IDENTIFYING SHIFTS IN GTA'S PEDAGOGICAL CONTENT KNOWLEDGE (PCK)

Outcomes of a "Scientific Teaching" course for biology graduate teaching assistants at a large research university

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- Over **10,000** lab seats

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Arizona State University

- Over 20,000 students in undergraduate biology courses
- Over 10,000 lab seats
- Approximately **2,800** majors in biology

Problem

- SoLS serves a growing number of students in undergraduate courses.
- Many courses are taught by Graduate Teaching Assistants (GTAs) who have little to no training in teaching science.

Innovative TA Program

- Innovative TAs (ITAs) intended to have roles different from traditional GTAs

Innovative TA Program

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- ITA Program Requirements:
  - Faculty submit proposals
  - ITAs must be knowledgeable about the course content
  - ITA Training:
    - Fall semester – limited to orientation 2.5 days
    - Spring semester – “Scientific Teaching” course

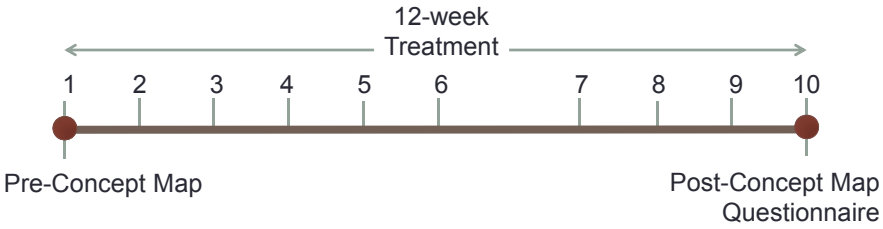
The "Scientific Teaching" Course

Focus on Two Big Ideas:

1. **Student understanding** in undergraduate biology
2. **Reformed teaching practices** in undergraduate biology

"Scientific Teaching" Course

Knowledge of Student Understanding	Knowledge of Instructional Strategies
Constructivism Conceptual Change	Inquiry Active Learning Strategies Student Motivation 5E Lesson Design



Purpose of the pilot study

- To identify shifts in pedagogical content knowledge (PCK) of ten biology ITAs at a large research university during their participation in a “Scientific Teaching” course

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  2. What were the changes in the areas of **student understanding of science** and **instructional strategies**?

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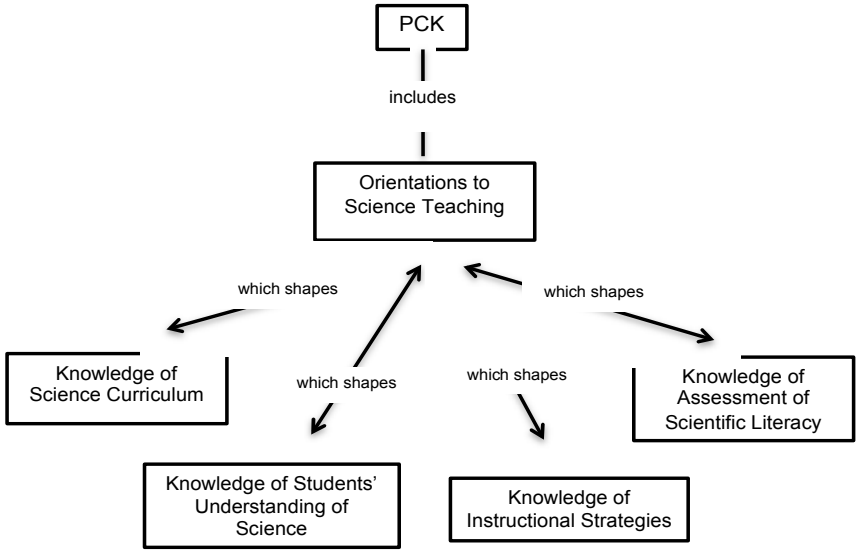
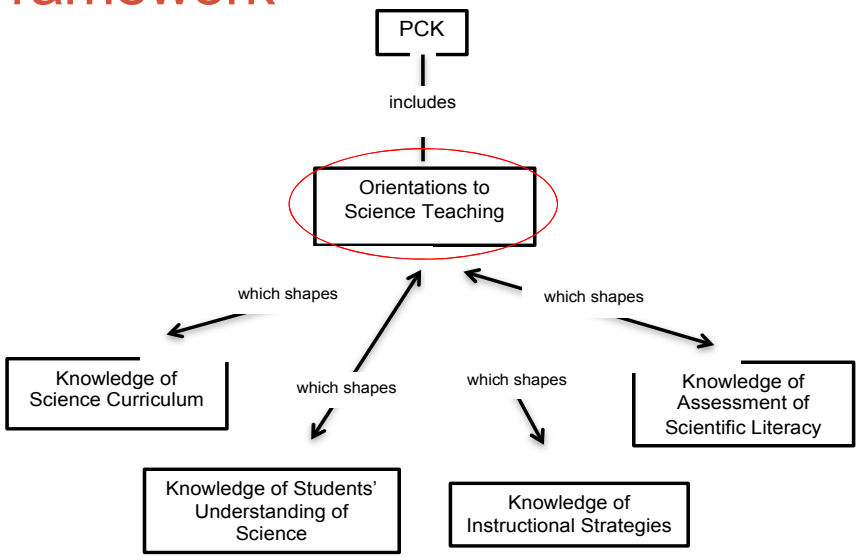
- Research questions:
  1. What were their **orientations** toward teaching?
  2. What were the changes in the areas of **student understanding of science** and **instructional strategies**?
  3. What were the **barriers and bridges** in building their PCK?

Framework



PCK model for science teaching (simplified version). (Friedrichsen, Van Driel,, and Abell, 2011).

Framework



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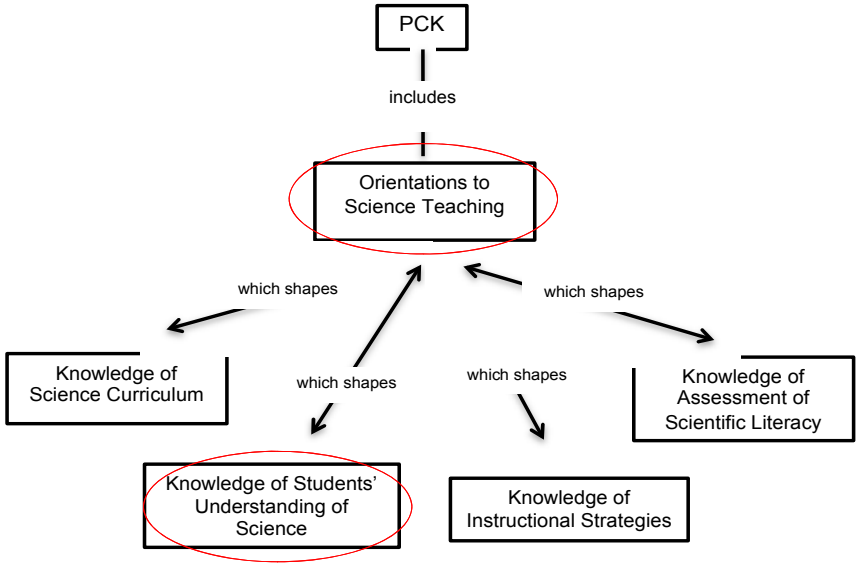

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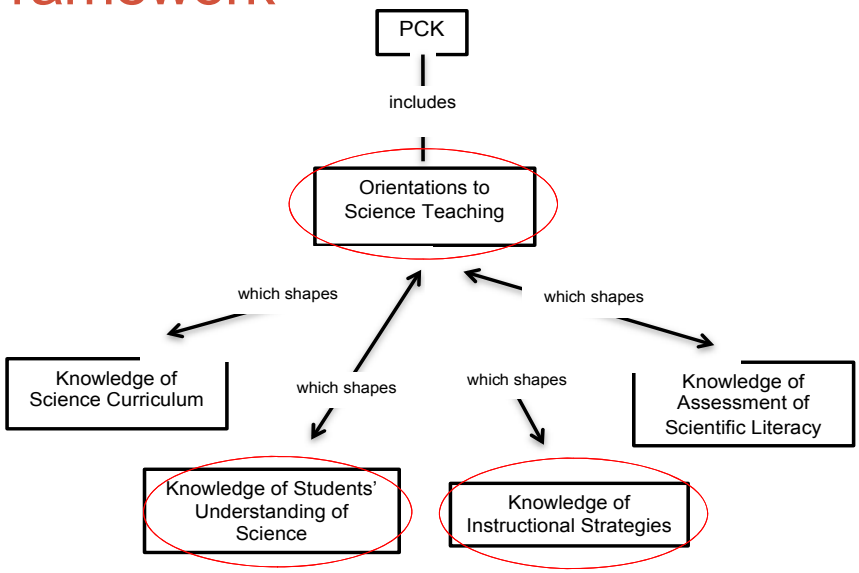
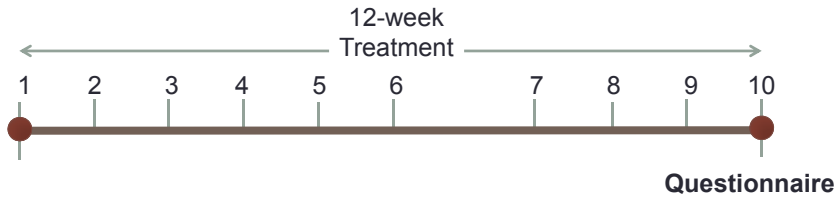


PCK model for science teaching (simplified version). (Friedrichsen, Van Driel,, and Abell, 2011).

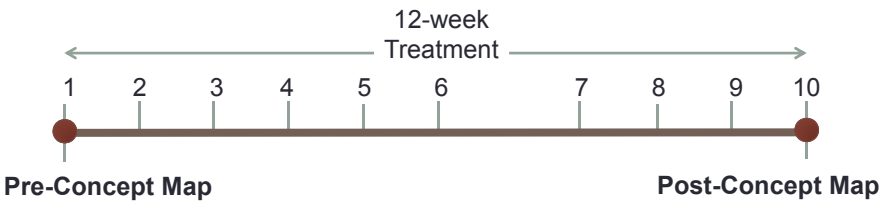
Mixed-methods study

- Question #1 – What were the ITAs **orientations** toward teaching?
- Qualitative - Questionnaire responses were coded to classify the ITAs into one of five orientations.



Mixed-methods study

- Question #2 - What were the changes in the areas of **student understanding of science** and **instructional strategies?**
- Quantitative method – Concept map data was quantized using a rubric and descriptive statistics were generated.



Mixed-methods study

- Question #3 – What were the **barriers and bridges** to building their PCK?
- A mixed-methods approach was used to analyze the qualitative and quantitative data along with demographic data.

Participants

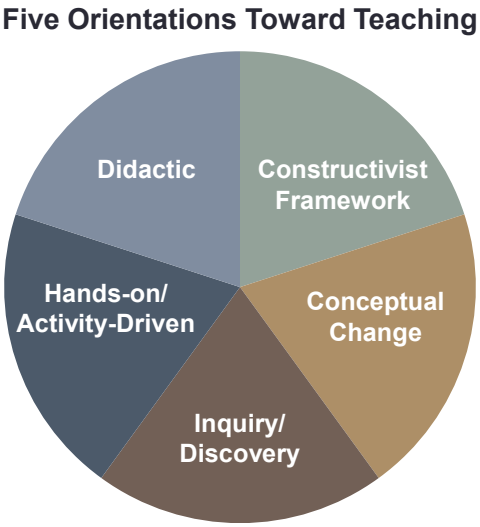
Name*	Gender	Prior K-12 Teaching (years)	Total GTA Experience (semesters)
Bruce	M	0	Over 9
Ellen	F	0	Over 9
Judith	F	1	8
Scott	M	3	6
Danielle	F	0	4
Patrick	M	0	4
Rose	F	0	3
Annie	F	0	2
Joe	M	1**	2
Laura	F	0	1

* - pseudonym ** - ITA gained teaching experience in an after-school program

Limitations

- Based upon the small sample size (n = 10), the findings are not generalizable to a large population of graduate teaching assistants.
- Given that the data was collected at the beginning and end of the "Scientific Teaching" course, the findings cannot be extended beyond the timeframe of the study.

Question #1 – What were their **orientations** toward teaching?



Question #1 – Analysis of Questionnaire

- Excerpt from Questionnaire (Annie)

*I worked with the students directly every week during recitation. At first I was primarily **lecturing** and **taking questions** from students. Later in the semester I had them **work in groups to solve problems**; I would walk around to the groups and **ask them questions about the problems**, and **take questions from them**. I would also **picked individuals or groups to explain** how to solve the problems to the class.*

Constructivist Framework Orientation

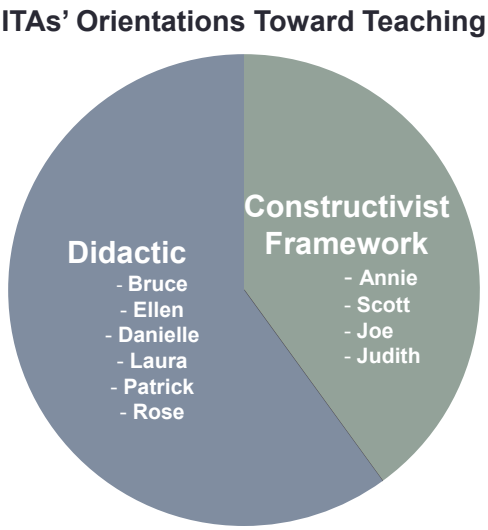
Question #1 – Analysis of Questionnaire

- Excerpt from Questionnaire (Bruce)

*I interact with students in the lecture as well as the lab that meets two times a week. The lecture interaction involved me **presenting lecture material** as well as **facilitating small group discussions**. The laboratory section allowed me to **work with students on a 1 on 1 basis** as well as assist the lead lab TA. I **lectured roughly 50%** of the time and was present in lab 50% of the time.*

Didactic Orientation

Question #1 - Analysis of Questionnaire



QUESTION #2 – What were the changes in the areas of **student understanding** and **instructional strategies**?

QUESTION #2 – Indicators of Knowledge

Indicators of Knowledge of Student Understanding in Science	Indicators of Knowledge of Instructional Strategies
• Knowledge of common student misconceptions • Connected to students' lives (authenticity) • Typical student trajectories of understanding (learning progressions)	• Activities build on each other • Consider students' ideas and experiences • Include multiple representations and learning experiences • Instructional decisions consider pros and cons • Inquiry application • Motivating environment

(Weizman, Covitt, Koehler, Lundeberg, and Oslund, 2008)

Question #2 – Analysis of Concept Maps

Score	0	1	2	3
Level of explanation of knowledge domain of PCK	The topic is not present.	The topic was just mentioned.	The topic was partly elaborated.	The topic was clear and explained.

- Scored each concept map for **student understanding** and **instructional strategies**

Scoring rubric for concept maps in four domains of knowledge (Weizman, et. al., 2008)

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- Scored each concept map for **student understanding** and **instructional strategies**
- Calculated **average score**
- Calculated **differences** between the averages of the pre- and post-concept map scores

Scoring rubric for concept maps in four domains of knowledge (Weizman, et. al., 2008)

Question #2 – Analysis of Concept Maps

Pre-Concept Map (Scott)

Post-Concept Map (Scott)

Score for Student Learning = 0

Score for Instructional Strategies = 0

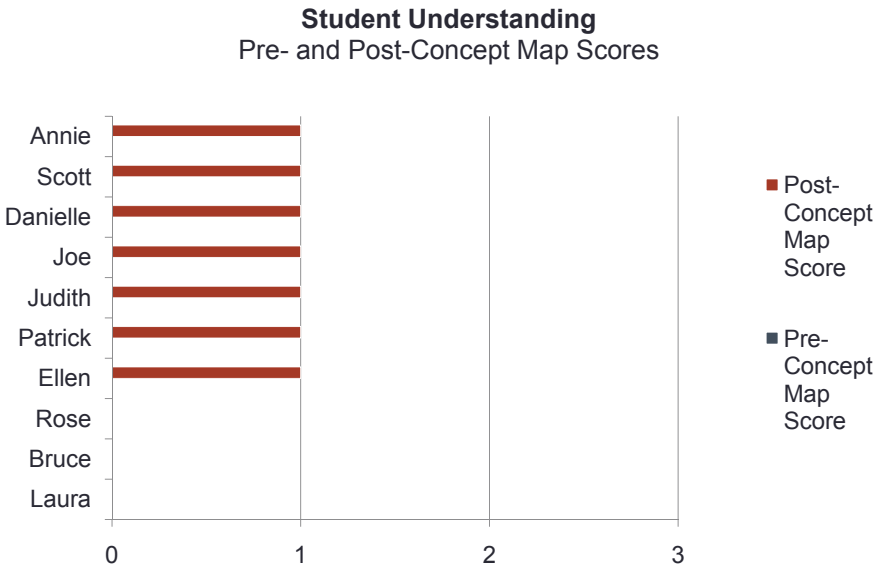
AVERAGE SCORE = 0

Score for Student Learning = 1

Score for Instructional Strategies = 2

AVERAGE SCORE = 1.5

Question #2 – Analysis of Concept Maps



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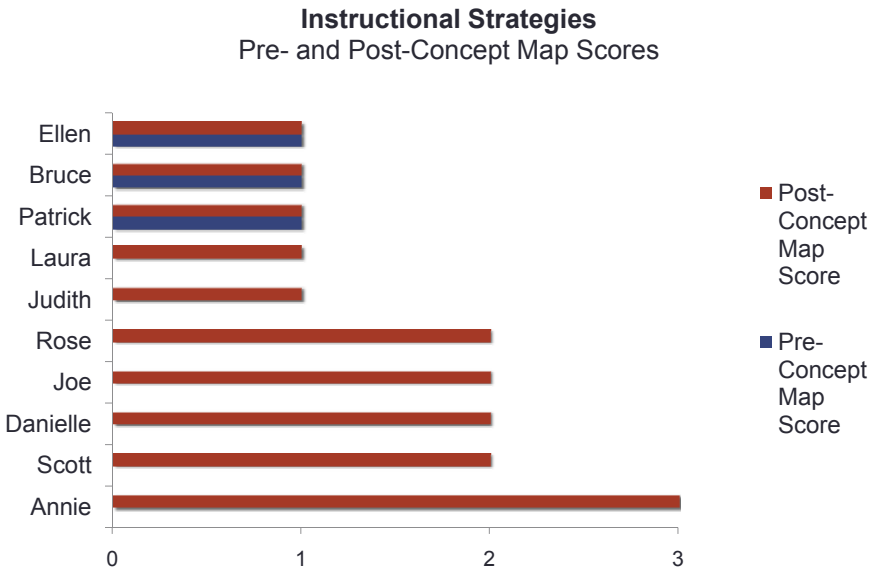

Question #3 – What were the **barriers** and **bridges** to building their PCK?

- Questionnaire responses
- Pre- and post-concept maps

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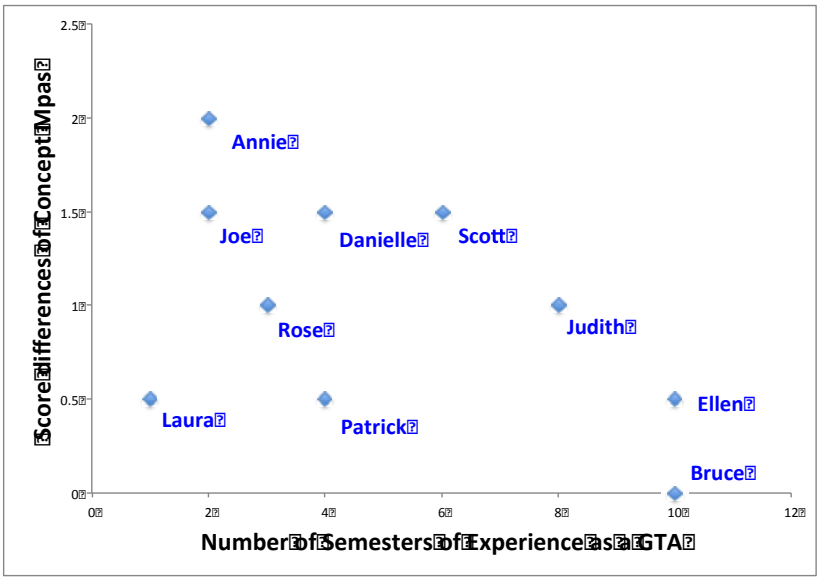
- Questionnaire responses
- Pre- and post-concept maps

- Total semesters of GTA experience
- Reported primary reason for being an ITA

C-Map Score Differences vs. GTA Experience



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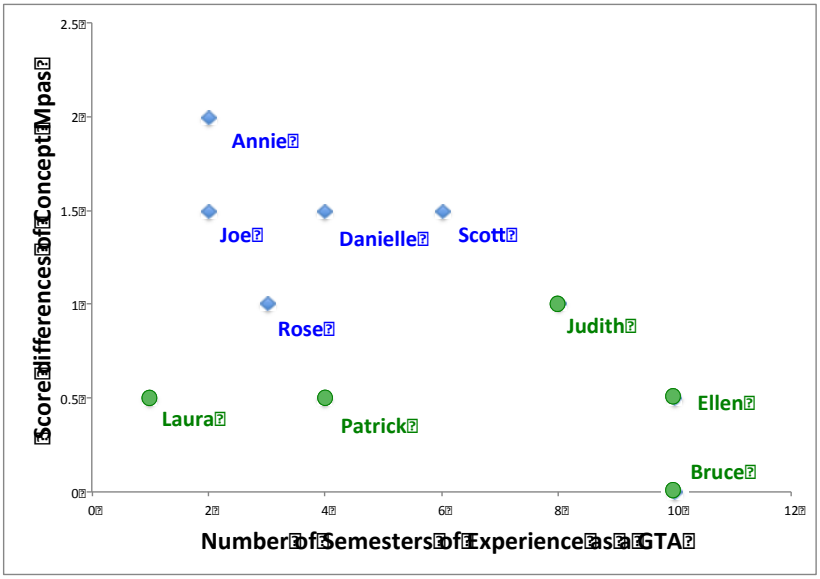
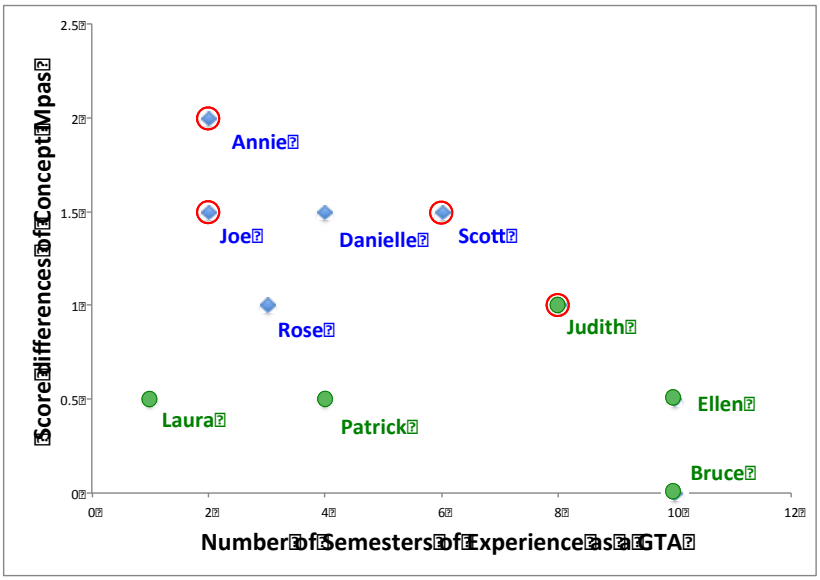


Green – denotes participant being an ITA primarily for funding
Blue – denotes participant being an ITA for teaching experience

C-Map Score Differences vs. GTA Experience



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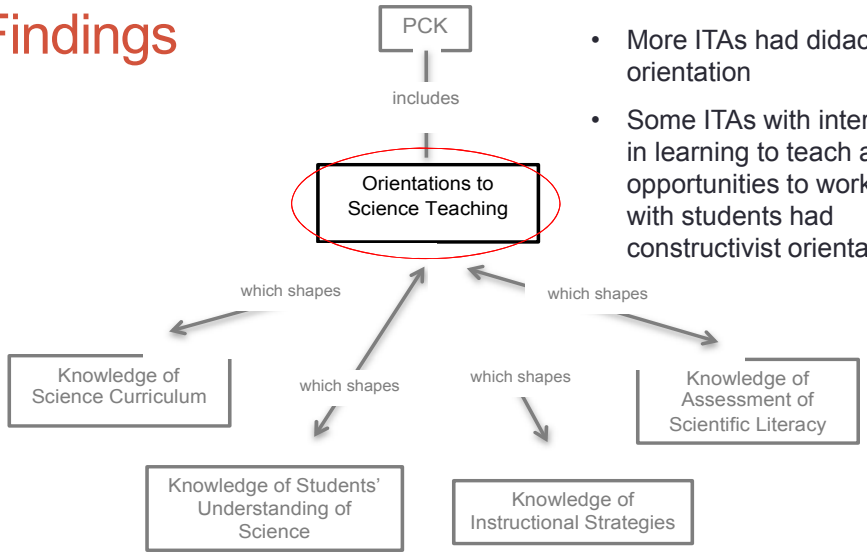
Blue – denotes participant being an ITA for teaching experience
O – denotes participant reported interactions with students using innovative strategies (constructivist)

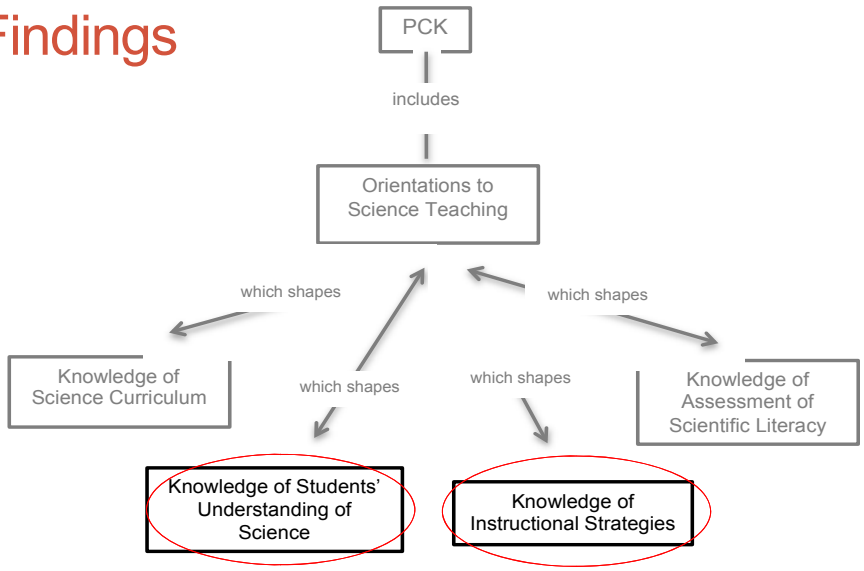
Findings



- More ITAs had didactic orientation
- Some ITAs with interest in learning to teach and opportunities to work with students had constructivist orientation

PCK model for science teaching (simplified version). (Friedrichsen, Van Driel,, and Abell, 2011).

Findings



- ITAs developed more knowledge in the area of instructional strategies than student understanding

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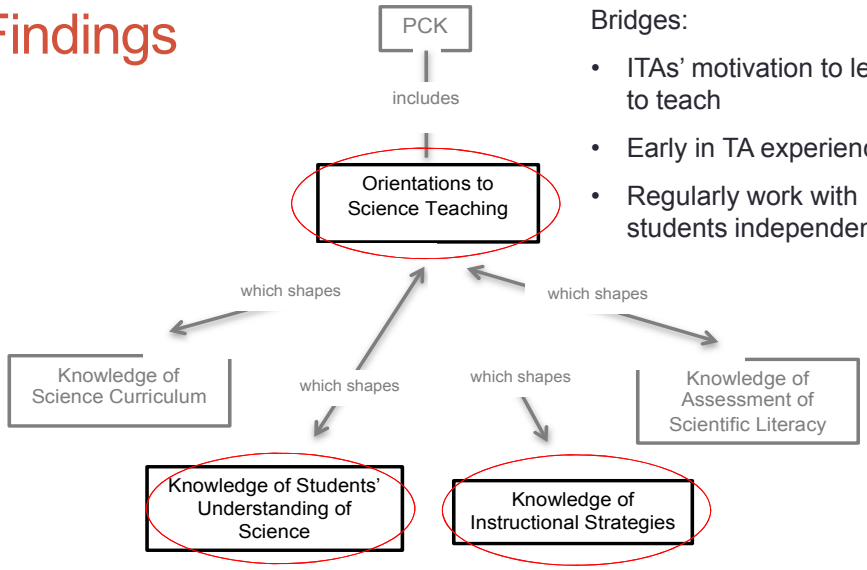
Findings



Bridges:

- ITAs' motivation to learn to teach
- Early in TA experience
- Regularly work with students independently

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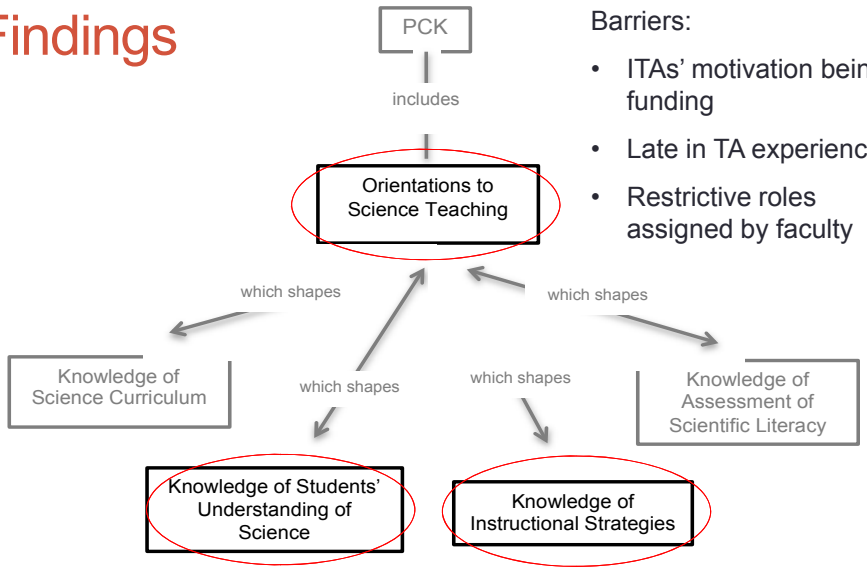
Findings



Barriers:

- ITAs' motivation being funding
- Late in TA experience
- Restrictive roles assigned by faculty

PCK model for science teaching (simplified version). (Friedrichsen, Van Driel,, and Abell, 2011).

Discussion

- In light of the Concerns-based Adoption Model (CBAM) study, the findings of this pilot study indicate that the ITAs primarily had a concern for task and did not transition to thinking about students. (Hall & Hord, 2001)
- As a minimum of 80 hours of professional development are needed before changes are found in teacher practices, the "Scientific Teaching" course is not currently designed to produce significant changes. (Supovitz & Turner, 2000)
- Research in education also reports that teachers build their knowledge when they are engaged in practice. Those ITAs with higher PCK were afforded opportunities to practice. (Cochran-Smith, M. & Lytle, S. L., 1999)

Implications

Considerations for the Innovative TA Program:

- Initiate training early in TA experience
- Build a community that values teaching – ITAs and faculty
- Develop a coherent program that allows students to move from thinking about what students are doing to how students are learning
- Provide incentives for completing the program

Implications

Considerations for the "Scientific Teaching" Course:

- Incorporate strategies for ITAs to develop more interest in learning to teach undergraduate biology
- Provide more experiences in thinking about student understanding

Future Study

- Fall 2012 – Approximately 40 GTAs enrolled in the "Scientific Teaching" course
- Research using more pre- and post- data to capture changes in PCK
- Make classroom observations during the fall semester training and following the training in the spring

Thank you to ..

Dr. Julie Luft, University of Georgia
Dr. Valerie Stout, Arizona State University
Christian Wright, Arizona State University

For more information, contact

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