Developing Large Scale Effective STEM Teacher Learning Communities at the National Science Teachers Association

http://learningcenter.nsta.org/impact

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Goals for this Talk

- Share an overview of our STEM e-learning portal and the need it addresses.
- Share strategies behind the design and affordances provided via our online professional learning community.
- Share and discuss research findings and studies that are supporting our on-going design efforts.
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Barclay! The adjacent school district’s test scores went up 25% last year apparently due to STEM ‘professional learning communities.’ Whatever that is... I want two of them!
Need: Importance of Teacher Learning

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

- Detrimental effects occur when teachers do not feel confident in science

Teacher Learning and Professional Development: Appears effective when it addresses the following

**Teachers’ Belief System**
- Elicit existing attitudes, experiences, and self-efficacy towards science education and understandings regarding the nature of science

**Subject Matter Knowledge and Pedagogical Content Knowledge**
- Knowledge of science content tied to real-world examples including *representations & models*, along with ability to develop and implement *scientific and engineering practices* to facilitate students’ deeper understanding and active learning through argumentation and evidence

**Understanding How Students Learn**
- Knowledge of formative assessment strategies to help make students’ thinking visible as build upon students’ existing knowledge and prior experiences through social discourse
The Framework and Next Generation Science Standards have a New Vision of Science Learning that Leads to a New Vision of Teaching

Intertwine three dimensions

- Scientific and Engineering Practices
- Disciplinary Core Ideas
- Cross-cutting Concepts
What are promising practices for teacher learning?
What are promising practices for teacher learning?

- Job-embedded, aligned to local curriculum
- Informed by student learning data and work
- Part of local PLC or CoP (building capacity from within, collaborative)
- On-going, year long, of sufficient duration, intensity, and coherence. (50-80 hours/year)
- Addresses teachers’ personal learning needs/preferences within district strategic initiatives (bounded autonomy)
2010 National Education Technology Plan

Through online learning systems, teachers may enhance their learning through blending the best of onsite PD with online PD that provides immediacy, convenience, self-direction, and collaboration with other colleagues and experts via professional learning communities.

For teachers to effectively facilitate using interactive resources, learning systems, and connectedness to online communities, teachers need to experience it firsthand—as part of their own learning and professional development.

Blended Teacher Learning

- Integration between Onsite and Online Learning

- Involves the mix of *pedagogical strategies* in combination with various *modes and mediums* leveraging *technology-mediated solutions* to maximize desired learning outcomes

(Kim, Bonk & Oh, 2008; Lockee, BB., Moore, M., Burton, J., 2001; Smith & Kurthen, 2007; Tang & Bryne, 2007; Vaughan, 2007; Verkroost, Meijerink, Lintsen, & Veen, 2008; Yoon & Lim, 2007)
## Research in Online and Blended Learning

<table>
<thead>
<tr>
<th>Study</th>
<th>PD Program Model</th>
<th>Target Audience/Content Area</th>
<th>Research Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berger et al. (2008)</td>
<td>Blended online and face-to-face</td>
<td>High School Physics (n=16)</td>
<td>Strong online participation linked to student work, Your Comments, Hot Polls, Hot Reports, Smashing Sentences</td>
</tr>
<tr>
<td>Krall et al. (2009)</td>
<td>Self-paced, on-demand, hands-on kits, mentor</td>
<td>Elementary and Middle Science and Inquiry (n = 43)</td>
<td>Significant gains in subject knowledge. Hands-on most valued. Low mentor rating via email -- too critical</td>
</tr>
<tr>
<td>Owston et al. (2008)</td>
<td>Blended online and face-to-face</td>
<td>Middle School Science &amp; Math (n = 33)</td>
<td>Significant gains in teacher perception of inquiry. Weak online participation. Challenges in online component even when provide release time. Reading articles and commenting.</td>
</tr>
</tbody>
</table>
### Research in Online and Blended Learning

<table>
<thead>
<tr>
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<th>PD Program Model</th>
<th>Audience &amp; Content</th>
<th>Research Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>del Valle et al. (2009)</td>
<td>Self-paced, 12 week module, instructor help</td>
<td>K-12 in-service teachers (n=59)</td>
<td>Mastery-sig. time over longer period, Task-focused-less time in shorter period, not prefer cohort learning. Procrastinator-little time, longer period to complete, prefers cohort learning.</td>
</tr>
<tr>
<td>Lowes et al. (2007)</td>
<td>4-week course, async discourse, readings, group project at end. 6 schools, 3 states</td>
<td>Middle &amp; High (grades 6-10), school-wide reform</td>
<td>Online discourse analysis. Cheerleader-affirming + new information increases online participation. Vary over course to more questioning/challenging at end.</td>
</tr>
<tr>
<td>Whitaker (2007)</td>
<td>On-demand: 3 levels of support. A) web access B) reflection tools, resources, C) 1-on-1 video chat and teaching clip.</td>
<td>pre-K teachers (n=235)</td>
<td>Level of service significantly affects teacher participation. Group C log on more, Group A log on for longer periods of time, but significantly less frequently. Personalized feedback strongly valued. Better to respond quickly with brief message that delayed with longer posts</td>
</tr>
</tbody>
</table>
Anderson’s Equivalency of Interaction

While learner-learner, learner-content, and learner-instructor interaction is preferred for online interaction to enhance learning, if one of the three interactions is designed well, the other two may be offered in a diminished capacity and still provide an equitable learning experience. This addresses scalability issues where diminished support may be available.

Anderson, T. (2003) Getting the mix right again: An updated and theoretical rationale for interaction. *International Review of Research in Open and Distance Learning, 4*
Learning Center Overview
A Critical Piece of the Teacher Learning Solution

- Self-Directed Access
- 11,000+ resources
- Free tools to help teachers diagnose, organize, personalize, and document their learning
- Immediate free access to online advisors and colleagues through chat and discussion
- Recognition system with badges tied to personal profiles

http://learningcenter.nsta.org
Teacher indexes learning needs

Resources, and opportunities suggested

Teacher selects based on unique needs/preferences. Creates Growth Plan

self directed study

joins others

Group discussion online

knowledge assessment

Live Online Advisor “Help desk” and email Content Mentors

Just-in-time, on-demand learning resources and diagnostic tools

Analytical Research Database

Into Teacher Portfolio

takes moderated course

Professor for graduate credit online
The National Science Teachers Association Learning Center

Sept 2013: **11,000+** Learning 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>Science Objects [94]</td>
<td>Short Courses [20+/year]</td>
</tr>
<tr>
<td>Sci Packs [24]</td>
<td></td>
</tr>
<tr>
<td>Archived Seminars/Podcast [1,840+]</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 [5,800+]</td>
<td>Symposia [3-6/year]</td>
</tr>
<tr>
<td>NSTA Press Books [310+]</td>
<td>PD Institutes [6-10/year]</td>
</tr>
<tr>
<td>e-Chapters [2,140+]</td>
<td>NSTA Conf./Forums [5/year]</td>
</tr>
</tbody>
</table>

Resources tagged to filter or sort by learning preference
The Learning Center has grown substantially since 2010

- 132,029 Active Users:
  - 26,736 Members (20.3%)
  - 105,293 Non-Members (79.7%)

- Active User Growth:
  - 58,030 on 9/21/2010
  - 65,737 on 9/21/2011
  - 83,769 on 9/21/2012
  - 107,336 on 5/21/2013
  - 132,029 on 9/21/2013

- 1,170,666 Resources in Libraries:
  - 433,550 on 9/21/2010
  - 661,516 on 6/21/2011
  - 928,070 on 9/21/2012
  - 1,170,666 on 5/21/2013
Learning Center
Selected Tools to Facilitate Personalization and Sharing
PD Indexer and The PD Plan and Portfolio

• Identify Personal Learning Needs in Core Ideas of Science

• View Resources and Opportunities for Consideration

• Add to Your Individual Growth Plan
Pre and Postassessment

<table>
<thead>
<tr>
<th>Category</th>
<th>No. of Items</th>
<th>No. of Cases</th>
<th>Internal Consistency*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth History</td>
<td>20</td>
<td>111</td>
<td>.704</td>
</tr>
<tr>
<td>Magnetic and Electric Forces</td>
<td>22</td>
<td>114</td>
<td>.821</td>
</tr>
<tr>
<td>Nature of Light</td>
<td>20</td>
<td>105</td>
<td>.737</td>
</tr>
<tr>
<td>Atomic Structure</td>
<td>16</td>
<td>102</td>
<td>.882</td>
</tr>
<tr>
<td>Cell Structure and Function</td>
<td>23</td>
<td>261</td>
<td>.636</td>
</tr>
<tr>
<td>Chemical Reactions</td>
<td>23</td>
<td>101</td>
<td>.877</td>
</tr>
<tr>
<td>Elements, Atoms, &amp; Molecules</td>
<td>28</td>
<td>103</td>
<td>.812</td>
</tr>
<tr>
<td>Cell Division &amp; Differentiation</td>
<td>22</td>
<td>97</td>
<td>.752</td>
</tr>
<tr>
<td>Cells &amp; Chemical Reactions</td>
<td>24</td>
<td>94</td>
<td>.821</td>
</tr>
<tr>
<td>Force and Motion</td>
<td>25</td>
<td>220</td>
<td>.816</td>
</tr>
<tr>
<td>Energy</td>
<td>20</td>
<td>227</td>
<td>.759</td>
</tr>
<tr>
<td>Solar System</td>
<td>20</td>
<td>238</td>
<td>.695</td>
</tr>
<tr>
<td>Plate Tectonics</td>
<td>20</td>
<td>216</td>
<td>.790</td>
</tr>
</tbody>
</table>

Category: My Content Knowledge
Goal: Cell Differentiation: Depth of Understanding

My Tasks:
- Define Evidence
- Edit Goal
- Delete Goal

Instructions and How-To Animations

Identified Professional Development Resources

<table>
<thead>
<tr>
<th>PD Resource to Address Goal</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell Division and Differentiation: Continuity of Life</td>
<td>I am a middle level teacher, now responsible for 3 preps, and am teaching in an area with little experience</td>
</tr>
</tbody>
</table>

Expected Date of Goal Completion
6/1/2011

Goal Statement
- Empty - Add information

Why I chose this goal, and where I am now
- Empty - Add information

Standards
My Library

Upload and share your own resources

Over 4,100 public collections shared

Over 50,000 personal resources uploaded

Two GB free space for your personal files
Learning Center
Selected Resources and Opportunities

FREE NSTA Science Objects
• Two-hour free online learning experience in a particular topic

• Interactive simulations of phenomena in an engaging way

• Questions to promote learning via inquiry-based strategy

• Based on Disciplinary Core Ideas in the NGSS

• Over eighty (94) free Science Objects currently available
Animation Analysis

The following animation shows a ball rolling along a track. Replay the motion a number of times and then answer the multiple-choice questions that follow. In answering those questions, feel free to replay the animation if necessary. Select the icon to launch the animation in a new window.

Figure 5.2. Ball on Complex Track Animation
For those unable to engage with the interactive component, select this link for a long text description: Text Description

Practice

Okay, now that those mental wheels are turning, see if you can answer these questions. If you miss an answer or two or three, it might be worth your while to review the appropriate sections of this Science Object.

What is the approximate position of Point E in relationship to Point A?

- E is about 350 centimeters away from A, at an angle of about 80 degrees with respect to Line Y.
Interactive Learning beyond Narrative and Images

Which of the following best describes the concept of inertia?

- **Correct Answer:** Inertia is the reason the object keeps moving even after you release it, but it is not something that pushes the object along. Once you release the object, there might be forces of air friction and gravity acting on it, but the object itself doesn’t do any pushing.

- **Incorrect Answer:** Inertia is something that pushes an object along once you have thrown and released it.

If a force is exerted on an object, you can be sure the object will accelerate.

**Check Your Thinking**

False. In order to figure out whether or not an object will accelerate, you must determine the net force acting on it. It's possible that the force in question is balanced out by another force, leading to zero net force and zero acceleration.
Over 260 free Simulations and Animations
NSTA offers 110 free live web seminars during the school year.

Over 550 delivered with 30,000 educators reached since 2004.
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Learning Center
Community
Building a Vibrant Learning Community

- **Psycho-emotional Roles for Growth and Recognition**
- **Compelling Content**
- **Moderated Social Learning Discourse**
Interaction Opportunities

**Consume/Engage/Excite**
- Just-in-time resources from trusted source and/or colleagues

**Consume/Contribute/Extend**
- Resources/Strategies support local student-driven data
- Professional Learning Community

**Consume/Mentor/Enlighten**
- Elevate stature in community
- Serve in leadership capacity
- Contribute to improvement and generation of resources
- Refine strategies, support others

- Early Career/Novice
  - Increase Knowledge, Confidence, and Pedagogy

- Mid Career
  - Hone practice and Pedagogical Content Knowledge

- Experienced Teachers
  - Contribute (coach/mentor)

Collaboration and Recognition
- Deeper Exchangement
Wendy Ruchti
Wendy Ruchti has been part of the Educational Foundations Department at Idaho State University’s College of Education since 2008. She received a PhD in Education from the University of Idaho in 2005 with an emphasis in curriculum and instruction in STEM education. At ISU, she has taught several educational foundations courses. Her research interests include elementary science education and creating collaborative online learning environments. Before coming to ISU, she taught middle school science and math.

Lara Smetana
Lara Smetana is an assistant professor of science education at Southern Connecticut State University. She brings classroom experience as an 8th grade physical science teacher and has worked with a variety of informal education programs across the country. Lara teaches courses in elementary science methods and educational technology and mentors student teachers. Her research interests include pre- and in-service teacher education and the use of educational technology in science teaching and learning.

Kathy Sparrow
Dr. Kathy Sparrow is currently an adjunct professor at Florida International University (FIU), teaching Elementary Science Methods. She previously worked as a middle and high school science teacher as well as the Science Supervisor for Akron Public Schools. She was a Regional Director for SECO, served on the NSTA Board of Directors and was president of the National Science Education Leadership Association (NSELA). Kathy was also awarded the Outstanding National Science Supervisor Award in 1999.
Growth across all community forums

• 12 Discussion Forums
• 2,200+ User Generated Topics
• 22,000+ Posts by Users
• Physical Science
• Life Science
• Earth/Space Science
• Pedagogy
• Evaluation/ Assessment
• Research in Science Ed
• STEM
• NGSS
**About Me:** As a teacher, I bring experience to my work at the Vermont Agency of Education. I am co-lead in Vermont’s role in NGSS development. As the Elementary Science & Mathematics Specialist I assist with the implementation of the CCSS in both Mathematics and English Language Arts. Recently our team developed a Short Focused Research Project based on science content for K-2 students that is being shared regionally throughout the state. I am a member of a collaborative team of specialists from New Hampshire, Rhode Island and Measured Progress who develop, and construct the NECAP science assessment. In 2000, I was honored as Vermont’s elementary Presidential Awardee for Excellence in Science Teaching. I am an active NSTA member who is currently on the committee that chooses the Outstanding Science Trade Books.

**Affiliation:** VT Agency of Education

**Location:** West Barnet, VT
Integrating high quality content with moderated discourse to improve personal practice:

I use the Learning Center to share ideas that I have and learn more about the ideas of others. What I’ve found in our practice is that, if you isolate yourself, it basically stunts your growth... there’s no follow-up or conversation with other educators... So the opportunity to talk “education” in these forums is very valuable, you get insights from other people regarding these resources. In that way it has been very crucial to my growth as an educator...

See: http://learningcenter.nsta.org/impact/testimonials.aspx
Teacher Recognition
Administrator Affirmation
Welcome to Your Personalized Learning Web Space!

Albert, you've already earned **2765 Activity Points**!

You've recently earned: **Platinum Indexer Complete Indexers**
You're close to earning: **Diamond Commenter Post 25 more comment/questions**

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.
Follow your top colleagues' online activity and contributions

**Top Commenters**

Building a worthwhile learning community provides opportunities for you to recognize those leaders that share their ideas, lessons and resources. The top commenters are those that contribute their voice in the Community Forums. Join the dialog!

<table>
<thead>
<tr>
<th>Pos</th>
<th>Name</th>
<th>Commenter Points Earned</th>
<th>Recent Donations/Badges</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dorian Janney</td>
<td>3,440</td>
<td><img src="image1.png" alt="Image" /></td>
</tr>
<tr>
<td>2</td>
<td>Therese Houghton</td>
<td>3,230</td>
<td><img src="image2.png" alt="Image" /></td>
</tr>
<tr>
<td>3</td>
<td>Angelika Fairweather</td>
<td>2,670</td>
<td><img src="image3.png" alt="Image" /></td>
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<tr>
<td>4</td>
<td>LeRoy Attles</td>
<td>2,430</td>
<td><img src="image4.png" alt="Image" /></td>
</tr>
<tr>
<td>5</td>
<td>Lorrie Armfield</td>
<td>2,050</td>
<td><img src="image5.png" alt="Image" /></td>
</tr>
</tbody>
</table>
Teacher perceptions of administrator recognition matters. Affirmation has impact.

**Pre-Service Methods Professor:** I have to admit that I was skeptical about the points/badges system working with my students, but I was SO-O-O-O-O wrong! I simply put an announcement on Blackboard praising the top folks to date over the weekend. I didn't even think about the fact that the only man in one class had the overall top points. Several young women announced, "We can’t let Terry get away with that!" And so it began.... Sally mocked them for not checking their profile page for updates on their points...I haven't met with my other class yet, but they too have upped the ante. I don't know what their reason is. I just know that a small group has infected the larger group.

Recognizing Teacher Learning and Leadership

- **Provide opportunities to build reputation and contribute to the community and as part of your own personal growth**
- **Over 48,000 badges earned in 2011-2012**

*Administrator:* One of our teachers sent the following information after receiving a note from NSTA that stated: Congratulations! You have been selected as the NSTA Learning Center Top Advocator for the week of May 28 – June 3, 2012.

She was delighted and wrote, "Look at what I got in my email! ...NSTA picked me!! It's all because of you that I started this science journey in the first place! Thank you!!"
Badges to encourage community activity and sharing

**Disseminator: Share an LC collection**

Select a collection to share

- Onyx Disseminator - Share a collection with 1 person
- Pearl Disseminator - Share a collection with 5 people
- Ruby Disseminator - Share a collection with 10 people
- Emerald Disseminator - Share a collection with 25 people
- Sapphire Disseminator - Share a collection with 50 people
- Diamond Disseminator - Share a collection with 100 people
- Platinum Disseminator - Share a collection with 150 people

10 Activity Points (AP)
Badges to encourage and document significant learning

Complete and pass a SciPack final assessment 100 Activity Points (AP)
View the Sci Packs

SciPack Activator - Complete 1 SciPack and pass the Final Assessment

SciPack Optimizer - Complete 3 Sci Packs and pass the Final Assessment

SciPack Accelerator - Complete 6 Sci Packs and pass the Final Assessment

To earn your Activity Points after completing the SciPack final assessment, visit the My PD Record and Certificates page. While there you may view, save, and print your SciPack certificate.

Complete all Sci Packs within Physical Science 1000 Activity Points (AP)
View the Sci Packs

PS SciPack Ultimotor - Complete all Sci Packs within Physical Science

Notice relative weighting of activities. Those that take more effort earn more points.
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Learning Center

Impact

Pre/Post Assessment Results
Peer-reviewed Publications
Conference Proceedings
Third-Party Evaluations

http://learningcenter.nsta.org/impact
### Force and Motion Assessment

- **1626 Pre-tests taken with a 56% avg score**
- **549 Post-tests taken with a 67% avg score**

Totals as of 6/7/2012

![Graphs](#)

### Energy Assessment

- **1108 Pre-tests taken with a 66% avg score**
- **373 Post-tests taken with a 78% avg score**

Totals as of 6/7/2012

![Graphs](#)

### Oceans Effect on Weather and Climate Assessment

- **653 Pre-tests taken with a 57% avg score**
- **228 Post-tests taken with a 69% avg score**

Totals as of 6/7/2012

![Graphs](#)
Peer-Reviewed Journals, Proceedings, and Books

• First steps towards a social learning analytics for online communities of practice for educators. International Learning Analytics and Knowledge Conference (2012).


• Social Network Analysis of Affiliation Networks to Promote Online Communities of Practice for Science Education, International Network for Social Network Analysis, Social Networks Conference (2012).


• Evaluation of online, on-demand science professional development material involving two different implementation models. *Journal of Science Education and Technology* 17(1): 19-31, (2008).
Third-party Evaluation Studies

- **Quasi-experimental Design Study:** Across 3 districts finding *significant gains in teacher content knowledge using single SciPack*. (2008). n=45, teachers in grades 5-8

- **Experimental Design Study:** Pretest-posttest delayed-treatment/control group design with random assignment finds *significant gains in teacher content knowledge, teacher self-efficacy, and students’ gain scores for grades 5-8 in treatment group across two SciPacks*. (2009-2010), n = 56

- **Descriptive Study:** Dissertation research finds *significant gains in teacher learning* for pre-posttest and pretest-final assessment. (2010). n = 85, teachers grades 3-6 from 11 different states.


See: [http://learningcenter.nsta.org/research/](http://learningcenter.nsta.org/research/)
Latest Research Studies

- **NSF VOSS study**: as Co-PI with RAND Corporation looking at which affordances are of greatest import and impact within our online community and for blended learning (Susan Strauss).

- **NSF DRK12 study**: Smaller study, looking at our blended PD district-based efforts with EDC (Lauren Goldenberg and Marian Pasquale).

- **US Department of Education, Office of Educational Technology ongoing research**: Connected Educator’s Project looking at community management and value creation with the American Institutes for Research and the Friday Institute for Educational Innovation (Darren Cambridge, Sherry Booth, Shaun Kellogg).
Articles, Interviews, Panels, and Case Studies

Learning Center recognized as “Notable” web seminar July 24 1:00-2:00 PM EST
With insight from AIR…

CS 10K Community Work Plan
January 2013, NSF CS PI Conference

“The [CS10K Community] site will issue digital badges, modeled off of the National Science Teachers Associations’ Learning Center badging System, to recognize teachers with specific qualifications, expertise, experiences, or contributions to the community.”

Effort sponsored by the US Department of Education, Office of Education Technologies, and the National Science Foundation
I think the best blended learning model is:

1. Providing access to an online repository of digital content to enhance onsite PD experiences

2. Extending face-to-face summer experiences online via discussion with other colleagues on promising practices and strategies for pedagogy

3. Interacting in real time online throughout the year with leading scientists, engineers, and education experts from institutions such as US Department of Education, NASA, NOAA, and NSF discussing research with examples of applications for the classroom

4. Helping teachers diagnose and create long term growth plans that cater to their unique learning needs and connects them with resources and access to others with similar learning goals online whereby they might receive recognition and attribution as they collaborate
Purpose: To enhance the personal learning of teachers by providing a suite of tools, resources, and opportunities to support their individual long-term professional growth based on their unique learning needs and preferences and within a professional learning community.
Developing Large Scale Effective STEM Teacher Learning Communities at the National Science Teachers Association

Thank You

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