

Active Calculus

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These slides available at <http://gvsu.edu/s/0Qf> (0 = zero, not “Oh”)

Plan for today

- + Meet the audience via PollEverywhere - learn who we all are and what would be most helpful today. Possible things we can discuss that I have planned:
 - + Overview of active learning
 - + Introduction to the *Active Calculus* text and related resources
 - + How to structure an overall course with AC
 - + How to structure a typical day with AC
 - + How to promote student buy-in

 - + Haynes will share the chat-stream with me; I'll post responses on [my blog](#).
- 

A couple of short polls

Please go to the following URL, which is also posted in the chat-stream window:

PollEv.com/mattboelkins857



Overview of Active Learning

Three things we stipulate for today's discussion

1. what we mean by “active learning”

AMS [blog post on defining active learning](#): “In short, active learning requires students to **do meaningful learning activities and think about what they are doing**. ... in practice active learning refers to activities that are **introduced in the classroom**.”

“Interactive Engagement (IE) methods are those designed at least in part **to promote conceptual understanding through interactive engagement of students in heads-on (always) and hands-on (usually) activities which yield immediate feedback through discussion with peers and/or instructors**.” (Hake, [via Epstein](#))

Are there other phrases or terms you would use to characterize “active learning”? Type your suggestions in the chat window.



2. what we now know about IE vs TI

“Both the FCI in physics and the CCI in calculus show that **traditional instruction has remarkably little effect on basic conceptual understanding**, and this has been the greatest shock to faculty. Research dating back more than thirty years has shown that most students emerge from standard introductory courses without a solid grasp of the basic concepts.”

([Epstein](#))

[PNAS study](#): active learning in STEM corresponds to 55% lower DFW rates than traditional lecture -- more success for all students and with lower achievement gaps

Seymour & Hewitt: SME students leave. Top four reasons: 1. Loss/lack of interest in SME; 2. non-SME majors offer better education/more interest; **3. Poor teaching by SME faculty; 4. Curriculum overload/fast pace overwhelming.** See Yoshinobu: [The Coverage Issue](#).

Conclusion: on balance, active learning is better for students



3. teaching with active learning is hard(er)


Student buy-in: many students report that they like -- indeed prefer -- TI over IE. Our personal experience, [the sobering study that Darryl Yong links to](#).

Developing good materials takes time: from an [AMS blog post on the topic](#), “learning to effectively design and use active learning techniques is challenging, and the process of integrating these activities into one’s ‘teaching toolbox’ requires both patience and a willingness to persist through setbacks.”

For the former: great stuff from Dana Ernst, <http://danaernst.com/setting-the-stage/>

For the latter: we need to develop even more free and open-source materials that are widely shared in our community.

What is an example of a free, open resource for IE that you use or contribute to? Share by chat.





Features of Active Calculus

free and open-source

Main landing page: <https://activecalculus.org/>

Available in [HTML](#) or [PDF](#)

Source code on [GitHub](#)

Single and [multivariable](#) texts

Activities workbooks in PDF by request or in print via Amazon

Print versions ([single](#), [multi](#)) on Amazon for nominal cost

Do you have questions about the format or availability of the text?



A typical section

For example: <https://activecalculus.org/single/sec-1-8-tan-line-approx.html>

- + An average section is structured to correspond to about 2 hours of class meeting time
- + Objectives, introduction, and preview activity
- + 3-4 activities; few worked examples; brief exposition
- + Knowls & links to applets
- + Summary
- + Anonymous interactive WeBWork exercises
- + 3-4 more challenging non-WeBWork exercises

Second example for more applets: <https://activecalculus.org/single/sec-3-5-rel-rates.html>

(Be sure to try the HTML on a smartphone)





Structuring a course that uses Active Calculus

Expectations of students

“Be active, caring, productive contributors to our learning community” - [syllabus](#)

Complete [Daily Prep Assignments](#) (at least two class meetings per week) [5%]

Engage actively to work on in-class activities from text (daily in class; some assessed in *)

Complete online WeBWorK (via login, weekly) [10%]

Complete [weekly or semi-weekly writing assignments based on non-WW exercises](#) [20%]

[Labs](#) and graded* in-class activities [10%]

Timed in-class assessments [55%]

What would you like to know about the structure or syllabus?



User experiences

If you have used Active Calculus, what have you found that works well for your overall course structure in what you assign and assess? What has been challenging to you?

What I hear from others

My own experience

[Formal reviews of the text](#)





Structuring a typical day using Active Calculus

How 50 minutes might go

I have a written script with estimated times

- + Daily* prep debrief and discuss (6-8 minutes) [* - about every other 50-minute meeting]
- + Brief lecture & discussion to build on DP and set stage for next activity (5-7 minutes)
- + Activity - student work and subsequent discussion (15-20 minutes)
- + Closure, transition, new ideas - brief lecture & discussion (5-7 minutes)
- + Activity - student work and subsequent discussion (15-20 minutes)

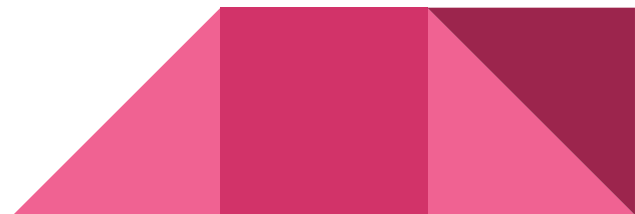
If an hour and 50 minute class, rinse and repeat (wo DP)



Things I don't (or very rarely) do

- + Spend more than 15 minutes a week on homework questions
- + Take homework questions on the fly; instead, all are submitted in advance as part of DP so I can triage
- + Go over the full results of activities in detail; we discuss questions where many students may be struggling (and I sometimes post select typeset solutions)
- + Lecture for more than 10 minutes at a time
- + Hand back papers before the last 2 minutes of class
- + Go over exams at length in class

What would be helpful to discuss regarding a typical day?





Developing student buy-in

The first day

Day 1 is crucial

Dana Ernst: [Setting the Stage](#)

My version:

- Before-class [Google survey](#) on who students are
- Let them know via email they'll be expected to share a hobby they are good at
- In pairs and fours: what is your hobby and how'd you get good at it?
- On the board (see next slide): at left, your hobby; at right, how you got good
- Discuss

Also: know their names as fast as possible. What BK then says.



Your hobby - something you are good at

- Sports
 - Drawing
 - Cooking
 - Golfing
 - Basketball
- Softball
 - ✓ Fishing
 - Baseball ✓
 - Drums
 - Volleyball
 - Cooking
 - Ballet
 - Photography
 - Singing
 - Water Skiing
 - Sailing
- Running ✓✓
- Choir ✓
- Clanet
- Competitive Swimming
- Produce music
- Soccer

What you did to get good at your hobby

- Repetition
 - moving closer to my family
 - work hard ✓
 - Practice of it in early age
 - Study and focus 7 years ✓
 - Practice & play everyday in the spring ✓
 - Constant practice (learn new songs often)
- Practice
 - Do it a lot
 - Have a good mind set
 - Lots & lots of practice ✓✓✓✓✓
 - Take classes everyday!
 - Good Teachers
 - practice everyday
- Be bad at it for a long time but keep trying ✓
- Work and listen to people who are good at it
- Keep doing it!

The other days

Daily prep check-ins and encouragement; spot collection, otherwise in-person

[Microaffirmations](#) & Francis Su's [alternatives to mathematical microaggressions](#)

Talking honestly and regularly (always briefly) about how learning is hard work and takes engagement and struggle

Honoring mistakes and productive failure. Discussing “natural mistakes” and “good attempts” with relentless positivity

Recent addition: [metacognition assignment for first-year students](#)

Writing assignments & exams: [revise & resubmit](#)





Open discussion of other items
participants have raised & misc

Miscellaneous notes and resources

[My blog](#) has posts about resources such as [preview activities in Desmos](#) and [daily prep assignments in an online format](#)

The [GVSU Math YouTube Channel](#)

[APEX Calculus](#) - a more traditional calculus text that's free and open source

[Understanding Linear Algebra](#) - a new free, open linear algebra text



Thank you

Thank you so much for attending today

If there are topics or questions we didn't get to, I'll review the chat stream and reply or post in some reasonable way. I'd also welcome hearing from you directly at boelkinm@gvsu.edu or [@mattboelkins](https://twitter.com/mattboelkins).

