

Technology Use in Undergraduate Mathematics Classrooms

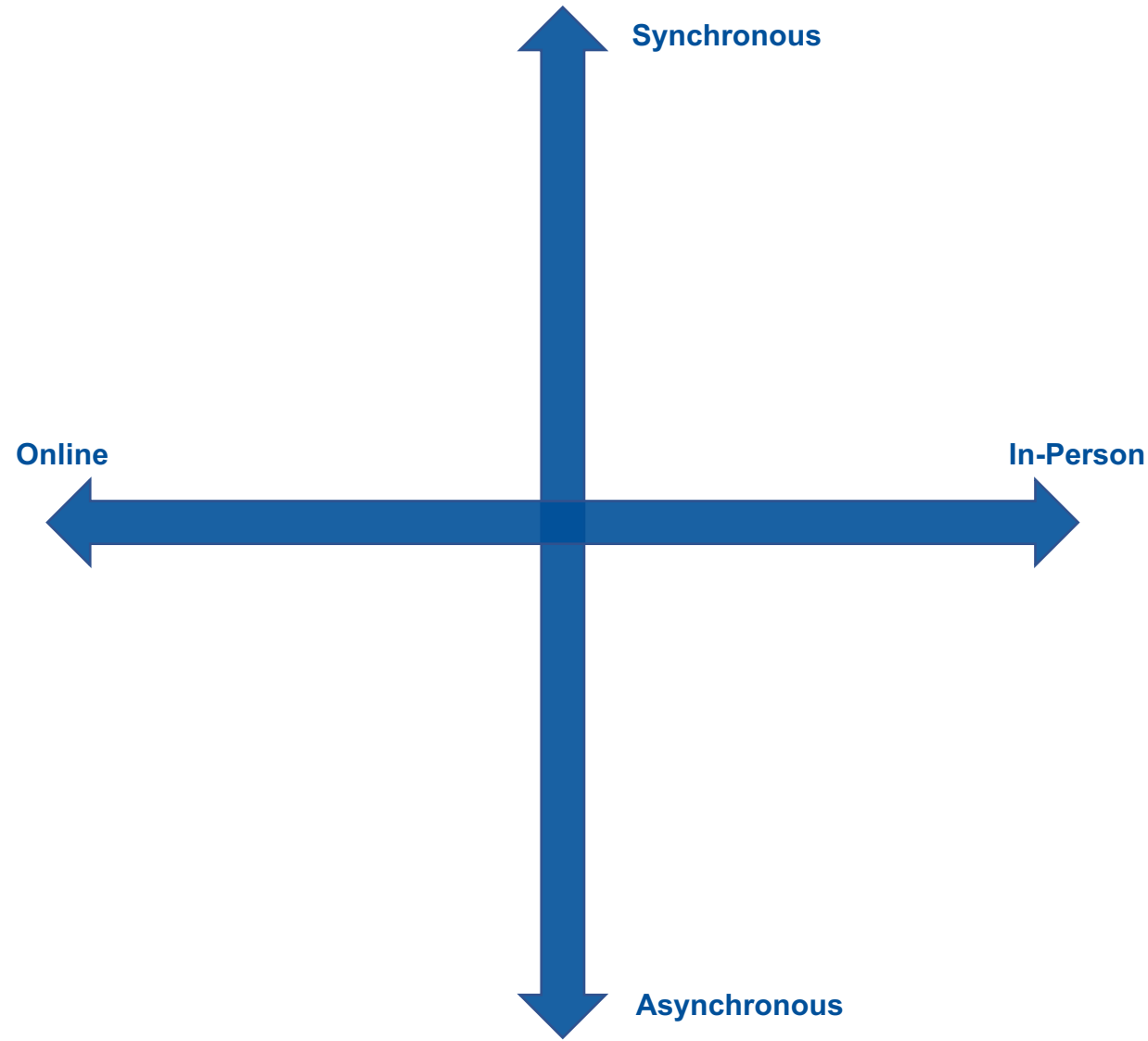
Dr. Darryl Chamberlain Jr., Embry-Riddle Aeronautical University – Worldwide
Dr. James Quinlan, University of Southern Maine
& the MAA Subcommittee on Technology in Mathematics Education

INTRODUCTION

What does technology use in undergraduate mathematics classrooms look like post-COVID?



Course Delivery Approaches



How would you classify:

- Traditional “Sage on a Stage”
- Flipped Classroom
- Discovery Learning
- Emporium Model
- Hybrid Model
- HyFlex Model
- Distance Learning

What role does technology play in these delivery methods?

Types of Educational Technology – General Presentation

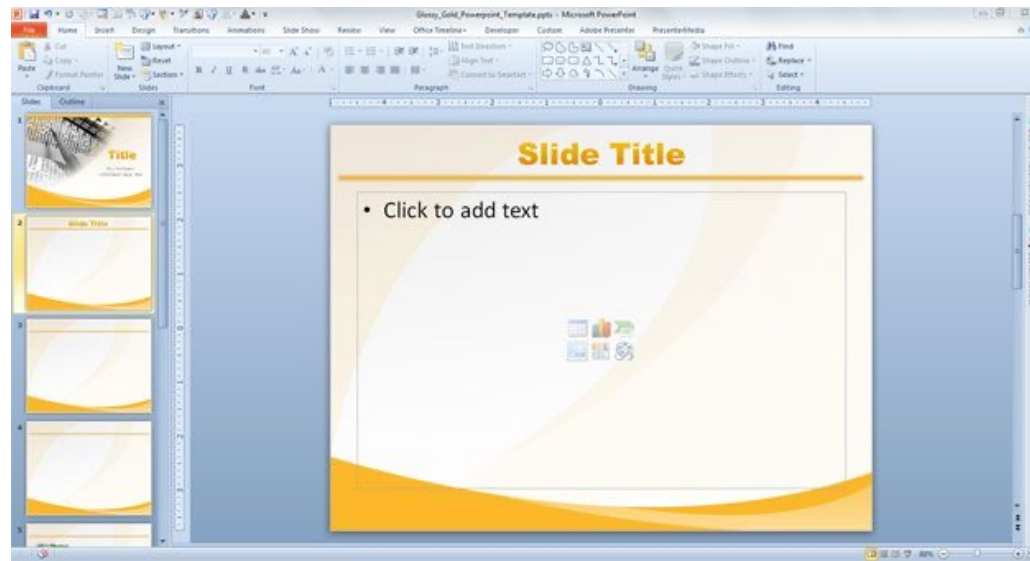
Projectors



Computer



Powerpoint/Slides

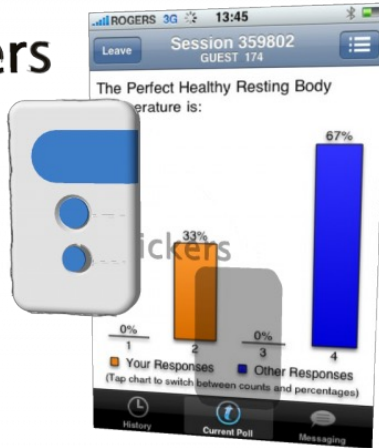


Tablets

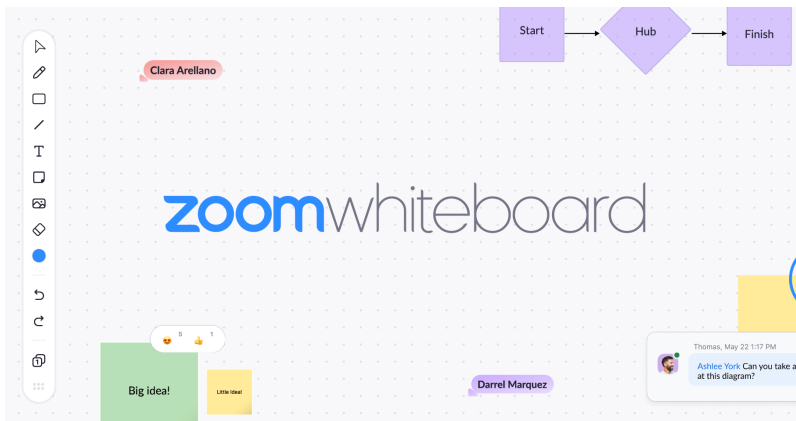


Types of Educational Technology – Interaction

Clickers



Conferencing Programs



Websites (Padlet)

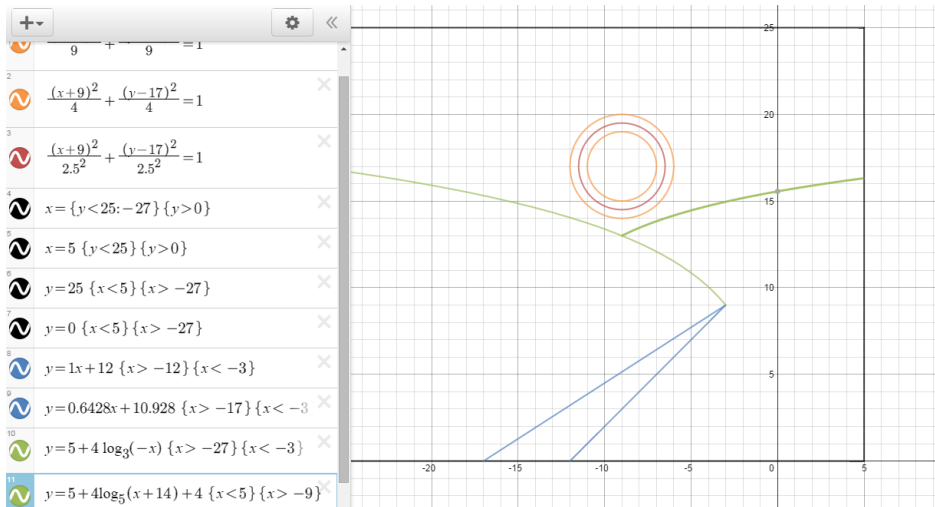
darrylchamberlain + 8 • 4mo

Providing Feedback for Students in Science and Mathematics

Types of Feedback	How do students use feedback?	Value of Feedback to Students	How can you provide feedback in Canvas?	What else do you want to know?
<p>Timely feedback.</p> <p>0 comments</p> <p>Add comment</p>	<p>To achieve the learning outcomes.</p> <p>1 comment</p> <p>Add comment</p>	<p>Find a different career</p> <p>0 comments</p> <p>Add comment</p>	<p>Announcements</p> <p>General comments for every one - after or foreshadowing</p> <p>1 comment</p> <p>Anonymous 4mo Videos recorded with Zoom, in the cloud, have auto-captioning</p> <p>Add comment</p>	<p>I see mixed reactions b students when they rec corrective feedback fro Most of the time, stude appreciative. Other time to stop the discussion o student's post.</p> <p>2 comments</p> <p>Add comment</p>
<p>Acknowledgement</p> <p>0 comments</p> <p>Anonymous 4mo Praise</p> <p>Add comment</p>	<p>Learning how to learn better in the future</p> <p>1 comment</p> <p>Add comment</p>	<p>Feedback can play a crucial role in boosting students' confidence and encouraging them to engage more with the material</p> <p>2 comments</p> <p>Anonymous 4mo Exactly! Then they are more willing to learn the next new thing.</p> <p>Add comment</p>	<p>I have trouble organizing my thoughts verbally. So if I write it out and then read it, I feel like I'm doing twice the work for the same outcome.</p> <p>1 comment</p> <p>Anonymous 4mo</p>	<p>Great point about g feedback--what co other ways to incor feedback in suppl videos or announce</p> <p>1 comment</p>
<p>Provide resources to correct their mistakes.</p> <p>1 comment</p> <p>Anonymous 4mo Elaborative Feedback</p>	<p>further understanding of material</p> <p>You sometimes can tell they had the "ah ha" moment</p> <p>2 comments</p>	<p>It is part of the learning</p>		

Types of Educational Technology – Graphing and Calculation

Online Graphing Calculator (Desmos)



Programming Languages

```

$ gcc area-circle.c -o area-circle.out
$ ./area-circle.out
Enter the radius of a circle
10
Area of the circle = 314.16
$
  
```

Answer Engines

WolframAlpha computational knowledge engine

Search: eigenvalues of $\{\{a,b,c\},\{b,d,e\},\{c,e,f\}\}$

Input: Eigenvalues of $\begin{bmatrix} a & b & c \\ b & d & e \\ c & e & f \end{bmatrix}$

Results:

$$\lambda_1 = \frac{1}{3\sqrt[3]{2}} \left((2a^3 - 3a^2d - 3a^2f + \sqrt{(4(-a^2 + ad + af - 3b^2 - 3c^2 - d^2 + df - 3e^2 - f^2)^3 + (2a^3 - 3a^2d - 3a^2f + 9ab^2 + 9ac^2 - 3ad^2 + 12adf - 18ae^2 - 3af^2 + 9b^2d - 18b^2f + 54bce - 18c^2d + 9c^2f + 2d^3 - 3d^2f + 9de^2 - 3df^2 + 9e^2f + 2f^3)^2) + 9ab^2 + 9ac^2 - 3ad^2 + 12adf - 18ae^2 - \right)$$

Types of Educational Technology – Learning Resources

Paid Learning Systems



Open-Source Textbooks (OpenStax)



Open Access Learning System

WebWork: MTH110_Master

https://webwork-math.gvsu.edu/webwork2/MTH110_Master/Exponential_Modeling_2/3/?effectiveUser=frobishm

Outlook BB Yahoo! Yahoo! Mail VitalSource WeBWorK Calendar Class Schedule Desmos Dept blog Amazon Math Center Stats Center Imported From IE Inksurvey Google

WeBWorK **MAA** MATHEMATICAL ASSOCIATION OF AMERICA

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This set is visible to students.

(1 pt) local/MTH110_probs/exp-table-3.pg

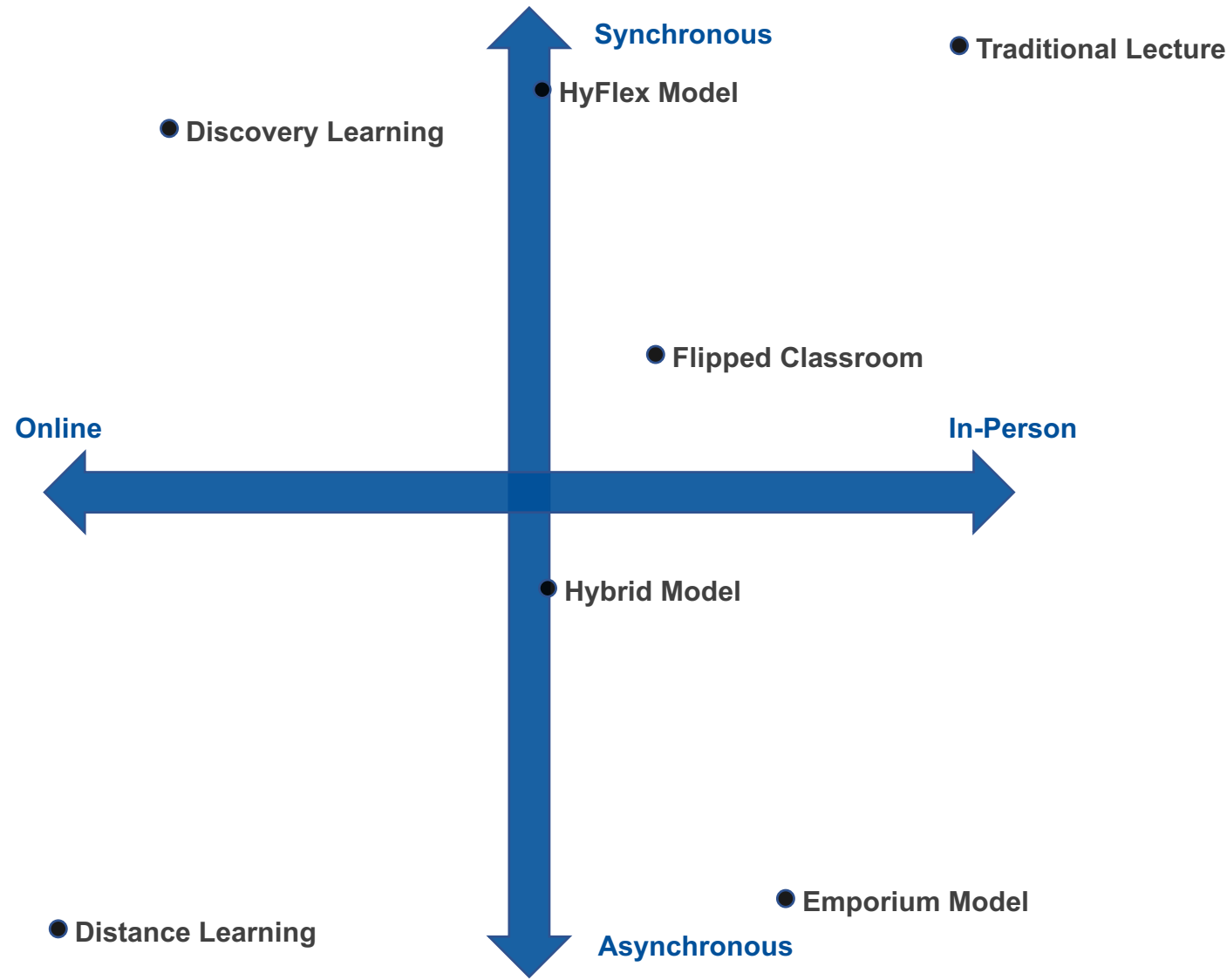
Find a function that best fits the values below:

$x =$	0	10	20	30	40
$f(x) =$	-4	-16	-64	-256	-1024

$f(x) =$

to 4 places

Research Questions



How is technology used in post-secondary classrooms?

- What role does technology play in sync/async classrooms?
- What role does technology play in online/in-person classrooms?
- How does technology use differ for instructors and students?
- What motivations do instructors hold for using technology?

Methodology

- Exploratory Survey through Qualtrics
- Sent to all MAA members through MAA connect
- Open coding of free responses, Statistical summary of multiple-choice responses

qualtrics^{XM}



MAA **CONNECT**

Where Math and Communities Intersect

Survey Questions

<u>Institutional</u>	<u>Sync Tech Use</u>	<u>Async Tech Use</u>	<u>Misc</u>
<u>Demographics</u> <ul style="list-style-type: none"> Type Size Avg Class Size 	<ul style="list-style-type: none"> <i>Instructor</i> tech use during <i>teaching</i> <i>Student</i> tech use during <i>teaching & assessments</i> 	<ul style="list-style-type: none"> <i>Instructor</i> tech use during <i>teaching</i> <i>Student</i> tech use during <i>teaching & assessments</i> 	<ul style="list-style-type: none"> Do you anticipate using more technology? Are there obstacles to using more technology?
<u>Instructor Demographics</u> <ul style="list-style-type: none"> Type Highest Degree Typical Courses Gender Identity Race 	<ul style="list-style-type: none"> Primary reason for <i>instructor</i> tech during <i>teaching</i> Primary reason for <i>student</i> tech during <i>teaching & assessments</i> 	<ul style="list-style-type: none"> Primary reason for <i>instructor</i> tech during <i>teaching</i> Primary reason for <i>student</i> tech during <i>teaching & assessments</i> 	

Statistic – Weighted Use Percentage

$$100 * \frac{\sum(n_i * w_i)}{\sum n_i}$$

$$100 * \frac{24 + 3.75 + 2.5 + 3.25 + 0}{24 + 5 + 5 + 13 + 2} \approx 68\%$$

How much?	Weight
Nearly every class	1
A lot	0.75
About every other class	0.5
A little	0.25
Never	0

How much?	Count	Weighted Count
Nearly every class	24	24
A lot	5	3.75
About every other class	5	2.5
A little	13	3.25
Never	2	0

Preliminary Results – Sync Tech Use

Instructor Tech during Teaching

- *Projector (68%)*
- *Other Presentation Software (42%)*
- *Other Calculator (36%)*
- *Open Access Learning System (34%)*
- *Powerpoint/Slides (32%)*

Other Presentation Software: DocCam, PDF notes, Webpage, Zoom

Other Calculator: Desmos, Excel, MATLAB

Student Tech during Teaching/Activities

- *Graphing Calculator (41%)*
- *Other Calculator (38%)*
- *iPad/Tablet (35%)*
- *Open Access Learning System (29%)*
- *Paid Learning System (23%)*

Other Calculator: Desmos, Excel, MATLAB

Student Tech during Quizzes/Exams

- *Graphing Calculator (38%)*
- *Other Calculator (32%)*
- *Other Learning Resource (12%)*
- *Programming Language (12%)*
- *iPad/Tablet (10%)*

Other Learning Resources: Instructor notes, Student notes

Preliminary Results – Async Tech Use

Instructor Tech during

Teaching

- *Open Access Learning System (38%)*
- *iPad/Tablet (29%)*
- *Other Calculator (28%)*
- *Other Learning Resource (24%)*
- *Other Presentation Software (22%)*

Other Learning Resource:
Personal notes, YouTube, Websites

Student Tech during

Teaching/Activities

- *Other Calculator (46%)*
- *Graphing Calculator (44%)*
- *Open Access Learning System (43%)*
- *Other Learning Resource (33%)*
- *iPad/Tablet (31%)*

Other Learning Resources:
Instructor videos, YouTube, Khan Academy

Student Tech during

Quizzes/Exams

- *Other Calculator (41%)*
- *Graphing Calculator (31%)*
- *Open Access Learning System (24%)*
- *Other Learning Resource (17%)*
- *Programming Language (12%)*

Other Learning Resources:
Instructor notes, Student notes

Preliminary Results – Reason for Technology



Sync Instructors

- 21 – Visualization
- 12 – Presentation
- 12 – Save Time
- 12 – Interactive
- 10 – Demonstration



Async Instructors

- 9 – Presentation
- 5 – Reinforcement
- 4 – Save Time
- 4 – Homework
- 4 – Visualization

Conclusion and Next Steps



Primary role of technology to shift from chalkboard writing to digital presentation, especially for visualizations and quick calculations/verifications.

Interactive reason for using technology did not match actual technology use in synchronous and asynchronous classrooms.

Consider ways to incorporate technology to improve student interactions.

THANK YOU



Darryl Chamberlain Jr., Ph.D.

Assistant Professor of Mathematics and Statistics

**Associate Chair, Department of Mathematics,
Science, & Technology**

Embry-Riddle Aeronautical University

Darryl.Chamberlain@erau.edu



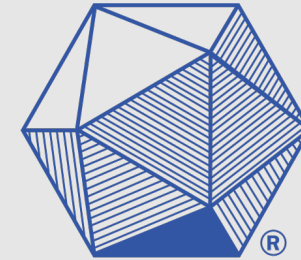
James Quinlan, Ph.D.

Assistant Professor of Computer Science

Department of Computer Science

University of Southern Maine

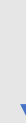
James.quinlan@maine.edu



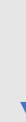
MAA

MATHEMATICAL ASSOCIATION OF AMERICA

**MAA Council on Teaching and
Learning (CTL)**



**Committee on the Teaching of
Undergraduate Mathematics (CTUM)**



**Subcommittee on Technology in
Mathematics Education (STME)**