Do GTAs' Nature of Physics Epistemologies Change Through Teaching Experience?

Cathy Ezrailson in cooperation with:
Teruki Kamon, Peter McIntyre, Cindy Raisor, Alexei Sokolov & David Toback

TAMU Visual Physics Project

Supported in part by NSF Grant No. 0083336

AAPT Winter Meeting Jan 2005

http://www.coe.tamu.edu/~ezrailson
The Questions

RQ 1: Do GTAs' epistemologies as well as beliefs about the Nature of Physics and physics teaching change through experience gained teaching Visual Physics?

RQ 2: Does GTA understanding of the Nature of Physics and learning about physics impact the character of instruction they engage in during recitation and lab?

RQ 3: Does the character of their teaching experience have an impact on GTA beliefs?
The Design: Mapping Change

The Sample

Physics 218 Partial Course Reform – Recitation, Lab and GTA Training

Fall 2003, Ns=250
Fall 2004, Ns=300

The Sample

Fall 2003
9 Sections
Physics GTAs

Visual Physics
Trained GTAs
N = 3

Control
Untrained GTAs
N = 2

Fall 2004
11 Sections
Physics GTAs

Visual Physics
Trained and Experienced
N = 3

Visual Physics
Trained Novice
N = 2

The Sample

Fall 2003
9 Sections
Physics GTAs

The Sample

Fall 2004
11 Sections
Physics GTAs

The Instruments:

• MPEX2  • FCI
• RTOP  • Interviews

AAPT Winter Meeting Jan 2005  http://www.coe.tamu.edu/~ezrailson
Problem: Impact of GTA Epistemologies on Instruction and Conversely...

Extending VP Studies from Fall 2003 and Spring 2004 to Fall 2004

MPEX2: Probes GTA Physics Expectations:

- **Coherence** (discrete/connected continuum)
- **Independence** (Authority/Student-centered continuum)
- **Conceptual Understanding** (global fit/fact-based)

RTOP: Assesses the *Character* of Instructional Methods

GTA Comments show *Impact* of Instruction on GTA Beliefs
Findings 1: Relationship between Belief & Experience

Do GTAs’ beliefs change through experience?

MPEX2 Summary
Novice GTAs Trained Fall 03

MPEX2 Summary
Experienced GTAs Fall 04

MPEX2 Summary
Control GTAs Not Trained

AAPT Winter Meeting Jan 2005
http://www.coe.tamu.edu/~ezrailson
Findings 2:
GTA Beliefs about Physics and Physics Teaching Impact Instruction

Do NOP beliefs impact the character of instruction?

Traditional university lecture (passive) < 20
University lecture with demonstrations (some student participation) < 30
Traditional high school physics lecture (with student questions) < 45
Partial HS reform (some group-work; most discourse still with teacher) < 55
Medium sized (N > 50) university lectures with Mazur-like group-work (ConcepTests) and a student Personal Response System 55-75
Modeling curriculum (varies with amount and quality of discourse) 75-99
Comparison with National Physics Reform: Student Hake Gain Vs Pretest Data

III. CONCEPTUAL TEST RESULTS
A. Gain vs Pretest Graph - All Data

- Experienced Trained GTA VP Sections 2004
- Novice Trained VP Sections 2003
- Untrained Control GTA Sections 2003
Findings 3: Relationship between Character of Experience & Belief

Table 19 GTA Sample Comments on the Pre and Post MPEX2 Assessments

<table>
<thead>
<tr>
<th>GTA</th>
<th>Group</th>
<th>GTA Comments</th>
<th>Pre</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>GTA</td>
<td>Control</td>
<td>“Most students rely on lecture only to get the information and don’t practice problems or think.”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GTA</td>
<td>Treatment</td>
<td>“Thinking will give students more understanding, after the lecture.”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GTA</td>
<td>“A”</td>
<td>“It takes more than an isolated example to truly understand a topic”</td>
<td></td>
<td>“An understanding of a concept requires different skills from solving a problem. You need a vision of the whole system and breaking down into parts.”</td>
</tr>
<tr>
<td>GTA</td>
<td>“C”</td>
<td>“An understanding of a concept requires different skills from solving a problem. You need a vision of the whole system and breaking down into parts.”</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Does the character of the teaching experience *impact GTA beliefs*?
Student Survey Scores

Student Feedback: Survey and Interview

- Means of student feedback -- weeks 1, 7 and 14,
- Measures student satisfaction with GTAs (defined by RTOP).
- Student surveys correlate one-to-one with RTOP items
- Correspondence between researchers’ GTA evaluation and student assessment of GTA adherence to reformed methodology.
Implications

GTAs often are the only one-one interface with students and may command half of the instructional time in a typical physics course. What they believe and understand about the nature of physics impacts how they teach it.

Training and experience influence GTAs’ beliefs about the Nature of Physics and physics learning. Since, learning to teach effectively is a process not an event, skills improve with practice over time. Are GTAs given ample opportunity for epistemological growth?

More correlated qualitative supporting data to capture the true nature of GTA and student responses are needed in order to avoid bias and misinterpretation of responses on standardized tests and surveys.
Topics for Further Study

Better categorization of epistemological expressions of belief-in-context and definitions of what constitutes “progress” from an immature to a mature epistemology as well as workable ontology about the nature of physics

Mapping of correlations between what GTAs actually know and are able to do — long-term, short-term and in novel settings as they teach students. A better understanding of this process as it occurs

Using a battery of integrated tools -- VASS, MPEX, Diagnoser, FCI, Interviews to get a more fine-grained feel for how beliefs impact the “facets” of physics thinking – a clearer picture of requisite interactions emerge
Selected References


