Systemic Strategies for Increasing Inclusive Teaching

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8 December, 2019

Inclusive Teaching: What and why

> "*Inclusive teaching involves deliberately cultivating a learning environment where all students are treated equitably, have equal access to learning, and feel valued and supported in their learning. Such teaching attends to social identities and seeks to change the ways systemic inequities shape dynamics in teaching-learning spaces, affect individuals' experiences of those spaces, and influence course and curriculum design.*" —UM CRLT

- That is: inclusive teaching is intentional, and
- Systemic: it is a guiding intent, not one pedagogy or curriculum.

What we know matters:

- Academic Belonging: *Feelings of belonging correlate strongly with learning.*
- Transparency: *Clear expectations, norms improve students' learning and persistence.*
- Structured Interactions: *Promote a sense of acceptance in the community*

Inclusive Teaching: How and where

Or, how can we implement a guiding intent?

What we know works:

- Active learning classrooms
  - Improve student understanding and affect in math, especially for women. *Study: 40 courses, 100 course sections: Laursen (2014), J Rsch Math Ed*
  - Improve student performance and retention. *Metaanalysis 225 studies: Freeman (2014), Proc NAS*
  - Are endorsed by the CBMS: "*we call on [faculty and policy makers]. . . to ensure that effective active learning is incorporated into post-secondary mathematics classrooms*." *CBMS statement, 2016*
- Other strategies, to promote
  - *Academic belonging*, *Transparency*, *Structured interactions*, *Critical engagement of difference*

Outline

- Introduction
- Outline
- Context
- Active learning in Michigan Math
  - History
  - Michigan Math model
  - Support and structure
  - Implementation thoughts
- Other inclusive teaching thoughts and Michigan Math
  - New initiatives: mastery assessment
  - Instructor tools and awareness: pipeline building
- Conclusions and things to take away

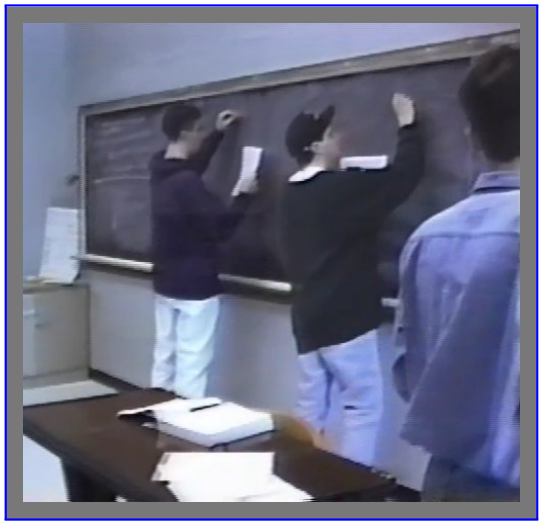
U(M) Math

- The University of Michigan (a.k.a., the university about 80 km west of Windsor):
  - 48,000 students; 31,000 undergraduates
  - 7,300 regular instructional faculty
- And our Department of Mathematics:
  - About 70 tenure-line and continuing lecturer faculty
  - About 65 post-doctoral faculty
  - About 120 graduate students
  - About 600 math majors
  - About 2,700 students in first three math courses (fall 2019)

- $+$ A (25-year) history of reform instruction (“calculus reform”)

Active Learning at U(M)

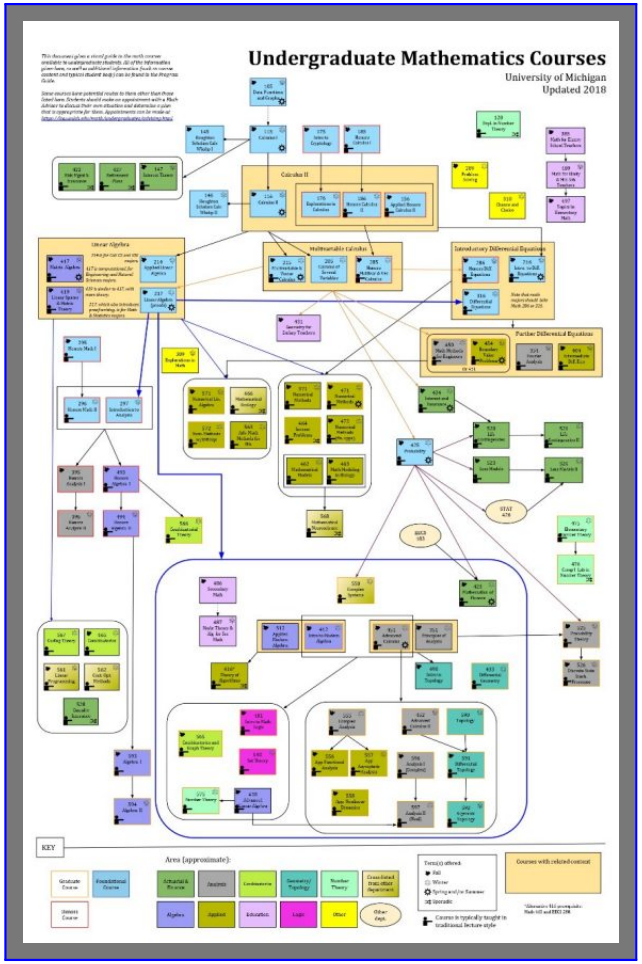
- A brief history
  - Calculus Reform (1990s)
    - Class sections to ~~24~~ 32 students
    - Active learning: in class, team homewk
    - Conceptual focus, with skills assessed by “gateway” tests
    - *and calculators. . .*
  - Faculty Expansion Program (2015)
    - Class sections to 18 students
    - 15 post-docs, 7 lecturers, 2 tenure-line added faculty



- Scale (Fall 2019):
  - 129 instructors in first three courses *(mostly graduate students and post-docs)*
  - 161 class-sections of those
- Structure. . .

Michigan Math Structure

- Coordination
  - Faculty course coordinator for each course (and, in fall, a faculty co-coordinator for calculus I)
  - Graduate student co-coordinator (mostly)
- Uniformity
  - Uniform daily schedules
  - Uniform exams and final, and grading
  - Uniform web homework
  - Section/individually graded work factors in only as an adjustment
- (Mostly) Uniform course pedagogy
  - Highly conceptual focus in class, and on assessment
  - Active learning in the classroom



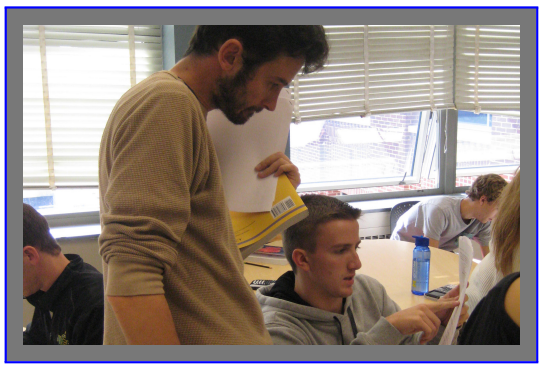
Sample Active Learning Class

10:10–10:15am	Group work on introductory problem
10:15–10:20am	Announcements
10:20–10:30am	Summary of group work solutions
10:30–10:40am	Mini-lecture on new material
10:40–11:10am	Group work on new material
11:10–11:20am	Discussion of solution group wrote on board
11:20–11:25am	Group discussion
11:25–11:30am	Summary of remaining group work

Total:

group work: $\sim$40 min

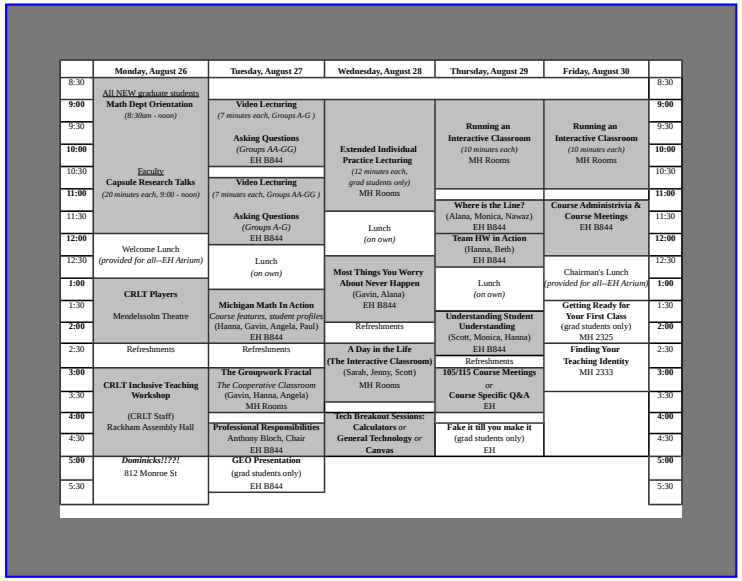
lecture: $\sim$40 min



Building “Michigan Math”

New instructor training program
(Most instructors are grad students and post-docs)

- One week before fall term
- Goal: prepare new instructors to teach with active learning,
  - Build community and buy in from instructors
  - Facilitate creation of buy in from students
  - Give scripts/outlines for first week
  - Give teaching tools and practice to implement active learning
  - Provide background on course structure and goals



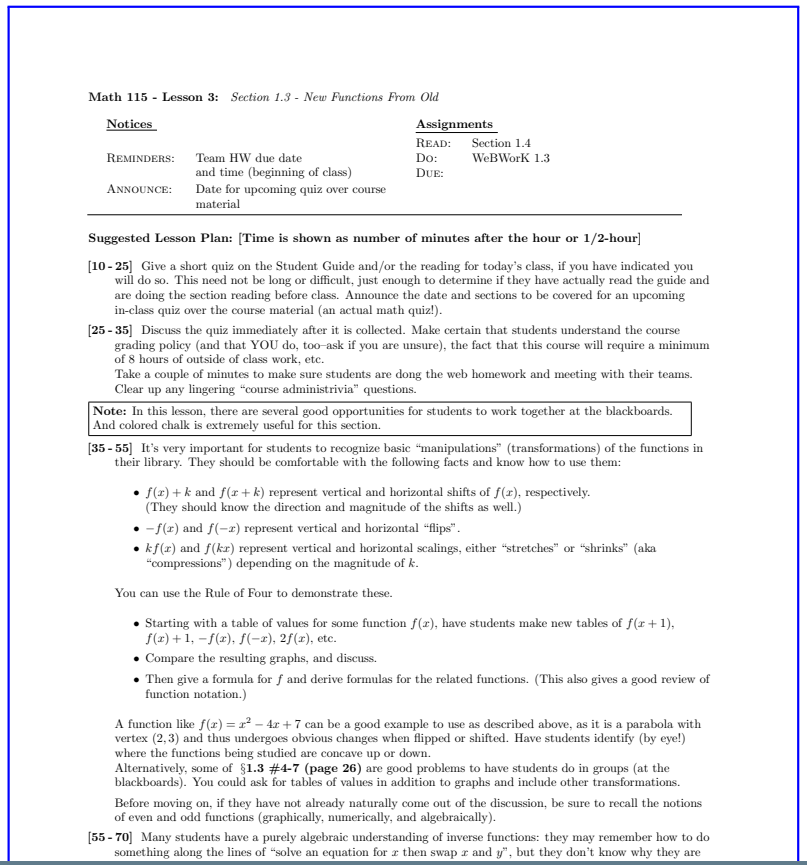
	Monday, August 26	Tuesday, August 27	Wednesday, August 28	Thursday, August 29	Friday, August 30	
8:30	All NEW graduate students					8:30
9:00	**Math Dept Orientation** *(8:30am - noon)*	**Video Lecturing** *(7 minutes each, Groups A-G)*	**Extended Individual Practice Lecturing** *(12 minutes each, grad students only)* MH Rooms	**Running an Interactive Classroom** *(10 minutes each)* MH Rooms	**Running an Interactive Classroom** *(10 minutes each)* MH Rooms	9:00
9:30		**Asking Questions** *(Groups AA-GG)* EH B844				9:30
10:00						10:00
10:30	Faculty **Capsule Research Talks** *(20 minutes each, 9:00 - noon)*	**Video Lecturing** *(7 minutes each, Groups AA-GG)*		**Where is the Line?** (Alana, Monica, Nawaz) EH B844	**Course Administrivia & Course Meetings** EH B844	10:30
11:00		**Asking Questions** *(Groups A-G)* EH B844	Lunch *(on own)*	**Team HW in Action** (Hanna, Beth) EH B844		11:00
11:30						11:30
12:00	Welcome Lunch *(provided for all--EH Atrium)*	Lunch *(on own)*	**Most Things You Worry About Never Happen** (Gavin, Alana) EH B844	Lunch *(on own)*	Chairman's Lunch *(provided for all--EH Atrium)*	12:00
12:30						12:30
1:00	**CRLT Players** Mendelssohn Theatre	**Michigan Math In Action** *Course features, student profiles* (Hanna, Gavin, Angela, Paul) EH B844	Refreshments	**Understanding Student Understanding** (Scott, Monica, Hanna) EH B844	**Getting Ready for Your First Class** (grad students only) MH 2325	1:00
1:30						1:30
2:00			**A Day in the Life (The Interactive Classroom)** (Sarah, Jenny, Scott) MH Rooms	Refreshments	**Finding Your Teaching Identity** MH 2333	2:00
2:30	Refreshments	Refreshments		**105/115 Course Meetings** *or* **Course Specific Q&A** EH		2:30
3:00	**CRLT Inclusive Teaching Workshop** (CRLT Staff) Rackham Assembly Hall	**The Groupwork Fractal** *The Cooperative Classroom* (Gavin, Hanna, Angela) MH Rooms				3:00
3:30						3:30
4:00		**Professional Responsibilities** Anthony Bloch, Chair EH B844	**Tech Breakout Sessions: Calculators** *or* **General Technology** *or* **Canvas**	**Fake it till you make it** (grad students only) EH		4:00
4:30						4:30
5:00	***Dominicks!!!?!*** 812 Monroe St	**GEO Presentation** (grad students only) EH B844				5:00
5:30						5:30

Sustaining “Michigan Math”

- Ongoing support
  - Course meetings
  - Lesson plans
  - Class visits
  - Midterm evaluation feedback
- Specific support for Inclusive teaching
  - Structural inclusivity
  - Support for inclusive teaching
    - CRLT workshop on inclusive teaching (new instructor training; 2017–)
    - Increased emphasis on inclusion throughout training week (2017–)
    - CRLT follow-up workshops on inclusive teaching in course meetings (2019–)

Course Structure & Inclusion

- *Transparency*—
  - Michigan Math in Action: the first class day
  - Exam problem use in class
  - Lesson plans and learning objectives
- *Academic Belonging*—
  - New instructor training: growth mindset, student buy-in strategies
  - Small classes, instructor/student connections
- *Structured Interactions*—
  - Team homework roles
  - Team creation strategies
- *Engaging Difference*—
  - Rule of four
  - Team work



Math 115 - Lesson 3: *Section 1.3 - New Functions From Old*

Notices

REMINDERS: Team HW due date and time (beginning of class)
ANNOUNCE: Date for upcoming quiz over course material

Assignments

READ: Section 1.4
DO: WeBWorK 1.3
DUE:

Suggested Lesson Plan: [Time is shown as number of minutes after the hour or 1/2-hour]

[10 - 25] Give a short quiz on the Student Guide and/or the reading for today's class, if you have indicated you will do so. This need not be long or difficult, just enough to determine if they have actually read the guide and are doing the section reading before class. Announce the date and sections to be covered for an upcoming in-class quiz over the course material (an actual math quiz!).

[25 - 35] Discuss the quiz immediately after it is collected. Make certain that students understand the course grading policy (and that YOU do, too–ask if you are unsure), the fact that this course will require a minimum of 8 hours of outside of class work, etc.
Take a couple of minutes to make sure students are dong the web homework and meeting with their teams.
Clear up any lingering "course administrivia" questions.

Note: In this lesson, there are several good opportunities for students to work together at the blackboards. And colored chalk is extremely useful for this section.

[35 - 55] It's very important for students to recognize basic "manipulations" (transformations) of the functions in their library. They should be comfortable with the following facts and know how to use them:

- $f(x) + k$ and $f(x + k)$ represent vertical and horizontal shifts of $f(x)$, respectively. (They should know the direction and magnitude of the shifts as well.)
- $-f(x)$ and $f(-x)$ represent vertical and horizontal "flips".
- $kf(x)$ and $f(kx)$ represent vertical and horizontal scalings, either "stretches" or "shrinks" (aka "compressions") depending on the magnitude of k.

You can use the Rule of Four to demonstrate these.

- Starting with a table of values for some function $f(x)$, have students make new tables of $f(x + 1)$, $f(x) + 1$, $-f(x)$, $f(-x)$, $2f(x)$, etc.
- Compare the resulting graphs, and discuss.
- Then give a formula for f and derive formulas for the related functions. (This also gives a good review of function notation.)

A function like $f(x) = x^2 - 4x + 7$ can be a good example to use as described above, as it is a parabola with vertex $(2, 3)$ and thus undergoes obvious changes when flipped or shifted. Have students identify (by eye!) where the functions being studied are concave up or down.
Alternatively, some of **§1.3 #4-7 (page 26)** are good problems to have students do in groups (at the blackboards). You could ask for tables of values in addition to graphs and include other transformations.

Before moving on, if they have not already naturally come out of the discussion, be sure to recall the notions of even and odd functions (graphically, numerically, and algebraically).

[55 - 70] Many students have a purely algebraic understanding of inverse functions: they may remember how to do something along the lines of "solve an equation for x then swap x and y", but they don't know why they are

Implementation Thoughts

- Active learning in any classroom
  - Gavin's lecture to active learning model: say half as much
  - Lecture examples can frequently turn into active learning activities
  - Inquiry Based Learning
- Class size and active learning
  - Not every active learning class is 18 students large
    - Michigan Math: 32 student sections
    - Calculus III, Differential Equations: 80–120 student lectures
- Resources
  - Other schools' materials
  - Your materials
  - AIBL, etc.

Outline, updated

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Course Structure & Assessment

- Gateway/Mastery testing
  - Primarily skills tests
  - Repeatable, infinite practice
  - Now in Data Functions and Graphs, Calculus I–III, Linear Algebra
    - and Differential Equations

- Move to (more) mastery assessment (course before calculus)

Current	New (tentative)
Exam 1 (25%)	Exam 1
Exam 2 (30%)	Exam 2
Final (40%)	Mastery Assessments (9)
WebHW (5%)	Final Mastery
	WebHW
	Section Work

Course Redesign Timeline

- Summer 2019
  - Course design work: goals, timeline
  - Draft learning objectives
  - Preliminary course structure work
- Fall 2019
  - Course material development
  - Finalize course structure for pilot
  - Facilities update to create new testing lab
- Winter 2020—pilot
- Summer 2020
  - Update materials, revise course structure
    - Start work on Calculus I
- Fall 2020—first implementation

Building Instructor Awareness

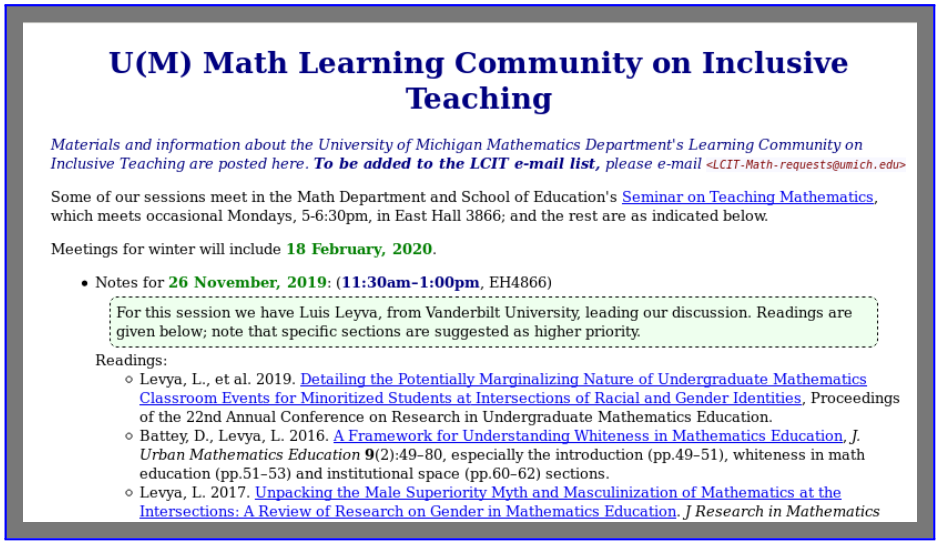
". . . inclusive teaching is a guiding intent, not one pedagogy or curriculum. . . "

Building a community of instructors

- Instructor Training
- In-semester workshops (math 105)
- Math LCIT—Learning Community on Inclusive Teaching
  - Winter 2018–
  - 4–6 meetings/winter term, 2/fall term
  - Summer 2019: 8 meetings of an LCIT book group
    - Boaller, *Mathematical Mindsets*
    - Hottinger, *Inventing the Mathematician*
  - 6+ graduate students, 8+ post-docs, 10+ continuing faculty, 16+ visitors/School of Education/others

Math Learning Community on Inclusive Teaching

- Funding (US$2000) from CRLT/UM Provost, to “create faculty communities looking at inclusive teaching.”
- Premise: *prerequisite to meaningful Department change are exploration and background; and building a core of instructors with knowledge and appropriate skills*
- Most meetings are discussions over a provided lunch:
  - For each: readings, with discussion leaders.
  - Synopsis, questions, discussion.
  - *Partial model: IBL lunches in Department.*
  - 1 external speaker/winter term



U(M) Math Learning Community on Inclusive Teaching

Materials and information about the University of Michigan Mathematics Department's Learning Community on Inclusive Teaching are posted here. ***To be added to the LCIT e-mail list,*** *please e-mail* <LCIT-Math-requests@umich.edu>

Some of our sessions meet in the Math Department and School of Education's Seminar on Teaching Mathematics, which meets occasional Mondays, 5-6:30pm, in East Hall 3866; and the rest are as indicated below.

Meetings for winter will include **18 February, 2020**.

- Notes for **26 November, 2019**: (**11:30am–1:00pm**, EH4866)

  For this session we have Luis Leyva, from Vanderbilt University, leading our discussion. Readings are given below; note that specific sections are suggested as higher priority.

  Readings:
  - Levya, L., et al. 2019. Detailing the Potentially Marginalizing Nature of Undergraduate Mathematics Classroom Events for Minoritized Students at Intersections of Racial and Gender Identities, Proceedings of the 22nd Annual Conference on Research in Undergraduate Mathematics Education.
  - Battey, D., Levya, L. 2016. A Framework for Understanding Whiteness in Mathematics Education, *J. Urban Mathematics Education* **9**(2):49–80, especially the introduction (pp.49–51), whiteness in math education (pp.51–53) and institutional space (pp.60–62) sections.
  - Levya, L. 2017. Unpacking the Male Superiority Myth and Masculinization of Mathematics at the Intersections: A Review of Research on Gender in Mathematics Education. *J Research in Mathematics*

Systems, Connections, and Synergy

- "Reform," active learning pedagogy
  - (in part) Motivates new instructor training
  - (in part) Supports Department's IBL work
- New instructor training
  - Addresses active learning, inclusive teaching
  - Systemic improvement of course instruction
- Development of core of instructors with knowledge and skills
  - (in part) lead to evaluation of course assessment
  - (in part) prompted reimagining of assessment in introductory courses.
- Systemic improvement of course assessment
  - Mastery assessment

Implementation Thoughts

- Inclusive teaching entry points
  - Active learning
    - Can promote inclusivity
    - Can be low-floor/high-ceiling
    - Needs to be supported, assessed, and updated
  - Assessment
    - Admits some "easy" implementation (*e.g.,* Gateway testing)
- Inclusive teaching capacity building
  - Community and knowledge building can be inexpensive
- Questions?

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