Technology Integration in Active Learning Mathematics Classrooms:

Faculty Perceptions and Challenges

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Who we are…

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Impetus for Study

- Methods used to engage students actively in mathematics
- Technology use by mathematics faculty

- Are mathematics instructors integrating technology in an active learning (inquiry-based) classroom?
- Is it true that even in a classroom that was pedagogically created to engage student learners (e.g., active learning, IBL) that technology was mainly used to display graphics and make calculations faster?

Purpose

The purpose of this exploratory pilot study was to collect data on three items:

1. What are mathematics instructors' knowledge of the technological tools available to them?
2. How are mathematics instructors using technology while teaching?
3. What challenges have mathematics instructors encountered in using technology in the mathematics classroom?

Demographics

- Participants
  - How chosen (Inquiry-based learning)
  - Emails sent (~1000)
  - 106 completed survey and gave consent
- Age range
  - 28 – 84 years
- Years teaching range
  - 10 years or less = 26%
  - 11 years or more = 74%
- Gender
  - Male = 66%, Female = 34%
- 26 survey questions

Computer proficiency levels with using technology while teaching

How would you rate your general computer/technology proficiency level?	Percentage
No ability	0%
Poor	1%
Moderate	13%
Good	31%
Very Good	42%
Expert	12%

Comfort levels with using technology while teaching

What is your comfort level with using computers/technology during teaching	Percentage
Not comfortable at all	3%
Mildly comfortable	16%
Comfortable	35%
Very comfortable	35%
Extremely comfortable	11%

Technology tools available versus used

	What technologies are available to you in your classroom?	Which technologies do you use for teaching?
Electronic projector (with computer)	89%	69%
Computer / laptop	78%	75%
PowerPoint software	75%	20%
Document Camera	73%	61%
Excel software	68%	22%
Math software	64%	53%
DVD, VCR, Filmstrip	44%	9%
Smartphone	30%	14%
Smartboard	22%	12%

How are they using technology?

- Many responses included using clickers to engage the students in discussion, using document cameras or projectors to display both instructor and student work and visualize content, using mathematical software to explore concepts, and even having students code their own software to help them investigate their ideas.

- Results helped us come to the conclusion that our preconceived ideas about technology only being used as presentation tools or calculators were **incorrect**.

How are they using technology?

"Use clickers to engage students in discussion based questions where they discuss until they arrive and agree on an answer. Use Excel in Stats classes to collect/analyze data during class. Use java applets to explore ideas related to Statistics (e.g. changing sample sizes and seeing how that changes averages or standard deviations). Use document camera to project student work."

How are they using technology?

“Well, that's a big question! Generally, I assign tasks where students use mathematical software to explore things that either allow them to create conceptual knowledge or make conjectures (and hopefully prove them). Examples: In geometry I'll have the students use GeoGebra to make conjectures about Euclidean, hyperbolic, or projective geometry. (I typically give them a worksheet with some task to explore, with open-ended questions to help guide them.) In linear algebra I will create a Mathematica lab to have them, say, explore the geometric nature of eigenvalues and eigenvectors. Sometimes the software is merely a platform for them to explore, using code I already created for them. Other times my intention is for them to learn how to use the software as a tool for their own explorations, where they create the code to investigate their ideas. “

How are they using technology?

“In class, I often use programs and websites such as Mathematica and Desmos to visualize concepts that we're discussing in class. I also have students project their solutions to homework problems from the classroom computer or document camera.”

How are they **NOT** using technology?

- “I specifically avoid the use of technology in inquiry-based learning classes.”

- “Not much to be honest. Most of the IBL courses I teach are proof based and I haven't figured out how to incorporate a computer well into those courses. Mostly when I use computers it's for a graphing capability.”

How are they **NOT** using technology?

- “Sparingly. * In calculus courses, occasionally we will graph something on the classroom computer (using Sage or Mathematica or Geogebra etc.) and project it to the whole room. Students will simultaneously graph using their laptops. * Sometimes a student will have a long proof or solution to present, and will use the document camera. * On the day before a vacation (Thanksgiving or spring break) we will sometimes watch a movie (usually _Flatland_, especially in Calc 3) instead of having class.”

How are they **NOT** using technology?

- “Very occasionally. Might take a picture of student work on board one day and use projector to discuss the work the next day.”
- “I don't typically use it in my inquiry-based courses since those involve students making presentations at the board."
- “I use almost no technology--usually the blackboard. I do sometimes have the students interact with one another using Moodle outside of class to work on specified challenges outside of class.”

Challenges

- Time
- Technology reliability (when the tech doesn't work)
- Technology proficiency (learning curve)
- Technology is not a seamless integration with the content being taught
- Lack of student hardware (laptops, phones)
- Poor infrastructure and support
- Distraction for the students

Implications

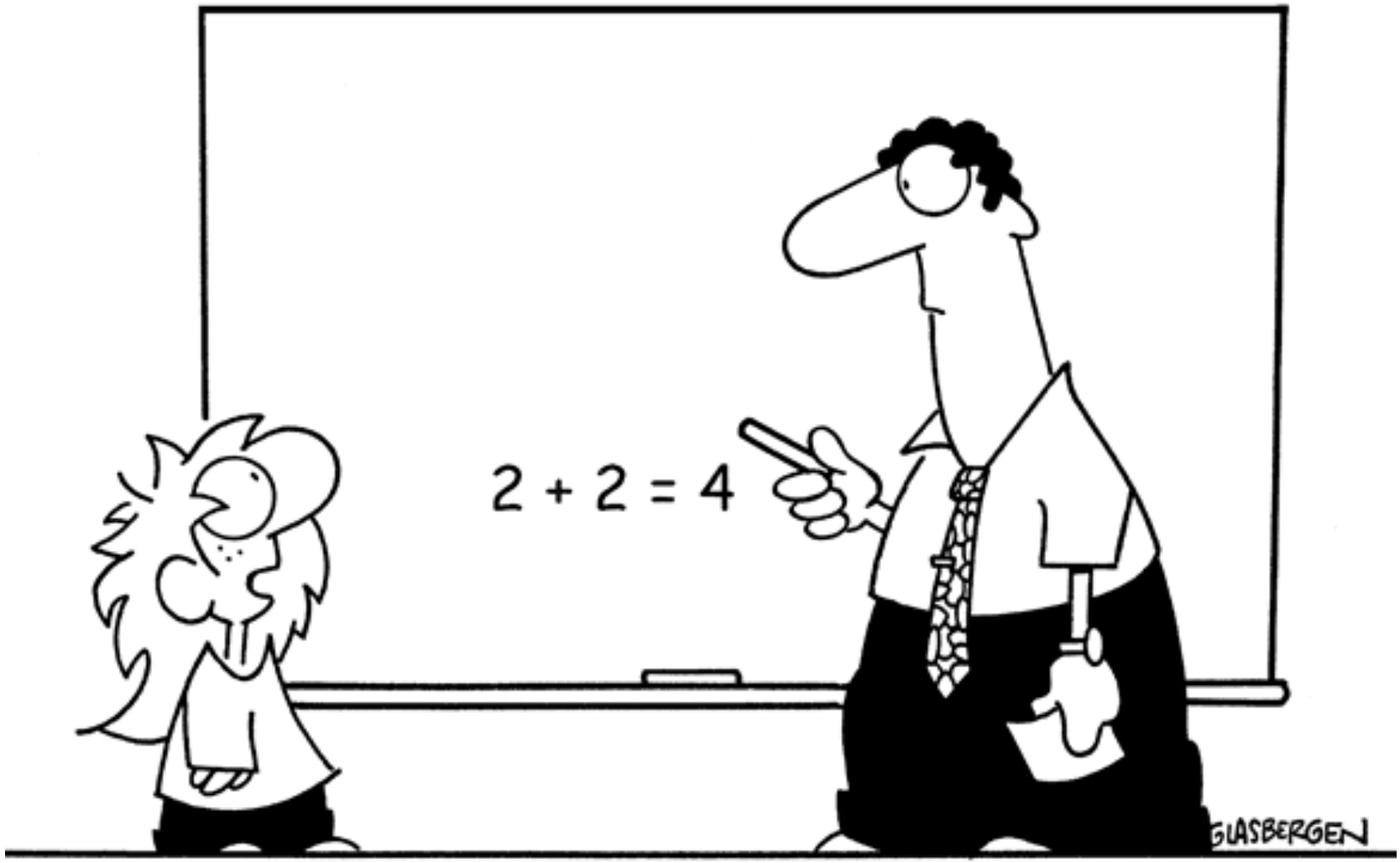
- Went in not expecting such high levels of proficiency and comfort level with technology
- it emerged from a number of participants that they thought we were asking the wrong questions in the survey. A few participants stated they thought we should be discussing pedagogy, and technology ‘outside’ the classroom versus what we asked.

Future Plans

- Clarity on the survey
- Identify **exemplary** instructors
  - How to improve mathematics understanding and reduce mathematics anxiety

Future Plans

- It should be noted data were collected prior to COVID-19 so instructor perceptions may have changed since a considerable amount of instruction has moved online.
- We intend to send out additional surveys with follow-up questions and interviews to gain more knowledge regarding trends, issues, and challenges and determine the transferability of the exemplary-teacher knowledge of technology in active learning mathematics classrooms to teacher education students.
- Also, future research will examine both face-to-face in-person and online classrooms.



"How can I trust your information when you're using such outdated technology?"

Using Technology	Technology Integration
Technology usage is random, arbitrary & often an afterthought	Technology usage is planned & purposeful
Technology is rare or sporadically used in the classroom	Technology is a routine part of the classroom environment
Technology is used purely for the sake of using technology	Technology is used to support curricular goals & learning objectives
Technology is used to instruct students on content	Technology is used to engage students with content
Technology is mostly being used by the instructor(s)	Technology is mostly being used by the student(s)
Focus on simply using technologies	Focus on using technologies to create and develop new thinking processes
More instructional time is spent learning how to use the technology	More instructional time is spent using the technology to learn
Technology is used to complete lower-order thinking tasks	Technology is used to encourage higher-order thinking skills
Technology is used solely by individuals working alone	Technology is used to facilitate collaboration in & out of the classroom
Technology is used to facilitate activities that are feasible or easier without technology	Technology is used to facilitate activities that would otherwise be difficult or impossible
Technology is used to deliver information	Technology is used to construct & build knowledge
Technology is peripheral to the learning activity	Technology is essential to the learning activity

Contact us…

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