

**The Scholarship of Teaching and Learning in College Mathematics
AMATYC Webinar - March 27, 2019**

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Additional Resources Mentioned During the Webinar

Examples of SoTL work in all fields (not just mathematics) can be found in the following open access journals:

InSight: A Journal of Scholarly Teaching
<http://insightjournal.net/>

International Journal of Scholarship of Teaching and Learning (IJSoTL)
<https://digitalcommons.georgiasouthern.edu/ij-sotl/>

Journal of Scholarship of Teaching and Learning (JoSoTL)
<https://scholarworks.iu.edu/journals/index.php/josotl>

Teaching & Learning Inquiry
<https://tlijournal.com/>

See also the Teaching Journals Directory at
<https://cetl.kennesaw.edu/teaching-journals-directory> which is searchable by discipline and topic in higher education.

Examples of projects by Carnegie Scholars

Three of the 14 cases found here are from mathematics:
http://gallery.carnegiefoundation.org/gallery_of_tl/castl_he.html

Book by microbiologist

Thinking About Teaching and Learning: Developing Habits of Learning with First Year College and University Students, by Robert Leamson, describes how an award-winning teacher re-examined and changed his teaching practice after finding that his students were not gaining a real understanding of course material, even though they were performing well on exams. This 20-year old book, published in 1999 by Stylus Press, is still a worthwhile read. It was mentioned near the end of the webinar as an example of the power of asking *What is?* questions. Available from Stylus or Amazon.

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What is the Scholarship of Teaching and Learning (SoTL)?

SoTL is the scholarly work that instructors do when they bring their disciplinary knowledge to bear on questions of teaching and learning, draw conclusions based on evidence gathered from students in a systematic way, subject their findings to peer review, and make them public for others to build on.

3 Types of SoTL Questions from the Taxonomy of SoTL Questions (Hutchings, 2000)

What works? Does this teaching method or approach work?

What is? What are students really doing, thinking, or feeling when they...?

What could be? Can we show a case where something (really good) happens (*a vision of the possible*)? Does a special opportunity exist to explore and document the outcomes?

The SoTL Investigation Process

The problem or question What is the problem or question about teaching or learning you wish to address in your investigation? Describe the student behavior that you wish to change or to understand better.

Background Investigate what others have done to address this problem or question. As a start, search for your topic on databases such as ERIC (eric.ed.gov), JSTOR (www.jstor.org), or PsycINFO (www.apa.org/psycinfo)

Your plan Indicate how you plan to solve the problem or answer the question. What will you do to change or understand the behavior you wish to investigate? Has this been tried before?

Evidence* How will you demonstrate the effectiveness of your solution or the success of your investigation? What evidence will you gather?

Moving forward Draft a timeline, seek collaborators as needed, identify possible dissemination venues.

***Special Note Regarding Research with Human Subjects:** Because SoTL often involves making public the work of students, teachers, or other people associated with teaching and learning, it is considered research with “human subjects” and special considerations apply. To ensure the protection of human subjects, federal guidelines (see <https://www.hhs.gov/ohrp/regulations-and-policy/index.html>) require review and approval of all human subjects research by an oversight Institutional Review Board (IRB). Inquire about IRB resources within your institution prior to collecting evidence. If your institution does not have an IRB, other IRB resources may be available through professional organizations or partnerships. Undertaking a study of your own students for your own personal information and never going public with results does not require IRB review, but best practice would encourage it.

Background Reading

Bennett, C. & Dewar, J. (2012). An overview of the scholarship of teaching and learning in mathematics. *PRIMUS: Problems, Resources, and Issues in Mathematics Undergraduate Studies*, 22(6), 458-473.
doi:10.1080/10511970.2011.585389

Dewar, J. (2008). An apology for the scholarship of teaching and learning. *InSight: A Journal of Scholarly Teaching*, 3, 17–22. Retrieved from <https://files.eric.ed.gov/fulltext/EJ888405.pdf>

Resources for Doing SoTL and Going Public

Dewar, J. & Bennett, C. (Eds.). (2015). *Doing the Scholarship of Teaching and Learning in Mathematics*. Washington, DC: Mathematical Association of America.

How-to-do SoTL Website: <https://my.vanderbilt.edu/sotl>

Conference List: <https://cetl.kennesaw.edu/teaching-conferences-directory>

Journal List: <https://cetl.kennesaw.edu/teaching-journals-directory>

Professional Societies: International Society for the Scholarship of Teaching and Learning (<https://www.issotl.com>)

Specific Two-Year-College SoTL Resources: AMATYC (<https://www.AMATYC.org>), AMATYC’s journal *MathAMATYC Educator* (<https://amatyc.site-ym.com/page/MathAMATYCEducator>), and Project SLOPE (Scholarly Leaders Originating as Practicing Educators), a SoTL initiative within AMATYC (<https://www.amatyc.org/?ProjectSlope>)

<Additional References on Back>

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REFERENCES CITED IN THE WEBINAR

- delMas, R., Garfield, J., Ooms, A., & Chance, B. (2007). Assessing students' conceptual understanding after a first course in statistics. *Statistics Education Research Journal*, 6(2), 28–58. Retrieved from [https://iase-web.org/documents/SERJ/SERJ6\(2\)_delMas.pdf](https://iase-web.org/documents/SERJ/SERJ6(2)_delMas.pdf)
- Dewar, J. & Bennett, C. (Eds.). (2015). *Doing the Scholarship of Teaching and Learning in Mathematics*. Washington, DC: Mathematical Association of America.
- Dewar, J., Larson, S. & Zachariah, T. (2011). Group Projects and Civic Engagement in a Quantitative Literacy Course. *PRIMUS*, 21(7), 606–637. Retrieved from <https://www.tandfonline.com/doi/abs/10.1080/10511970903579048>
- GAISE College Report ASA Revision Committee. (2016). *Guidelines for Assessment and Instruction in Statistics Education College Report 2016*. Retrieved from: <http://www.amstat.org/education/gaise>
- Garfield, J. & delMas, R. (2006, September 25). *Assessment Resource Tools for Improving Statistics Thinking*. Retrieved from <https://apps3.cehd.umn.edu/artist/>
- Hutchings, P. (Ed.). (2000). *Opening Lines: Approaches to the Scholarship of Teaching and Learning*. Menlo Park, CA: The Carnegie Foundation for the Advancement of Teaching.
- Lightner, R. & Sipple, S. (2013). Scheduling scholarship: Promoting faculty engagement in two-year colleges. *Community College Journal of Research and Practice*, 37(6), 453–466. Retrieved from <https://www.tandfonline.com/doi/abs/10.1080/10668921003609293?src=recsys&journalCode=ucjc20>
- Nuhfer, E. & Knipp, D. (2003). The knowledge survey: A tool for all reasons. In C. Wehlburg & S. Chadwick-Blossey (Eds.), *To Improve the Academy*, v. 21, pp. 59–78, San Francisco: Jossey Bass. Retrieved from http://pachyderm.cdlib.org/elixr-stories/resource-documents/knowledge-survey/KS_a_tool_for_all_reasons.pdf
- Tinberg, H., Killian Duffy, D. & Mino, J. (2007). The scholarship of teaching and learning at the two-year college: "Promise and peril." *The Magazine of Higher Learning*, 39(4), 26–33. Retrieved from https://www.researchgate.net/publication/239800122_The_Scholarship_of_Teaching_and_Learning_at_the_Two-Year_College_Promise_and_Peril
- Zachariah, T., Larson, S., & Dewar, J. (2006). *Quantitative literacy through community-based group projects: An emerging model*. National Center for Science and Civic Engagement. Retrieved from <http://ncsce.net/quantitative-literacy-through-community-based-group-projects>

ADDITIONAL REFERENCES AND RESOURCES

- Boyer, E. (1990). *Scholarship Reconsidered: Priorities of the Professoriate*. Princeton, NJ: Carnegie Foundation for the Advancement of Teaching.
- Burke, M. (2015). A pedagogical odyssey. In J. Dewar and C. Bennett (Eds.), *Doing the Scholarship of Teaching and Learning in Mathematics* (pp. 107–116). Washington, DC: Mathematical Association of America.
- Dewar, J., Bennett, C. & Fisher, M. (2018). *The Scholarship of Teaching and Learning: A Guide for Scientists, Engineers, and Mathematicians*. New York, NY: Oxford University Press.
- Shulman, L. (2013). *Situated Studies of Teaching and Learning: The New Mainstream*. Keynote address at the 10th Annual Conference of the International Society for the Scholarship of Teaching and Learning, Raleigh, NC, October 3. Retrieved from <https://www.youtube.com/watch?v=bhvwLW-5zMM>

The Scholarship of Teaching and Learning in College Mathematics

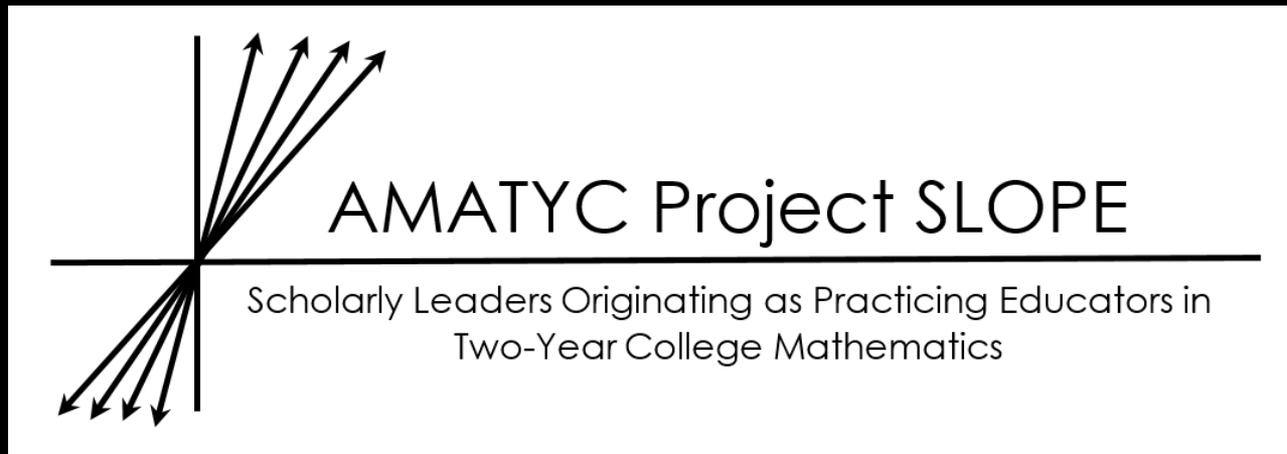
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Polling Question

What are you hoping to learn about the Scholarship of Teaching and Learning (SoTL)?

Outline for the Webinar

Part I About SoTL

Example: Quantitative Literacy (QL) course

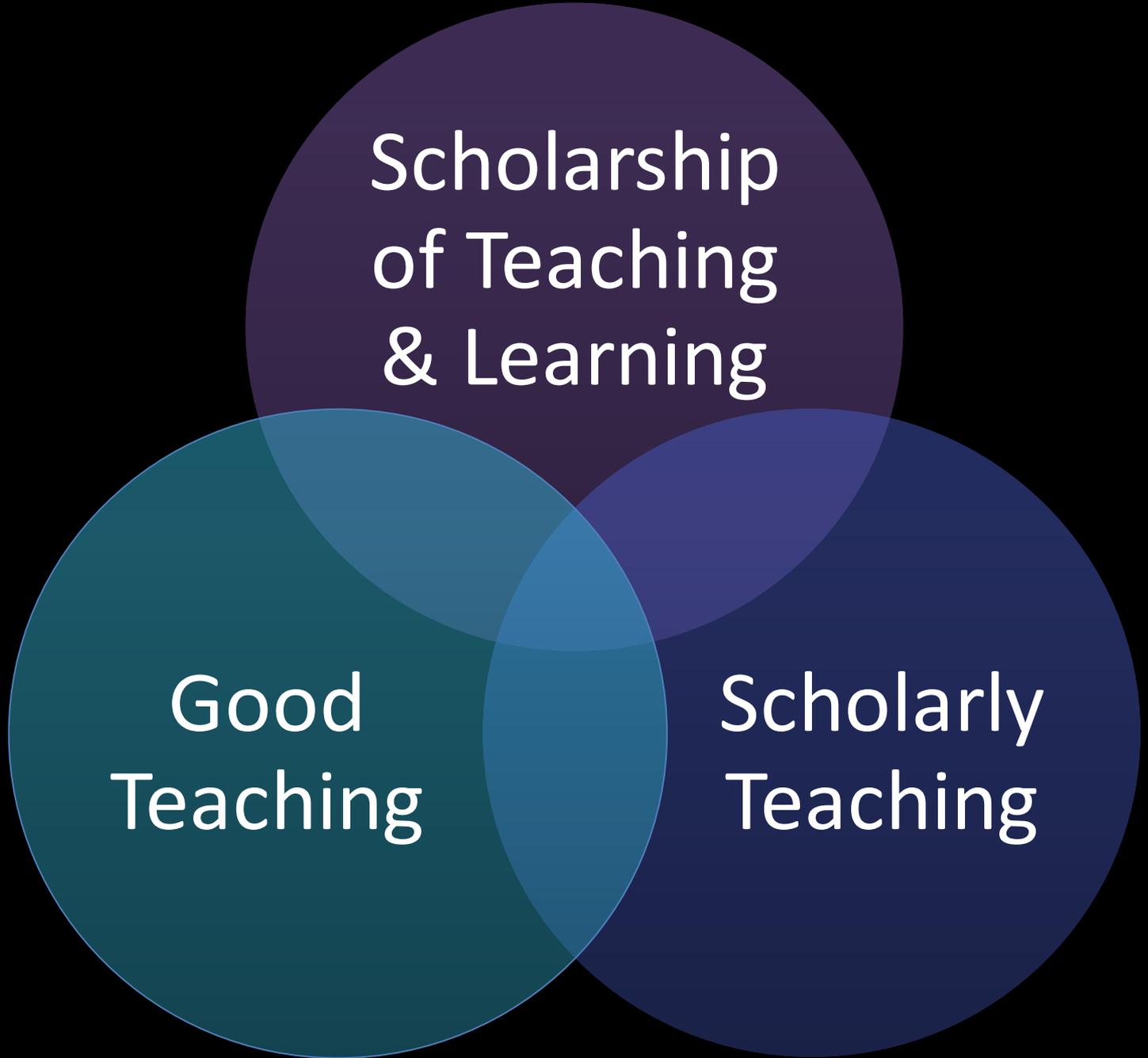
Part II SoTL in 2YC

Example: Statistics course

Part III Q&A

Part I - About SoTL

- Confusion about what SoTL is
- A definition
- 3 types of SoTL questions
- Example in a QL course



Scholarship
of Teaching
& Learning

Good
Teaching

Scholarly
Teaching

What is SoTL?

Scholarly work that faculty do when they bring their disciplinary knowledge to bear on questions of teaching & learning, **draw conclusions based on evidence gathered from students*** in a systematic way, subject their findings to **peer review**, and make them **public for others to build on**.

*NOTE: This makes SoTL **human subjects** research.
(See webinar handout.)

In SoTL...

A teaching Situation
or Problem

becomes



an Invitation to begin a
scholarly inquiry

3 Types* of SoTL Questions

*Hutchings (2000)



What works?

What is?

What could be?

3 Types* of SoTL Questions:

- **What works?**
 - Does this teaching method work?
- **What is?**
 - What are students really doing/thinking/feeling?
- **What could be?** (a vision of the possible)
 - We just want to show something is possible.
 - We try to document a situation where something really interesting/good happens.

*Hutchings (2000)

Quantitative Literacy (QL) at LMU

- The QL course was the primary way that students whose major did not require a math course met the university's gen. ed. math requirement.
- The overarching course goal was to provide students with quantitative skills that would be useful in their future.
- No math prereq. beyond admission to LMU.
- Engaging students who had such widely varying math backgrounds **was a teaching challenge!**

An Opportunity Arose



SENCER (Science Education for New Civic Engagements and Responsibilities), an NSF-funded curriculum project (www.sencer.net) that promotes teaching science and math *through* real world problems.

Experimental QL at LMU

- Guided by SENCER, we modified the QL course to have students work in teams and use the math they were learning in class to conduct research projects on local issues.
- Our “**experiment**” took place in 5 of 20 sections taught in 2005-06.
- Began as a *What could be?* investigation:
What happens if group projects on community issues are incorporated into a typical QL course?
- *What works?* and *What is?* followed later.

A Sampling of Projects

Who does/doesn't use the student health center and why?



Which is the best coffee venue on campus?



Is there enough campus parking and is it safe?



The Content of the 2 QL Courses

- Number Sense (both courses)
 - Percents and large and small numbers
- Mathematics of Finance (both courses)
 - Credit cards, loans, taxes, investments
- Elementary Statistics (both courses)
- Elementary Probability Theory (taken out)
- Theory of Voting (taken out)
- Model Project on Student Loan Debt (added)

Added Student Learning Outcomes

1. Be aware of the usefulness of math
2. Have greater confidence in using math
3. Be able to use math. tools to describe, analyze, and make recommendations about community issues.
4. Be engaged with a community issue and more likely to do so in the future

Pre-existing assessment

- QL students took a pre/post multiple choice test on course content.
- Test had 12 questions, 9 of which were appropriate material for experimental version.

Polling Question

What evidence would you gather for this *What could be?* question:

What happens if group projects on community issues are incorporated into a typical QL course?

Evidence gathered

- Student Project Reports (written and oral)
- Pre- and Post-Tests
- Knowledge Survey (Nuhfer and Knipp, 2003)
- Surveys
- Focus Group

What works? questions the study answered.

- Does the experimental (SENCER) course improve student understanding/confidence?
[Yes, **pre/post test** and **knowledge survey**]
- Do SENCER students learn more?
[A little bit, On one (of 9) **post-test questions** (explaining margin of error), SENCER students performed significantly better than students in the standard course; no significant difference on the other 8 questions.]

What works/is? questions the study answered (cont.)

- Does the SENCER approach work to teach students to use mathematical tools to describe, analyze, and make recommendations about community issues?
[Yes, **project reports** (written and oral)]
- What do students think about the projects?
[Very positive response, in **focus group**, 79% said yes keep them, 5% maybe, 16% no]

For more details, see

- Dewar, J., Larson, S. & Zachariah, T. (2011). Group projects and civic engagement in a Quantitative Literacy course. *PRIMUS*, 21(7), 606-637.
- <http://ncsce.net/quantitative-literacy-through-community-based-group-projects/> also provides details about the course, assessments, and how the projects were organized in stages

Part II – SoTL in 2YC Math

Does SoTL fit into our work?

- Teaching is central to our work
- Teaching a profession that goes well beyond time spent in the classroom

How is SoTL an act of teaching?

- Combines reflection, inquiry and exchange on teaching
- Informs practice, improves teaching and learning
- Renews engagement

(Lightner & Sipple, 2013; Tinberg, Killian Duffy & Mino, 2007)

Statistics SoTL Study in a 2YC

- Teaching and learning problem
- Desire to make changes to my teaching
- Research questions
- Method
- Outcomes

Descriptive Statistics

Descriptive statistics are used to understand and interpret data, to generate questions, to select methods of analysis, and to provide a basis for inference.

Traditional Methods

What is the mean chocolate chip count for the sample of 5 chocolate chip cookies?

20 chips, 19 chips, 16 chips,
20 chips, and 21 chips.

Traditional Methods

What is the mean chocolate chip count for the sample of 5 chocolate chip cookies?

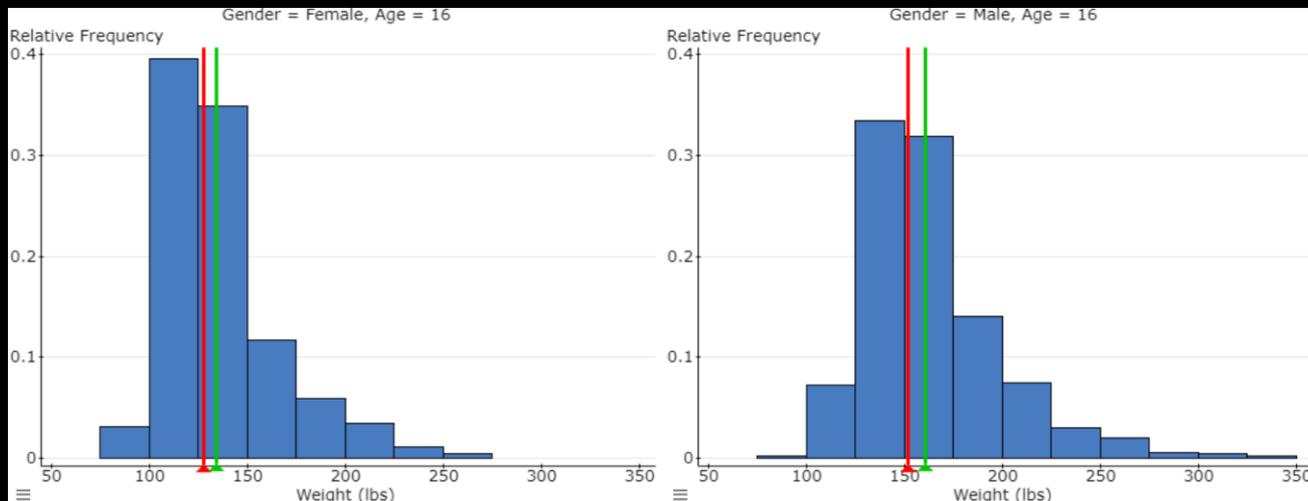
$$\begin{aligned}\bar{x} &= \frac{\sum x}{n} \\ &= \frac{20 \text{ chips} + 19 \text{ chips} + 16 \text{ chips} + 20 \text{ chips} + 21 \text{ chips}}{5 \text{ cookies}} \\ &= 19.2 \text{ chips per cookie}\end{aligned}$$

My students could even do this!

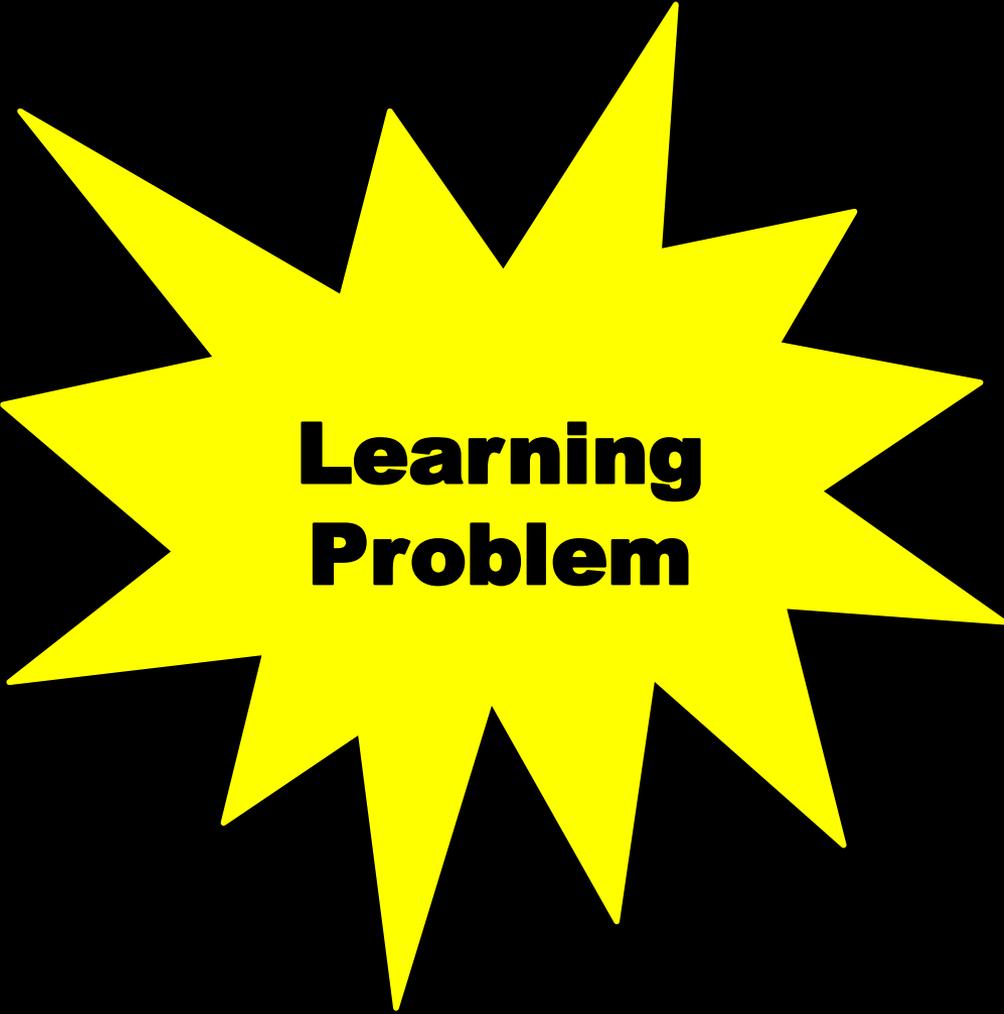
$$s = \sqrt{\frac{n(\sum x^2) - (\sum x)^2}{n(n-1)}}$$

But my students couldn't do this...

Describe a similarity between the distribution of observed weights of 16-year old females and the distribution of observed weights of 16-year old males.



In other words...I had a

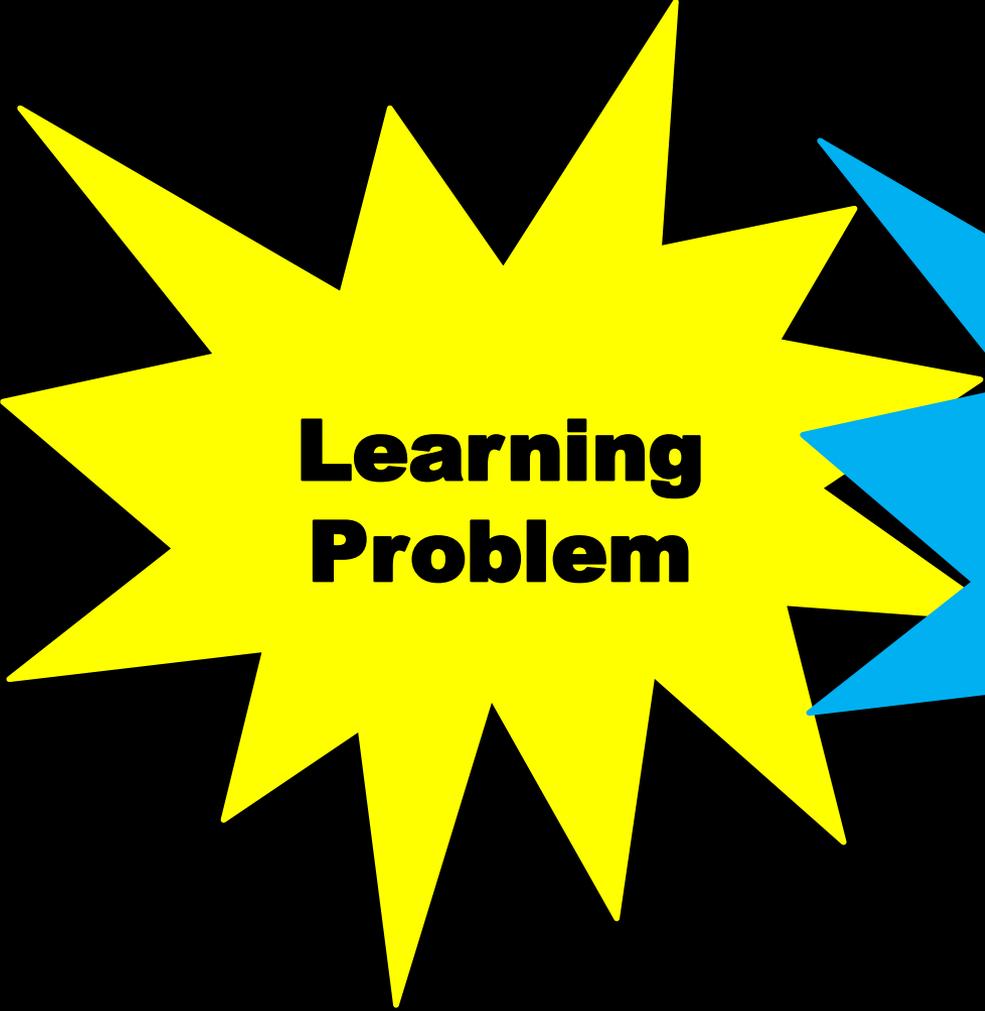


**Learning
Problem**

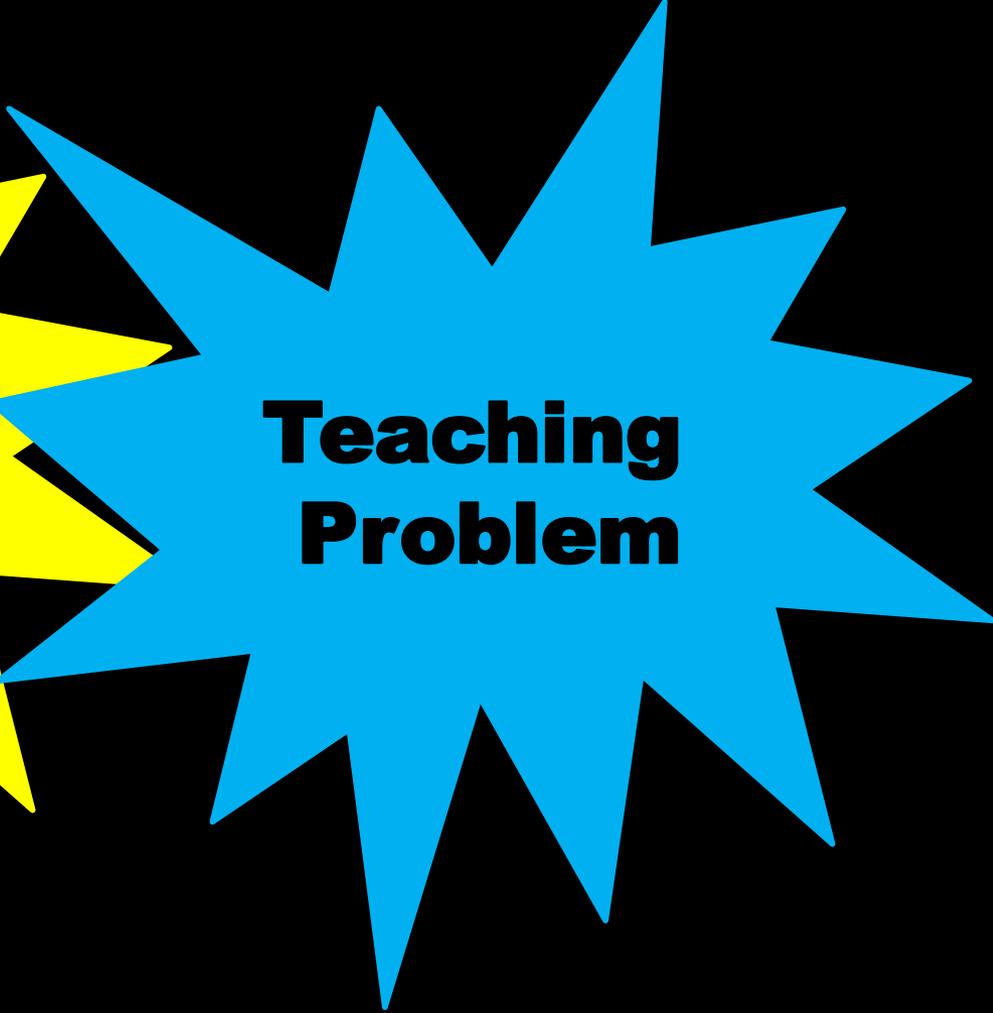
Stop talking about cookies. Nobody cares about the cookies.

You are at your best when you bring in the real stuff. We learn best when you are excited about the real stuff.

In other words...I had a



**Learning
Problem**



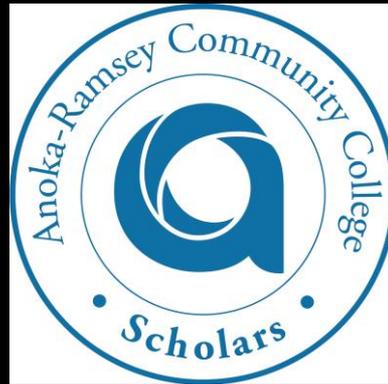
**Teaching
Problem**

It was time to make changes!

- Guidelines for Assessment and Instruction in Statistics Education (GAISE) College Report 2016
- Teaching with GAISE: Statistical Literacy for the 21st Century – AMATYC webinar 5/22/17
- StatPREP (NSF #1626337), 2017 -2018, St. Paul Hub, statprep.org

It was time to do some inquiry!

- Anoka-Ramsey CC Scholars Program, 2017 - 2019



Research Question

- What are the impacts of GAISE (2016) informed teaching and learning methods in introductory statistics?
- Do students identify, interpret, and operate flexibly and accurately with measures of center and spread?

Method

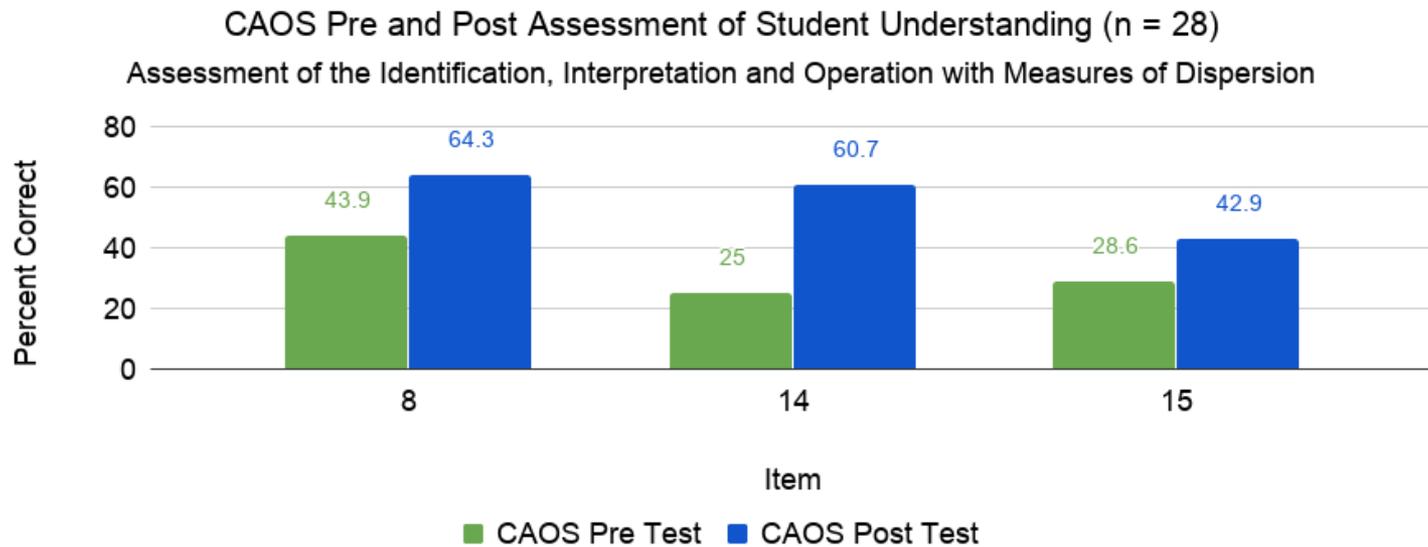
- Classroom teaching experiment
- Two-week unit on descriptive statistics
- Data collection was integrated into teaching, learning, and assessments for the course

Evidence Gathered

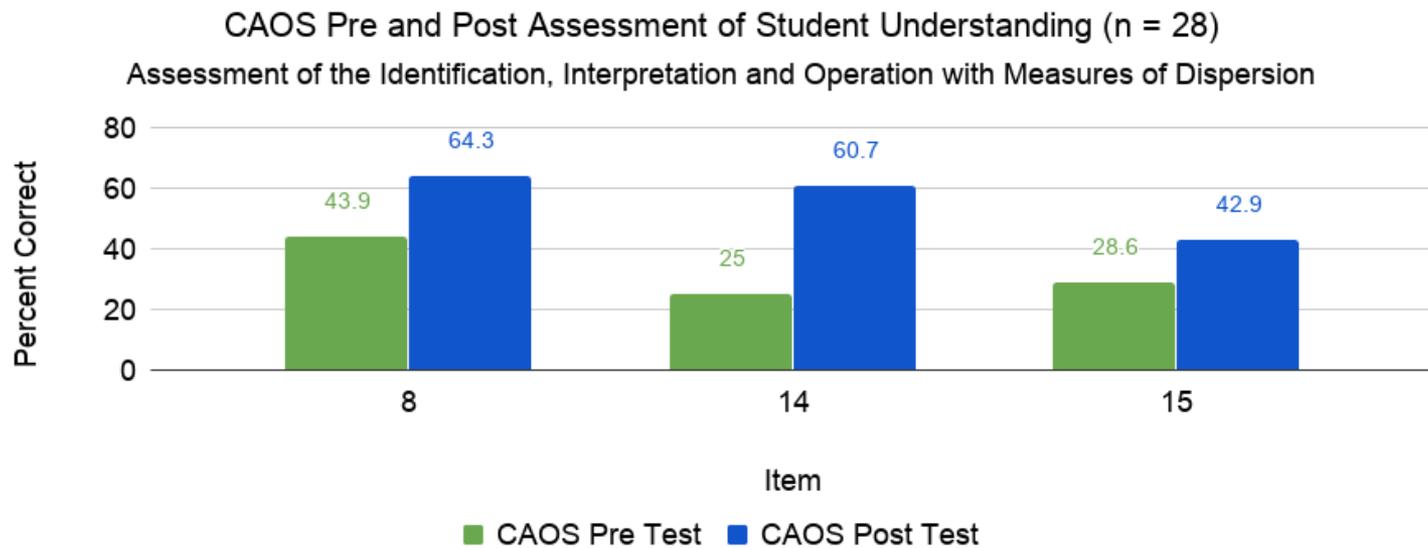
- **CAOS – Comprehensive Assessment of Outcomes in a First Statistics Class**
(delMas, Garfield, Ooms & Chance, 2007)
- **ARTIST Scale Assessments – Assessment Resource Tools for Improving Statistical Thinking**
<https://apps3.cehd.umn.edu/artist>
- **Written Post Assessment – AP Exam Questions**
<https://apcentral.collegeboard.org/courses/ap-statistics/exam>

CAOS Pre-Post Analysis

- Look at a snapshot of some data:
 - 3 CAOS items
 - Interpretation of a graphical displays of data, identification of standard deviation, and comparison of spread across two distributions



| | Item Description | Pre | Post | p-value |
|---|--|------|------|---------|
| 8 | Ability to determine which of two boxplots represents a distribution with a larger standard deviation. | 43.9 | 64.3 | 0.068 |



| | Item Description | Pre | Post | p-value |
|----|--|------|------|---------|
| 14 | Ability to correctly estimate and compare standard deviations for different histograms. Understands lowest standard deviation would be for a graph with the least spread (typically) away from the center. | 25 | 60.7 | 0.003 |
| 15 | | 28.6 | 42.9 | 0.106 |

Modest learning gains demonstrated

- Observing, describing and interpreting distributions through graphical displays and numerical summaries of data
- Significance of student learning gains was mixed and modest, yet sustained across 12 weeks

Sharing of Outcomes

- Anoka-Ramsey CC Faculty Research Symposium, October 2018
- Anoka-Ramsey CC Math Department Development Day, January 2019
- Joint Math Meetings, January 2019
- AMATYC Webinar, TODAY!, March 2019

Part III – Q & A

What questions do you
have about SoTL?

Please write questions in
chat window.

SOME QUESTIONS

Does every SoTL study involve changing or experimenting with something?

Part III – Q & A

What questions do you
have about SoTL?

Please write questions in
chat window.

Contact Info

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References Cited

- delMas, R., Garfield, J., Ooms, A., & Chance, B. (2007). Assessing students' conceptual understanding after a first course in statistics. *Statistics Education Research Journal*, 6(2), 28 – 58.
- Dewar, J. & Bennett, C. (Eds.). (2015). *Doing the Scholarship of Teaching and Learning in Mathematics*. Washington, DC: Mathematical Association of America.
- Dewar, J., Larson, S. & Zachariah, T. (2011). Group projects and civic engagement in a Quantitative Literacy course. *PRIMUS*, 21(7), 606-637.
- Garfield, J. & delMas, R. (2006, September 25). *Assessment Resource Tools for Improving Statistics Thinking*. Retrieved from <https://apps3.cehd.umn.edu/artist>

References Cited (cont.)

- Hutchings, P. (Ed.). (2000). *Opening Lines: Approaches to the Scholarship of Teaching and Learning*. Menlo Park, CA: The Carnegie Foundation for the Advancement of Teaching.
- Lightner, R. & Sipple, S. (2013). Scheduling scholarship: Promoting faculty engagement in two-year colleges. *Community College Journal of Research and Practice*, 37(6), 453 – 466.
- Nuhfer, E. & Knipp, D. (2003). The knowledge survey: A tool for all reasons. In C. Wehlburg & S. Chadwick-Blossey (Eds.), *To Improve the Academy*, v. 21, pp. 59-78, San Francisco: Jossey Bass.
- Tinberg, H., Killian Duffy, D. & Mino, J. (2007). The scholarship of teaching and learning at the two-year college: "Promise and peril." *The Magazine of Higher Learning*, 39(4), 26 – 33.