# The Role of Affect in OST's Support of Student Interest in STEM Careers

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Our STEM Project

- MSOSW
  - Middle Schoolers Out to Save the World
  - 14 Classrooms grade 6-7 in 4 states
    - Texas, Louisiana, Maine, Vermont

- NSF Innovative Technology Experiences C6
  - 3 years, 2008 – 2011, $1.4 M

- NSF/ITEST #0833706

Project Locations
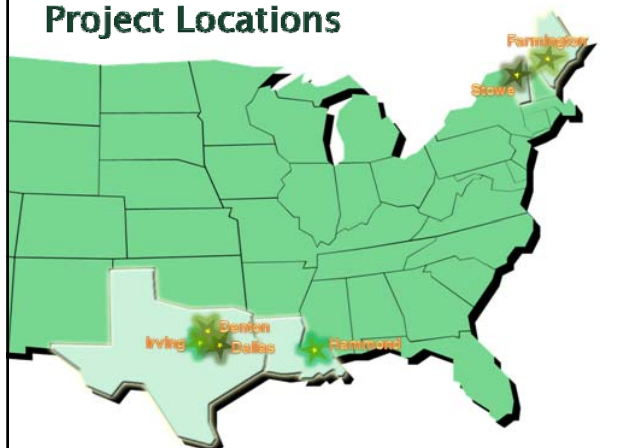
Project Activities

- Standby Power Monitoring, What If Projections
  - Save $ locally,
  - Reduce CO_2 globally
- Teachers train students to monitor home appliances
  - Classroom data aggregation, upload to database
  - Spreadsheet projections
- OST activity coordinated IST
  - School reaches out to home

Teacher Training Summer '09

Instrumentation for STEM Projects

- STEM Semantic Survey
  - ◦ Semantic Differential
  - ◦ 7-point scale pairs (interesting – boring) 5 areas:
    - Science
    - Math
    - Engineering
    - Technology
    - STEM Career
- Career Interest Inventory
  - ◦ 13 item Likert (SD to SA), 3 subscales
  - ◦ Based on US Dept. Ed. STEM Assessment in Hawaii

Key Issue or Broad Problem

- Assessment of STEM Career Interest
  - ◦ Across multiple grade levels
    - Grades 6–16 & beyond
- Can Reliable, Valid Instruments be identified
  - ◦ Reliability is job one
    - Construct Validity is job two
      - Discriminant Validity is job three
- What is our target or goal?
  - ◦ Changing Low Student Interest to High
    - Keeping High STEM Interest High
  - ◦ How high is high (interest in STEM careers)?

Challenges or specific needs

- What's Really Important?
  - ◦ Aptitude, Content Mastery, or Attitude (Interest)
    - Can low student interest be changed?
    - Do early interests really predict careers?

- Longitudinal Studies needed for answers
  - ◦ Grade 6 through college graduation (11 yrs.)
    - But awards are 3–5 years
    - Sustaining interventions is difficult
    - Attrition (w/families moving) makes studies messy

Approaches or Opportunities

- ▸ School Year Studies are Practical
  - ◦ Snap shot longitudinal, within year
    - • Replicated across grade levels
    - • Replicated across time (years)
- ▸ Long Term, High Interest Problems Abound
  - ◦ Greenhouse Gas Emissions
    - • Global Warming
  - ◦ Energy, Water, Food, Quality of Life
- ▸ Data Gathering Workforce is Massive
  - ◦ "*The largest single workforce in the world is students and their teachers*" (Allan Baer)

Benefits or Positive Outcomes

- ▸ Productive Citizens
- ▸ Problems Solved
- ▸ World Saved ☺

- ▸ And now, for a progress report …
  - • NSF PIs (ITEST), Technology Faculty (SITE), Teachers (T)
    - • vs.
  - • Middle School Students (MSOSW S) and
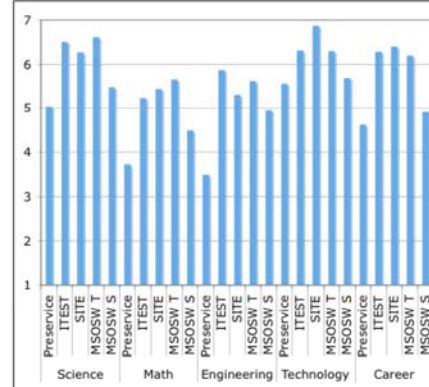 - • University Preservice Teachers (Preservice)

Semantic Perception: Spring '09

Instructions: Choose one circle between each adjective pair to indicate how you feel about the object.

To me, SCIENCE is:

1.	fascinating	①	②	③	④	⑤	⑥	⑦	mundane
2.	appealing	①	②	③	④	⑤	⑥	⑦	unappealing
3.	exciting	①	②	③	④	⑤	⑥	⑦	unexciting
4.	means nothing	①	②	③	④	⑤	⑥	⑦	means a lot
5.	boring	①	②	③	④	⑤	⑥	⑦	interesting

To me, MATH is:

1.	boring	①	②	③	④	⑤	⑥	⑦	interesting
2.	appealing	①	②	③	④	⑤	⑥	⑦	unappealing
3.	fascinating	①	②	③	④	⑤	⑥	⑦	mundane
4.	exciting	①	②	③	④	⑤	⑥	⑦	unexciting
5.	means nothing	①	②	③	④	⑤	⑥	⑦	means a lot

2009 Baseline Data Findings: STEM Semantics

Preservice Pilot Test Fall 2009

- University 2nd/3rd year students in Technology Integration Course
- 2 of 9 sections of 20-24 students
  - One Tuesday, One Thursday, same time
- Treatment over 3 weeks
  - Video of impact of global warming
  - Monitoring TV, computer, printer standby
    - Voluntary reading of referred articles
- Comparison group discussed learning styles

14th Graders Oct. 2009

Standby Power Quiz (Meier, Lawrence Berkeley Labs)

http://ngm.nationalgeographic.com/2008/04/climate/standby-quiz-interactive.html

Sample Question:

The Answer IS:

Vampire Electronics

Click through ten multiple-choice questions to find out how much you know about electronic waste.
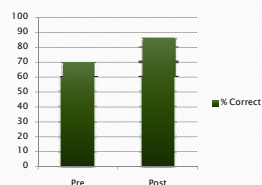
Question: 1 2 **3** 4 5 6 7 8 9 10

18.09

Correct

Generating the electricity necessary to keep the opener ready means emitting more than 50 pounds of CO2 a year.

Preservice Teachers Fall 2009

Knowledge of Standby Power

(bar chart: Pre, Post; % Correct)

- Vampire Power Quiz
  - Mean Pre = 70.0%
  - Mean Post = 86.3%

- $t = 2.9$ ($p < .01$)

- Effect Size = .94

- .2 small, .5 moderate,
  - .8 large (Cohen's d)

| Intervention Produced | > Content Knowledge |

Preservice Teachers Fall 2009

(line chart: Pretest, Post Test; Treatment, Comparison)
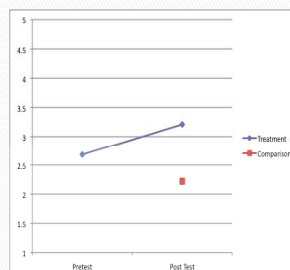
- STEM Career Pt. 2 Interest (Science)
  - Treatment Grp = 3.21
  - Comparison Grp = 2.22

- $f = 13.3$ ($p < .001$)
- Effect Size = 1.03

- .2 small, .5 moderate,
- .8 large (Cohen's d)

| Intervention Produced | > College / Career Att. |

College / Career Success Subscale
F2009 Preservice (Part 2, 5 Items, Alpha =.94)

		SD	D	U	A	SA
5.	I will make it into a good college and major in an area needed for a career in science.	①	②	③	④	⑤
6.	I will graduate with a college degree in a major area needed for a career in science.	①	②	③	④	⑤
7.	I will have a successful professional career and make substantial scientific contributions.	①	②	③	④	⑤
8.	I will get a job in a science-related area.	①	②	③	④	⑤
9.	Some day when I tell others about my career, they will respect me for doing scientific work.	①	②	③	④	⑤

Mixed Methods Approach (TIMSS, PISA, SITES, NELS Qualitative Items)

Survey Section	NELS Survey Analysis	Control (n=17)	Post (n=19 matched to Pre)	Pre (n=19)	Gain Pre to Post	Percent Gain
	n	17	19	19		
	date assessment given	10/6/09	10/8/09	9/24/09		
A	For each activity, check the box that best describes whether you have participated in these science or math activities during the past year.					
v14	after school	3	12	5	7	37
v15	science/engineering projects	4	7	0	7	37
v16	computer clubs/groups	5	7	3	4	21
v17	design/build clubs/groups	3	7	2	5	26
v18	science fair	5	6	5	1	5
v19	community groups	6	9	5	4	21
v20	summer camp/classes	5	9	4	5	26

Nolte & Harris, 2009

Target Audience for 2009 (Middle Schoolers)

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Successes / Challenges

- Successes: 2 new Career Interest instruments
  - Semantic Differential, 5 Scales (Alpha .84 – .94)
  - Likert Career Interest (Science), 3 Scales (.78–.94)

DeVellis Reliability Guidelines

Below .60	Unacceptable
Between .60 and .65	Undesirable
Between .65 and .70	Minimally acceptable
Between .70 and .80	Respectable
Between .80 and .90	Very good
Much above .90	Excellent (Consider shortening the scale)

(DeVellis, 1991, p. 85)

Successes / Challenges

- Challenges
  - ◦ 10+ year wait to confirm success

- Best Path?
  - ◦ Bring the home back into the school, and vice-versa
    - · Choose a meaningful problem for student & society
  - ◦ Out of School Time
    - · has much more time for self-motivated learning
  - ◦ But teachers should be the best for guiding learning
  - ◦ Combine the best of both OST & IST worlds

MSOSW Project Site

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