



Spring 2019 - First Time Teaching Calculus 1 (As a

Values and beliefs as an instructor were not explicitly written

"Calculus is the foundation for most of the mathematics used by

scientists and engineers, so it is important for students to

graduate student)

understand."

or even carefully considered.

Best guess based on memory is:

B. Student Learning Outcomes

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Spring 2019 - First Time Teaching Calculus 1 (As a graduate student)

- Student learning outcomes (phrased as "course objectives" in the syllabus) were, in abbreviated form:
- Gain content knowledge, Bloom's Cognitive Domain Level 1: Remember.
- Apply this knowledge to other situations and disciplines. Bloom's Cognitive Domain Level 3: Apply.
- Be prepared to take calculus 2. Bloom's Cognitive Domain Level 2: Understand.

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(X+h. f (x+h))

 $\lim_{x \to 1^{-}} \frac{f(x) - f(t)}{x - t} \neq \lim_{x \to 1^{+}} \frac{f(x) - f(t)}{x - t}$ $\implies \lim_{x \to 1^{+}} \frac{f(x) - f(t)}{x - t} \rightarrow \text{DNE}$

F(X)

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Spts	4pts	3pts	2pts	1pts	Opts
Each problem was fully annotated, and annotations were easily distinguish- able from original work.	Annotations were sufficient where present but missing in some places.	Annotations were made on all problems but were insufficient or hard to distinguish from original work.	Annotations were missing in some places and were insufficient and/or hard to distinguish from original work.	Some evidence of annotations exists but instructions were mostly ignored.	Annotations were missing or instructions were completely ignored.

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K(f)



Now - Post-LAMP

- Updates to my values and beliefs are provided below.
 Value: It is important to work on solving the world's biggest problems (e.g. global poverty, climate change, animal
- welfare).
- Value: Problem-solving ability, growth-mindset, and a love of learning are important traits for students to develop.

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 Belief: Learning to think like a mathematician (e.g. using mathematics as a metacognitive framework for recursive improvement) prepares students to work on solving these problems.

Future Directions

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- It's hard to predict changes in values and beliefs, but I can imagine the following additions:
- Value: All curious minds should have access to learning mathematics. The lower the barrier-to-entry, the better.
- Belief: Diversity of opinion is essential to solving collectiveaction problems and thus we should strive to teach mathematics to the most diverse group of students possible.

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 $\frac{dC}{dt}$: Change in Pedagogies Over Time



$\frac{dA}{dt}$: Change in Values Over Time

Now - Post-LAMP

Assessment Strategy	Pedagogy/AL Modality	UOL Guideline	Columbia's Principle	Student Learning Outcome
	/Topped Classroom - Provide lecture videos autilide of class so that class time can be used to active learning.	Arousde Options for Expression & Communication Use multiple media for communication — Video and of many ways content will be supplied in the course.	Proceiple 4. Design All Churse Elements for Accessibility – Video allows for closed captions, adjustable speed, and repeat viewing.	SLO 1: Standard course expectations.
Reading Assignments - Short, completion grade assignments designed to introduce studients to trylics, get them interested, and help them identify points of conductor behave being Laught in class.	While Min may use an an action barrang modulity is demotive supports other exploses work. Takin students have to actively engage with reading an videos.	Provide Options for Physical Action: Vary the methods for require and resignation — Technol readings are one of many ways cancerd will be sugglied in this course.	Principle 4: Design A3 Course Elements for Accessibility – The testbook is available physicable phosph net required) and digitably for free as a PDI and is a phonotylable tags. Table allows for the use of access readers, constraint modifications, and test size charges.	3LD 4. Embrane failure not just as inevitable, but as an exercise step in the learning property
Group Warksheets - In class assignments through which students valve "eary" problems including the important concepts followed by a "have" problem that requires using multiple techniques.	Prom Based Learning — secargoneting readiness, economies in India, both sudvisibal and team (RA1 and ISA1).	Provide Options for Sustaining Effort and Penilitence, Foster calaboration and community Variety Droughs to that students get cognorumities to meet and calaborata with everyone in the class. Entitier generating analysis from other groups.	Procepte 2: Establish and Support a Clevis Climete that (extent beinspipe to All Stautents - Denoue groups randomly for Estress, work with each proup to ensure all statents are participating and each voice is frand and valued, ask for freedback and meaner ('m available to methate confint.	SLO 3: Demonstrate an understanding of the underform mathematical converts through calified (or making programs through a problems that require a synthesis of concepts to which students have not specifically been taugh how to do.
	Four Evaluations — General work will be graded by alter groups before lawing addression for instructor evaluation.	Arounder Optimum für Exponential & Communication Burdel Dennis wir werder productional invasis of exposit- for protection and performance — having Gamman methodsins and environment of the second second understand dennis inspection and importantly to har- herers endowed perchange instruments.	Poincipie d- fait Esplicit Musikei é apret tations - Gaathe communicate a shart is required el en- tradionity-heije them for understand this through gene availation.	
	Adustines - Caam review with Reshcards presenting one alement of term/defention pair or problem type/unlockin strategy pair, Students will randomly draw a card and must field their match.	Provide Options for Comprehension Highlight partnerss, critical Jean-res, big Johns, and relationships – Go through envilupie resulting this, make sure all students get the chance to see all pairs to enginesity the environmental converts.		SLO 1. Standard course expectations.
Written Hamowerk – Assignment's designed in give students practice with the content and their mathematical writing ability.	Self-Assessment - in addition to my grading and levelback, require students to grade some of their own work. Assign grade as combination of my assessment and their effort is self-assessment.	Provide Options for Self-Regulation: Develop Infl- assessment and reflection	Procepte 2: Set Explicit Student Expectations Clearly communicate what is required of my students, help them to understand this through self-assessment.	50.0 4: Embrace failure not just as inevitable, bu as an essential step in the learning process.
Datares – Frequent, low stakes quizzes designed to give students practice in an examiliar environment and for not to determine what towers students may be having with the content.	Muddlest Point – Include a question in each quiz axing what concept shufeets currently first the must challenging, Interfeave common responses into future assignments.	Provide Options for Executive Functions: Enhance capability for monitoring progress - The simple Alt of stating what is most confusing will help students to learn the concept.		5LO 4: Embrace failure not just as investable, but as an essential step in the learning process.
Concept Inventory - Pro- and post-terretar				A2
	Offerenzated Instruction Design course content based on input from students regarding interests, participes, and pixels.	Provide Multiple Altrant of Engagement, Optimize relevance, value, and authenticity	Principle 1: Establish and Support a Class Conste that Fasters Belanging to A3 Souderts	

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 $f'(c) = \frac{f(b) - f(a)}{b - a}$





Future Directions

- I anticipate returning to Level 6 (Create) in Bloom's Cognitive Domain. More consideration is necessary to align SLOs with pedagogies and assessment strategies before this can be successful.
- As groupwork is a major element in this course, an SLO specifically relating to this is desired.

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improvement) prepares students to work on solving problems.

Now - Post-LAMP

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- action problems and thus we should strive to teach mathematics to the most diverse group of students possible

- An important future direction is to put more careful consideration into data collection and analysis. (I do have quite a bit of data, and preliminary analysis shows a positive trend, but I've chosen to focus on the qualitative here. Feel free to contact me for more info.)
- Observationally, my students from the semesters during LAMP better developed problem-solving abilities than my students pre-LAMP.
- Here are some selected quotes from anonymous student surveys:

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f"'(x)>0

E: Findings



$\frac{c}{t}$: Change in Pedagogies Over Time

1 Star



Pedagugy/AL Modality



- "I am generally uncomfortable with group work, especially with math, Like to just do things myself. But I admit that Cedar's process of putting usin groups and forcing us to talk things out and think was helpful in the learning. Working on problems, even ones we did not know or fully understand, was helpful when in a group setting;"
- "Exposing the mind to the content 3 times and then quizzing on said content was an impeccable design of teaching. I really enjoyed how much thought and effort that was put into creating the course."



ts and problem-solving were excellent, I ngage in the equations more fully than if the a piece of paper. I also noticed that ren't normally good with calculus to navigate them easier in the more we Dr. Wiseman was an energetic and demonstrated a deep understanding rall. I think the unique group learning for a more engaging learning process, and he material."

ork and the method of assistance where nrough problems but not give us the works and readings contributed to a more ge."

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Now - Post-LAMP

- There's a feedback loop between assessment strategies and student learning outcomes. I never made any attempt to assess SLO 2, causing me to realize it wan't very well-aligned with my values. It has been thus been replaced. To assess the replacement, I plan to gather affective data through a survey of my students' feelings about being required to solve
- problems that don't look like the ones they've been shown. Similarly, the new SLO 3 will be assessed by asking students to solve these types of problems, and explain their thought process.

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



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Future Directions

 Due to this being a coordinated class (taught by 5-6 different instructors each semester), I'd like to better collaborate with my colleagues on writing summative assessments that more accurately measure what we actually value – right now, our exams are something students can pass through rote application of algorithms, which lends itself to the cram-andforget method of simulated learning.

