Online Professional Development: Research on Teacher Perceptions, Learning Preferences, and Learning Outcomes for Self-directed NSTA Web Courses

Al Byers, Ph.D.
Greg Sherman, Ph.D.
Kristine Chadwick, Ph.D.
Session Overview

- Overview of the e-PD system and need to address scale and sustainability

The NSTA Learning Center

- Three District Pilot Study, Grades 5-8 n=45

Study 1: Pre/Post Evaluation 2008

- Purposive, Descriptive non-randomized, Grades 3-6 n = 85

Study 2: Experiment 2009

- Large Midwestern Urban District, Grades 5-8 n = 56

Study 3: Descriptive Quantitative 2010

NSTA National Science Teachers Association
Where are we in Science in the US?

- **4th Grade:**
  - 34% scored “Proficient” or above
  - 28% scored below “Basic”

- **8th Grade:**
  - 30% scored “Proficient” or above
  - 37% scored below “Basic”

- **12th Grade:**
  - 21% scored “Proficient” or above
  - 40% scored below “Basic”

*NOTE: Proficient represents solid academic performance. Basic shows partial mastery of skills*

2009 NAEP Results: The Nation’s Report Card
Teacher Content Knowledge

- A significant, positive correlation exists between student achievement and teachers’ content knowledge (subject matter AND pedagogical content knowledge).

- Detrimental classroom effects when teachers do not feel confident in their knowledge of science.

The US PD Landscape

What we know—Local Systemic Change K-8 Evaluation: (75,000 data points -10 yr NSF Longitudinal study)

Teachers of Science with less than 16 hours of PD in last year:

– What % at K-4 level?  76%
– What % at 5-8 level?  57%
– What % at 9-12 level?  32%

Research calls for 50-80 hours/yr to effect a change in practice.

Welcome to Your Professional Development Web Space!

Albert, you've already earned **1250 Activity Points**!

You've recently earned:
- Ruby Commenter
  - Post comment/questions

You're close to earning:
- Sapphire Commenter
  - Post 16 more comment/questions

Be sure to update your profile and review your points & badges!

With these resources you can build your professional development plan, track your activities and assess your progress. You can start at "Explore Learning Opportunities" below or by creating your game plan with the PD Plan and Portfolio tool. You may also review an archived Web Seminar or a multimedia overview of the Learning Center.

**Explore Learning Opportunities**
- Advanced Search

**By Subject**
- Earth & Space Science
- Life Science
- Physical Science

**By Grade Level**
- Elementary
- Middle School
- High School
- College

**By State Standards**
- Select your state to begin:
  - Choose a state

**See all FREE Lesson Plans**
**See all FREE Resources**

**NEW LIVE SUPPORT**
- Online Advisors now available!

**Featured PD Resource**
- Atomic Structure: Properties of Atoms

**LIVE SUPPORT ONLINE**
- Click here

**Hours of Operation**

**NSA WEB SEMINARS**
- Live Interactive Learning @ Your Desktop
Jan. 2011 Collection: 6,000+ PD Resources and Opportunities Available

<table>
<thead>
<tr>
<th>Do-It-Yourself Learning</th>
<th>Live Online Seminars &amp; Classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>SciGuides [36]</td>
<td>Web Seminars [120/yr]</td>
</tr>
<tr>
<td>Science Objects [80]</td>
<td>Short Courses [50+/year]</td>
</tr>
<tr>
<td>SciPacks [21]</td>
<td></td>
</tr>
<tr>
<td>Archived Seminars/Podcast [350+]</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Books &amp; Articles</th>
<th>In Person Experiences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Journal Articles [3,600+]</td>
<td>Symposia [6-10/year]</td>
</tr>
<tr>
<td>NSTA Press Books [252+]</td>
<td>PD Institutes [6-10/year]</td>
</tr>
<tr>
<td>e-Books [136+]</td>
<td></td>
</tr>
<tr>
<td>e-Chapters [784+]</td>
<td></td>
</tr>
</tbody>
</table>

http://learningcenter.nsta.org
Study 1: Pre/Post Evaluation

- Overview of the e-PD system and need to address scale and sustainability
- Purposive, Descriptive non-randomized, Grades 3-6 n = 85
- Three District Pilot Study, Grades 5-8 n = 45
- Large Midwestern Urban District, Grades 5-8 n = 56
Study 1: Evaluation Questions

- Do Sci Packs facilitate Force and Motion Skills, Knowledge & Attitudes (SKA)

- Do implementation models (100% online versus blended) impact SKA?
Study 1: Participants

- 13 (13) middle school teachers from large Midwest district (Blended)
- 16 (12) middle school teachers from large Southeast district (100% online)
- 16 (16) middle school teachers from small Pacific Northwest district (100% online)
Study 1: Methods

- Implementation of SciPacks (Blended versus 100% online)
- Force and Motion Skills and Knowledge Pretest-Posttest
- Attitude Survey (confidence pre & post)
- Interviews with Site Coordinators
Study 1: Results

- All sites demonstrated gains in achievement, both 100% online were significant gains
- Face-to-face sessions were valued
- Participants from all groups indicated increase in confidence in teaching F&M; relevance and satisfaction with PD
- Coordinators were positive, suggested graduate credit availability & more face-to-face if PD applied to lesson development
Study 2: Experimental

- Overview of the e-PD system and need to address scale and sustainability
- Purposive, Descriptive non-randomized, Grades 3-6 n = 85
- Three District Pilot Study, Grades 5-8 n=45

Study 1: Pre/Post Evaluation 2008

Study 2: Experiment 2009

Study 3: Descriptive Quantitative 2010

The NSTA Learning Center

Large Midwestern Urban District, Grades 5-8 n = 56
Study 2: Research Questions & Design

Questions
- Do SciPacks increase teacher content knowledge?
- Do SciPacks increase teachers’ science teaching efficacy?
- Do teachers report changes in practice as a result of SciPacks?
- How do teachers plan to use their new knowledge and resources to positively affect student science learning?
- How do the students of participating teachers perform on assessments in earth science and force and motion?

Design
- A two pretest-posttest delayed-treatment control group design
- Stratified random assignment of 60 teachers
  - Stratified by composite pretest score (knowledge assessment and science teaching efficacy measure) and recruitment group (new teacher program or 5th grade teacher group)
  - Early attrition of 4 teachers for effective sample of 56 teachers
Study 2: Participants

- Teachers were recruited from two programs within the district, including one for 5th-grade science teachers and one for new middle school teachers.

- **Force & Motion (26 teachers, or 46%, completed):**
  - Group A (treatment): 19 teachers (5 middle, 14 5th grade) completed the *Force & Motion* SciPack
  - Group B (control): 7 teachers (2 middle, 5 5th grade) completed the *Force & Motion* SciPack

- **Earth’s Changing Surface (24 teachers, or 43%, completed):**
  - Group B (treatment): 10 teachers (3 middle, 7 5th grade) completed the *Earth’s Changing Surface* SciPack
  - Group A (control): 14 teachers (3 middle, 11 5th grade) completed the *Earth’s Changing Surface* SciPack
Study 2: Methods

- Teacher pre and post assessments in the 2 SciPack content areas
- SciPack Final Assessments
- Teacher Survey
  - Science teaching efficacy
  - Preparedness to teach content
  - Instructional practices
- Student pre and post assessments
Study 2: Results

- Teachers’ sense of efficacy for teaching science and their perceived preparedness to teach earth science and force and motion increased over the course of the study.
- Science teaching practices generally did not change over the course of the study; the study timeline may have influenced teachers’ application of new knowledge and classroom instruction.
- As a group, teachers significantly increased their content knowledge in earth science and force and motion. Treatment teachers achieved higher gain scores than control teachers in both content areas.
- Students of participating teachers improved their performance in earth science or force and motion.
  - Fifth-grade students in treatment teachers’ classrooms scored significantly higher on an earth science assessment than did those in control teachers’ classrooms.
  - Sixth- and eighth-grade students of treatment teachers had force-and-motion gain scores that were significantly larger than the gain scores of students in control teachers’ classrooms.
- Moderate attrition rates may have influenced the paucity of statistically significant results; however, positive findings reported in this study are very encouraging and confirm a need to continue to test the effects of this model of teacher professional development on the students of the SciPack completers.
Study 3: Descriptive

- Overview of the e-PD system and need to address scale and sustainability

Study 1: Pre/Post Evaluation 2008
- Three District Pilot Study, Grades 5-8 n=45

Study 2: Experiment 2009
- Large Midwestern Urban District, Grades 5-8 n = 56

Study 3: Descriptive Quantitative 2010
- Purposive, Exploratory non-randomized, Grades 3-6 n = 85

The NSTA Learning Center
Study 3: Research Questions

- Which learner-content interaction strategies of self-directed online PD are of greatest import, satisfaction, and learning value from a sample of upper elementary science teachers (grades three - six):
  - Interactive Reference
  - Embedded Hands-on Activities
  - Personal Feedback Questions
  - Simulations
  - Pedagogical Implications

- Will age, years teaching experience, and learning style correlate with different content-interaction strategies?
Study 3: Participants

- 85 Educators from 11 different states teaching grades 3-6
- Gender: 88% female, 12% male
- Age of Participants: Ranged from 27-62 years

<table>
<thead>
<tr>
<th>Age Clusters</th>
<th>Study</th>
<th>US Public Schools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 30 Years</td>
<td>4.88%</td>
<td>18.7%</td>
</tr>
<tr>
<td>30-39 Years</td>
<td>28.05%</td>
<td>26.8%</td>
</tr>
<tr>
<td>40-49 Years</td>
<td>40.24%</td>
<td>23.9%</td>
</tr>
<tr>
<td>50-59 Years</td>
<td>23.17%</td>
<td>25.4%</td>
</tr>
<tr>
<td>60+ Years</td>
<td>3.66%</td>
<td>5.2%</td>
</tr>
</tbody>
</table>
Study 3: Participants

- Years Teaching Experience
  - Largest percentage with 4-9 years experience: 37%
  - Approximately mirrors percentages reflected at National level for most categories (Aud et al. 2010)

<table>
<thead>
<tr>
<th>Years Teaching Experience</th>
<th>Study</th>
<th>US Public Schools</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-3 Years</td>
<td>12.20%</td>
<td>17.0%</td>
</tr>
<tr>
<td>4-9</td>
<td>36.59%</td>
<td>28.0%</td>
</tr>
<tr>
<td>10-19</td>
<td>28.05%</td>
<td>27.9%</td>
</tr>
<tr>
<td>20+</td>
<td>23.16%</td>
<td>27.0%</td>
</tr>
</tbody>
</table>
Study 3: Methods — Study Design

- Bivariate Pearson Product Moment Correlations for age, years experience, learning achievement, interaction strategies
- Multiple One-Way Analysis of Variance for Kolb learning preference matches content-interaction strategy preference
- Paired Sample t-tests for Learning outcomes between pre/post and final assessments scores
- Dependent Variables:
  - Learning Achievement
  - Teacher perceptions of effectiveness for the five learner content-interaction strategies
- Independent Variables:
  - Age, Yrs Teaching Experience, and Learning Preference
Study 3: Methods — Instruments

- **NSTA Pretest/Posttest & Final Assessment**: Measures learning achievement (Chronbach α’s between .63-.84)

- **Kolb Learning Style Inventory 3.1 (2005)**: Determines preferred learning style. (Chronbach α’s between .73-.99)

- **Learner Content-Interaction Preference Survey**: Across 7 science content areas, determined learner preferences across 5 interaction strategies (*simulations, hands-on, personal feedback, interactive reference, pedagogical implications*):
  - This Type of Interaction is *Engaging to me*
  - This Type of Interaction *Facilitates My Learning* the Science Content
  - This Type of Interaction *Helps My Retention* of the Science Content
  - This Type of Interaction *Facilitates My Teaching* the Science Content
  - I would *Like to See More* of this Type of Interaction

Pooled strategy indexes across 7 content areas: Chronbach α reliability at least .91 or higher
Study 3: Results

- Three Interaction Strategies positively & sig. correlated with age:
  - Simulations \( r(102) = .20, p = .03 \)
  - Personal Feedback \( r(102) = .20, p = .04 \)
  - Interactive Reference \( r(102) = .008, p = .02 \)

- Two Interaction Strategies positively & sig. correlated with yrs teach exp:
  - Personal Feedback \( r(102) = .27, p = .006 \)
  - Interactive Reference \( r(102) = .22, p = .02 \)

- The overall correlation btw Age and Learning Achievement: *Not Significant*

- Year Teaching Experience and Learning Achievement:
  Positively and Significantly Correlated \( r(102) = .22, p = .03 \)

- **Pedagogical Implications** significantly *least preferred* strategy

- **Positive significant learning gains** for teachers via pre/post and final assessment completing modules across 7 content areas and grade levels
I think this content type (simulation)

I would like to see more of this content type.

Facilitates teaching the science content to my students.

Helps my retention of the science content over time.

Facilitates my learning science content.

Is engaging to me.

Frequency of Responses SD = 1 and SA = 7

Learner Perception Survey Choices

- 7. Strongly Agree
- 6
- 5
- 4
- 3
- 2
- 1. Strongly Disagree
I think this content type (hands-on)

Frequency of Responses
SD = 1 and SA = 7

I would like to see more of this content type.

Facilitates teaching the science content to my students.

Helps my retention of the science content over time.

Facilitates my learning science content.

Is engaging to me.

Learner Perception Survey Options

- 7. Strongly Agree
- 6
- 5
- 4
- 3
- 2
- 1. Strongly Disagree
I think this content type (Pedagogical Implications)

- Facilitates my learning science content.
- Helps my retention of the science content over time.
- Facilitates teaching the science content to my students.
- I would like to see more of this content type.

Frequency of Responses
SD = 1 and SA = 7

Learner Perception Survey Choices
- 7. Strongly Agree
- 6
- 5
- 4
- 3
- 2
- 1. Strongly Disagree
Anderson’s Equivalency of Interaction
Kolb Learning Style Inventory 3.1

CE and AE Dominant Style
- Prefer “hands-on” experiences
- Affective preference versus logic and technical ability
- Prefer to work with others
- Prefer group projects, field work, varied solutions to new challenges

Active Experimentation (AE)
Doing

AC and AE Dominant Style
- Ability to find practical uses for ideas and theories
- Ability to solve problems & make problem-solving decisions
- Prefer technical tasks and problems over social and interpersonal issues
- Prefer to experiment with new ideas, simulations, laboratory assignments and practical applications

Reflective Observation (RO)
Reflecting

CE and RO Dominant Style
- Prefer concrete situations from multiple viewpoints
- Excel at generating ideas (brainstorming solutions)
- Prefer to gather information
- Imaginative and emotional
- Prefer to work in groups
- Prefer personalized feedback

Converging (Practical)
Grasping

Converging (Social)

Abstract Conceptualization (AC)
Thinking

Assimilating (Intellectual)

Diverging (Creative)

Accommodating (Social)

Concrete Experience (CE)
Experiencing

Transforming

Grasping
Study 3: Research Implications

- Inform Instructional Designers creating online PD as to which interaction strategies of online content may be most engaging and maximize learning for elementary teachers
- Inform Education Administrators charged with selecting PD for their teachers
- Inform emerging theory related to online learner-content interaction: Anderson’s (2003) Equivalency of Interaction Theorem
Questions?

- Overview of the e-PD system and need to address scale and sustainability

**The NSTA Learning Center**

- Study 1: Pre/Post Evaluation 2008
- Study 2: Experiment 2009
- Study 3: Descriptive Quantitative 2010

- Three District Pilot Study, Grades 5-8 n=45
- Large Midwestern Urban District, Grades 5-8 n = 56

- Purposive, Exploratory non-randomized, Grades 3-6 n = 85

2008

2009

2010

Thank You

- **Al Byers**
  PH: 703-312-9294
  Email: abyers@nsta.org

- **Kristine Chadwick**
  PH: 304-347-0429
  Email: kristine.chadwick@edvantia.org

- **Greg Sherman**
  PH: 540-831-6859
  Email: gsherman2@radford.edu
Recognize our Collaborators