Integrating the MAA *IP Guide* into Professional Development

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Denver, Colorado

PROMESAS SSC PD

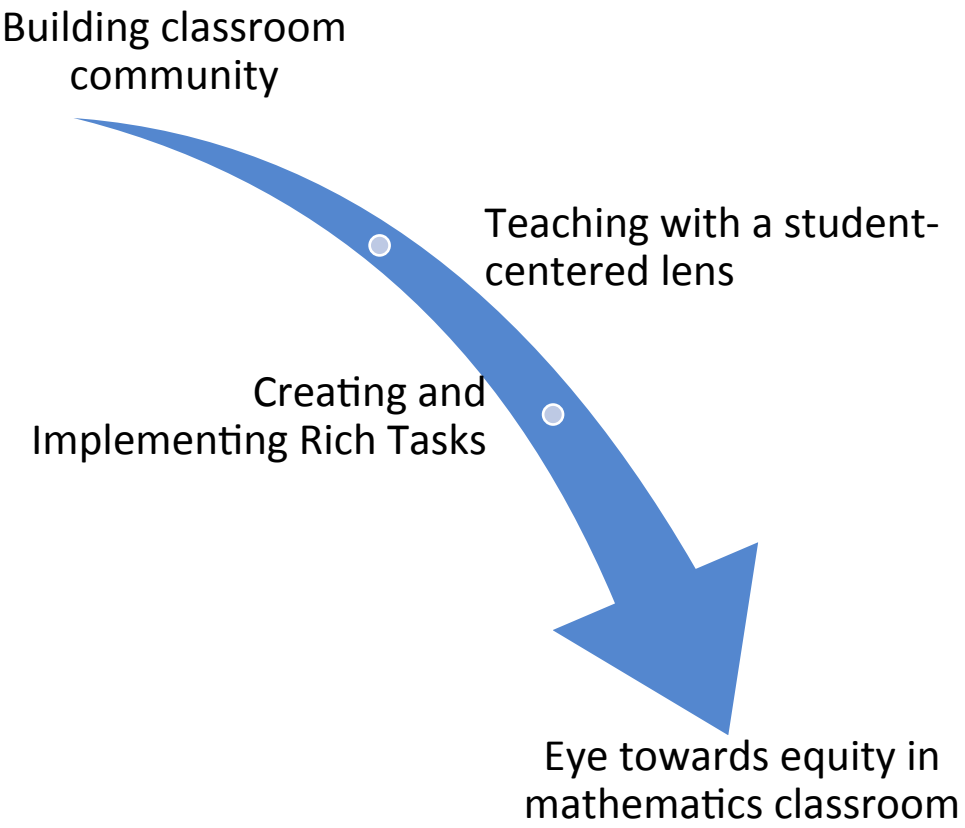
- *The STEM Service Courses Initiative of Project Pathways with Regional Outreach and Mathematics Excellence for Student Achievement in STEM*
  - 5-year project funded by US Department of Education, Title III, HSI STEM Grant #P031C160017
  - Collaboration between a 4-year institution & 3 community colleges
  - Address **systemic change** in teaching collegiate mathematics
  - Calculus I, Pre-Calculus, & Calculus II

- Emphasizes
  - cultural competency,
  - inclusive pedagogy, and
  - renewal of curriculum

Lead Mathematics Educator & Researcher

Simultaneously

- creating PD materials and
- working on *IP Guide*



PD Process

- Train Leads
  - Experience working on a rich task collaboratively
  - Discussed themes
  - Shared Readings
  - Collaboratively created materials for & facilitate PD
  - Informed them of PD

- PD Description
  - 1-week summer institute
  - Monthly follow-up meetings in Sept-Nov & Feb-April
  - 2-day May Meeting

Prior Readings

- Herzig (2005) who discussed the notion of creating a classroom that **promotes mathematics for everyone**,
- Smith and Stein (1998) who discussed the value of high-level cognitive tasks i.e., **rich tasks**,
- Aronson, Fried and Good (2002) who addressed the notion of **stereotype threat**,
- McMillan and Chavis (1986), who provided a working definition of **sense of community**,
- Laursen et al. (2014) who articulated the **benefits** of emphasizing **student-centered learning activities** and how such facilitation of the mathematics classroom promotes equity, and
- White and Mesa (in press) who **assessed** the level of cognitive demand (the richness) of **questions that community college Calculus I instructors** integrate into their courses.

Fall Semester: 2017

Focus on Assessment Chapter

ANDERSON'S TWO-DIMENSIONAL EXTENSION OF BLOOM'S TAXONOMY

- Lead & I
  - Discussed the taxonomy
  - Shared his prior exam on limits
  - Shared the evaluation of his his exam based on the taxonomy
  - Shared the evaluation of his latest exam
- Fellows
  - Evaluated their own exams

		Cognitive Process Dimension					
		Remember	Understand	Apply	Analyze	Evaluate	Create
Knowledge Dimension	Factual						
	Conceptual						
	Procedural						
	Metacognitive						

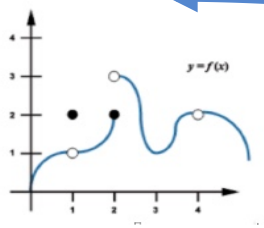
What ….

1) The position of an object is given by $s(t)=t^3-3$. What is the average velocity over the interval [0,3]?

2) The position of an object is given by $s(t)=2\cos t$. What is the average velocity over the interval $[0,\pi]$?

Find ….

Use the graph of $f(x)$ to find each limit.



3) $\lim_{x\to 1} f(x)$

4) $\lim_{x\to 2} f(x)$

5) $\lim_{x\to 4} f(x)$

6) $\lim_{x\to 2^+} f(x)$

7) $\lim_{x\to 2^-} f(x)$

Compute …

Let $g(x)=\begin{cases} 4x-10 & \text{if } x<5 \\ \dfrac{x^2-5}{x-5} & \text{if } x>5 \end{cases}$. Compute the following limits.

8) $\lim_{x\to 5^-} g(x)$

9) $\lim_{x\to 5^+} g(x)$

10) $\lim_{x\to 5} g(x)$

Let $h(x)=\begin{cases} x^2-3x-6 & \text{if } x<-2 \\ \dfrac{4-x^2}{x+2} & \text{if } x>-2 \end{cases}$. Compute the following limits.

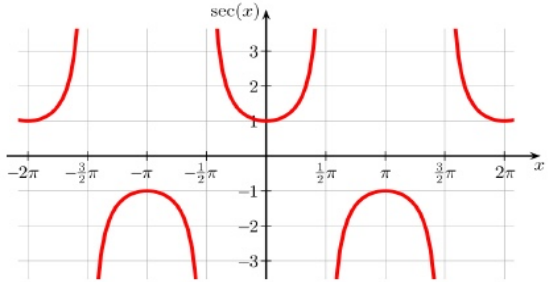
11) $\lim_{x\to -2^-} h(x)$

12) $\lim_{x\to -2^+} h(x)$

13) $\lim_{x\to -2} h(x)$

Find …

Use the graph of $f(x)=\sec x$, to find each limit.



14) $\lim_{x\to \frac{3}{2}\pi^-} \sec x$

15) $\lim_{x\to -\frac{1}{2}\pi} \sec x$

16) $\lim_{x\to 1}(3x^2+6x+1)$

17) $\lim_{x\to -3}\frac{4x}{x+9}$

18) $\lim_{x\to -5}\frac{x^2-25}{x+5}$

19) $\lim_{x\to 1}\frac{(x^2-3x+2)}{x-1}$

20) $\lim_{x\to 100}\frac{\sqrt{x}-10}{x-100}$

21) $\lim_{x\to 7^-}\frac{4}{x-7}$

22) $\lim_{x\to 5^-}\frac{x-6}{x-5}$

23) $\lim_{x\to 1}\frac{7}{x-1}$

24) $\lim_{x\to 3^+}\frac{-4}{x-3}$

25) $\lim_{x\to\infty}\left(-8+\frac{4}{x^2}\right)$

26) $\lim_{x\to\infty}\frac{4+3x+5x^3}{x^3}$

27) $\lim_{x\to -\infty}8x^5$

28) $\lim_{t\to -\infty}\frac{\sin t}{t^2}$

Find …

29) Find all vertical asymptotes of the function $f(x)=\frac{x}{x^2-1}$.

30) Find all vertical asymptotes of the function $f(x)=\frac{(x+3)(x-2)}{(x+2)(x+3)}$.

Give …

31) If one exists, find the horizontal asymptote of the function $f(x)=\frac{6x}{12x^2+1}$.

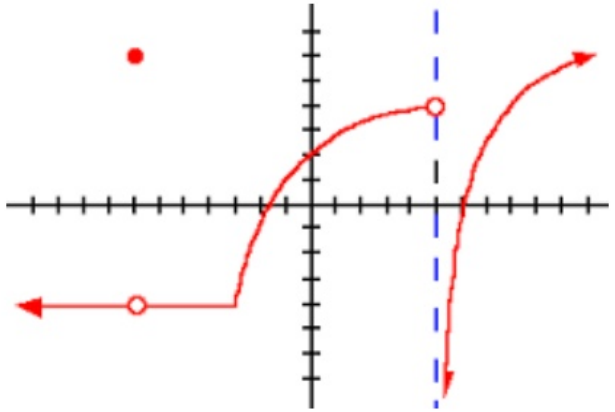
32) Give the 3 conditions that must be satisfied for $f(x)$ to be continuous at x=a.

Determine…

33) Determine the interval(s) on which the function $f(x)=e^{\sqrt{x-1}}$ is continuous.

Fellows' Reactions

Use the graph for #1-3



1) $\lim_{x\to 5^-} f(x) =$ _____

2) $\lim_{x\to -7} f(x) =$ _____

3) $\lim_{x\to \infty} f(x) =$ _____

Find …

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4) Let $h(x) = \begin{cases} x^2 & \text{if } x < -2 \\ \dfrac{x^2-4}{x+2} & \text{if } x \geq -2 \end{cases}$. $\lim_{x\to -2} h(x) =$ _____

5) $\lim_{x\to 5^-} \dfrac{x-6}{x-5} =$ _____

6) $\lim_{x\to 1} \dfrac{7}{(x-1)^2} =$ _____

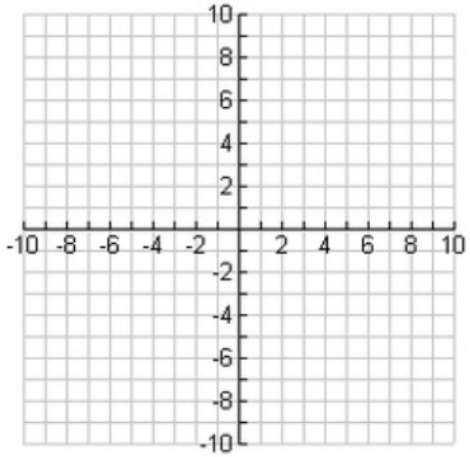
7) $\lim_{x\to \infty} \left(-8 + \dfrac{4}{x^2}\right) =$ _____

CREATE ….

8) Create an equation of a function $f(x)$ that has vertical asymptote at $x = 8$, and a horizontal asymptote at $y = 3$. $f(x) =$ _____

9) Sketch a graph of <u>one function</u>, $f(x)$ which satisfies <u>all</u> 4 of these conditions:

- Condition #1: $\lim_{x\to-\infty} f(x) = 0$
- Condition #2: $\lim_{x\to 0} f(x) = 5$
- Condition #3: $\lim_{x\to\infty} f(x) = -\infty$
- Condition #4: $f(x)$ not continuous at $x = 0$



Sketch …

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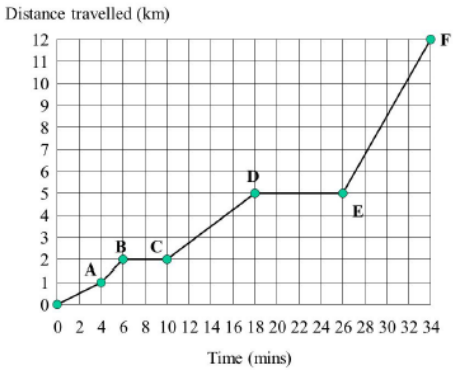
10) Use the graph below to complete the statement with a number, fraction, or decimal (any format).

Use correct units in your answer. The <u>average</u> velocity of the car trip between B and F is _____.



Complete statement …

(Extra Credit / Optional) *Larry's Terrific Laser Tag Arena* charges customers $10 to play for up to 2 hours in the Arena, and $5 for each additional hour. The maximum charge per customer is $20. On another sheet of paper, create a complete graph representing the cost of playing laser tag.

(Hint: Let the x-axis = time in hours, and the y-axis = price in dollars.)

Create …

Fellows' Reactions

		Cognitive Process Dimension					
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Knowledge Dimension	Factual						
	Conceptual						
	Procedural						
	Metacognitive						

Spring 2018

Created common exam questions for different Calculus I topic questions that fell into different cells

Exam writing became intentional

Spring Semester: 2018

All fellows receive a printed copy of the MAA *IP Guide*

MAA *IP Guide* Manifesto

*… we are compelled to **extend the reach of our efforts** beyond our own students in our own classrooms. It is **our responsibility to examine the system** within which we educate students …. It is **our responsibility to help our colleagues improve** and to find ways to improve that system. … so that our discipline realizes its full potential as a subject of beauty, of truth, and of **empowerment for all**.*

Such a sea change will require transforming how mathematics is taught and ***facing our own individual and collective roles*** *in a system that does not serve all students well. It is tempting to guard access to* ***mathematics as an exclusive club*** *– there is an underlying self-interest that makes appealing the default* ***belief that only special or gifted individuals can do mathematics****. We in the profession of teaching mathematics* ***must look inward*** *and determine if we hold that underlying belief. If this introspection reveals instructional practices affirming we subscribe to this belief, practices that exacerbate restricted access to mathematics,* ***we must discard those practices****. …*

Fellows' Reactions

Quotes from Fellows'

- **Student-Centered Learning:** *my new experience has given me a wonderful sense of freedom and sometimes an overwhelming sense of responsibility*
- **Rich Tasks:** *letting students answer questions not shown in lecture, at first seemed really hard, but students rose to the occasion. They not only surprised me, but I believe students surprised themselves*
- **Sense of Community:**
  - At first I thought it was a *bit overrated*, but it is the"*most valuable things . . . because* [the students] *really do work together more and they really do look out for each other more*
  - *I no longer feel like a ghost.*
- ***Equity:*** In *PROMESAS SSC, you're addressing . . . different student populations and how to engage them. And then day to day, bring[ing] that into your work and try[ing] to create a better experience for all students*

this IP Guide, it's like a recipe for me to be able to follow and be able to change my teaching


QUESTIONS
why
how
discover
questions
where?
?
asking questions
challenge
who?
clues
ask
who?
discover
what?
when?
Knowing
investigation
?
clues
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