Integrating the MAA *IP Guide* into Professional Development

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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 exam based on the taxonomy
  - Shared the evaluation of his latest exam

- Fellows
  - Evaluated their own exams

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<th>Knowledge Dimension</th>
<th>Cognitive Process Dimension</th>
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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 \([0, \pi]\)?

Use the graph of \( f(x) \) to find each limit:

3) \( \lim_{x \to a} f(x) \)

4) \( \lim_{x \to b} f(x) \)

5) \( \lim_{x \to c} f(x) \)

6) \( \lim_{x \to d} f(x) \)

7) \( \lim_{x \to e} f(x) \)

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

8) \( \lim_{x \to a} g(x) \)

9) \( \lim_{x \to b} g(x) \)

10) \( \lim_{x \to c} g(x) \)

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

11) \( \lim_{x \to a} h(x) \)

12) \( \lim_{x \to b} h(x) \)

13) \( \lim_{x \to c} h(x) \)

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

14) \( \lim_{x \to a} \sec x \)

15) \( \lim_{x \to b} \sec x \)

16) \( \lim_{x \to c} (3x^2 + 6x + 1) \)
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) \[ \lim_{x \to -3} (-8 + \frac{4}{x^2}) \]
26) \[ \lim_{x \to 1} \frac{4 + 3x + 5x^3}{x^2} \]
27) \[ \lim_{x \to -1} 8x^4 \]
28) \[ \lim_{x \to 2} \frac{\sin x}{x^2} \]
29) Find all vertical asymptotes of the function \( f(x) = \frac{x}{x^2 - 1} \).
30) Find all vertical asymptotes of the function \( f(x) = \frac{(x + 3)(x - 2)}{(x + 2)(x + 3)} \).
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 \( x = a \).
33) Determine the interval(s) on which the function \( f(x) = e^{-x^2} \) is continuous.
Fellows’ Reactions
Use the graph for #1-3

1) \( \lim_{x \to 4} f(x) = \) 

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

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

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

5) \( \lim_{x \to 6} \frac{x-6}{x-5} = \) 

6) \( \lim_{x \to -\infty} \frac{7}{(x-1)^2} = \) 

7) \( \lim_{x \to 0} \frac{-8 + \frac{4}{x}}{x} = \) 

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 one function, \( f(x) \), which satisfies all 4 of these conditions:

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

10) Use the graph below to complete the statement with a number, fraction, or decimal (any format). Use correct units in your answer. The average velocity of the car trip between B and F is ________.

(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.)
Fellows’ Reactions
### 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

ask who?

what?

when? knowing

investigation

how

ask

clues

questioning

challenge who?

where?

why?

discover questions