

Adapting Active Learning in Precalculus and Calculus Courses to Changing Conditions

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OLSUME

Adapting Your Vision to
Changing Circumstances

Martina Bode, University
of Illinois at Chicago

54%

of freshmen state that diversity was important in their decision to attend UIC.*

52%

of undergraduates are women.

38%

of students are first-generation college students.

36%

of freshmen report a first language other than English.*

60%

of undergraduates are Pell grant eligible.

70%

of undergraduates receive financial aid.**

80%

of students are commuters.

25%

of undergraduates are STEM majors.

40%

of students come from CPS high schools.

72%

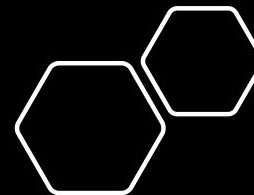
of freshman expect opportunities to interact with students from different backgrounds.*

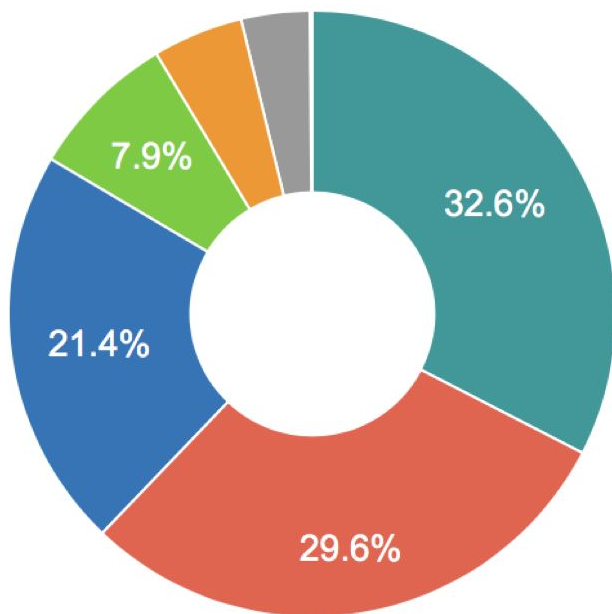
8.6%

of UIC students are non-traditional (aged 25 and up).

3%

are Out of State students.





- Hispanic/Latino
- White
- Asian
- Black or African American
- Non-Resident Alien
- Ethnicity Unknown
- Other

Demographics at UIC

About 20,000
undergrad students

Fall 2019

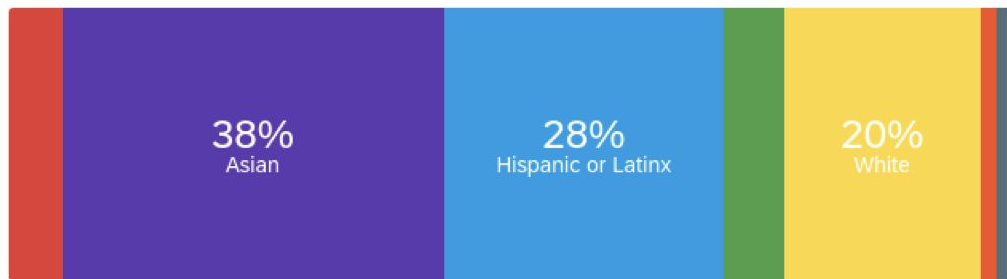


Fall 2019 Demographics

PreCalculus

Compare to
UIC:

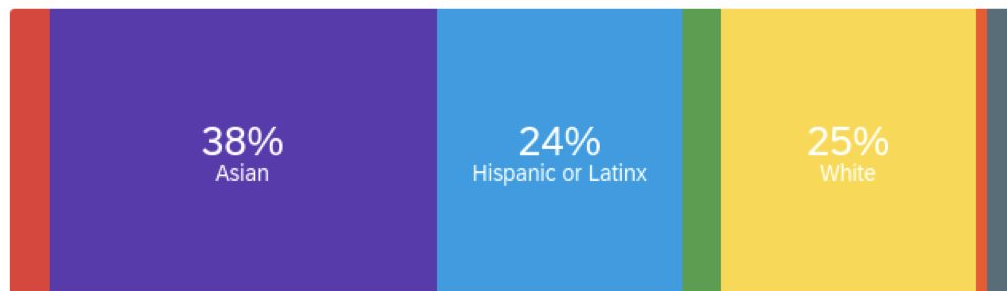
Fall 2019



Calculus I

Asian 21.4
Hispanic 32.6
White 29.6

Fall 2019



Calculus II

2014

Beginnings of Course Coordination & Active Learning

Low Pass Rates
in Precalculus
and Calculus
courses

Creation of two
new positions:

- Director of
Precalculus
- Director of
Calculus

Typical Format for Math Courses at UIC

Lecture component

- 120 students per class/600-1200 in a course
- 3 times per week (50 minutes each)

Discussion

- 20 students
- Taught by Teaching Assistants
- Two times per week (50 minutes each)
- Students work through worksheet problems in groups

Active Learning



**Students engage
with the material**



**Students work
collaboratively**



**Instructors and TAs
use student ideas**

- **Utilize what the space offers**
- **Build a communal environment**
- **Integrate Learning Assistants**

Learning Assistants (LA)

- Undergraduate students who assist in the classroom.
- Started with a pilot of 2 LAs in 2015



2.6 Continuity
3.1 Introducing the Derivative
3.2 Working with Derivatives

🎬 Watch the Panopto Video on Introduction to Continuous Functions

2.6 Continuity In words, a function f is continuous at a number a if the graph can be sketched without lifting a pencil at and near the point a .

Question 1 Sketch two graphs, one that is continuous everywhere, another that is not continuous at a point.



Definition: A function f is **continuous** at a number a if $\lim_{x \rightarrow a} f(x) = f(a)$.

Compare the definition with your two graphs above, does the continuous function satisfy $\lim_{x \rightarrow a} f(x) = f(a)$ for all a ? and what condition does your example of a non continuous function not satisfy?

A large, empty rectangular box with a thin black border, intended for the student to write their answer to the question above.

Most familiar functions are continuous on their domain. Every polynomial function is continuous, as are the sine, cosine, and exponential functions. The restriction for rational functions, tangent, secant, logarithms are that they are only continuous on their domain.

Course
Coordination &
Shared
Resources

Institutional Support



- Opening of a Math & Science Learning Center 2017-
- TLC (Teaching and Learning Communities) 2015-2017
- Center for the Advancement of Teaching Excellence (CATE) 2020-

Lecture Halls at UIC



Opening of Active Learning Classrooms in 2019



Spring 2019

A wide-angle photograph of a modern classroom. The room features white, curved desks arranged in a semi-circle, with blue chairs on wheels. Large windows on the left side provide ample natural light. The ceiling is white with recessed lighting and a curved, illuminated design. A large whiteboard is visible in the background.

New Classrooms Fall 2019

Results 2019 from new active learning classrooms

Precalculus: One instructor taught one section in the new active learning classroom, and another section in a traditional lecture hall.

Calculus I: All sections were taught in the new active learning classroom. Instructor used active learning in both rooms and had Learning Assistants in both rooms. All materials were the same for the course.

Calculus II: One instructor taught one section in the new active learning classroom, all other sections were taught in traditional lecture halls.

Precalculus
Spring 2019
Same
Instructor
Lecture Hall
versus New
Active Learning
Classroom

Precalculus	Lecture Hall	New Classroom
A	20 %	32 %
B	31 %	32 %
C	25 %	20 %
DFW	25 %	16 %

LatinX Students	Lecture Hall	New Classroom
A	19.1 %	28.6 %
B	23.5 %	33.9 %
C	29.4 %	25 %
DFW	27.9 %	12.5 %

Precalculus Historical View

LatinX Students	DFW	LatinX Students	DFW
(Lecture Hall)		(New Classroom Pilot with one section)	
Spring 2015	57.2 %		
Spring 2016	30.8 %	Spring 2019	12.5 %
Spring 2017	33.8 %		
Spring 2018	24.4 %		
Spring 2019	30.4 %		

Spring 2019

Calculus II: One
section of
Calculus II was
taught in the
new classroom

Calculus II	Lecture Hall	New Classroom
A	28 %	33 %
B	28 %	40 %
C	25 %	15 %
DFW	19 %	11 %

LatinX Students	Lecture Hall	New Classroom
DFW	24.4 %	15.2 %

Spring 2019

Calculus I: All
sections of
Calculus I were
taught in the
new classroom

Calculus I	Spring 2017	Spring 2018	Spring 2019
A	5.2 %	17.6 %	20.1 %
B	23.4 %	23.8 %	32.8 %
C	30.2 %	27.2 %	22.3 %
DFW	41.2 %	31.4 %	24.8 %

LatinX Students	Spring 2017	Spring 2018	Spring 2019
DFW	47.3 %	35.4 %	27.0%

Fall 2019

Calculus I: All
sections of
Calculus I were
taught in the
new classroom

Calculus I	Fall 2016	Fall 2017	Fall 2018	Fall 2019
DFW	26.4 %	21.6 %	20.4 %	17.7 %

Latinx	Fall 2016	Fall 2017	Fall 2018	Fall 2019
DFW	33.6 %	26.9 %	31.9 %	24.6 %

Everything was
starting to look
GREAT!

And then...

- Pass Rates
- Retention
- Performance
of LatinX
students



March 2020...



Martina Bode MWF 10am class - Shared screen with speaker view

Week 7 Content Meeting 1

Question 1. Find the family of antiderivatives for the following functions.

(a) $f(x) = x^2 + 10x + 5 \Rightarrow F(x) = \frac{x^3}{3} + 5x^2 + 5x$

(b) $g(x) = \frac{1}{x^4} + 3e^{2x}$

(c) $h(x) = 3 \cos x + \frac{5}{1+x^2}$

00:02:36 / 01:00:04

Speed

Chat Message

- yes
- yes
- $x^{3/3}$
- $x^{3/3}$
- $10x^{2/2}$
- $5x^2$
- $5x^2$

UIC Student Survey
A survey to all
enrolled UIC
students with 3,704
students (12.3%
response rate)
showed the
challenges students
face!

New Challenges

- **75% lack of personal motivation**
- **66% trying to balance school and family demands**
- **60% worry about not having a quiet place to study**
- **33% access to reliable internet/service**
- **12% access to reliable digital devices**
- **7% not having enough food**
- **3% not having a place to stay**



a community hard at work...

Building of a Community of Practice

- **Pre-pandemic monthly in person happy hours for lecturers**
- **Instructors from a variety of courses started to meet virtually weekly to exchange ideas**
- **New virtual formats were piloted in the summer**
- **Conversion of in person to virtual materials**
- **Creation of self guided content sheets and videos for initial asynchronous teaching**



The changing roles of Learning Assistants (LAs)

Pre-covid LAs helped during MWF lectures

During covid, they helped the TAs to facilitate TuTh discussion & ran online exam reviews

Transitioning back to in-person, all discussions have a TA and LA; and some LAs are helping in the lecture classes and run online exam reviews

Growth of the Learning Assistant program

Fall 2015

- 2 LAs in one section

Fall 2016

- 7 LAs in 2 courses

Fall 2017

- 26 LAs in 4 courses

Fall 2018

- 38 LAs in 4 courses

Fall 2019

- 48 LAs in 4 courses

Fall 2020

- 37 LAs in 6 courses

Fall 2021

- 57 LAs in 7 courses

Adjusted Format for Math Courses at UIC Fall 2020

Asynchronous guided materials

- 120 students per lecture/600-1200 in a course
- Taught by lecturers
- Optional meeting in online rooms to work through sample problems. Two to three times per week (50 minutes each)

Synchronous Discussion

- 20 students
- Taught by Teaching Assistants with the help of a Learning Assistant.
- Two times per week (50 minutes each)
- **Student presentations once a week**

Assessments

Before Covid

Homework (30%)

- Online and written

High Stake Exams (70%)

- 2 midterms
- final

During Covid

Homework (20%)

- Online
- Asynchronous Content (videos and worksheets)

Discussions (16%)

- Live presentations

Low Stake Exams (64%)

- 4-7 modules & final

How did we do?

PASS RATES FOR
VIRTUAL CLASSES
WITH ONLINE
ASSESSMENTS



INCREASING
NUMBERS OF
REPORTS OF
ACADEMIC
DISHONESTY CASES



GENERAL
EXHAUSTION...



Small print: Ds were converted to passing grades Spring & Fall 2020...

Fall 2021

Transitioning back to in person

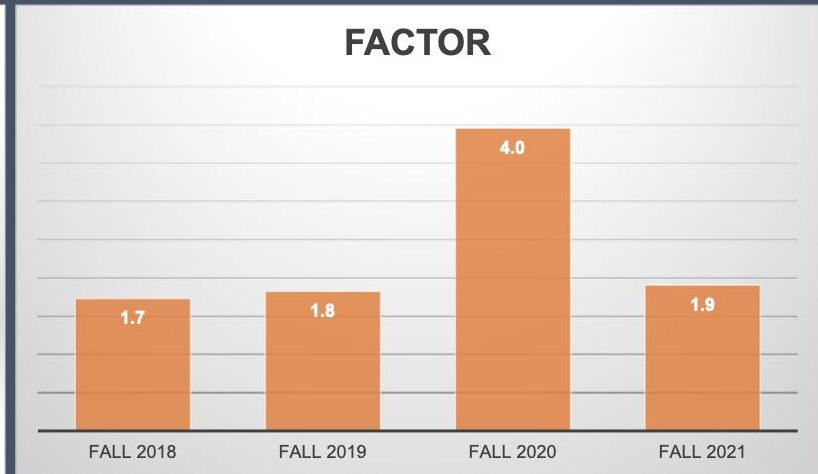
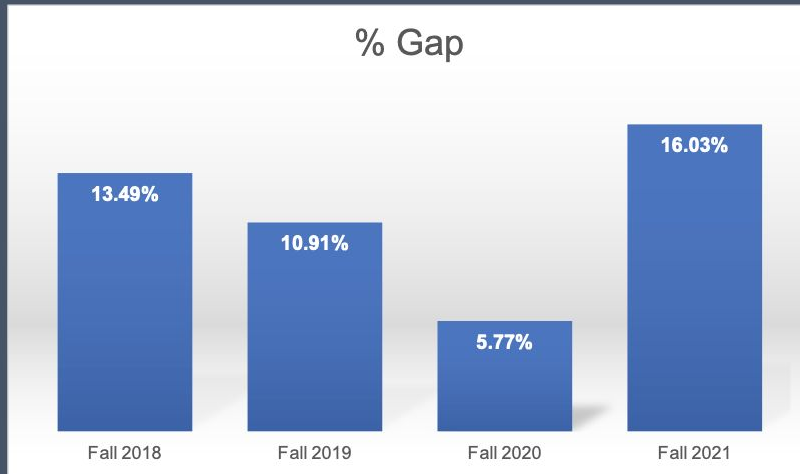
Lectures online

Discussions in person

Testing in person

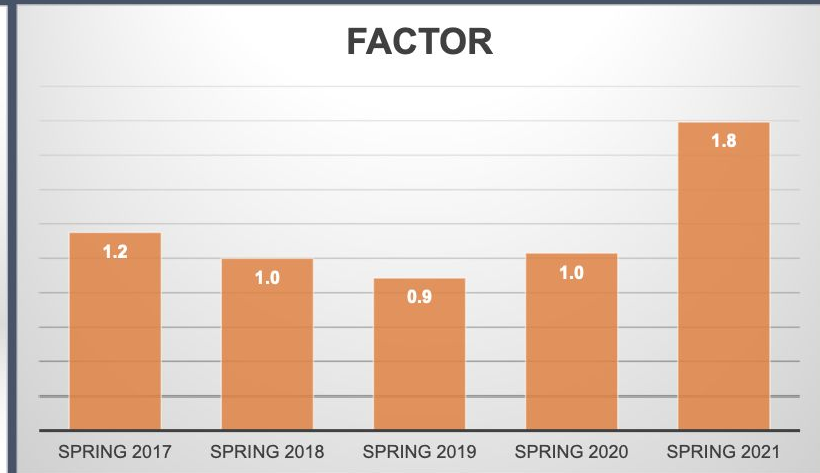
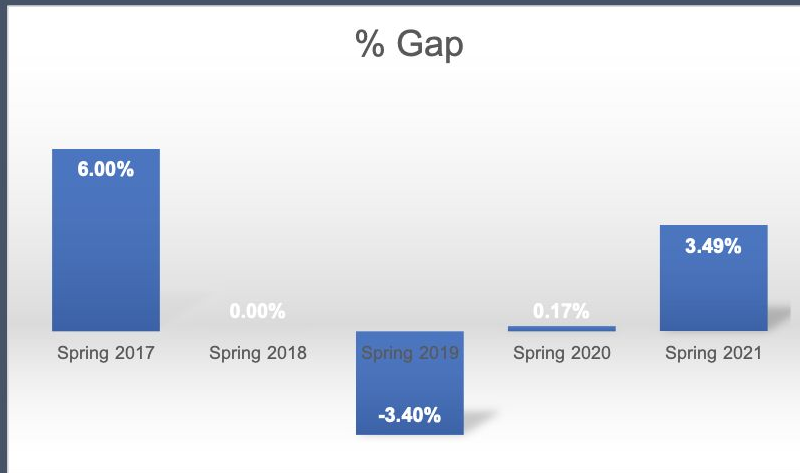
- Pass Rates down for all students
- DFW rates for latinX students almost twice as high as for white students

Performance gap (DFW Fall semesters) -latinX versus white students



* Ds were converted to passing grades Spring & Fall 2020...

Performance gap (DFW Spring semesters) latinX versus white students



* Ds were converted to passing grades Spring & Fall 2020...

Student Surveys

Semester	Participants
Fall 2019	1842
Spring 2020	500
Fall 2020	628
Spring 2021	924
Fall 2021	1080

IRB exemption UIC
Protocol Number 2019-1291

Active Learning – Student Perception

In this class, I am more actively involved than in traditional lecture classes.

Calculus I

- 2 strongly agree...
- 1 agree
- 0 neither agree nor disagree
- 1 disagree
- 2 strongly disagree



* This question was not asked Spring 2020

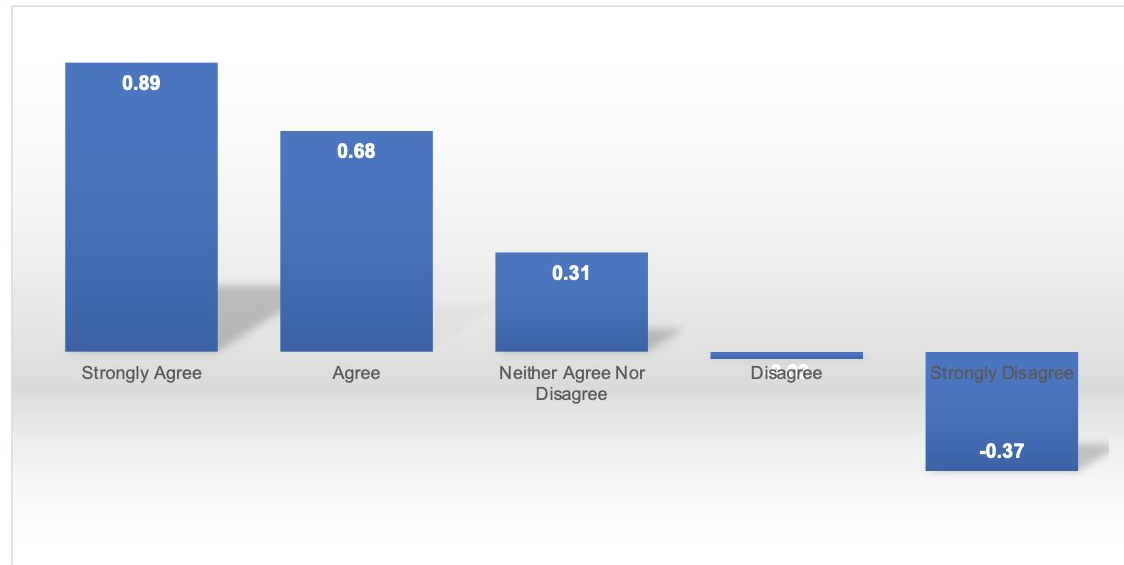
Active Learning – Student Confidence Gains by active learning

My confidence in my math skills since this math class has:

Calculus I

2 strongly increased...
1 increased
0 neither increased
nor decreased
-1 decreased
-2 strongly decreased

Fall 2019, 2020, and 2021
data combined



I am more actively involved than in traditional lecture classes.

Student Confidence Gains by expected final grade. My confidence in my math skills since this math class has:

Calculus I

2 strongly increased...
1 increased
0 neither increased
nor decreased
-1 decreased
-2 strongly decreased

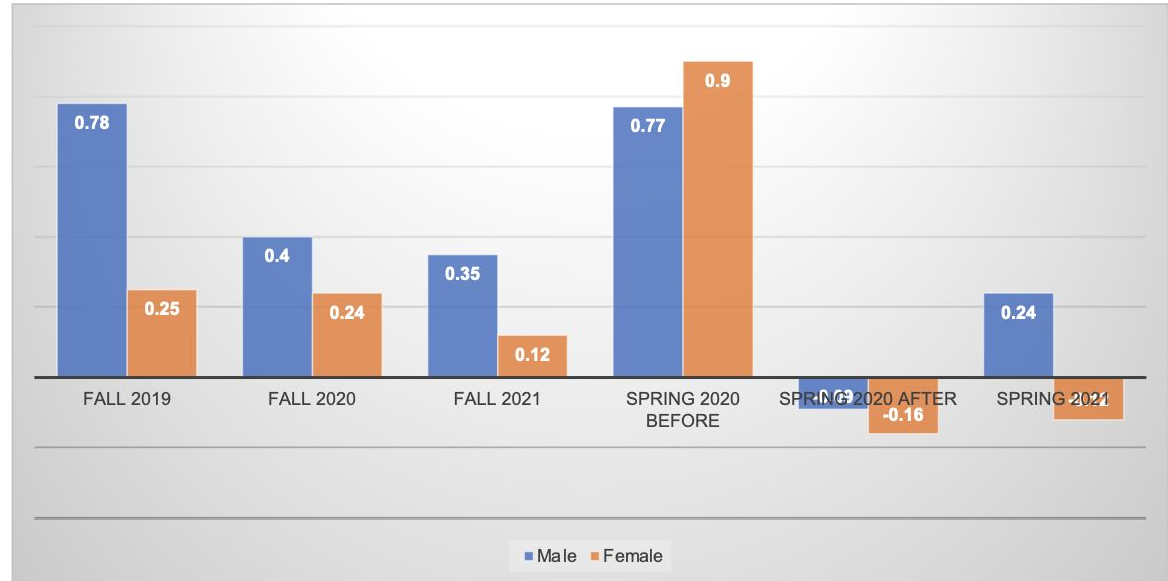


Expected final grade

Student Confidence Gains by gender. My confidence in my math skills since this math class has:

Calculus I

2 strongly increased...
1 increased
0 neither increased
nor decreased
-1 decreased
-2 strongly decreased



Spring 2020

Change in confidence gains in Calculus I

Wording of the questions

Before question:

My confidence in my math skills

BEFORE the change to distance learning was

After question:

My confidence in my math skills

AFTER the change to distance learning was

2 strongly increasing...

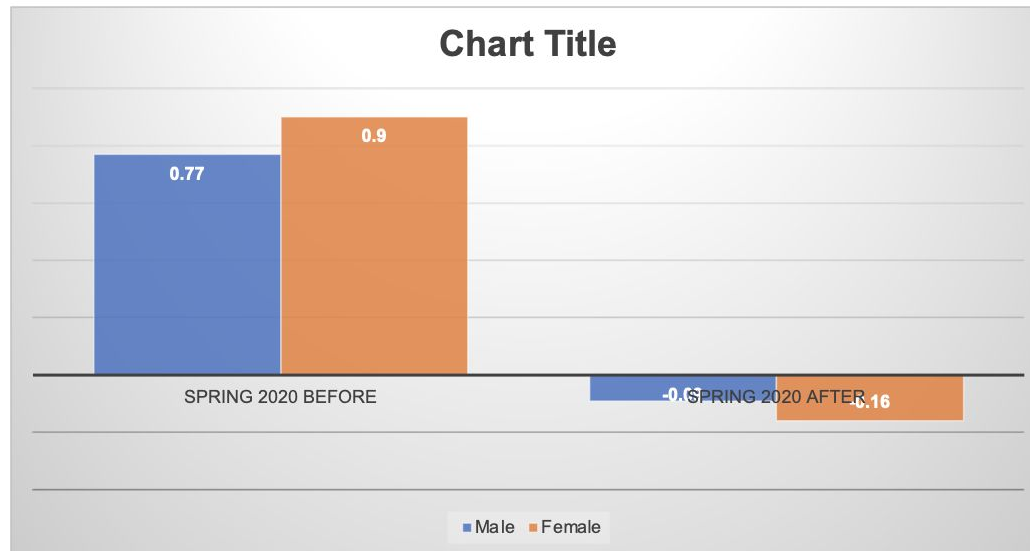
1 increasing

0 neither increasing

nor decreasing

-1 decreasing

-2 strongly decreasing



New Initiatives



Inclusive Syllabus Project



Diversity and Inclusion workshops for
Faculty & Graduate students in Math



<https://padlet.com/bodem/9n8jy7wzbbknzo3g>

What does active learning look like at your school?

What was the impact of the pandemic on student success at your school?

What are some positive outcomes?

What adjustments did you make?

What does your LA program look like?

And where do we go from here?



Thank You! Martina Bode, bodem@uic.edu

- Special thanks to:
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