

# Teachers' Curriculum Planning Behavior: Preliminary Research Results and an NSDL Perspective



Keith Maull  
Manuel Gerardo Saldivar  
Tamara Sumner



U. Of Colorado at Boulder  
And  
UCAR

# Outline

- Leveraging technology to help teachers
  - Purposeful planning
  - Differentiated instruction
  - Curriculum Customization Service
- Research questions
- Denver field trial
- Usage analytics
- Discussion
- Conclusion and Next Steps

**Purposeful planning is a tool.**

**Research shows it is effective.**

**But what exactly should teachers build with this tool?**

**Differentiated instruction.**

# Differentiated Instruction

- Student populations are growing more diverse
- Accountability movement is growing more pervasive
- Constructivist learning approaches are prevailing

→ Teachers must 'narrowcast' to students

# Example: Denver, CO

- 78,352 students (2009-2010)
  - 1.1% American Indian
  - 3.5% Asian
  - 16.2% Black
  - 54.1% Hispanic
  - 25.2% White
- 70.45% of students receive free/reduced lunch
- 11.75% of students are gifted/talented
- 24,519 (31%) of student are native English speakers
- Top five languages spoken by students:
  - Spanish (29,525 - 40% - includes ELL)
  - Vietnamese, Arabic, Karen, Burmese and Somali

**Diverse student populations call for differentiated instruction.**

**However, this differentiation must occur within the context of curriculum and standards.**

**A tool was developed to make this possible:**

**Curriculum Customization Service**

# Curriculum Customization Service

- Web-based curriculum planning tool
- Teachers' 'one stop shop' for:
  - Digital versions of curricular materials
  - Digital resources from DLESE/NSDL
  - Educational standards
  - Web 2.0 functionality
    - Sharing
    - Saving
    - Rating
    - Tagging

## Bedrock Geology

### > Big Idea

### Key Concepts

#### a. Geologic Maps

Geologic maps show the surface geology of an area, region or a larger land area. They are constructed using a variety of methods and contain generalizations.

- [Activity 2: Igneous Rocks and the Geologic History of Your Community](#)

#### d. Forces and Fault

Forces inside the Earth move the crust over time. Different types of faults (normal and strike-slip) are formed by different forces (compression, tension or shearing).

- [Activity 5: Structural Geology and Your Community](#)

#### e. Land Use & Geology

Different regions in the United States have different land uses based on the underlying geology.

- [Activity 1: Sedimentary Rocks and the Geologic History of Your Community](#)
- [Activity 7: Geology of the United States\\*](#)

Key concepts

### DPS Grade 9 Earth Science Curriculum

#### Unit 1: Understanding Your Environment

- [Bedrock Geology](#)

#### Unit 2: Earth's Dynamic Geosphere

- [Volcanoes](#)
- [Plate Tectonics](#)
- [Earthquakes](#)

#### Unit 3: Earth's Natural Resources

- [Water Resources](#)

Splash page



# Unit 1: Understanding Your Environment

## Bedrock Geology

Curricular unit

The geologic history of the Earth is determined by Earth Science principles such as differing rocks and sediments in different locations, forces inside

Units of Study » Unit 1: Understanding Your Environment: Bedrock Geology » Geologic Maps

### Key Concepts

#### a. Geologic Maps

Geologic maps show the surface geology of an area, region or a larger area. They are constructed using a variety of methods and contain generalizations.

#### b. Rock Types

#### c. Interpretation Principles

#### d. Forces and Faults

#### e. Land Use & Geology

Key concepts for Unit 1

### Geologic Maps

Key concept

CO state education standards

Teacher 'file cabinet'

EarthComm Activities

Interactive Resources

Education Standards

My Stuff (0)

Activity 2

Activity 3

Activity 4 \*

Resources from DLESE

#### Bedrock Geology: Activity 2: Igneous Rocks and the Geologic History of Your Community

Page: U 14  
Number of periods: 2.0

[http://ccs.dls.ucar.edu/protected/iat/bedrock\\_geology/chap01/ec\\_u2ch1a...](http://ccs.dls.ucar.edu/protected/iat/bedrock_geology/chap01/ec_u2ch1a...)

Classroom activity

Students develop their own scheme for classifying igneous rocks by closely examining igneous rocks. Students identify igneous rocks using a traditional igneous classification scheme and then compare this classification system to their own. Students learn how igneous rocks form and that rates of magma cooling determine grain size in igneous rocks. Students then examine the geologic map of their area to determine if any igneous rocks are present.

Keywords from Denver Public Schools: igneous rock, magma, lava, intrusive, extrusive

DPS guideline: Focus on Digger Deeper

From: EarthComm Activities



Activities (from curriculum)

## Unit 1: Understanding Your Environment

Lynne Davis (lynne) | [Logout](#) | [My profile](#) | [Find people](#) | [Units of Study](#)

### Bedrock Geology

The geologic history of the Earth is determined by Earth Science principles such as differing rocks and sediments in different locations, forces inside the Earth and basic geologic principles.

**Bedrock Geology**

[Units of Study](#) » [Unit 1: Understanding Your Environment: Bedrock Geology](#) » [Forces and Faults](#)

► [View All Stuff](#)

### Key Concepts

a. [Geologic Maps](#)

b. [Rock Types](#)

c. [Interpretation Principles](#)

#### d. Forces and Faults

Forces inside the Earth can create folds or faults over time. Different types of faults (reverse, normal and strike-slip) are formed by different forces (compression, tension or shearing).

e. [Land Use & Geology](#)

### Forces and Faults

EarthComm  
Activities

Interactive  
Resources

Education  
Standards

My Stuff for  
this Concept

Shared Stuff for  
this Concept

Top  
Picks (4)

Images /  
Visuals

Animations

Inquiry With  
Data

#### Forces in the Earth

<http://sciign.jpl.nasa.gov/learn/plate5.htm>

Save

Classroom activity

Scientific  
visualization

Reference

Rating:

\* \* \* \* \*

Saved by 0 users

This page discusses the three main forces (compression, tension, and shear) that drive deformation within the Earth. Students can click on an animation to see illustrations of each type. Links to a glossary are embedded in the text.

From: DLESE Community Collection (DCC)

#### Faults

<http://sciign.jpl.nasa.gov/learn/plate6.htm>

Save

Glossary

Reference

This site explains the three types of faults that result from plate movement. Animated diagrams are used to demonstrate strike-slip faults, normal faults, and reverse faults. There are also four photographs that show the results of actual earthquakes.

# 2009-2010 Denver Field Trial

- CCS available to all middle and high school Earth science teachers (n = 124)
- 98 teachers logged into the system at least once
- 49% user were regular users (3+ sessions per month)
- Qualitative data from surveys, interviews, and classroom observations
- Quantitative data from surveys and CCS Web logs



# Learn More About the CCS

- Kirsten Butcher (U. of Utah)
  - Tuesday, 11:35a, Hampton Ballroom
  - A cognitive interview protocol for assessing changes in teacher knowledge
- Holly Devaul (UCAR & Digital Learning Sciences)
  - Wednesday, 9:15a, Hampton Ballroom
  - Understanding impact: Results from a district-wide field trial of the NSDL Curriculum Customization Service

# Major Research Questions

Keith → Usage Analytics

- What behaviors did teachers exhibit when using the CCS?
- How do these behaviors map onto teaching practices observed 'in the wild?'

M. G. → Technology adoption

- How did the CCS impact teachers' differentiation of instruction?
- How and why did teachers decide to use the CCS?



# Usage Analytics

# Overall System Use

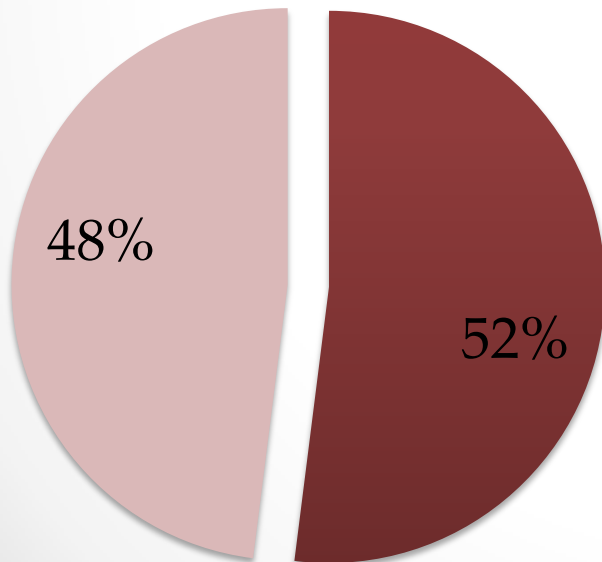
- 9 months (Aug 31-July 1)
- Aggregate Usage
  - ~1400 hours of total usage
  - ~3700 unique sessions
  - 98 distinct user IDs
- Average Usage
  - 22.7 minutes/session
  - 1.6 hours/month
  - 4.1 sessions/month

# Who Used The System?

- 6<sup>th</sup> and 9<sup>th</sup> grade Earth Science Teachers

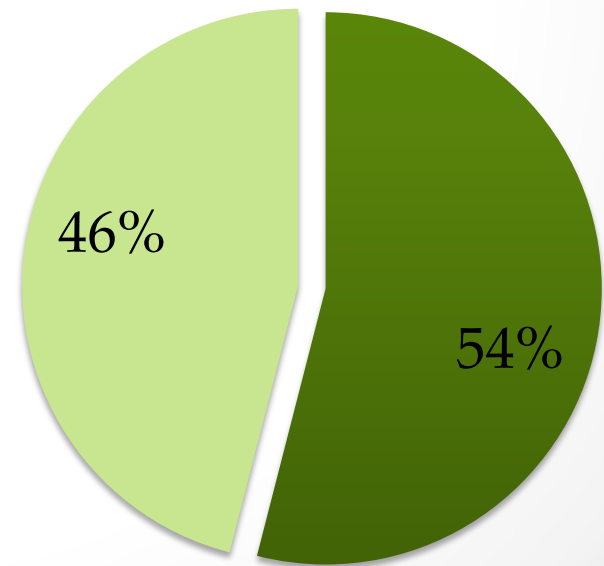
**% Activity**

■ 6th grade ■ 9th grade



**% Users**

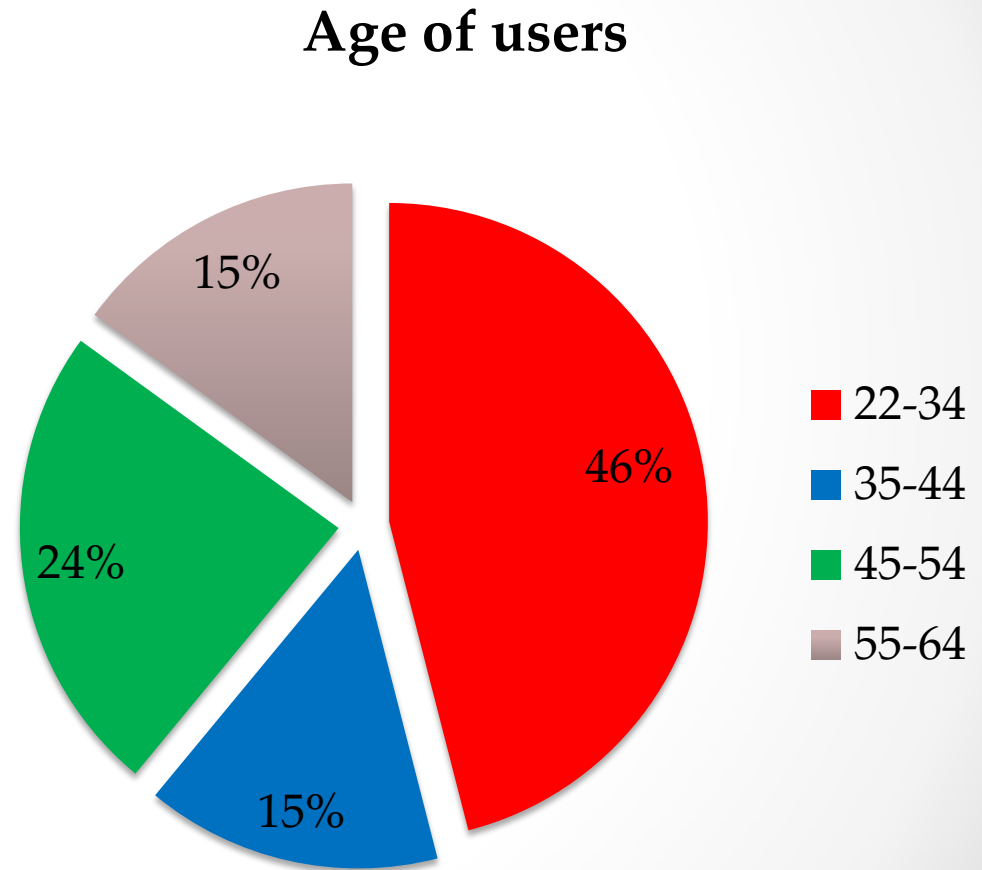
■ 6th Grade ■ 9th Grade





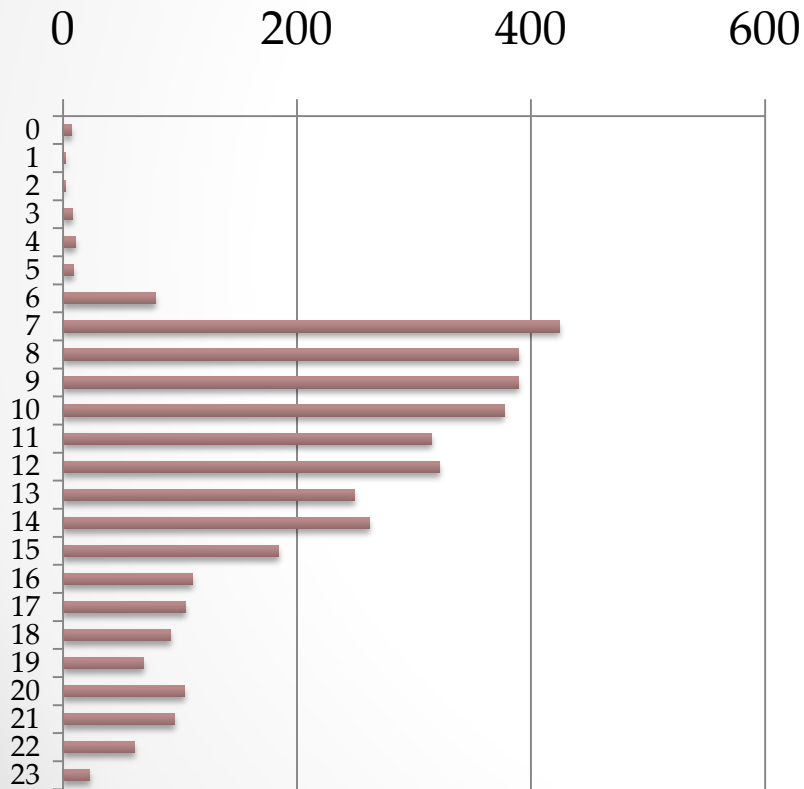
# Demographic Information

- Years Teaching
  - 10 years (n=64)
  - > 70% female

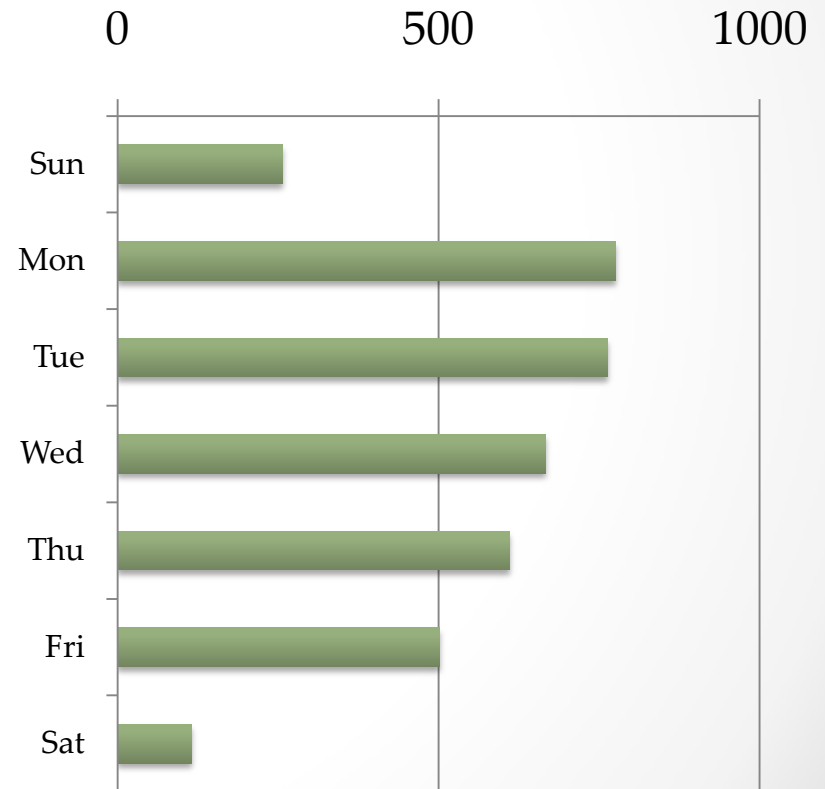


# System Usage Overview

## Time of the Day

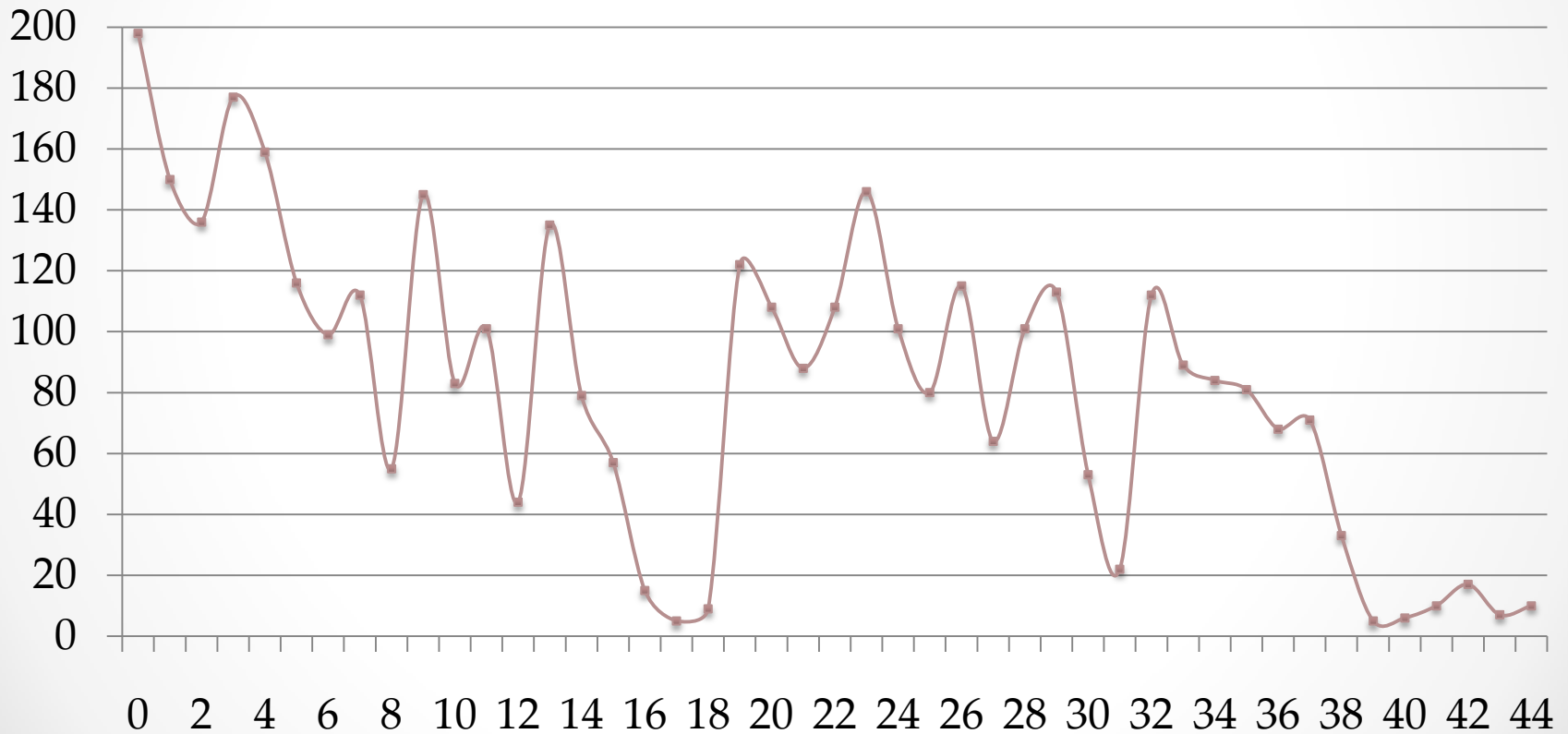


## Day of Week



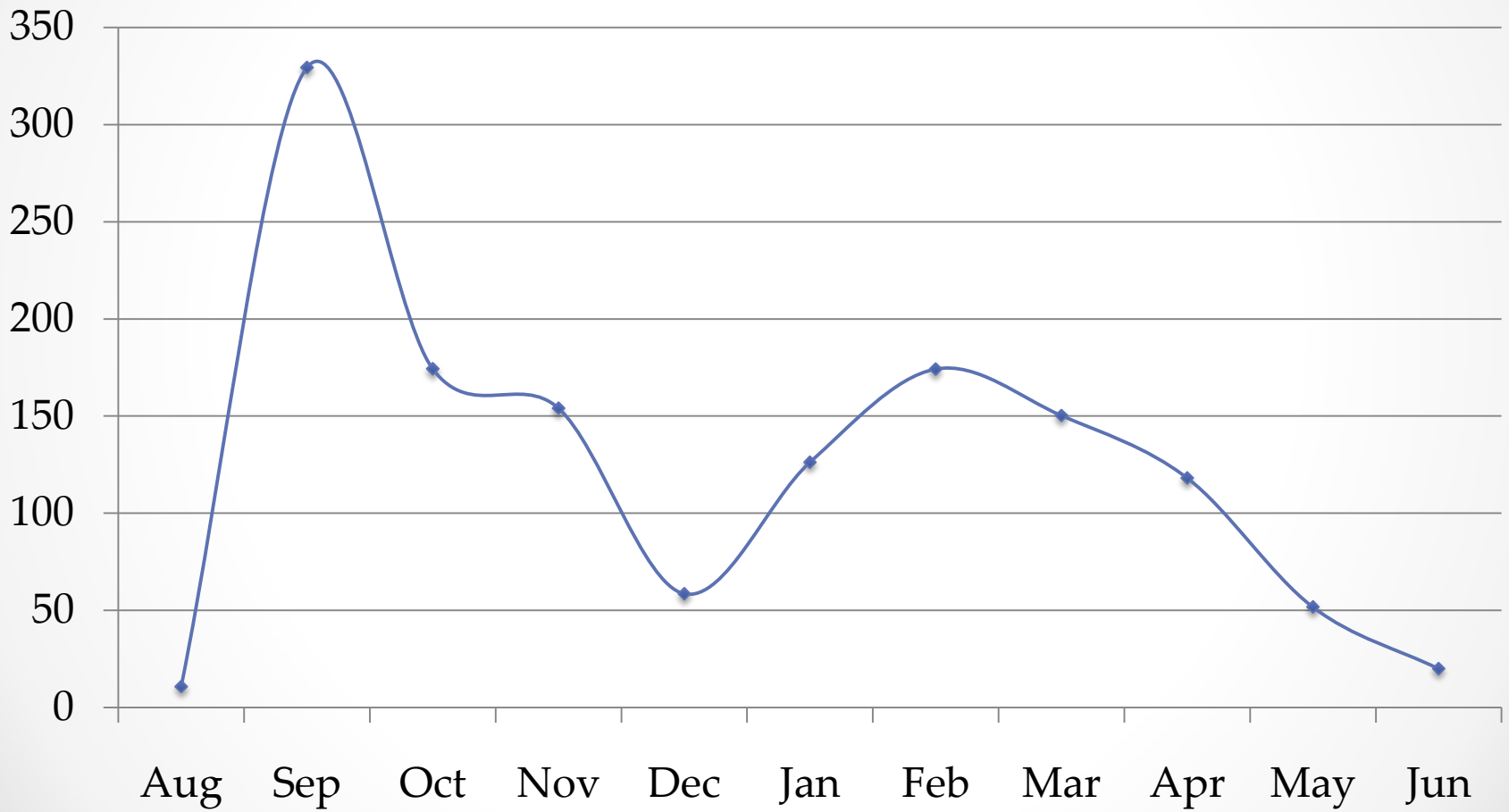
# System Usage : Weekly Usage

## Weekly Session Frequency



# System Usage :

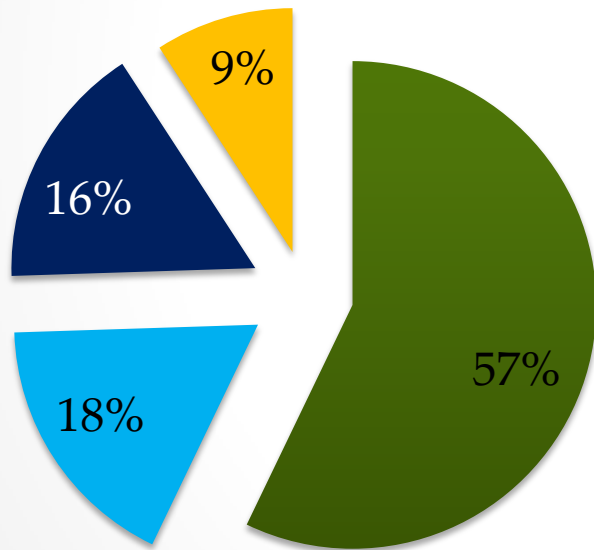
## Total Monthly Hours



# System Usage : Frequencies

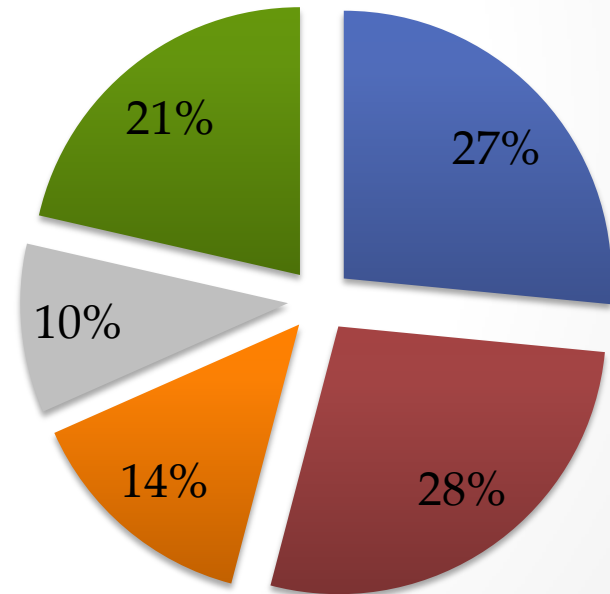
## Hours Per Month

■ <1 ■ 1-2 ■ 3-4 ■ >4



## Logins Per Month

■ <1 ■ 1-2 ■ 3-4 ■ 4-8 ■ >8



# System Usage : System UI Areas

**Investigating Our Dynamic Planet** Keith Mauli (mauli) | [Sign Out](#) | [My Profile](#) | [Manage People](#) | [Edit Curriculum](#) | [Reports & Admin](#) | [DPS Units of Study](#)  
Development server (for testing and demonstrations)

**Our Dynamic Planet**

The Earth is an evolving planet undergoing constant change due to the heat dynamics within its interior and the associated movement of lithospheric plates that make up its crust.

DPS Units of Study » [Investigating Our Dynamic Planet](#) » [Our Dynamic Planet](#) » [Convection Currents](#) ▶ [View All Stuff](#)

### Key Concepts

- [a. Fossil & Rock Evidence](#)
- [b. Earth's Crust](#)
- [c. Convection Currents](#)**
  - Convection currents within Earth's mantle drive the movement of lithospheric plates.
- [d. Plate Boundary Events](#)
- [e. Volcanoes](#)
- [f. Modeling](#)

### Convection Currents

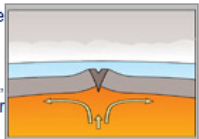
Investigation 3

IES Investigations | **Interactive Resources** | [Education Standards](#) | [My Stuff for this Concept](#) | [Shared Stuff for this Concept](#)

**Our Dynamic Planet: Investigation 3: Forces that Cause Earth Movements** Page: P 22  
Number of periods: 4

[http://ccs-dev.dls.ucar.edu/home/protected/iat/our\\_dynamic\\_planet/ies\\_...](http://ccs-dev.dls.ucar.edu/home/protected/iat/our_dynamic_planet/ies_...)

Classroom activity In Investigation 3, students are asked to consider whether or not the Earth's mantle moves. Students conduct a small-scale, hands-on investigation into the process of convection. Students also observe the teacher demonstrate convection using a heated beaker of water, a cup of oatmeal, and food coloring. Students are asked to consider these two activities as models of how convection operates in the Earth by mapping the elements of their experimental setup onto the layers of the Earth that they have studied in prior investigations.

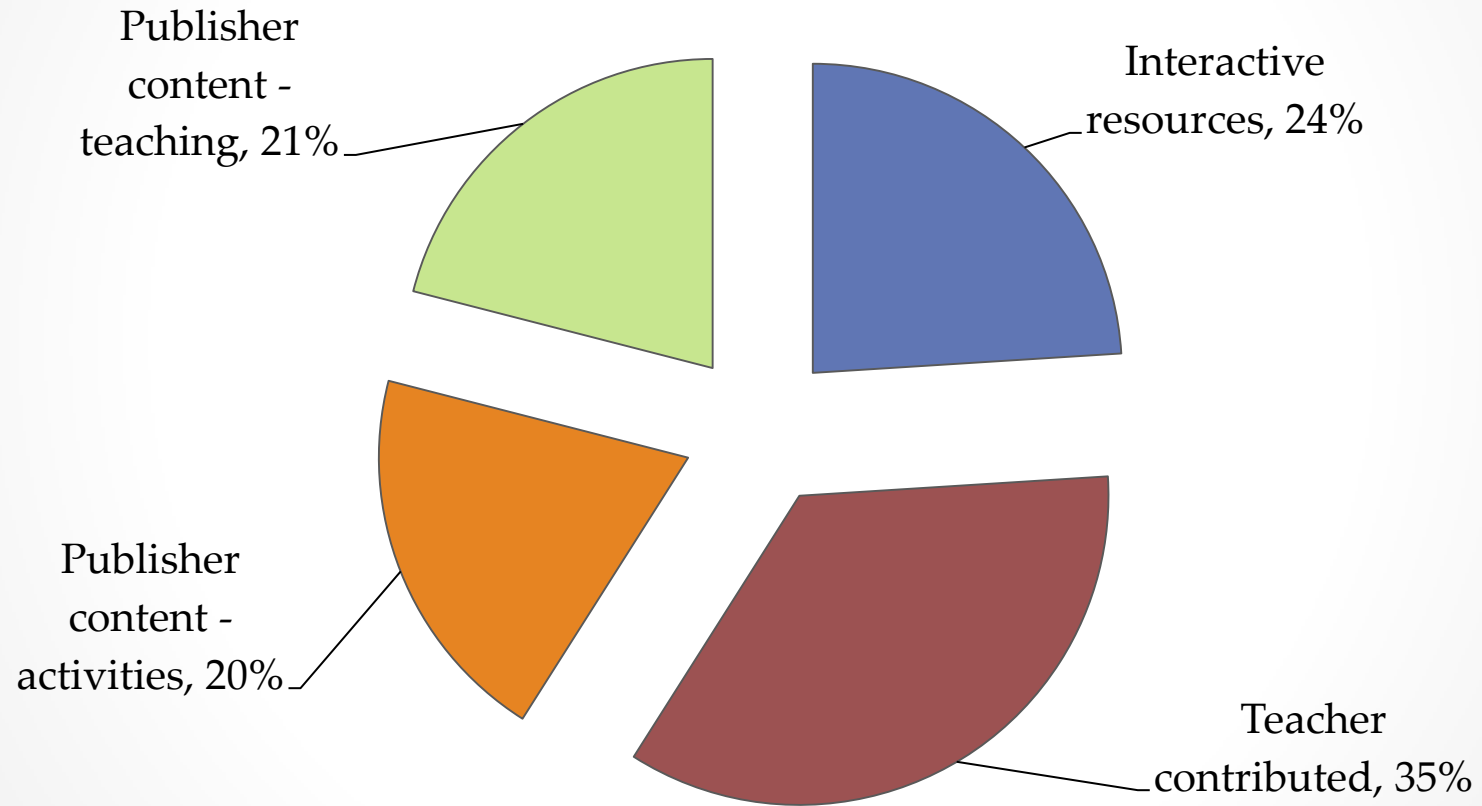


Keywords from Denver Public Schools: convection cell, lithosphere, asthenosphere, mid-ocean ridge, magma

From: IAT Activities

- ▶ [My Stuff for this Investigation](#)
- ▶ [Shared Stuff for this Investigation](#)
- ▶ [Key Concepts for this Investigation \(1\)](#)
- ▶ [Instructional Support Materials \(13\)](#)
- ▶ [Teaching Tips \(7\)](#)
- ▶ [Student Conceptions \(1\)](#)
- ▶ [Embedded Assessments \(3\)](#)

# System Usage : System UI Areas



# System Usage : NSDL Resources

Investigating Our Dynamic Planet Keith Maul (maul) | [Sign off](#) | [My profile](#) | [Manage people](#) | [Edit curriculum](#) | [Reports & admin](#) | [DPS Units of Study](#)  
[Development server \(for testing and demonstrations\)](#)

**Our Dynamic Planet**

The Earth is an evolving planet undergoing constant change due to the heat dynamics within its interior and the associated movement of lithospheric plates that make up it's crust. **Our Dynamic Planet**

DPS Units of Study » [Investigating Our Dynamic Planet: Our Dynamic Planet](#) » [Convection Currents](#) ▶ [View All Stuff](#)

**Key Concepts**

- a. [Fossil & Rock Evidence](#)
- b. [Earth's Crust](#)
- c. [Convection Currents](#)**
- d. [Plate Boundary Events](#)
- e. [Volcanoes](#)
- f. [Modeling](#)

**Convection Currents**

Investigations | Interactive Resources | Educational Standards | My Stuff for this Concept | Shared Stuff for this Concept

Top Picks (6) | Images / Visuals | Animations | Inquiry With Data

**Mantle Convection Movies On-Line at Caltech** Save  
<http://www.gps.caltech.edu/~gumis/Movies/movies-more.html>

Scientific visualization This Caltech website contains movies and animations about mantle convection, along with brief summaries of the science behind it. Topics covered include supercontinents, superplumes, Australia, oceanic plates and faults, plate tectonic models, and stirring by mantle convection.

Video

Rating: (not yet rated)  
\* \* \* \* \*

Saved by 0 users From: DLESE Community Collection (DCC)

**Animation of Convection in the Mantle** Save  
[http://www.classzone.com/books/earth\\_science/terc/content/visualizatio...](http://www.classzone.com/books/earth_science/terc/content/visualizatio...)

Scientific visualization This animation from Exploring Earth shows a cross section of Earth; it illustrates a mathematical model of how convection might occur in the mantle.

Rating: (not yet rated)  
\* \* \* \* \*

Saved by 6 users From: DLESE Community Collection (DCC)

**Savage Earth: Hell's Crust - Our Everchanging Planet** Save  
<http://www.pbs.org/wnet/savageearth/hellscrust/index.html>

Tutorial This is an on-line article from the PBS (Public Broadcasting Service) Savage Earth Series. The article discusses plate tectonics with a focus on mantle convection, plate boundaries, hot spots, and the structure of the Earth. The article is illustrated and contains links to Shockwave animations. Each sidebar provides a summary of the respective topic and some supporting illustrations.

Map

Scientific illustration

More...

Rating: (not yet rated)  
\* \* \* \* \*

Saved by 3 users From: DLESE Community Collection (DCC)

Tags:  
ELA (1)  
At grade 6 (1)  
15-45 min. (1)

**Geology - Plate Tectonics** Save  
<http://www.ucmp.berkeley.edu/geology/tectonics.html>

Video

Reference

Rating: (not yet rated)  
\* \* \* \* \*

Saved by 2 users

Keywords: Pangaea, Continental drift, Orogenesis, Convection, Sea floor spreading, Geomagnetic anomalies

From: DLESE, NASA ED Mail Collection

**Plate Boundaries** Save  
<http://scign.jpl.nasa.gov/learn/plate4.htm>

Reference

Scientific illustration

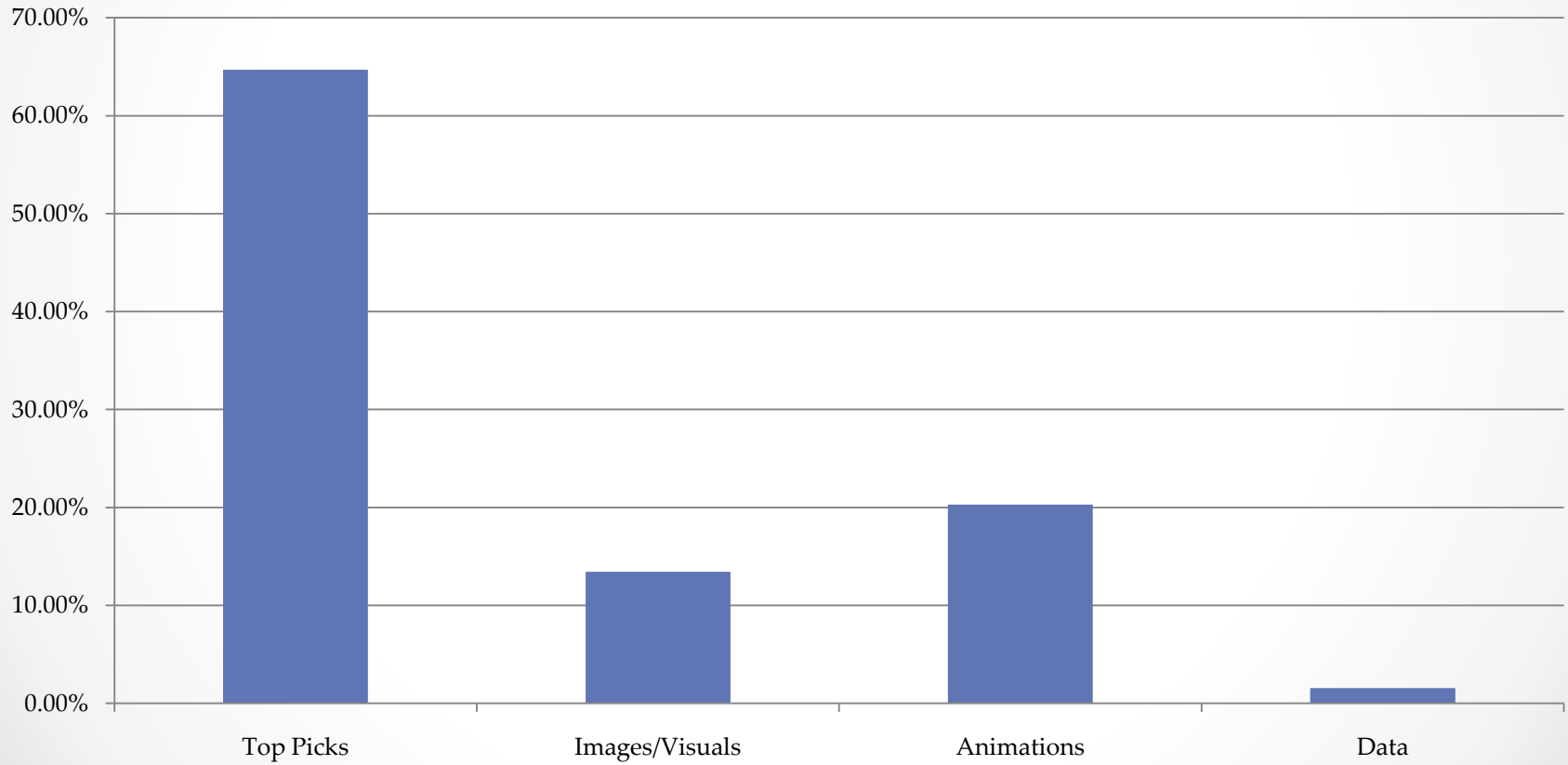
Rating: (not yet rated)  
\* \* \* \* \*

This site provides information on plate boundaries, which are found at the edge of the lithospheric plates and are of three types: convergent, divergent and conservative. Wide zones of deformation are usually characteristic of plate boundaries because of the interaction between two plates. The three boundaries are characterized by their distinct



# System Usage : NSDL Resources

## % Interactive Resources Use



**Discussion:**  
**Triangulating Usage Analytics  
with Other Data Sources**

# Major Research Questions

Keith → Usage Analytics

- What behaviors did teachers exhibit when using the CCS?
- How do these behaviors map onto teaching practices observed 'in the wild?'

# Teachers' Use of CCS

**NSDL resources were deeply contextualized vis-à-vis DPS learning goals**

Evaluation survey results (n=84):

- CCS has made it easier for me to find interactive resources that support the DPS key concepts [for the Earth science curriculum] (90% agreed/strongly agreed)
- CCS has helped me teach EarthComm/Investigating Earth Systems more effectively. (78% agreed/strongly agreed)

# Teachers' Use of CCS

**The CCS made it easier for teachers to integrate resources into their planning practices.**

- The CCS has helped me integrate interactive digital resources, such as videos and animations, into my instruction with greater confidence and frequency (84% of respondents agreed)
- The CCS has helped me to include more alternate representations of science phenomena into my teaching (88% of respondents agreed)

# Teachers' Use of CCS

Access to each others' materials helped teachers institutionalize and apply pedagogical knowledge and techniques.

- Ability to upload and share is very useful (84%)
- I look at *Shared Stuff* for new ideas (96%)
- The CCS has increased my awareness of other teachers' practices. (59%)
- The CCS has resulted in DPS teachers sharing resources with one another more than ever before (48%)

# Major Research Questions

M. G. → Technology adoption

- How did the CCS impact teachers' differentiation of instruction?
- How and why did teachers decide to use the CCS?

# CCS and Differentiation

Interactive digital resources already are valued by teachers because they aid differentiation.

- Using interactive resources in the classroom enables me to better meet the learning needs of students in my classroom. (90%)



# CCS and Differentiation

The CCS helped strengthen and enlarge the digital resource → differentiation 'pipeline.'

- Overall, the CCS has helped me to differentiate instruction with greater CONFIDENCE than I had previously. (75%)
- Overall, the CCS has helped me to differentiate instruction with greater FREQUENCY than I had previously. (64%)

# CCS and Differentiation

Differentiation is a means to an end (constructivist instruction). The CCS helped achieve this goal.

- The CCS has helped me use inquiry-based instruction more effectively in my classroom. (57%)
- The CCS has had a positive impact on my students' learning. (86%)

# Conclusion and Next Steps

- The CCS has been adopted by a significant number (>50%) of DPS Earth science teachers
- Usage is robust, diverse, and appears to achieve project goals of more differentiated instruction
- Usage analytics map onto real world behaviors



# Conclusion and Next Steps

Keith's next steps:

- Data mining to streamline analysis of teacher behaviors
- Quantifying *use diffusion*

M. G.'s next steps:

- Qualitative case studies describing *How?* and *Why?* of CCS adoption
- Exploring teachers' notions about differentiation
- Graduating
- Employment

# Further Reading

Maull, K. E., Saldivar, M.G. & Sumner, T. R. (Under review). Using data mining to evaluate the instructional planning behaviors of science teachers. *Journal of Educational Data Mining*.

→ [Keith.Maull@colorado.edu](mailto:Keith.Maull@colorado.edu)

Saldivar, M. G., Maull, K. E., Kirshner, B. R. & Sumner, T. R. (In press). A two- dimensional framework for evaluating teachers' technology adoption. In M. Orey, et. al. (Eds.), *Educational Media and Technology Yearbook, Vol. 36*. New York: Springer.

→ [Saldivar@colorado.edu](mailto:Saldivar@colorado.edu)

→ [www.mgsaldivar.com](http://www.mgsaldivar.com)