Building an Organism

Change in Program Structure, Teacher Knowledge and Affective Orientation over the course of a Three Year Cohort Program

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Overview of the Session

- Co-Development of the Program/ Program Model
- Program Strategies/Structures
- Intended Outcomes
- Approach to Research/Evaluation
- Major Findings
- Lessons Learned

Co-Development of the Program/Program Model

Co-Development of Program

- Context:
  - Illinois Math & Science Partnerships
  - RFP called for graduate programs that would allow teachers to qualify for additional endorsements
  - K-8 teachers --> middle grades physical science teachers

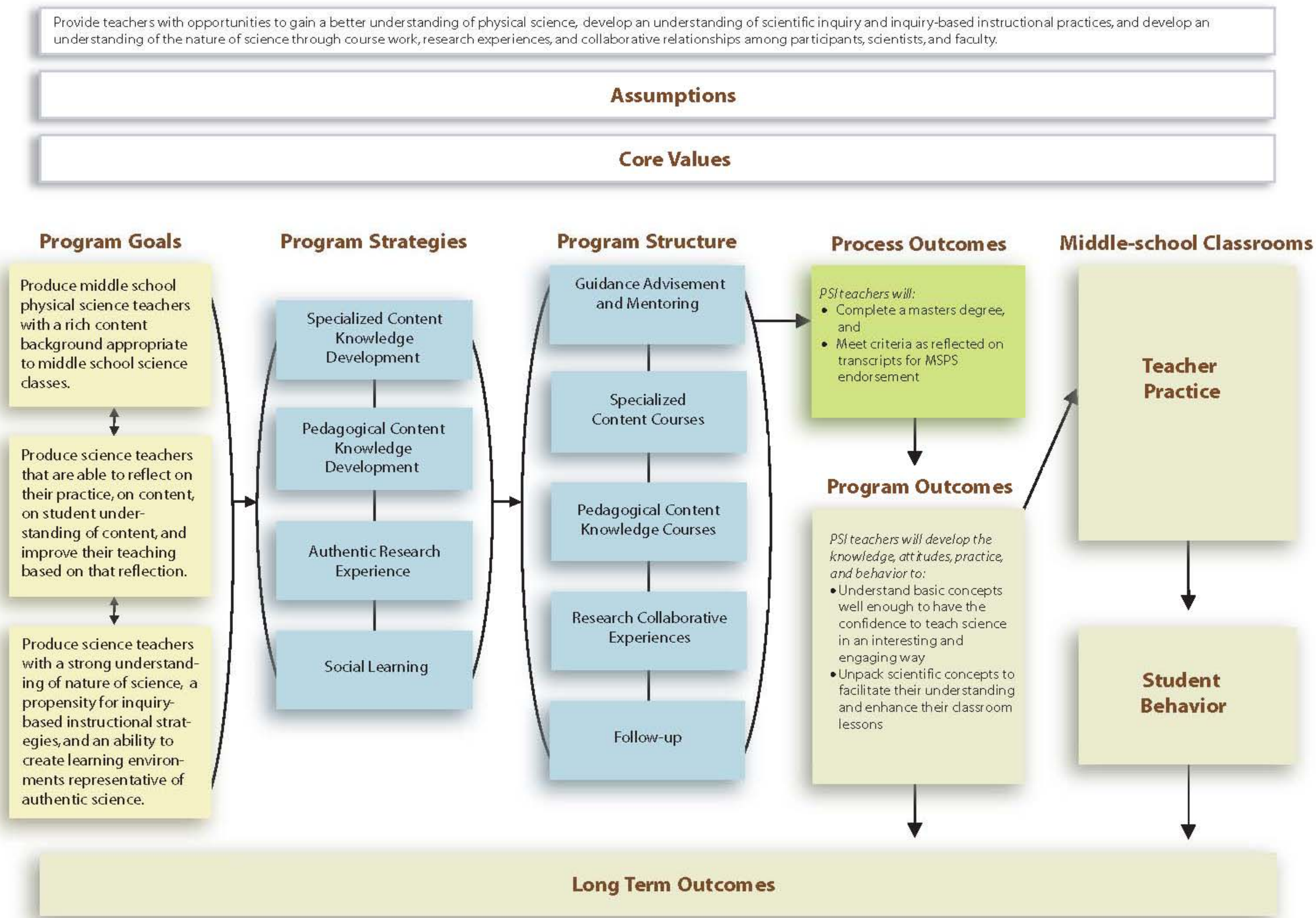
Co-Development of Program (con't.)

- Program developed from the ground floor
- Started with a program model during first year
- Process consistent with other program model efforts that articulating how program outcomes link to core program strategies (Rogers et al 2000; Race & Brett, 2004; Renger, 2006)

The Program Model

- Facilitated development of the program and its implementation
- Guided change in the midst of implementation
- Guided the evaluation

IIT PSI Program Model



Modeled Program Components

- Program Purpose
- Assumptions Core Values
- Program Goals
- Program Strategies
  - Specialized Content Knowledge Development
  - PCK Development
  - Authentic Research Experience
  - Social Learning

- Program Structure
  - Guidance Advisement and Mentoring
  - Specialized Content Courses
  - PCK Courses
  - Research Collaborative Experiences
  - Follow-up

Program Model: Identified Outcomes

- Process
  - Complete a Masters Degree
  - Meet criteria for MSPS endorsement
- Program
- Middle-school classrooms
  - Teacher Practice
  - Student Behavior
- Long-term

Program Model

Concerted planning effort led to a conscious and reflective effort to connect:

Program Strategies ⟷ Outcomes ⟷ Measures

…. More about outcomes and measures later

Program Strategies and Program Structure

Planned Course Sequence

PSI Course Sequence Full Program			
Summer '08	Physical Science		
Fall '08	Research	Energy and Forces	Clinical
Spring '09	Practicum I	The Atomic World	Supervision
Summer '09	Physical Science	Inquiry and Problem Solving	
Fall '09	Research	Advanced Strategies	Assessment
Spring '10	Practicum II	Physical Science Applications	and Evaluation
Summer '10	Action	Physical Science Instrumentation Methods	Adolescent Psychology
Fall '10	Research	Science Curriculum	
Spring '11	Course		

Implemented Course Sequence

PSI Course Sequence Cohort 1.0			
Summer '08	Physical Science		
Fall '08	Research	Energy and Forces	Clinical
Spring '09	Practicum I	The Atomic World	Supervision
Summer '09	Physical Science	Inquiry and Problem Solving	
Fall '09	Research	Physical Science Applications	Assessment
Spring '10	Practicum II	Physical Science Instrumentation Methods	and Evaluation
Summer '10	Action	Science Curriculum	
Fall '10	Research	Adolescent Psychology	
Spring '11	Course		

Reason and Support for Changes

- Progress in building a rapport and supportive climate in the content classes
- Sense that one summer course was the limit
- Confidence that other pedagogy courses were sufficient

Physical Science Courses

- Designed from scratch by Science Education and Physics Faculty
- Continuity of Instructors
- Sequence:
  - Energy and Forces
  - The Atomic World
  - Physical Science Applications (Astronomy & Biology)
  - Physical Science Instrumentation Methods

Physical Science Research Practicum

- Placed in Research Labs on campus in groups of at least two
- Equivalent to two semester courses
- Periodic seminar meetings and assignments in other courses for reflection

Outcomes

Overview of Intended Outcomes

Teacher:

- Knowledge
- Attitudes
- Practices and Behavior

Student:

- High Engagement
- Doing Science

Intended Teacher Outcomes

Knowledge: PSI teachers will

- Develop knowledge and science skills (e.g., use heuristics, analyze empirical data)
- Have a sophisticated view of science (i.e., generating and connecting multiple representations of scientific ideas)

Intended Teacher Outcomes (con't.)

Attitudes: PSI teachers will develop confidence in

- Content science knowledge and skills (including mathematics)
- Ability to teach science
- Experimenting with teaching strategies

Intended Teacher Outcomes (con't.)

Practice and Behavior: PSI teachers will

- Understand basic concepts well enough to have the confidence to teach science in an interesting and engaging way
- Unpack scientific concepts to facilitate their understanding and enhance their classroom lessons

Intended Student Outcomes

Students of PSI teachers:

- Are highly engaged and interested (in science)
- Collect, manipulate, interpret and present data
- Make empirically supported arguments

Outcomes/Measures Alignment Teachers

Outcomes	Measures
•**Knowledge**	**DTAMS – ((Diagnostic Science Assessment for Middle School Trettor,** *et al*.**, 2007)**
	VNOS-C (Views of Nature and Science, Lederman et al., 2001)
•**Attitudes**	**Survey Battery/Focus Group**
•**Practice and Behavior**	HRI COP (Horizon Research Institute, Classroom Observation Protocol, 2005)/ Focus Group

Outcomes/Measures Alignment: Students

Outcomes	Measures
• Knowledge	ISAT (Illinois State Achievement Test) Specific Content Tests
• Engagement • Doing Science	HRI COP Focus Groups

As a Result ….

- Teachers’ will learn science
- Teachers’ will demonstrate positive attitudes toward teaching
- Teachers’ practices in teaching science will incorporate scientific inquiry
- Students will be engaged and do science
- Teachers perceptions will inform further design of the program model

Approach to Research and Evaluation

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Overview of Measures and Time Periods

Measure	Time Periods			
	T1 (2008)	T2 (2009)	T3 (2010)	T4 (2011)
DTAMS	x	x	x	x
VNOS	x		x	x
Attitude Survey Battery	x		x	x
HCOP	x	x	x	x

DTAMS

Subscales:

DEC – Declarative Knowledge (knowledge of definitions and facts)

INQ – Scientific Inquiry and Procedures

SCH – Schematic Knowledge (deep understanding of science concepts, laws, theories, principles, rules)

PED – Pedagogical Content Knowledge

KnowTOT – Total Knowledge Score

DTAMS (con't.)

Subscales:

MAT – Properties and changes of properties of matter

Motion Force – Self explanatory

Ener – Energy

Content Total – Total score across content areas

STS - Science Technology and Society Knowledge

VNOS

Sub-scales:

- Tentativeness
- Creativity
- Subjectivity
- Empirically-Based
- Socio-Cultural Embededness
- Theory and Law
- Observation and Inferences

Attitude Battery

- Attitudes in Teaching Science (ATS) survey (Race, 2001; Race, 2003) – 4 scales
- Personal Science Teaching Efficacy Belief (PSTEB) scale – [part of Science Teaching Efficiency Belief Instrument, STEBI; (Riggs & Enochs, 1990)] -- 1 scales
- Interest in Becoming a Science Teacher Nieswandt, Barret, & McEneaney, 2010) --- 1 scale

Attitude Battery (con't.)

ATS – Four scales

Perceptions toward

- Use of Best Practices Instructional Strategies
- Teaching and their Individual Learning
- Moving Away from Traditional Methods
- Confidence in Teaching Science
- Using Inquiry-based Practices

Attitude Battery (con't.)

All Attitude Items

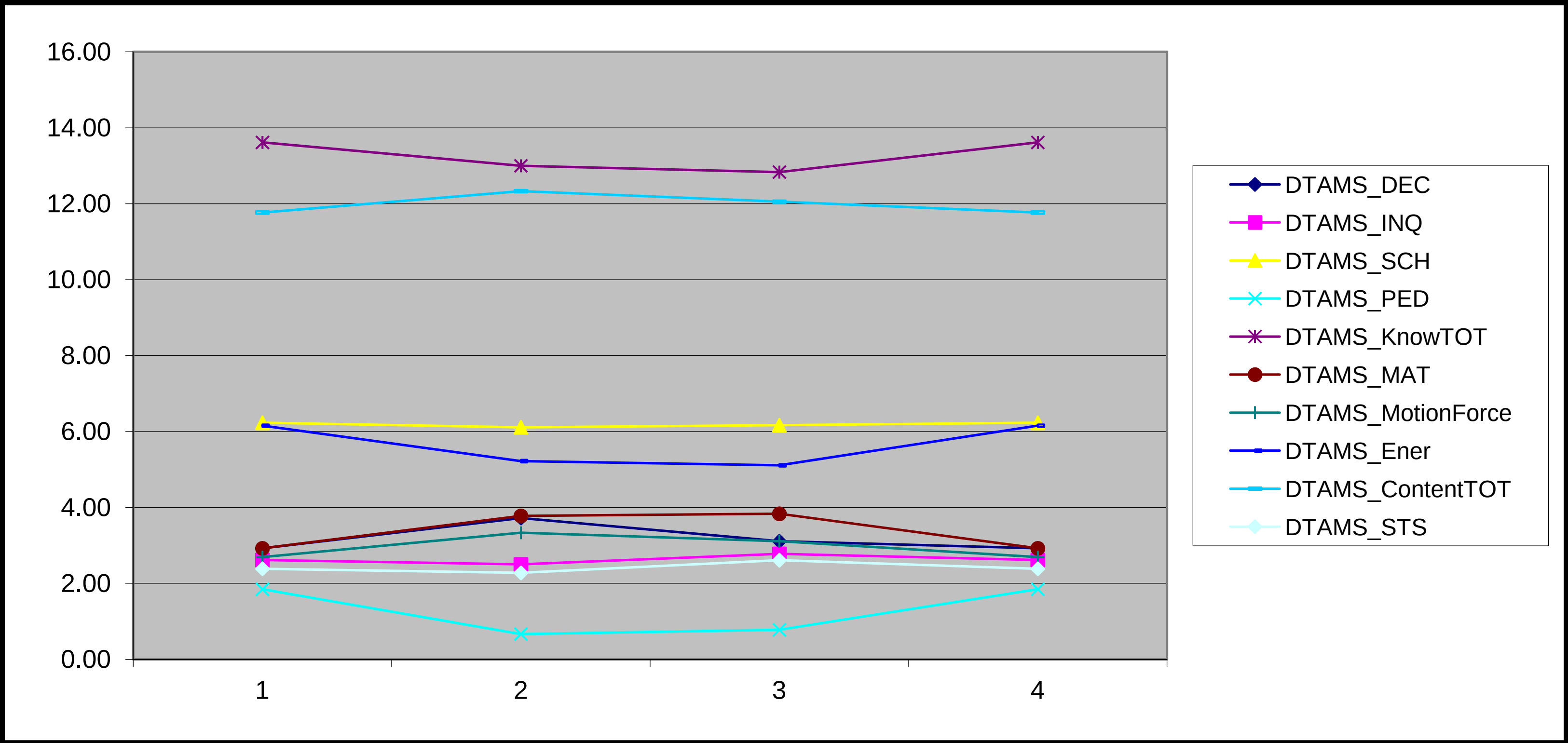
- Assessed using a Likert-type scale (5 = Strongly Agree, 1 = Strongly Disagree)
- Negatively worded items reverse coded
- Thus, higher the score the more positive the attitude

Teacher Practice and Behavior

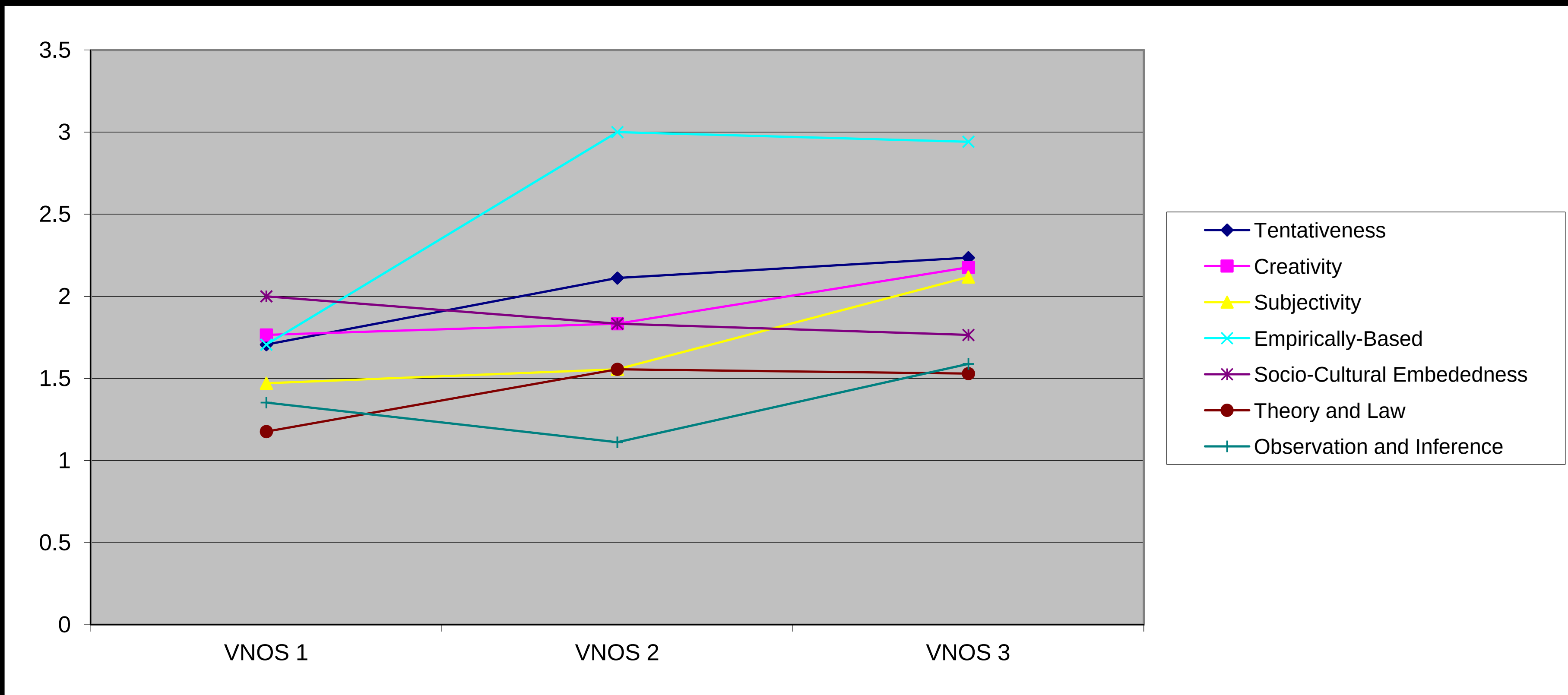
- Actual classroom behavior observed with Horizons Classroom Observation Protocol (HCOP, 2005)
- Overall plus specific-section ratings such as:
  - Contextual background
  - Lesson description, instructional materials and classroom instruction
  - Design and implementation
  - Science content
  - Classroom culture

Major Findings

Growth in Teacher Knowledge



Growth in Teacher Knowledge



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Change in Attitudes toward Teaching Science*

Baseline to End-of-Program (EP), significant increase in positive attitudes towards

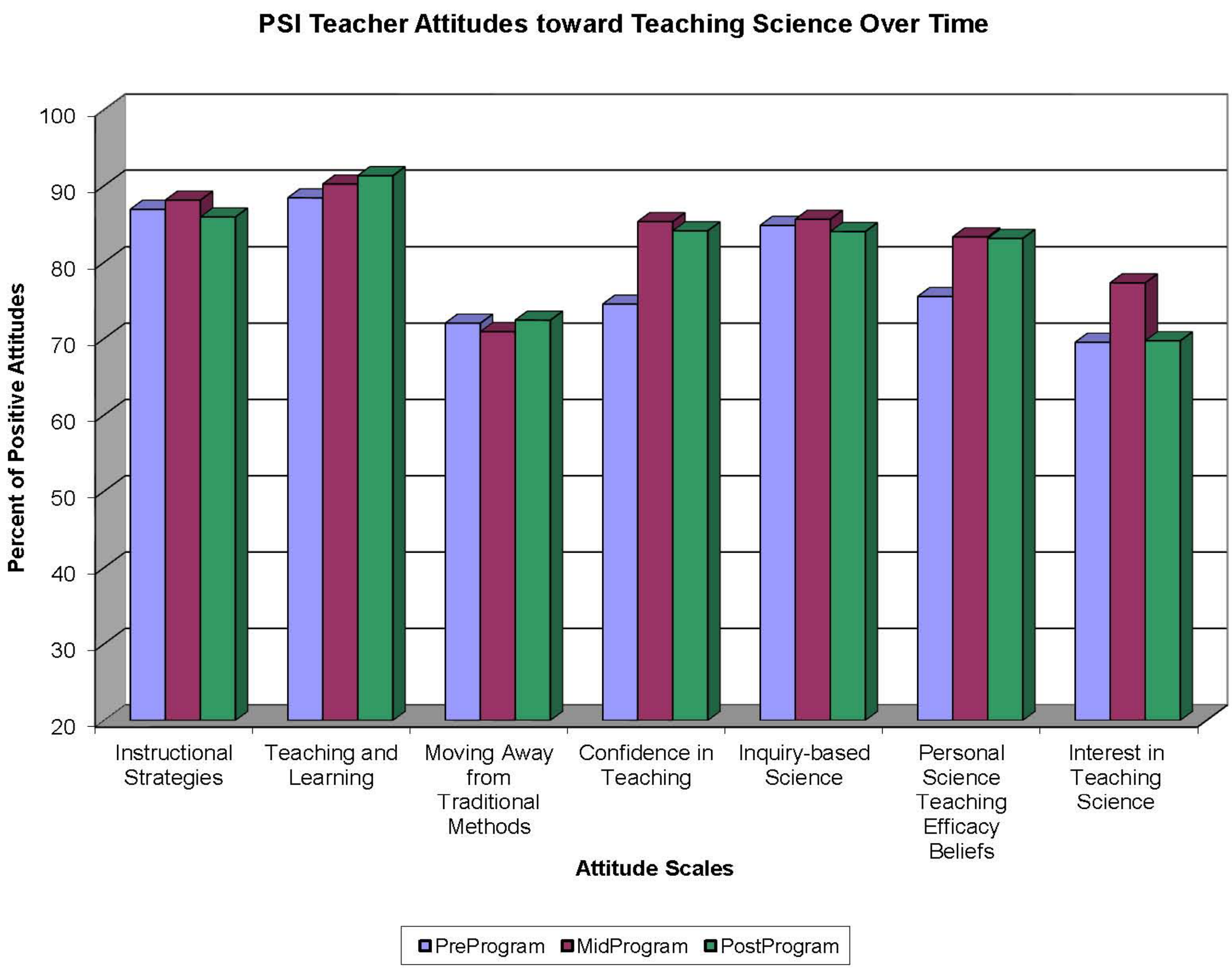
- Confidence in Teaching Science

  Baseline = 26.36 (SD = 4.94) vs. EP = 29.43 (SD = 3.73) $p < .03$

- Personal Science Teaching Efficacy Beliefs (PSTEB)

  Baseline = 49.07 (SD = 8.84) vs. EP = 54.00 (SD = 8.09) $p < .02$

*[Statistical tests conducted on only baseline to end-of-program comparisons.]



PSI Teacher Attitudes toward Teaching Science Over Time
Percent of Positive Attitudes
100
90
80
70
60
50
40
30
20
Instructional Strategies
Teaching and Learning
Moving Away from Traditional Methods
Confidence in Teaching
Inquiry-based Science
Personal Science Teaching Efficacy Beliefs
Interest in Teaching Science
Attitude Scales
PreProgram
MidProgram
PostProgram

Growth in Teacher Practice and Behavior

- Rating of quality of lesson on 5 levels and a narrative rationale for rating
  - **Level 1:** ineffective instruction; (a) passive learning, (b) activity for activity sake
  - **Level 2:** elements of effective instruction
  - **Level 3:** beginning stages of effective instruction; (a) low, (b) solid, (c) high
  - **Level 4:** accomplished, effective instruction
  - **Level 5:** exemplary instruction

Overview of Rating of Quality of Observed Lessons over Time

	Time point and number of teachers observed			
Level	T1 (2008) n=8	T2 (2009) n=12	T3 (2010) n=11	T4 (2011) n=15
1	0	2	0	1
2	1	1	1	1
3	6	7	6	8
4	1	2	2	1
5	0	0	2	4

Teacher Perceptions of Practice Gains and Changes

- Observed changes in classroom practice was supported by interviews
- By the end of the program all participants stressed that they:
  - increased their science content knowledge
  - felt very positive, proud and confident about their acquired knowledge
  - and as a result of this, felt secure in making changes in their teaching practice by teaching more inquiry-based lessons

Lessons Learned

Importance of Planning Year and Program Model

- Allowed for significant brainstorming with input from all participants
- Allowed for content courses to be designed from scratch as single sequence
- Program Model reified beliefs, ideas, strategies, etc.
- Program Model became reference point for later work (evaluation, program changes, etc.)

Appropriate Participant Work Load

- Spanning semesters may spread out work theoretically, but participants minds are still split to much
- One course during the summer

Connecting Too Many Parts

- Participants were sometimes unaware of how work in one course connected (or would connect) to work in another
- The variety of contexts for teachers inhibited more uniform implementation

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Pro’s and Con’s of Action Research

- Participants entered with little to no background in research, statistics, etc.
- One course for learning and implementing AR is difficult
- More appealing to participants than we expected
- All participants were engaged in personally meaningful investigations about their teaching practices
- All participants formed action plans out of their work
- Many submitted to professional conferences

Varied Experience with Research Practicum

- Quality depended on placement
- Those that were well integrated with research group had a positive experience
- Time may have reached the point of diminishing returns

Challenge of Late Additions

- Late joiners sometimes felt overwhelmed with the catch-up pace
- Felt welcomed and supported by the main group
- Illustrated benefit of cohort structure

Challenge of Multiple Evaluation Demands

- Federal, State, District, Program
- Evaluation fatigue on the part of the participants
- Teachers' time was the most limited resource
- Complexity of the variety of participants' contexts

Thank you!!

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