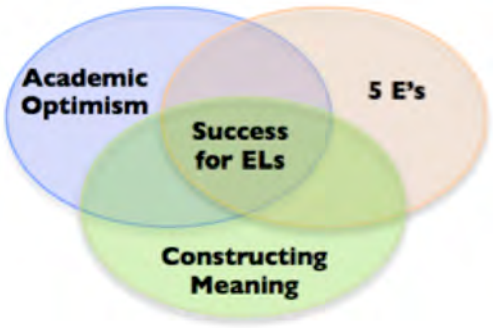
Secondary Constructing Meaning in Science: A Pathway to STEM for English Learners

COSA – ODE ELL Alliance Conference
Eugene, Oregon – March 13, 2014



Session Outcomes

1. Learn how to support English Learners in STEM classes to increase their engagement and achievement.
2. Study a pathway of courses and instructional supports to put ELs on track for STEM majors.
3. Be introduced to an example of collaboration between secondary and post-secondary schools to support the transition of underrepresented groups into STEM majors.

Agenda

- Who are our STEM students? Science instruction for all.
- Case Study: Liberty HS, Hillsboro, Ore.
  Science instruction that works for ELs
  - Academic Optimism
  - 5 'E's of strong science pedagogy
  - Constructing Meaning & GRR
- Making the jump to college – with support
- Reflection and closing

Every science or engineering lesson is in part a language lesson, particularly reading and producing the genres of texts that are intrinsic to science and engineering.

- Science Practice 8: Obtaining, Evaluating, and Communicating Information (NAS, 2012)

E.L. Achieve

hansonp@hsd.k12.or.us
scott@elachieve.org

Early Years' Profile

- Home language: Spanish
- Parents' education: No college education
- Years enrolled in public school in the US: K-12
- Years in ELD classes: 9
- Attitude about school in late elementary years:
  "I hated school… and I was a little bit behind from what I could tell."
- Experiences with in the early secondary years:
  "The 7th grade life science class was easy even though I didn't know what the teacher was talking about. We did worksheets and the answers were in the book. The tests were multiple-choice. I earned a B in the class." "In middle school and the first years of high school, I never thought about a career in science. I wanted to be a professional athlete. I didn't really care for school."

Think of a student in your school who has had life experiences similar to Jose	Name of the student: _____	Characteristics/Anecdotes about that student:

Video Note-taker

What helped Jose keep engaged in science and make it into a STEM field at Portland State University?

GAP Analysis

Where my site is now	Steps to get there	Where we want to be

Academic Optimism

5 E's of Science Pedagogy

Constructing Meaning

Action Steps for the Next Two Weeks:

Academic Optimism of Schools: A Force for Student Achievement

Wayne Hoy, C. John Tarter, Anita Hoy, 2006

Why are some schools high-performing in neighborhoods of low socioeconomic status (SES) while others are not?

Three organizational properties make a difference in student achievement:

- the academic emphasis of the school,
- the individual and collective efficacy of the faculty,
- the faculty's trust in the school's parents & students

"Optimism" is an appropriate overarching construct to unite academic press, efficacy, and trust because each concept contains a sense of what is possible. A school with high academic optimism is a collectivity in which the faculty believes that *it can* make a difference, that *students can* learn, and high academic performance *can* be achieved.

Academic emphasis is the extent to which a school is driven by a quest for academic excellence---the press for academic achievement.

- High but achievable academic goals for students: high rigor
- Learning environment is orderly and serious
- Attitude that students will not be allowed to fail
- Students are motivated to work hard
- Students respect academic achievement
- Teachers hold each other accountable to high student achievement

Collective efficacy is the judgment of teachers that the faculty as a whole can organize and execute the actions required to have positive effects on all students.

- Expectation and support for high individual teacher efficacy in knowledge and effective use of impactful instructional practices
- Focus on problem solving rather than upon blame
- All teachers are "data informed" about their effectiveness
- Provides confidence regardless of obstacles, motivates to challenging goals, and supports persistence until successful
- Reinforces and enhances trust and academic success

Relational trust

- Trust defined as one's ability to be vulnerable to the other based upon the belief that the other will act in one's best interests.
  - 5 facets: benevolence, reliability, competence, honesty, openness
- Cooperation sets the stage for effective student learning.; distrust makes cooperation virtually impossible
- Trust and cooperation among students, parents, and teachers influenced regular school attendance, persistent learning, and faculty experimentation with new techniques & resources

Optimism matters as much as talent or motivation in achievement, and it can be learned and developed. As individuals can develop learned helplessness, organizations can be seduced by pervasive pessimism—reinforcing, self-fulfilling, and defeating. Academic optimism views teachers as capable, students as willing, parents as supportive, and the task as achievable.

Each factor—efficacy, academic press, and trust—is related to, is dependent upon, and reinforces the other.

Three Dimensions:

Cognitive: collective efficacy is a group belief or expectation
Affective: faculty trust in parents, students, and in one another
Behavioral: academic emphasis is a push for behaviors that recognize, support, celebrate academic accomplishment

Optimism is thwarted by stress; thus, decreasing stress supports optimism. Teachers can lower their stress by increasing their agency through appropriate participation in decisions that affect their school lives.

Teaching with the Five E's Instructional Model in the STEM Courses

5Es	Suggested Activity	What the Teacher Does	What the Student Does
Engage	• Demonstration • Reading • Free Write • Analyze a Graphic Organizer • KWL • Brainstorming	• Creates interest. • Generates curiosity. • Raises questions. • Elicits responses that uncover what the students know or think about the concept/topic.	• Asks questions such as, Why did this happen? What do I already know about this? What can I find out about this? • Shows interest in the topic.
Explore	• Perform an Investigation • Read Authentic Resources to Collect Information • Solve a Problem • Construct a Model	• Encourages the students to work together without direct instruction from the teacher. • Observes and listens to the students as they interact. • Asks probing questions to redirect the students' investigations when necessary. • Provides time for students to puzzle through problems.	• Thinks freely but within the limits of the activity. • Tests predictions and hypotheses. • Forms new predictions and hypotheses. • Ties alternatives and discusses them with others. • Records observations and ideas. • Suspends judgments.
Explain	• Student Analysis and Explanations • Supporting Ideas with Evidence • Structured Questioning • Reading and Discussion • Teacher Explanation • Thinking Skill Activities: compare, classify, error, analysis	• Encourages the students to explain concepts and definitions in their own words. • Asks for justification (evidence) and clarification from students. • Formally provides definitions, explanations, and new labels. • Uses students' previous experiences as basis for explaining concepts.	• Explains possible solutions and answers to others. • Listens attentively to others' explanations. • Questions others' explanations. • Listens to and tries to comprehend explanations the teacher offers. • Refers to previous activities. • Uses recorded observations in explanations.
Extend	• Problem Solving • Decision Making • Experimental Inquiry • Thinking Skill Activities: compare, classify, apply	• Expects the students to use formal labels, definitions, and explanations provided previously. • Encourages the students to apply or extend the concepts and skills in new situations. • Reminds the students of alternative explanations. • Refers the students to existing data and evidence and asks, What do you already know? Why do you think…? • Strategies from Explore apply here also.	• Applies new labels, definitions, explanations, and skills in new, but similar situations. • Uses previous information to ask questions, propose solutions, make decisions, and design experiments. • Draws reasonable conclusions from evidence. • Records observations and explanations. • Checks for understanding among peers.
Evaluate	• Any of the Above • Develop a Scoring Tool or Rubric • Test • Performance Assessment • Produce a Product • Journal Entry • Portfolio	• Observes the students as they apply new concepts and skills. • Assesses students' knowledge and/or skills. • Looks for evidence that the students have changed their thinking or behaviors. • Allows students to asses their own learning and group-process skills. • Asks open-ended questions, such as: Why do you think…? What evidence do you have? What do you know about X? How would you explain X?	• Answers open-ended questions by using observations, evidence, and previously accepted explanations. • Demonstrates an understanding or knowledge of the concepts or skill. • Evaluates his or her own progress and knowledge. • Asks related questions that would encourage future investigations.

Lab Report Template

Crafting an Argument through Experimental Design

I. Introduction

The introduction is also often referred to as the 'purpose' or plan section. It should include the following:

	Possible Sentence Starters
❑ **Purpose or objective** of the experiment expressed clearly in one or two sentences, including the method used to accomplish the purpose.	*The purpose of the experiment was to_____ by _____.* *To gain a greater perspective on _____, _____ was _____.*
❑ **Background and theory** pertaining to the experiment. This can include: o Information from previous research o Explanations of theories o Methods or equations	*_____ is related to _____.* *_____'s (year) work in this area demonstrates _____.* *_____'s work has_____.* *This experiment builds upon _____.* *Work in this area includes _____.* *Other scientists have _____.*
❑ **A hypothesis** what is expected to happen based on background information.	*The question under consideration is _____.* *I intend to show_____.* *This experiment determines _____.*
❑ **Safety Information** if applicable (MSDS sheets).	*Safety considerations for _____ include _____*

II. Materials and Procedure

A simple listing of the equipment used in the form of a bulleted list and the process of the experiment exactly as it was done in the laboratory.

❑ **Bulleted list of materials**, complete and accurate (include units)

❑ **Step-by-step numbered list**, include enough information so that others who read the report would be able to duplicate the experiment at a later date.

III. Results

This section contains all the results of the experiment, including:

❑ **Raw data** (weights, temperature, etc.) organized into labeled and titled graphs, figures or tables.

❑ **Calculations** one sample of each calculation is needed then mention if it was repeated.

❑ **Important outcomes** including both those expected and unexpected.	*The process revealed / showed_____.* *As expected / Surprisingly, we observed_____* *The process led to / resulted in_____.*

## IV. Analysis *This is the section where the results are explained, and where you show that you have a thorough understanding of the concept of the experiment and the results obtained. The main question to be addressed is: "What is the significance of the findings?"*	**Possible Sentence Starters**
❑ **Compare expected results with actual results**	*The results are consistent/inconsistent with ____.* *The results show _____ and reinforce/refute _____.* *It was observed that _____. This observation supports/ contradicts _____.* *Contrary to expectations, _____.*
❑ **Analyze experimental error**	*Errors in the process included _____.* *An error was made when _____.* *Although _____was expected to occur. Possibly due to _____, _____happened instead.*
❑ **Explain how the methods could be improved.**	*The experiment could be improved by _____.* *The experiment would have been more effective if _____.* *Future experiments should _____.*
❑ **Build a claim of significance based on the results.**	*As a result of _____, it can be determined that_____.* *The results indicates that _____.* *It was apparent that _____.* *The findings demonstrate/confirm/suggest_____.*
## V. Conclusion *Incorporate the following components into the final section of your lab report.*	
❑ **Explain the results in terms of the purpose. Return to the hypothesis.**	*The experiment successfully/unsuccessful _____.* *The experiment was effective/ineffective because _____.*
❑ **Support the claim with evidence from other, similar experiments/studies**.	*The results relate to _____.* *The findings are similar to those of_____.*
❑ **One or two sentences that summarizes definitive conclusions from the results**.	*From _____, it can be concluded that _____.* *The process proves that _____.* *There can be no doubt that these findings _____.*

Works Cited

Basic rules

- ❑ Begin your Works Cited page on a separate page at the end of your lab report. It should have the same one-inch margins and last name, page number header as the rest of your paper.
- ❑ Label the page Works Cited (do not italicize the words Works Cited or put them in quotation marks) and center the words Works Cited at the top of the page.
- ❑ Double space all citations, but do not skip spaces between entries.
- ❑ Indent the second and subsequent lines of citations by 0.5 inches to create a **hanging indent**.
- ❑ List page numbers of sources efficiently, when needed. If you refer to a journal article that appeared on pages 225 through 250, list the page numbers on your Works Cited page as 225-50.
- ❑ https://owl.english.purdue.edu/owl/resource/747/05

They Say/ I Say paragraph, or starting paper structure.

In recent discussions of (broader topic)_____,
a controversial issue has been whether (your research paper focus)_____
_____
_____
.
On the one hand, some argue that (one perspective on your focus)_____
_____
From this perspective (same line of thinking, further developed)_____
_____.
.
On the other hand, however, others argue that (another perspective) _____
_____.
In the words of (expert's name)_____, one of this view's main
proponents, (good quote) "_____
_____"
(in-text citation: _____). According to this view, _____
_____
_____.
.
In summary, then, the issue is whether (summary of thinking) _____
_____
or _____.
.
My own view is that _____
_____
_____.
.
Though I concede that (a weakness of the side you're advocating for)_____
_____.
I still maintain that (your refutation or rebuttal that weakness)_____
_____.
For example, _____
_____.