Research Insights into Online Communities of Practice and Teacher Learning Online: The NSTA Learning Center

http://learningcenter.nsta.org/impact

Al Byers, Ph.D.
Darren Cambridge, Ph.D.
Greg Sherman, Ph.D.
Session Overview

- Overview of the e-PD system and need to address scale and sustainability
- Network Analysis and Visualization Techniques
- Three District Pilot, Grades 5-8, n=45
- Midwestern District, Grades 5-8, n = 56
- 13 District Evaluation Grades 5-12, n = 300
- Purposive, Descriptive non-randomized, Grades 3-6 n = 85

The NSTA Learning Center

Studies 1-3 Teacher and Student Learning 2008, 2009, 2010

Community Network Analysis Studies 2011

Study 4: Teacher Online Learning and Preferences Descriptive Quantitative 2010
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

Featured PD Resource
- Science Objects
  Atomic Structure: Properties of Atoms

NSSTA Featured Resources
- Live Interactive Learning @ Your Desktop

NEW LIVE SUPPORT
Online Advisors now available!
Feb. 2012 Collection: 8,300+ PD Resources and Opportunities Available

SciGuides [39]
Science Objects [87]
SciPacks [23]
Archived Seminars/Podcast [1,160]

Journal Articles [5,150+]
NSTA Press Books [280+]
e-Books [173+]
e-Chapters [1,020+]

Web Seminars [120/yr]
Short Courses [50+/year]

Symposia [6-10/year]
PD Institutes [6-10/year]

http://learningcenter.nsta.org/impact
Study 1-3

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

- Network Analysis and Visualization Techniques

- Three District Pilot, Grades 5-8, n=45
- Midwestern District, Grades 5-8, n = 56
- 13 District Evaluation Grades 5-12, n = 300

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

- The NSTA Learning Center

- Studies 1-3 Teacher and Student Learning 2008, 2009, 2010

- Community Network Analysis Studies 2011

- Study 4: Teacher Online Learning and Preferences Descriptive Quantitative 2010
Study 1: Evaluation Questions

- Do SciPacks 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
- Network Analysis and Visualization Techniques
- Study 4: Teacher online Learning and Preferences Descriptive Quantitative 2010
  - Purposive, Descriptive non-randomized, Grades 3-6 n = 85
- The NSTA Learning Center
  - Studies 1-3 Teacher and Student Learning 2008, 2009, 2010
  - Three District Pilot, Grades 5-8, n=45
  - Midwestern District, Grades 5-8, n = 56
  - 13 District Evaluation Grades 5-12, n = 300
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) & recruitment group (new teacher program or 5th grade teacher grp)
  - 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

- Self-reported efficacy and preparedness to teach earth science and force and motion *increased* over the course of the study.
- Pedagogy generally *did not change*; the study timeline may have influenced teachers’ application of new knowledge and classroom instruction.
- Treatment teachers achieved *significantly higher gain scores* than control teachers in earth science and force and motion 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 affected results; however, results are very encouraging and effects of PD should continue to be investigated.
Study 3: 13 District Blended PD

- Overview of the e-PD system and need to address scale and sustainability
- Network Analysis and Visualization Techniques

The NSTA Learning Center

Studies 1-3
Teacher and Student Learning
2008, 2009, 2010

Community Network Analysis Studies 2011

Study 4:
Teacher Online Learning and Preferences
Descriptive Quantitative 2010

- Three District Pilot, Grades 5-8, n=45
- Midwestern District, Grades 5-8, n = 56
- 13 District Evaluation Grades 5-12, n = 300
- Purposive, Descriptive non-randomized, Grades 3-6 n = 85

Teacher and Student Learning 2008, 2009, 2010
Study 3: Evaluation Questions

*Does IDEA program...*

- ...adequately provide a demonstration project for NASA to align selected materials with both state standards and district curricula?
- ...increase teacher content knowledge and pedagogical effectiveness (the universe; earth, sun, and moon; gravity and orbits; and the solar system)?
- ...implement an effective blended e-PD delivery model?
- ...increase student interest in earth/space science and STEM career opportunities?
Study 3: Program Overview

**Year One**
- Selecting and aligning NASA resources
- Metatagging selected resources
- Short courses (four 4-5 week online short courses...including SciPacks)
- ~40 archived web seminar podcasts

**Year Two**
- Web seminars (12 live web seminars with accompanying archives)
- Professional Learning Community support
- Online advisors
- Rewards and recognition (points and badges system)
Study 3: Evaluation Design

Mixed-method (quantitative and qualitative) approach by 3rd-party evaluators:

- Participant exams and surveys (pre-program and post-program)
- Participant interviews & focus groups
- Capstone event evaluation forms
- Student interest surveys
- Project records
- Learning Center extant data
Study 3: Participants

370 teachers total (200 short course + 170 LC access):

- Schools from 6 GE Foundation’s *Developing Futures Initiative* districts (GA, OH, PA, KY, NY, CT)
- Schools from districts near NSTA’s headquarters in northern Virginia
- Schools from districts with existing NSTA partnership
- Alumni of the NASA Explorer Schools project
Study 3: Results

- Goal 1: 200 NASA resources selected, tagged and aligned
- Goal 2: Increased confidence and feeling prepared; increased content knowledge
- Goal 3: CoP was highly-valued and active

<table>
<thead>
<tr>
<th>Community Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 4,062 resources added to libraries</td>
</tr>
<tr>
<td>• 321 shared resource collections</td>
</tr>
<tr>
<td>• 195 reviewed LC resources</td>
</tr>
<tr>
<td>• 405 community forum posts</td>
</tr>
</tbody>
</table>

- Goal 4: Relationship between teacher and student participation and increased student interest in STEM courses
Study 4: Descriptive, Exploratory

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

- Network Analysis and Visualization Techniques

- Studies 1-3: Teacher and Student Learning 2008, 2009, 2010

- Community Network Analysis Studies 2011

- Study 4: Teacher Online Learning and Preferences Descriptive Quantitative 2010

- Three District Pilot, Grades 5-8, n=45
- Midwestern District, Grades 5-8, n = 56
- 13 District Evaluation Grades 5-12, n = 300

- Purposive, Descriptive non-randomized, Grades 3-6 n = 85
Study 4: Research Question

- 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

Study 4: 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 4: 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 4: 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
I think this content type (simulation)

Frequency of Responses
SD = 1 and SA = 7

- 7. Strongly Agree
- 6
- 5
- 4
- 3
- 2
- 1. Strongly Disagree

Learner Perception Survey Choices

is engaging to me.
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.
I think this content type (personal feedback)

Learner Perception Survey Choices

- is engaging to me.
- 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

- 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

Learner Perception Survey Options

- I think this content type is engaging to me.
- Facilitates my learning of 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.

Survey Options:
- 7. Strongly Agree
- 6
- 5
- 4
- 3
- 2
- 1. Strongly Disagree
I think this content type (interactive reference)

- Frequency of Responses: SD = 7 and SA = 7

Learner Preference Survey Options:

1. Strongly Disagree
2. 1
3. 2
4. 3
5. 4
6. 5
7. Strongly Agree

- is engaging to me.
- facilitates my learning of 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.
I think this content type (Pedagogical Implications)

Learner Perception Survey Choices

- is engaging to me.
- 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
Study 4: Results

- **Pedagogical Implications** significantly least preferred strategy
- Three interaction strategies were significantly and positively correlated with age, and two with years experience

<table>
<thead>
<tr>
<th>Age</th>
<th>Years Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simulations</td>
<td>Personal Feedback</td>
</tr>
<tr>
<td>Personal Feedback</td>
<td>Interactive Reference</td>
</tr>
<tr>
<td>Interactive Reference</td>
<td></td>
</tr>
</tbody>
</table>

- **Positive significant learning gains** for teachers via pre/post and final assessment completing modules across 7 content areas and grade levels
### Significant Learning Gains for Teachers with Self-Directed Web Modules across 2 instruments

#### Paired Sample Descriptive Statistics (Table 16, p. 120)

<table>
<thead>
<tr>
<th>Pair</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Standard Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>102</td>
<td>61.31</td>
<td>18.45</td>
<td>1.83</td>
</tr>
<tr>
<td>Posttest</td>
<td>102</td>
<td>82.39</td>
<td>7.40</td>
<td>.73</td>
</tr>
<tr>
<td>Pretest</td>
<td>102</td>
<td>61.31</td>
<td>18.45</td>
<td>1.83</td>
</tr>
<tr>
<td>Final Assessment</td>
<td>102</td>
<td>79.14</td>
<td>12.91</td>
<td>1.28</td>
</tr>
</tbody>
</table>

#### Paired Sample t-Tests for Teacher Learning Gains (Table 17, p. 120)

<table>
<thead>
<tr>
<th>Paired Samples</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest–Posttest</td>
<td>102</td>
<td>21.09</td>
<td>1.81</td>
<td>11.63</td>
<td>101</td>
<td>.000</td>
</tr>
<tr>
<td>Pretest–Final Assessment</td>
<td>102</td>
<td>17.84</td>
<td>16.62</td>
<td>10.84</td>
<td>101</td>
<td>.000</td>
</tr>
</tbody>
</table>
Social Networking Analysis Studies

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

The NSTA Learning Center

Studies 1-3 Teacher and Student Learning 2008, 2009, 2010

Community Network Analysis Studies 2011

Study 4: Teacher Learning and Preferences Descriptive Quantitative 2010

- Three District Pilot, Grades 5-8, n=45
- Midwestern District, Grades 5-8, n = 56
- 13 District Evaluation Grades 5-12, n = 300

- Network Analysis and Visualization Techniques

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

NSTA National Science Teachers Association
Social Network Analysis of National Science Teachers Association Learning Center

## Connected Educators Research

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Evolution</strong></td>
<td>Tracking evolution of five emerging online communities; examining critical decisions made by leaders and the ways in which decisions are informed by data, resources, and people.</td>
</tr>
<tr>
<td><strong>Value creation</strong></td>
<td>Collecting value creation stories and survey data from a range of established communities to determine which online activities, content, and interactive features best support learning and provide value to educators.</td>
</tr>
<tr>
<td><strong>Engagement</strong></td>
<td>Beginning design-based research in new EPIC-Ed community. Current focus is on design interventions to increase “connectedness” among educators.</td>
</tr>
<tr>
<td><strong>Social roles</strong></td>
<td>Exploring the use of social network analysis in 4 communities to identify and better understand the connecting patterns and social roles of online community leaders.</td>
</tr>
</tbody>
</table>
Year of NSTA LC Posts 9/24/2010 - 9/28/2011

6978 posts
21 forums
492 members
557 topics

SNA using NodeXL
http://nodexl.codeplex.com/
Bimodal Network of Members & Topics

- **Nodes** – 2 types
  - **Topics**
    - Diamonds at right, colored by forum
    - Size ~ # of different members posting to topic
    - Forum groups set top to bottom by # of posts to the forum
  - **Members**
    - Black triangles on left
    - Size ~ # of different topics posted to
    - Top to bottom by # of posts made to all topics

- **Edges** – between members & topics
  - Opacity & color emphasis ~ # of posts (darker -> more posts)
Temporal Analysis

- Posts split into “Quintiles” of 1/5 of year’s posts
  9/24/2010 - 1/9/2011 (107 days)
  1/10/2011 - 2/26/2011 (47 days)
  2/27/2011 - 5/7/2011 (69 days)
  7/26/2011 - 9/28/2011 (64 days)

- Node positions constant - year’s activity

- Emphasis recomputed for each period
  - Node size
  - Edge color & opacity
Quintile 1  9/24/2010 to 1/9/2011

Early Months:
Very little activity from these members
Quintile 2  1/10/2011  to  2/26/2011

2nd Quintile: Activity building here, but still light
Quintile 3  2/27/2011 to 5/7/2011

3rd Quintile:
Lots of posts to Hawaii DoE forum
Quintile 4   5/8/2011 to 7/25/2011

4th Quintile: Hawaii DoE forum died out, but much more activity from these members.
Quintile 5  7/26/2011 to 9/28/2011

5th Quintile: Activity concentrated among these members, and healthy activity among lower posters.
Temporal View: Limited Activity Spurs Sustained Engagement?

- Q1 activity mostly by few very active members
- Q2 activity picking up among newer members
- Q3 very heavy posting to Hawaii DoE forum (pink, middle)
- Q4 mid-active members keep posting, now to the “standard” forums
- Q5 activity heavy for mid-posters, # members increasing
Next Steps for SNA in COCP

- Include member data
  - Some demographics, grades taught
  - District-wide PD (“cohorts”)
  - Points and badge activity

- Explore SNA metrics
  - E.g., high centrality compared to node degree

- Initiator-topic and member-initiator networks

- Unimodal (member-member) networks

- Eventually: provide tools for community mgt
Keeping Forums Real

- Members post to Topics
  - MT: Bimodal Member-Topic network of posts (TM = MT^T)
- Unimodal Member-Member network from MT
  - M(T)M = MT * TM
- Topics organized into Forums
  - F_n: Partition of topics into alternative forum configuration n; initial partition is F_0
  - MF_n: Bimodal Member-Forum network (F_nM = MF_n^T)
- Unimodal Member-Member network from MF_n
  - M(F_n)M = MF_n * F_nM
- T(M)T: Unimodal Topic-Topic network from MT
  - T(M)T = TM * MT
- Metrics
  - C(N): a cluster measure on a network N
  - D(F_m, F_n): the distance between 2 partitions
- Goal:
  Find a natural partition of T(M)T, and F_n close to it, such that C(M(F_n)M) is LOW
  I.e., F_n reflects the natural clustering in T(M)T, without segregating members
Adding Content Analysis

- Better to have a different way to represent the natural clustering of topics than by those who post to them
  - Textual content analysis
- Filtering out non-contextual content
  - Friendly banter
  - Might be useful for other purposes, but interference here
Questions

- Overview of the e-PD system and need to address scale and sustainability
- Network Analysis and Visualization Techniques
- Studies 1-3 Teacher and Student Learning 2008, 2009, 2010
- Study 4: Teacher Online Learning and Preferences
  Descriptive Quantitative 2010
- Three District Pilot, Grades 5-8, n=45
- Midwestern District, Grades 5-8, n = 56
- 13 District Evaluation Grades 5-12, n = 300
- Purposive, Descriptive non-randomized, Grades 3-6 n = 85
Access Articles & Reports: http://learningcenter.nsta.org/impact

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

- **Darren Cambridge**
  PH: 202-270-5224
  Email: dcambridd@gmail.com

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