Critical Learning Experiences for Preparing Teachers of Statistics

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HI-RiSE: A Hub for Innovation and Research in Statistics Education

Laying foundations for future data scientists and data literate citizenry

- **Collaborative** in our work
- **Connected** to classrooms and teachers
- **Committed** to open educational resources

Context

- **US Curriculum**: Higher expectations for statistical content
- **Higher Education**: Interest and tools for online learning increasing
- **Teacher Education**: Greater emphasis on learning based on practices of teaching
- **Practicing Teachers:** Feel overwhelmed and tend to marginalize statistics. *ASA a true positive influence here!!*
- **New Teachers**: Feel least prepared to teach statistics and demonstrate weak understandings (Lovett & Lee, 2017; 2018)

Live Outside My Comfort Zone and Go Big!

Commitment to, and designing for, online professional development and teacher education

Two recent efforts and one on the horizon!

Two MOOCs for Educators Aimed at Better Instructional Strategies

Teaching Statistics Through Data Investigations

4500+ registered

2100+ in Unit 1

800+ completed

Teaching Statistics Through Inferential Reasoning

THE WILLIAM & IDA FRIDAY INSTITUTE FOR EDUCATIONAL INNOVATION

Funded by William and Flora Hewlett Foundation

Enhancing Statistics Teacher Education with E-Modules

3 modules

In 2018-19

20+ courses

17+ institutions

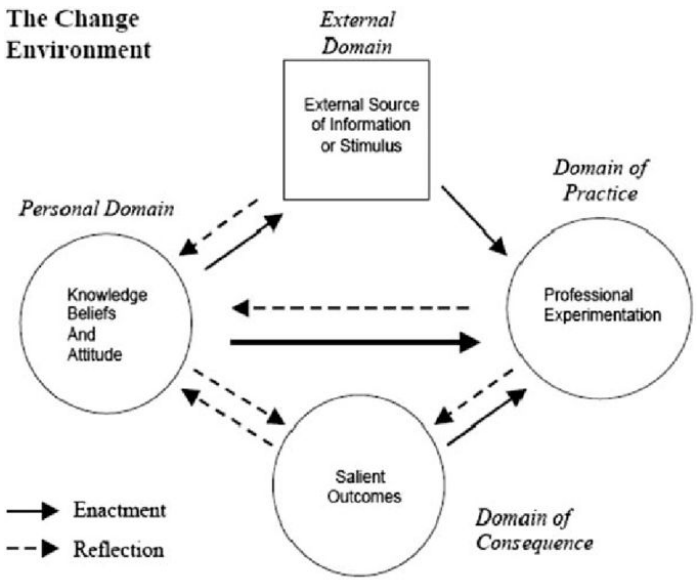
100+ registered in online portal

Funded by NSF (DUE 1625713)

THE WILLIAM & IDA FRIDAY INSTITUTE FOR EDUCATIONAL INNOVATION

Professional Change Model and Triggers for Critical Reflection

- Change process includes reflection and enactment among external domain and teacher's professional world (Clark & Hollingsworth, 2002)
- Mezirow's (2009) theory of transformational learning to examine stimuli that act as triggers to evoke cognitive dissonance for teachers where they question their understandings & perspectives from prior experiences



Clark & Hollingsworth (2002)

What impacts on teacher's learning can happen in online environments?

What experiences seem to matter most?

STE Online Design Features

CONTENT

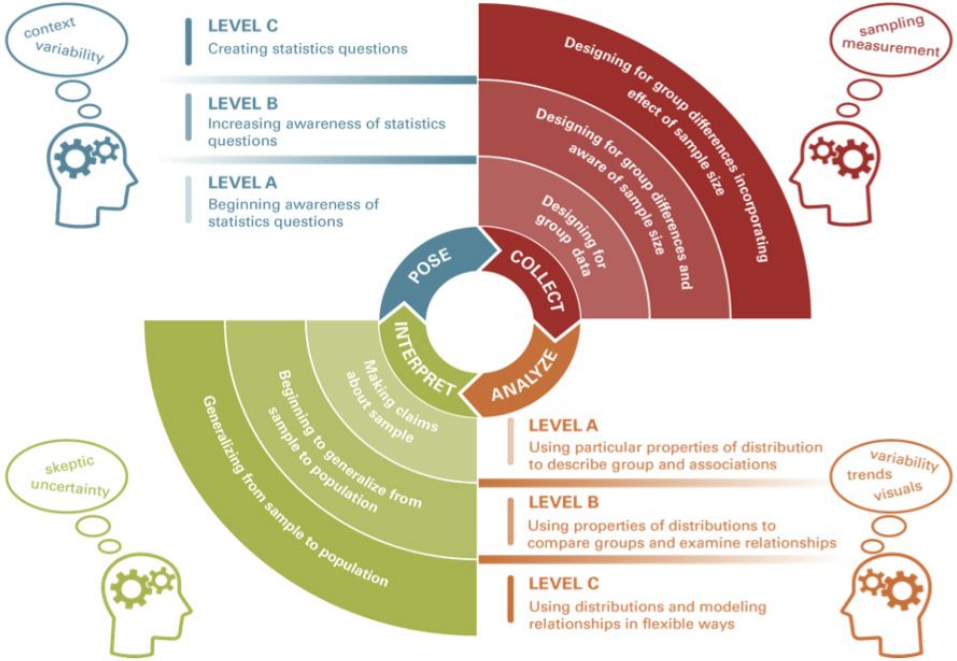
- Framing Based on GAISE and Research on Students' Learning
- Use of Free and Accessible Tools for Data Investigation
- Investigation of Engaging, Real, Larger, and Messy Data Sets
- Connection to Classroom Practice through Videos, Tasks, Frameworks
- Value Learning from Multiple Voices

DELIVERY

- All Units or Modules have Same Organization & Structure
- Simplify Access & Delivery
- Use Multimedia
- Prompt Meaningful Interactions

Supporting Students' Approaches to Statistical Investigations

GAISE-inspired framework



Multimedia Learning Opportunities

Brief Papers

Framework for Supporting Students' Approaches to Statistical Investigations
A Guiding Framework for the Teaching Statistics through Data Investigations
Hollylynne Lee and Dung Tran
Friday Institute for Educational Innovation
NC State University

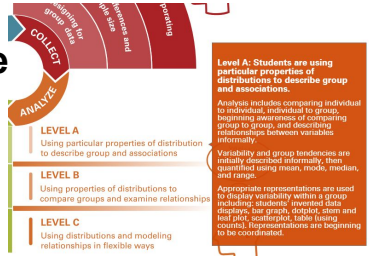
Data is omnipresent in everyday life, and students need to be prepared to make educated decisions when confronted with data in their lives. Learning statistics can assist students in developing data literacy skills and productive ways of reasoning to make sense of data. Students need opportunities to be involved in doing statistics – engaging in the statistical investigation process. These experiences should develop the sophistication of students' data investigation abilities and foster ways of reasoning that promote habits of mind involved in statistical thinking. To help teachers support students, we designed the Students' Approaches to Statistical Investigations [SASI] framework. The SASI framework is adapted from the Guidelines for Assessment and Instruction in Statistics Education at K-12 and college, endorsed by the American Statistical Association, which incorporates research on students' statistical thinking and productive statistical habits of minds.

The four phases typically used in a statistical investigation--posing a question, collecting data, analyzing data, and interpreting results--are at the core of the SASI framework. While these phases are often done in that order, they can also be non-linear and cyclic in nature. For example, one may start with a set of data that has already been collected, do some preliminary exploration of the data, then pose a targeted question involving only a few variables in the data set. From there, they merely need to select the appropriate data for the variables of interest and proceed to the analysis phase.

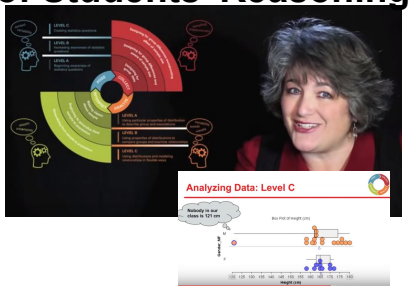
Productive statistical habits of mind are interwoven throughout the SASI framework. A habit of mind is developed when a person approaches situations in similar ways so that a more general heuristic is accumulated over time. The framework focuses on specific habits of mind that are productive for engaging in statistics. The framework also describes growth in statistical sophistication, from level A to C. The levels do not necessarily correspond to grade levels. As students are beginning to learn to conduct investigations, regardless of age or grade level, they should have experiences that allow them to grow in their statistical sophistication. The details in the levels are meant to provide guidance of reasonable expectations of students at each level. Thus, the level descriptions can be used to guide task development, instruction, and assessment. It is assumed that students working at level C within a phase of a statistical investigation are also able to incorporate understandings from levels A and B. Likewise, at level B students are able to incorporate ideas from level A.

The following pages provide more details about the statistical habits of mind and a description of what students are able to do within a statistical investigation at the three levels.

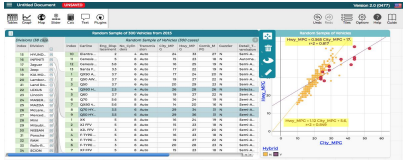
Clickable Diagram



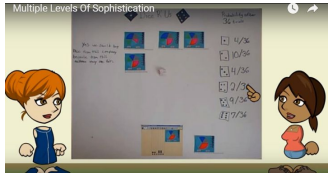
Instructor Video with Explanations and Examples of Students' Reasoning



Expert Panel Discussions



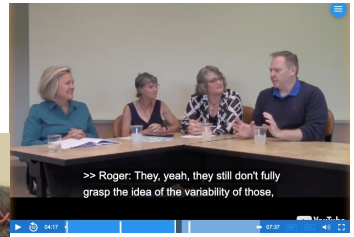
Using Technology to Make Sense of Real Data

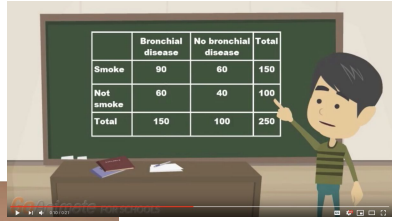


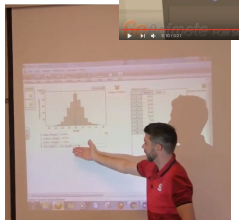
Classroom Videos

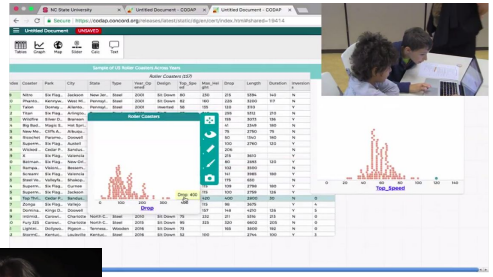
Connection to Classroom Practice

- Expert Panel Discussions
- Teacher Interviews
- Classroom Videos
- Videos of Student Work with Tools
- Expository Videos
- Meaningful Tasks









Impacts on Beliefs, Perspectives & Instructional Strategies

What resources triggered these shifts?

Data Sources

MOOCs

Discussion forums

Surveys: *unit, end-of course, 6 month follow-up*

Interviews

ESTEEM

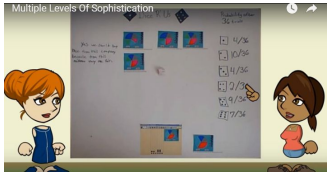
Discussion Forums

Post-Surveys

Interviews

Coding for Impact and triggers for teachers' learning

- "From the second video [Multiple levels of sophistication] it is apparent that each group of students investigating whether the die was fair or biased were at different levels of the SASI framework. The ways in which each group collected and analyzed data and interpreted the results indicated their levels of statistical sophistication."
- "I loved the video of Chris and HollyLynne talking about the mean [Developing the concept of mean]. It is helping me to get a big picture idea of the curriculum."
- "The SASI framework and example of statistical tasks [Dive into Data] were very useful to design, initiate statistical inquiry in classrooms. The SASI framework helped in becoming more objective and observant in what is going [on] in the classroom, where each group/child is heading and what are gap areas to be worked upon."



SASI Framework

Impacts on Perspectives about Statistics and Teaching Statistics

Understanding of **key statistical practices** and how these **practices are connected** rather than perpetuating statistics as a set of tools and procedures

Ability to **explore and learn from data**, impacting their perspectives on how **useful explorations with data could be for students**

Awareness of how **instruction should engage students** in various aspects of a **statistical investigation cycle**

Understanding of how **technology tools support learning** from **real**, sometimes **messy**, and **bigger data**

Moving beyond formulas

"I am comfortable with mathematics in general, but I was not comfortable with statistics....My biggest lesson learned was not to be afraid of data. I think that is something I am past now. Using real data, using bigger data sets, and *not* being so focused on "but can you do it by hand?". I think that was my biggest block with statistics as a math person is that so much of it actually is *not* meant to be calculated by hand." --ESTEEM Preservice teacher, Fall 2018 interview

Confessions about beliefs and practices

While listening to the "expert panel" and reading the posted articles at the beginning of the unit, I had a "lightbulb moment". Although I have been teaching HS math for 24 years, **I have never actually taught "statistics" as defined by the members of the expert panel. I have taught units that I THOUGHT were statistics**, but I was merely providing students with a few mathematical tools that statisiticians [sic] can use (e.g. finding a mean, making a histogram, calculating a standard deviation, etc.). Chris said that math teachers oftne [sic] jump right to the "analyze phase" with a given set of data without ever posing any meaningful questions, looking at how the data was collected, or even why it was collected. That sounds way too much like what is going on at my school for students who only expereince [sic] "stats" in our Algebra 2 course, and don't go on to the college level course we offer. Web added that this practice "trivializes" statistics. **Ouch!! Guilty as charged!!**..." --TSDI Fall 2015 classroom teacher

Questions and Investigations Matter

*"The mooc prompted me to rethink what sorts of questions I ask students, **shifting more to statistical reasoning** questions and **away from statistical processes**" -TSDI Fall 2015 Participant*

"The biggest lesson that I learned was about the role that a teacher can play in the investigative process that students go through. Teachers can pose questions that put students on a new path to investigate new data or to help students analyze a set of data differently." ESTEEM preservice teacher survey

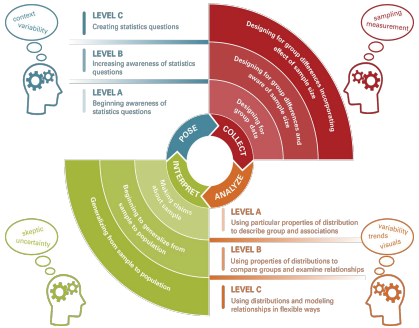
Importance of All Investigative Phases

"**Thinking of statistics as a cycle has really helped me** have a stronger understanding of Statistical thought. **Rather than just having students complete a page of computational type questions**, it really needs to be an **ongoing cycle of thinking**, investigating, considering, and then rethinking. **I am going to start using Pose, Collect, Analyze, and Interpret as prompts in the classroom**." *-TSDI Spring 16 Classroom Teacher*

Investigating real data with CODAP

"Being able to go ahead and do it on my own and seeing how it can be used and also seeing a video of a teacher doing that in the classroom, I think 10 years down the road, if I've forgotten everything else, I will definitely remember CODAP and how useful that is and try to implement something similar into my classroom."
-ESTEEM preservice teacher survey

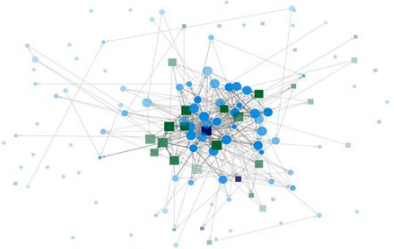
Triggers Influencing Changes



SASI Framework

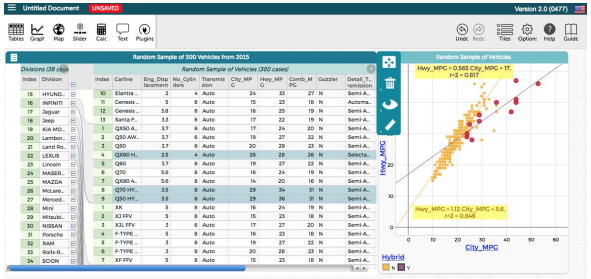
Classroom tested Tasks/Lessons

Classroom Videos of Teachers & Students



Engaging with Colleagues

Expert Panel and Teacher Discussions



Using Technology to Make Sense of Real Data

Critical Learning Experiences

Framing experiences in a cycle, habits of mind, & levels

Engaging with data with *easy to use* tools

Hearing importance and strategies from experienced others

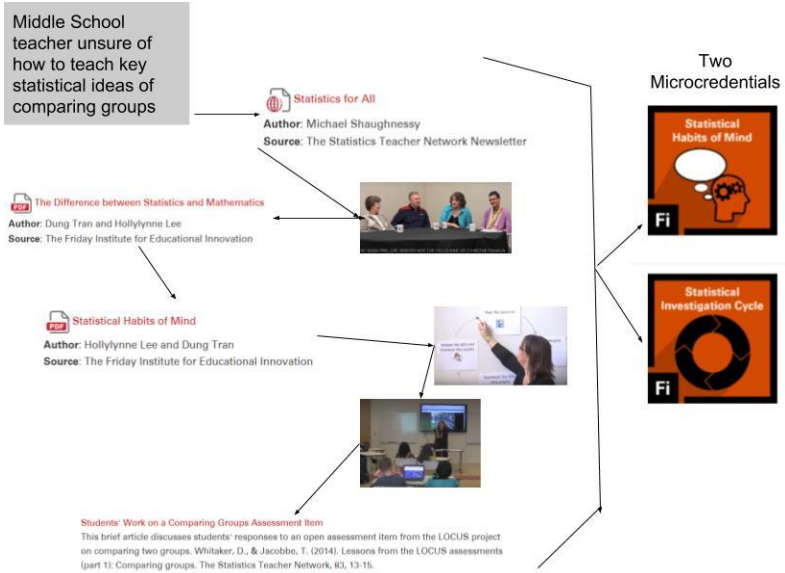
Seeing and reflecting on students' and teachers' experiences

Being critical about elements of tasks that matter

The Future....

InSTEP: Invigorating Statistics Teacher Education through Professional Online Learning

- Design personalized pathways for MS and HS teachers
- Dashboards, recommendation engines, microcredentials
- 2.9 million (DRK-12) 4 yrs
- Partner with RTI's Center for Technology to build platform



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Connect with me

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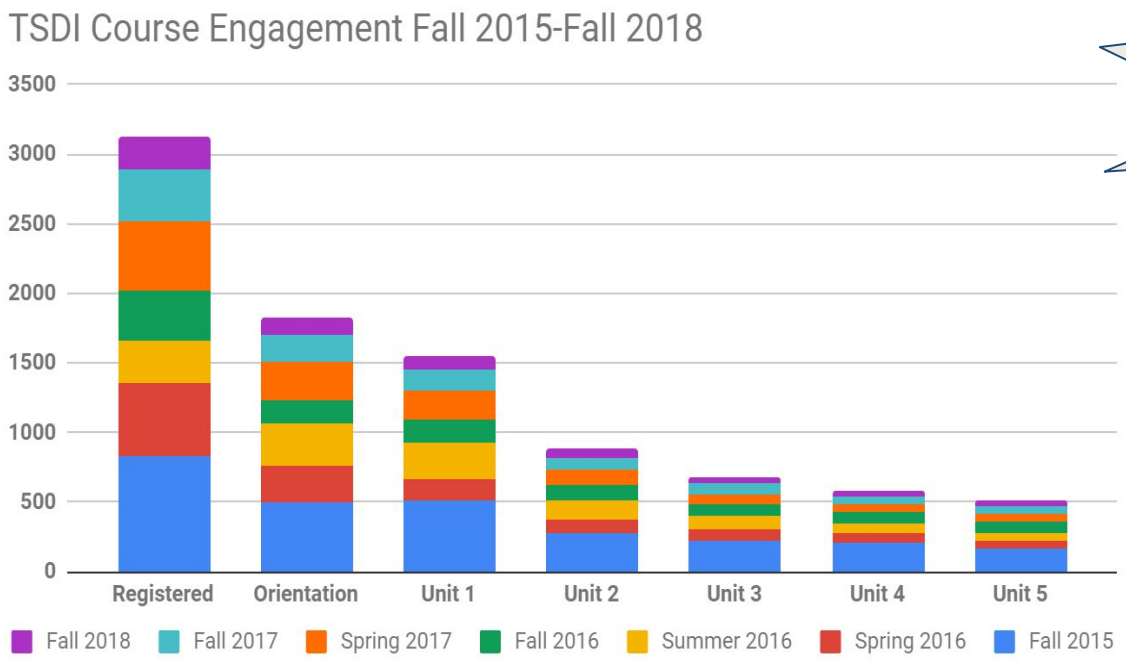
Access to all projects and free materials!!

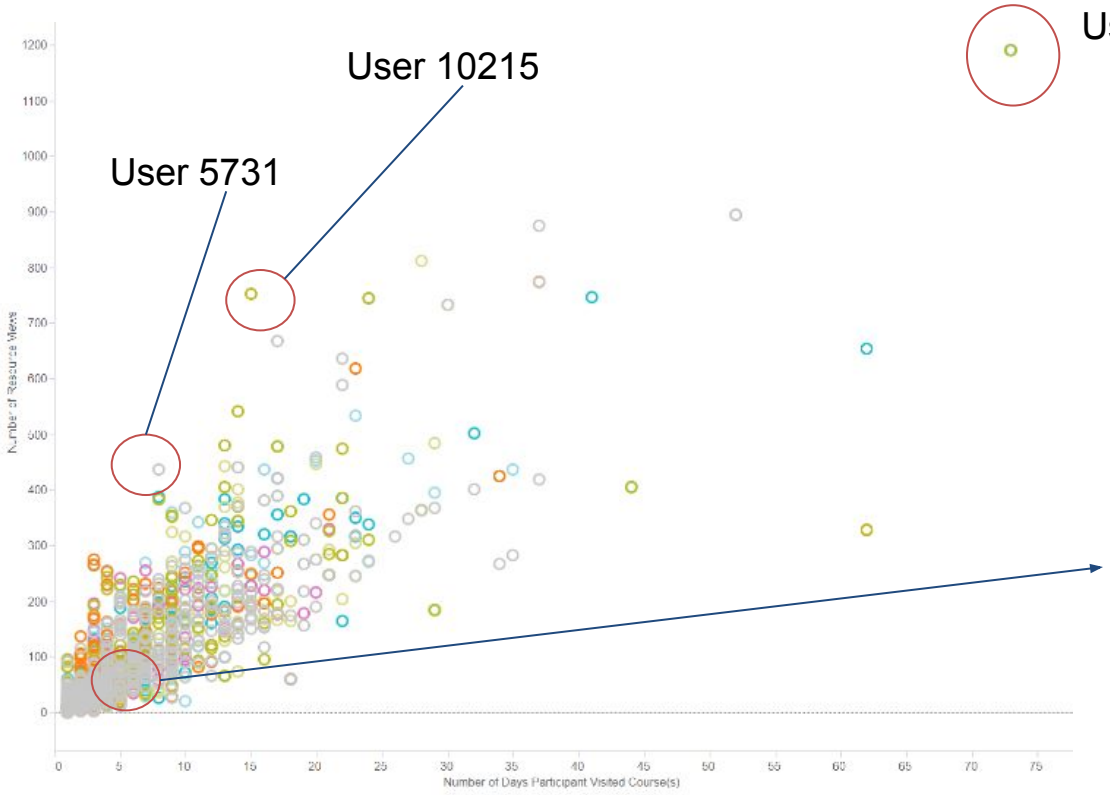
Trends in MOOC Activity

Unit Participation Across 7 Sections

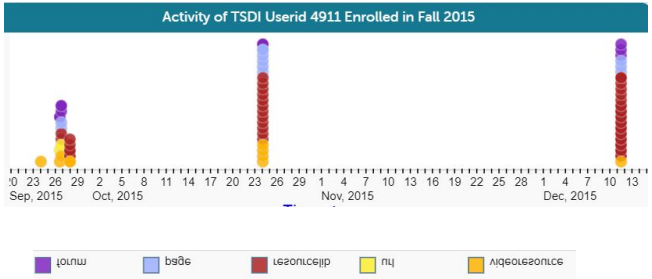


2723 unique registrants
1744 enrollees (**64%**) showed up!

- ★ Some skipped orientation and went straight to Unit 1, others came to orientation and did nothing else.
- ★ **33%** of those in Unit 1 made it to Unit 5!
- ★ **278** accessed a certificate

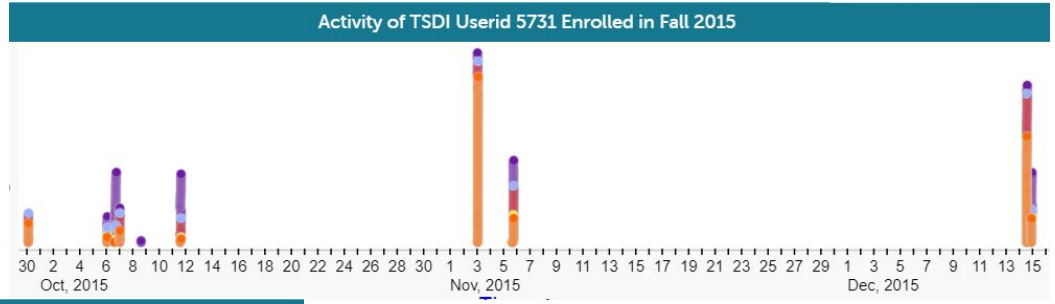


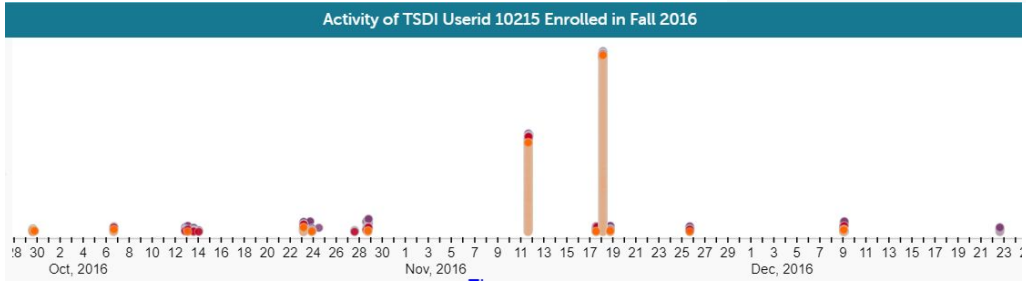
Most view 8 or less days and have less than 90 resource views



Female, masters degree, 10 yrs exp, K-12 classroom teacher, NC

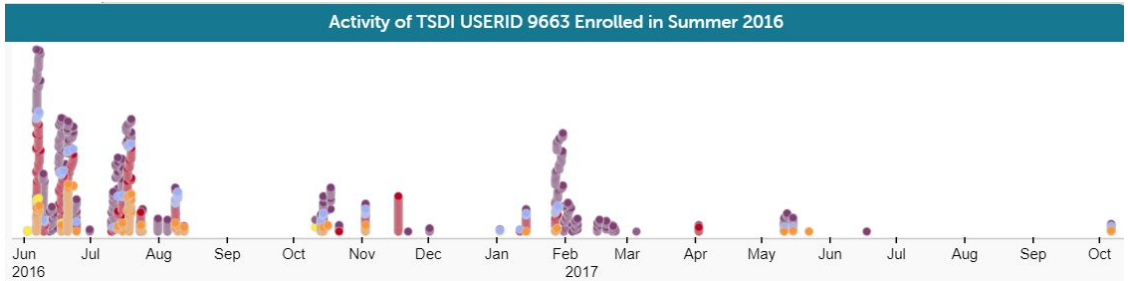
5731: 15 yrs exp, masters degree, female, college faculty, MD





10215: 10 yrs exp, male, doctoral degree, college faculty, MI

9663 Super Visitor and Resource User! 5 yrs exp, PhD, female, College faculty, Hungary, only 4 forum posts!



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