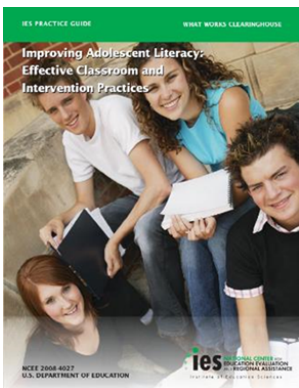
Multi-strategy Comprehension Approach

Multiple research-based comprehension strategy approach

- Combined use of multiple strategies:
  - More effective than approaches using only a single strategy
  - Effective in improving comprehension results

    Kamil et al. (2008). IES Practice Guide: *Improving Adolescent Literacy: Effective Classroom and Intervention Practices*

    National Reading Panel (2000).

- The greatest effects for improving comprehension may come from teaching multiple strategies across content areas.

  Foorman & Wanzek (2013). *Handbook of Response to Intervention*

  Dole, Brown, & Trathen (1996). *The Effects of Strategy Instruction on the Comprehension Performance of At-risk Students*

Multi-strategy Comprehension Approach

- It is imperative that Tier I instruction for older students provide a focus on reading, vocabulary, and academic language, background knowledge, making inferences, and comprehension strategy use as these practices best predict students' comprehension of text (Cromley & Azevedeo, 2007).

    Foorman & Wanzek (2013). *Handbook of Response to Intervention*

- Teacher modeling and explicit explanations during instruction in specific vocabulary and comprehension strategies has strong evidence.

    Kamil et al. (2008). IES Practice Guide: *Improving Adolescent Literacy: Effective Classroom and Intervention Practices*

Differentiated Instruction

- Instructional activities should provide scaffolding to ensure that students understand the skills they need to acquire.

    Kamil et al. (2008). IES Practice Guide: *Improving Adolescent Literacy: Effective Classroom and Intervention Practices*

- Make available intensive and individualized interventions for struggling readers that can be provided by trained specialists

    Kamil et al. (2008). IES Practice Guide: *Improving Adolescent Literacy: Effective Classroom and Intervention Practices*

Sample Lesson
Topic Question

* Before reading:

  What motivates people to learn difficult material or concepts?

Sample Lesson
Predictive Writing

Before text reading, use the Text-Based Question Handout to record your answer to this question:

What motivates students to challenge themselves academically?

Base your response on your current background knowledge.

Research Base:
Topic Question and Predictive Writing

• Research studies indicate reading achievement is increased at all grade and ability levels when students are taught to activate and build background knowledge, preview, predict, and confirm predictions.

Foorman & Wanzek (2013). H*andbook of Response to Intervention*

Sample Lesson
Vocabulary Front Loading

- Words for Vocabulary Word Wall:
  - Words introduced in this section: *resounding, interplay, Ebola, spatial dynamics*
  - Words introduced previously in text-reading: *ecology, epidemic*

Research Base:
Vocabulary Instruction – Context and Affixes

- Researchers suggest teaching a multi-part vocabulary strategy that includes the following:
  - Contextual analysis (to infer word meaning)
  - Morphemic analysis (to derive word meaning)

    Kosanovich, Reed, & Miller (2010). *Bringing Literacy Strategies into Content Area Instruction: Professional Learning for Secondary-level Teachers*

Research Base: **Vocabulary Instruction – Context and Affixes**

• Students need to be explicitly taught academic vocabulary central to the meaning of text. Locating the words in text, providing definitions, and then extending the words' meaning through extension activities is a successful instructional strategy.

Foorman & Wanzek (2013). *The Handbook of Response to Intervention*

Sample Lesson
Text Coding

- Listen as the facilitator reads a portion the following text:

   "Math for the Real World"

   Mark the text with the following codes:

- **B – this section provides information on the benefits of the Mathematical and Theoretical Biology Institute (MTBI)**

- **C – this section of text provides information on challenges of the MTBI**

- **F – this section of text provides facts regarding how the MTBI is organized or implemented**

Sample Lesson
Text Coding Discussion

- **After text coding:**

- In small groups, compare and discuss the similarities and differences in text coding.

- Support your coding using information from the text.

Research Base:
Text Coding

- Similar text coding strategies, such as INSERT, Vaughn & Estes (1986), have been found to increase reading comprehension

  Marcell (2007). *Traffic Light Reading: Fostering the Independent Usage of Comprehension Strategies with Informational Text*

Research Base:
Text Coding Discussion

- Kamil et al. (2008) noted moderate levels of evidence for providing opportunities for extended discussion of text as well as increasing student motivation and engagement in literacy learning.

  Foorman & Wanzek (2013). *Handbook of Response to Intervention*

Sample Lesson
First Written Response After Reading

After the initial reading, use the Text-Based Question Handout in the participant notebook to answer the following question:

- **According to the text, what factors motivate students to challenge themselves academically?**

Research Base:
First Written Response After Reading

- Having students in grades 2–12 write about material they read enhances comprehension. This was true for students in general and students who were weaker readers or writers in particular. It also applied across expository and narrative texts as well as subject areas (language arts, science, social studies).

  Graham & Hebert (2011). *Writing to Read: A meta-analysis of the Impact of Writing and Writing Instruction on Reading*

Sample Lesson
Directed Note Taking

Guiding Question: According to the text, what factors motivate students to challenge themselves academically?

- **Relevance of Learning to Life**

- **Opportunity for Choice in Learning**

- **Sense of Comradery in Learning**

- **Learning Creates the Opportunity to Help Others**

Use your directed note taking graphic organizer and be sure to utilize the text features such as charts, graphs, photographs, and illustrations as you take notes.

Research Base:
Directed Note Taking

- Research studies indicate reading achievement is increased at all grade and ability levels when students are taught to use graphic organizers to arrange, categorize, and/or relate key information in text.

Foorman & Wanzek (2013). *The Handbook of Response to Intervention*

Kim, Vaughn, Wanzek, & Wei (2004). *Graphic Organizers and their Effects on the Reading Comprehension of Students with LD: A Synthesis of Research*

Sample Lesson
After Directed Note Taking

Compare notes in pairs or small groups

  Place a star next to the most significant note in each category:

- **Relevance of Learning to Life**

- **Opportunity for Choice in Learning**

- **Sense of Comradery in Learning**

- **Learning Creates the Opportunity to Help Others**

Sample Lesson
Extended Text Discussion

Take positions and discuss which of the following factors motivate students the most to challenge themselves academically?

- **Relevance of Learning to Life**

- **Opportunity for Choice in Learning**

- **Sense of Comradery in Learning**

- **Learning Creates the Opportunity to Help Others**

Research Base:
Extended Text Discussion

- Discussions that require students to agree, disagree, and justify their responses:
  - Help students filter text information.
  - Serve as a means for teachers to assess student understandings.

    Kosanovich, Reed, & Miller (2010). *Bringing Literacy Strategies into Content Area Instruction: Professional Learning for Secondary-level Teachers*

Research Base:
Extended Text Discussion

- A recent meta-analysis indicates dramatic improvement in reading comprehension when students engage in lively and meaningful conversation around text. These engaging text based discussions increase student talk and comprehension more than other types.

    Kamil (2009). CTL Conference, Portland, OR: *Moving Research into Classrooms*

    Murphy, Wilkinson, Soter, Hennessey, & Alexander (2009). *Examining the Effects of Classroom Discussion on Students' Comprehension of Text: A Meta-analysis*

Sample Lesson
Student Question Generation

1. **Are there programs like this at other universities and have they produced the same results? (Paragraphs 8 & 9)**
2. **Why is there underrepresentation of minorities in those acquiring doctorates in science, engineering, and mathematics? (Paragraph #9)**

Generate questions unanswered from your first text reading. Record your questions on your Student Question Generation graphic organizer as you work in pairs or small groups.

Sample Lesson
Student Question Generation

Share questions with the whole group to identify which are common, and which questions are most relevant to the topic and/or significant to learning

Record/post common and relevant/significant questions for future use in:

- extended text discussion
- seeking answers in text-reading throughout the remainder of the chapter/unit
- focusing on unanswered questions in collaborative inquiry.

Research Base:
Student Question Generation

- Effective comprehension strategies include:
  - question generation.
  - use of graphic organizers.

  National Reading Panel (2000).

Sample Lesson
Final Written Response

- **According to the text and further discussion, in your opinion, which of the following factors motivate students the most to challenge themselves academically?**
  - **Relevance of Learning to Life**
  - **Opportunity for Choice in Learning**
  - **Sense of Comradery in Learning**
  - **Learning Creates the Opportunity to Help Others**
- Use information from notes and discussion to help write final response on the Text-Based Question Handout.
- Share answers in small groups.
- As part of whole class discussion, record responses to the question in multiple choice format.

Research Base:
Final Written Response

- Effective comprehension instruction should incorporate writing; writing in response to reading improves critical thinking.

    Carnegie Council on Advancing Adolescent Literacy (2010). *Time to Act: An Agenda for Advancing Adolescent Literacy for College and Career Success*
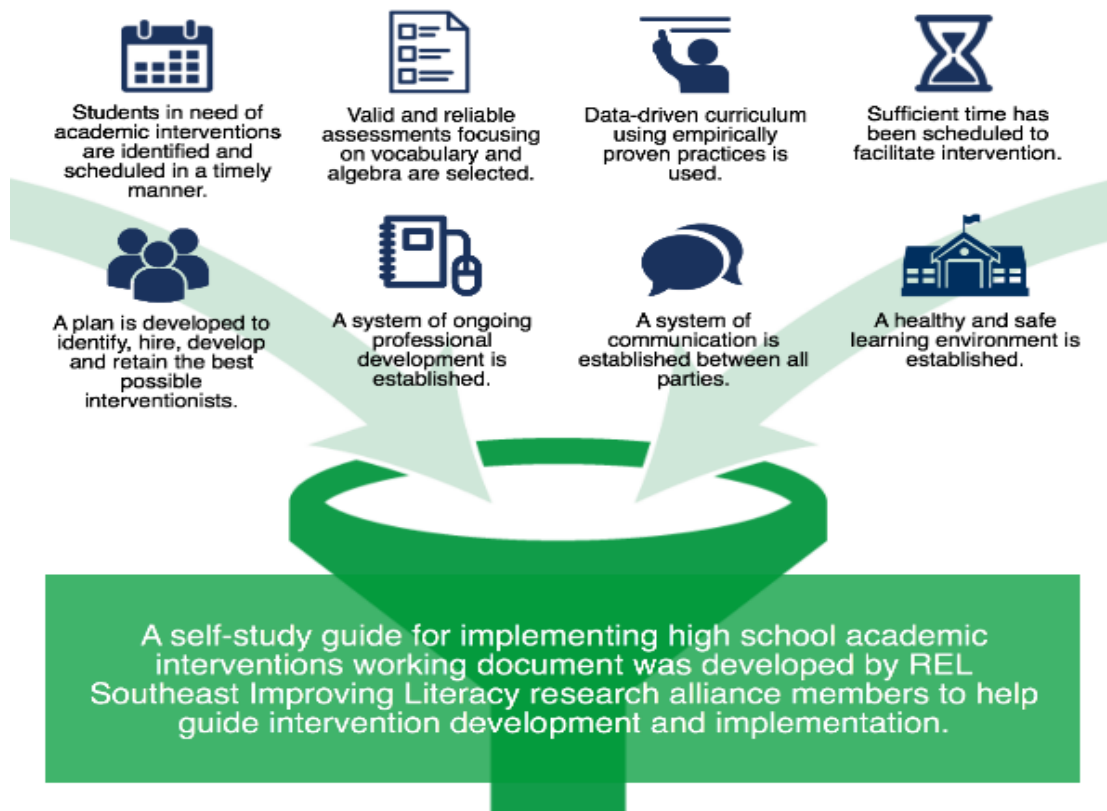
Questions?

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Implementing academic interventions is a complex process

Students in need of academic interventions are identified and scheduled in a timely manner.

Valid and reliable assessments focusing on vocabulary and algebra are selected.

Data-driven curriculum using empirically proven practices is used.

Sufficient time has been scheduled to facilitate intervention.

A plan is developed to identify, hire, develop and retain the best possible interventionists.

A system of ongoing professional development is established.

A system of communication is established between all parties.

A healthy and safe learning environment is established.

A self-study guide for implementing high school academic interventions working document was developed by REL Southeast Improving Literacy research alliance members to help guide intervention development and implementation.

From the REL Southeast *Self-study guide for implementing high school academic interventions*

Scoring Guide Area 1: Student Selection
Students in need of academic interventions are identified and scheduled in a timely manner.
1.1: A plan is developed and implemented for timely (in close proximity to the student's first day of school) identification of students who are at-risk and/or failing to meet grade-level academic expectations. (p. 1)
1.2: A schedule is created and implemented to ensure that struggling students receive academic intervention in a timely (in close proximity to the students' first day of school) manner. (p. 2)

Scoring Guide Area 2: Assessment Selection and Data Use
Valid and reliable assessments are selected and used to determine the need for intervention.
2.1: 2.1. Valid and reliable standardized literacy assessments are selected and used to determine the need for literacy intervention. For high school students the literacy assessments should include measures of embedded vocabulary, comprehension, and the ability to interpret text and derive meaning. For students far below grade level assessments should include measures of potential instructional needs in phonics and decoding multisyllabic words. (p. 3)
2.2: Valid and reliable standardized math assessments are selected and used to determine the need for intervention, with the focus on improving algebra knowledge. For high school students the math assessments should include measures of conceptual knowledge, procedural knowledge, and procedural flexibility. (p. 4)
2.3: Formative assessments that align with instructional goals are used to monitor student response to intervention. (p. 4)
2.4. Data are used by teachers and students to set goals, adjust instructional practices, and guide the selection of curriculum materials in order to enhance student-centered learning, improve student motivation, and increase student engagement. (p. 5)

Scoring Guide Area 3: Content and Instruction
Data-driven curriculum using empirically proven practices is used.
3.1: Criteria for selecting and using programs and curricula that have been shown to have a positive effect on student achievement are used (see What Works Clearinghouse http://ies.ed.gov/ncee/wwc/; Coalition for Evidence-Based Policy, 2003). (p. 6)
3.2: A plan is developed and implemented for academic interventions that reflects instructional practices empirically shown to increase student achievement. (p. 7)

Scoring Guide Area 4: Instructional Time
Sufficient time has been scheduled to facilitate intervention.
4.1: The school has established a schedule that maximizes instructional time for academic interventions through various formats such as standalone courses, pull-out or push-in intervention groups, integration of intervention strategies in content area courses, and out-of-school time. (p. 8)
4.2: The school has established a schedule that delivers academic interventions with the appropriate frequency, consistency, and duration to meet students' instructional needs. (p. 9)

Scoring Guide Area 5: Interventionist or Teacher Selection
A plan is developed to identify, hire, develop, and retain the best possible individuals to deliver interventions for struggling students.
5.1: A plan is developed and implemented to identify or hire school faculty and staff who will deliver academic interventions to students daily or nearly daily in small groups. The individuals delivering interventions should be able to teach academic skills in an engaging manner to students during classroom intervention or content area instruction. (p. 10)
5.2: A plan is developed and implemented to identify available community volunteers and cross-age tutors who can deliver academic interventions to students daily or nearly daily in small groups. (p. 11)

Scoring Guide Area 6: Professional Development and Ongoing Support
A plan is developed and implemented to provide professional development and ongoing support to school faculty, staff, and community volunteers delivering interventions and strategy instruction for educators delivering initial instruction.
6.1: A plan is developed and implemented to provide professional development for individuals delivering academic interventions and strategy instruction for content area teachers. (p. 12)
6.2: A plan is developed and implemented to conduct ongoing observations of and provide feedback and support to individuals delivering academic interventions. (p. 13)

Scoring Guide Area 7: Communication
A plan is developed and implemented to facilitate effective communication and collaboration among administrators, instructional coaches, classroom teachers, intervention teachers, parents, and guidance counselors to ensure that each student's instructional needs are met.
7.1: A plan is developed and implemented for communication and collaboration that will ensure successful start-up of academic interventions. (p. 14)
7.2: A plan is developed that enables teachers, those delivering interventions, and parents to collaborate regularly regarding students' growth in targeted skill areas. (p. 15)

Scoring Guide Area 8: Intervention or Classroom Environment
A healthy and safe learning environment is established that is conducive to student engagement, student productivity, and intensive academic instruction.
8.1: A plan is developed and implemented to ensure a healthy and safe learning environment for academic interventions. (p. 16)

TEXT-BASED QUESTION – Shaping Your Written Response

Math and Science – Math for the Real World

Predictive response before reading and extended text discussion:

What motivates students to challenge themselves academically?

_____

_____

_____

_____

_____

_____

First draft after reading the selection and completing directed note-taking:

According to the text, what factors motivate students to challenge themselves academically?

_____

_____

_____

_____

_____

_____

_____

Final response after rereading the text and extended text discussion:

According to the text and further discussion, in your opinion, which of the following factors motivate students the most to challenge themselves academically: relevance of learning to life; opportunity for choice in learning; sense of comradery in learning; or learning that creates the opportunity to help others?

_____

_____

_____

_____

_____

_____

_____

_____

_____

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_____

_____

_____

Consider how did your thinking improve each time you were asked to complete this written response?

Collaborative work:
Sharing your written response with others and hearing differing viewpoints.

Math for the real world

Student-driven research program applies math to thorny social and biological problems

Carlos Castillo-Chavez, second from left, with MTBI students.

April 13, 2016

The students see math in everything. The obesity epidemic. The effects of second-hand smoke. Prison reform. Political ads.

They ask: Can we model these populations? Can we reveal what factors make a difference, and what happens when they change?

And, above all: Can I use math to help solve these problems?

"They are determined to solve an important problem," says Carlos Castillo-Chavez, mathematical biologist at Arizona State University (ASU) and executive director of the school's Simon A. Levin Mathematical, Computational and Modeling Sciences Center. "It is their choice, it is their problem and they work passionately."

For the last two decades, Castillo-Chavez has worked with these students, attendees at the Mathematical and Theoretical Biology Institute (MTBI), a summer program for undergraduates funded by the National Science Foundation (NSF).

MTBI teaches students the core topics of mathematical biology, then sets them loose on a research problem of their choosing. The program is notable not only for the diversity of those problem topics, but for its resounding success in recruiting and training minority students.

Since MTBI was founded, 70 percent of the student participants have been from minority groups. More than half of all MTBI students have gone on to graduate school. The program has produced more than 100 Ph.D. students; 71 of which are underrepresented minorities. These numbers are impressive, especially when you consider that only about 7 percent of all science and engineering doctorates in the U.S. are awarded to minority students. The number is even smaller for mathematics Ph.Ds.

"The program's model is quite unique," says Jennifer Slimowitz Pearl, acting deputy division director of NSF's Division of Mathematical Sciences that funds MTBI. "It's clearly had a big impact, both on the lives of individual students and on the broader issue of increasing diversity in mathematics, a priority for NSF."

MTBI has been nationally recognized for its work boosting diversity in mathematics. In 2011, the program received for a Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring, the nation's highest honor for STEM mentoring.

Castillo-Chavez credit's the program's success to its focus on student-led, socially relevant research.

"Many minorities think that getting involved in math is like playing chess -- that you're not going to be able to help anybody," Castillo-Chavez says. MTBI teaches them otherwise. "It helps them realize they can contribute to their own communities."

Latest research on Ebola

MTBI changed Diego Chowell's life.

He entered the program just out of high school, and it revealed a world where math could help him understand and solve real-world issues.

This summer, Chowell will finish his graduate studies at ASU then head to Memorial-Sloan Kettering Cancer Center, where he will research the interplay between the immune system and cancer progression

Chowell is an author on one of MTBI's most recent scientific articles, a roundup of Ebola-related research done by MTBI students. Notices of the American Mathematical Society published the paper this month.

The West Africa Ebola outbreak is the largest in history, killing over 11,000 people since the epidemic first started in 2014. Chowell wanted to know if it was possible to recognize infected people before they start showing symptoms and what that might mean for virus control efforts.

He discovered that while it was possible to identify infected people, the information is only worthwhile if there are enough facilities to isolate Ebola-infected people.

Another team highlighted in the paper worked on the spatial dynamics of Ebola -- how behavior of people in infected regions influences the spread of the disease -- and how mass quarantines, imposed to prevent Ebola, actually helped increase rates of the virus.

Forging a community of mentors

MTBI proved a humbling experience for Victor Moreno. In the beginning, when students take foundational classes in mathematical modeling and analysis, the graduate advisers -- like Moreno -- know pretty much everything. That changes after the students dig into their research topics. "You start realizing 'I need to know a little bit more!'" he said.

Castillo-Chavez says realizations like those are the whole point.

Faculty -- whose research interests are often highly specialized -- like to have research topics under control. "That creates a sense that we are geniuses," Castillo-Chavez said. "If students move us into a different direction, they realize that we don't have the answers, that we struggle. And often they come up with better ideas."

And they often become passionate about the research. Moreno, a Ph.D. student at ASU, says his group occasionally worked 15 hours straight, fueled by the challenge of finishing a manuscript (each team must present one at the program's end) and the excitement of getting results from the data.

Two decades and nearly 440 students after MTBI started, the program has grown into a full-blown community. Undergraduates return as graduate advisers, who return as faculty mentors. MTBI alumni believe in mentoring at all levels, Castillo-Chavez says, and in building diverse communities.

Take Kamuela Yong. His own mentor was a MTBI alum. Her support helped pivot Yong, transforming him from an engineering student who solved math problems to a mathematician who solves ecology problems. She pushed Yong to get a higher degree -- he's likely the first native Hawaiian to receive a Ph.D. in applied math. A former adviser for MTBI, Yong is now assistant professor at University of Hawaii'i-West O'ahu and applying the lessons MTBI taught him.

"I'm now ready to be a mentor, and keep encouraging the next generation," he said.

-- Jessica Arriens, (703) 292-2243 jarriens@nsf.gov

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Erika Camacho
Stephen Wirkus
Carlos Castillo-Chavez
Gerardo Chowell-Puente

Related Institutions/Organizations
Arizona State University

Related Programs

Workforce Program in the Mathematical Sciences

International Research Experiences for Students

Related Awards

#1263374 REU Site: The Mathematical and Theoretical Biology Institute

#1261211 IRES: Population Dynamics and Complex Systems: Challenges and Opportunities

Total Grants

$501,264

Multi-strategy Comprehension Approach

Title of Text/Article: Math for the Real World

Teacher Notes:
- Materials:
  - Text or article (of sufficient complexity to promote high-level thinking)
  - Sticky notes (for opening "topic question, question generation, written responses, etc.)
  - Chart paper
  - Markers, rubrics (for Text-Based Discussion, Student Written Responses, Question Generation, etc.)
  - Student copies of handouts (for Written Responses, Direct Note-Taking, and Question Generation).
- Preparations:
  - Number paragraphs of selected text/article for ease of locating text evidence during discussions.
  - Develop and display Final/Essential Question at the beginning of the lesson to communicate upfront for students the lesson's final question and learning outcome.
  - Text-marking: Develop and display a code system appropriate for the text to use in text-coding. Select a small text segment and preplan corresponding coding example(s) to model the text-coding process for students.
  - Directed Note-taking: Develop a graphic organizer with headings appropriate for the text. Select a small text segment and preplan corresponding note(s) to model the note-taking process.
  - Question Generation: Select a small text segment and preplan a corresponding question(s) to model the Question Generation process for students.
  - Any audio visuals, specimens, and/or samples to enhance lesson.

Tasks: Teacher asks topic question to launch opening discussion, teaches a few vocabulary words directly, reads aloud to model text marking for students, students read the text and participate in directed note-taking and extended text-based discussion.

Purpose: To bring world relevance to text reading, establish a purpose for reading, model fluent reading, provide opportunities for students to become interactive with the text, and think critically about information in the text.

Topic Question: What motivates people to learn difficult material or concepts?

Written Response to the Text-Based Question What motivates students to challenge themselves academically?

Multi-strategy Comprehension Approach

Vocabulary Instruction

Para-graph #	Academic or Discipline Specific Vocabulary	Word Part or Context
8	*Resounding* – Word part: from English – re (again) + from Latin sonare (sound or noise) + from English ing (in the act of) also means "much talked about" Context – **…but for its *resounding* success**.	Both
15	*Interplay* – Word part: from Latin– inter (small) + from English play (free or unimpeded movement) Context: …**where he will research the *interplay* between the immune system and cancer progression.**	Both
17	*Ebola* – Context – **"The West Africa Ebola outbreak is the largest in history, killing over 11,000 people…"** Ebola was named after a river in Africa near where the disease was first observed	Context
19	*Spatial dynamics* – Word part: spatial referring to "space" and "dynamics" from Greek meaning "power or force" Context: **…worked on the spatial dynamics of Ebola – how behavior of people in infected regions influences the spread of disease – and how mass quarantines…**	Both and punctuation

- Direct students to locate words introduced in the text by paragraph number.
- Model for students how to derive word meaning(s) from word parts (prefix, root, suffix) and/or context. Record meanings of word parts and words on chart paper.
- Variations for Vocabulary Instruction:
  - record meanings of word parts and words in word study guide, journal writing, graphic organizers, etc.
  - post word parts, words, and their meanings on a vocabulary word wall; refer to word wall during reading, discussions, and writing throughout the lesson and subsequent lessons.

Reading #1

Text-marking

B – this section of text provides information on the benefits of the Mathematical and Theoretical Biology Institute (MTBI)

C – this section of text provides information on the challenges of the MTBI

F – this section of text provides facts regarding how the MTBI is organized or implemented

- Model for students by reading the text aloud and coding a portion of the text. Students follow along and mark their copy. Students proceed to code the rest of the text independently. Students share text markings with table group or partner.

Reading #2

Directed Note-Taking - Record notes containing the most important information relevant to the guiding question

Directed Note Taking: *Math for the Real World*					
Guiding Question: According to the text, what factors motivate students to challenge themselves academically?					
Para-graph #	**NOTES** **According to the text, what factors motivate students to challenge themselves academically?**	Check relevant categories below			
		Relevance of Learning to Life	**Opportunity for Choice in Learning**	**Sense of Comradery in Learning**	**Learning Creates Opportunity to Help Others**
6	**"It is their choice – it is their problem and they work passionately."**	x-	x		

12	"Castillo-Chavez credits the program's success to its focus on student-led, socially relevant research."		x		x-

- Present a guiding question to direct students thinking while taking notes. Teacher models note-taking using an example statement from the text, then selecting the category or categories that support the statement. Students complete note-taking collaboratively or independently.
- Conduct small- and whole-group efferent discussion. Ask groups to come to consensus on which category is the most impactful according to the support from the text.

First Draft Written Response to the Text-Based Question
According to the text, what factors motivate students to challenge themselves academically?

- Ask students to complete the second Written Response.
- Variations for this Written Response: Sticky notes quick writes, collaborative partners, written conversations

Tasks: Teacher models the generation of a complex question based on a section of text, relating to a broad perspective or issue. Students record the questions, and then students re-read the text to generate their own questions.

Purpose: To provide students with a demonstration of question generation and the opportunity for them to interact with the text by generating questions to further deepen their comprehension.

Reading #3

Question Generation

Question Generation: *Math for the Real World*					
Para-graph #	**Questions**	**Check relevant categories below**			
		Relevance to Life	**Choice**	**Comradery**	**Opportunity to Help Others**
8 & 9	Are there programs like this at other universities and have they produced the same results?		x		x
9	Why is there underrepresentation of minorities in those acquiring doctorates in science, engineering, and mathematics?		x		

- Teacher models re-reading a portion of the text and generates one or two questions.
- Students continue to review/scan the text and use their recorded notes to generate questions about information in the text collaboratively or independently.

Multi-strategy Comprehension Approach

- To conclude question generation, the teacher has students:
  - share their questions with the related category whole class and discuss which questions they have in common, and which questions are most relevant or significant to their learning.
  - record/post common and relevant/significant questions to encourage:
    - extended efferent text discussion
    - students to seek/locate answers in text-reading throughout the remainder of the chapter/unit focusing on unanswered questions in collaborative inquiry.

Task: Teacher posts an essential question that is text-based, students discuss answers, and review/revise answers to the final/essential question based on discussion.

Purpose: To provide opportunities for students to interact with the text and with their peers to:
- identify text information most significant to the final/essential question.
- facilitate complex thinking and deep comprehension of text..

Final Written Response to the Text-Based Question
According to the text and further discussion, in your opinion, which of the following factors motivate students the most to challenge themselves academically: relevance of learning to life; opportunity for choice in learning; sense of comradery in learning; or learning that creates the opportunity to help others?

Content and Literacy Connections: Carefully select text that aligns with standards; list content standards and literacy standards addressed in lesson.

Directed Note-Taking

Directions: Record notes containing the most important information relevant to the guiding question.

		Check relevant categories below			
	"Math for the Real World" **National Science Foundation**				
	Guiding Question: According to the text, what factors motivate students to challenge themselves academically?				
Para-graph #	**NOTES**	**Relevance of Learning to Life**	**Opportunity for Choice in Learning**	**Sense of Comradery in Learning**	**Learning Creates Opportunity to Help Others**
6	**"It is their choice – it is their problem and they work passionately."**	x-	x		
12	**"Castillo-Chavez credits the program's success to its focus on student-led, socially relevant research."**		x		x-

Page 2 Question Generation

Directions: Record questions that you have based on your notes and text-reading.

Para-graph #	Question	Check relevant categories below			
	"Math for the Real World" **National Science Foundation**				
	QUESTIONS				
		Relevance of Learning to Life	Opportunity for Choice in Learning	Sense of Comradery in Learning	Learning Creates Opportunity to Help Others
8 & 9	**Are there programs like this at other universities and have they produced the same results?**		X		X
9	**Why is there underrepresentation of minorities in those acquiring doctorates in science, engineering, and mathematics?**		X		