

The Calculus Tapes

Gene Gloeckner, School of Education,
Colorado State University

Katherine Gloeckner

Mary Worthley, Department of Mathematics,
Colorado State University

Very Brief Background

- US College System
- Colorado State University: Land Grant University (est. 1870)

Environment

- 8 week accelerated course in 1st year calculus held in summer, covering the same material as the same course given in autumn, or in spring (limits, derivatives, integration, with some applications, aimed at STEM majors).
- Classes held Mon – Fri, 1.5 hr duration.
- Run by graduate teaching assistant.
- 3 exams, and a final exam, held in class. Online, and written homework required.
- 20 – 50 students in summer.

Method

- Student recorded reflections after class, as well as after working on homework, preparing for exams, and any other time she remembered.
- Recordings were transcribed.
- Transcription reviewed using how student motivation relates to their self-regulation of study behaviour lens.
- Transcript reassessed to see what else useful could be gleaned.

Expected Results

- As an “A” Student, she used proven study techniques:
 - listening closely in class;
 - reviewing/expanding colour coded class notes;
 - summarizing;
 - flip cards;
 - challenging her understanding;
 - using feedback from written assignments;
 - explaining to friends; and
 - attending office hours.
- Student also not intrinsically interested in math – believes it’s “just numbers” (#14 & #17), but very interested in her chosen course. Highly motivated to do well. Very capable of self-regulation.

Other Observations – From the student's perspective

- This student had the ability to put new material in context with her previous learning.

“So I guess that’s a little bit comforting just that the language kinda sounds familiar” (#15)

“People always say these functions can be derived and don’t need to be memorized but I feel like math is almost a language and if you can see what’s coming, you are a lot better off.” (Comment on #23)

Other Observations – From the student's perspective

- This student was organized enough to complete homework, as well as challenge her understanding and revise material .

“I’m going to go study once I get home and what I’m going to do is, my boyfriend who’s gone through calculus three and differential equations and all that fun jazz, I’m gonna sit down and go through those practice problems again and I’m gonna try to explain to him how to do it and then those kinda I’ve been highlighting not actually highlighting, but I should go back and highlight kinda main hitters from my notes that are like, you know what this is something I definitely need to know I definitely should be able to explain it and see if I can essentially teach him what I’ve learned so far in calculus one and hopefully all the stuff that will be on this first exam. ” (#16)

“The best way to learn is to teach.” (Comment.)

Other Observations – From the student's perspective

- This student consciously formulated very specific questions to ask instructor/friends.

“...an observation I had about office hours which is kinda how people treat the professor or the person helping them. They seem to get really frustrated with the math and then that kinda turns into frustration like at the professor ...” (#16)

“...that I try to make sure that that frustration stays on the page and that when I'm talking to people you know I'm saying this is what I'm trying, this is what isn't working, and try to be very like civil about it ...” (#16)

“So I try to make sure when she comes over I, you know, explain what I am doing... So, trying to keep it really specific, and I've found that by doing that usually I can figure it out by the time you know, I would even ask her; I'm like oh I'm not getting it so I'm like alright what am I not getting and I go through and figure it out and then I don't even have to ask and it's great and I think I learn more because I have to work through it myself, so. “ (#16)

Other Observations – From the student's perspective

- The affect of sitting in different place in the classroom on her learning
 - Prefers to sit near the front to increase engagement in presentation and ownership of the material. (#11 and comment)
 - When forced to sit further back
 - Issues with seeing around the other students.
 - Harder to keep up. (#15)

Other Observations – From the instructor's perspective

- Think time:

“Another thing I loved about the summer class was that I had time to walk away when I got frustrated because I wasn't as limited on time“ (comment)

“...she was like ‘we're going to take a really quick break and come back and figure out how these are connected’ and I was kinda like well, yeah. I was sitting there and thinking how the heck are they connected? Oh crap, because I realized they are totally separate in my brain” (#16)

“Actually what I think would really help I realized today in class was just having clicker questions in class so that when we learn something we can try to apply it, you know give us a little bit of time to think , work through something kind of simple and figure it out and figure out if you get it or you don't. It's really difficult to listen to a lecture and understand the material instantly.” (#27)

Other Observations – From the instructor's perspective

- Think time (cont):

“Something I noticed in class today was actually needed like this wait time that my education classes talk about. It was, we were just talking about something and you know I’m trying to write it down and then you know get it written down like almost as fast as Hillary does on the board so then she asks a question and I look at it and then somebody shouts out the answer right away and I was like ‘Wait! No!’ I like, I need it to sink in a little bit, I need to think about it for a second and it’s like now I have the answer so I’m like flat out lazy when I look at it. Even though I want, I know I need to understand and I’m looking at it, I know the answer so I’m just like well there it is I don’t have to actually like have to try to think about it, spend that couple extra seconds letting it sink in and being like oh this is what it is. So it was one of those times when I really felt I needed that little bit of time to think about it instead of you know having it answered right away, just because I felt a little bit like well crap, I have no idea if I could have gotten that by myself like absolutely no idea so yeah.” (#41)

Other Observations – From the student's perspective

- The “vibe” from the other students:

“I think the whole class was pretty much done though. I don't think anyone wanted to be there anymore. We got out a little bit early so they were just like alright, trying to learn you know the introduction to a brand new topic right before the weekend after, I mean it wasn't that hard of a class but it was another kind of tedious class so. Yeah it just, I kinda feel like the whole class has to be there with me and like you know what I don't care enough right now to care about it ...” (#24)

“It's amazing how much the vibe of the class can influence my personal motivation.” (Comment)

Other Observations – From the instructor's perspective

- The ability to maintain focus throughout the whole course.

“Alright, it’s the Friday of a three day weekend and I am so done with calculus right now I am just completely fried, like I don’t even know. We were talking about something at the end of class today like implicit derivatives and it just went whoo right over my head.” (#24)

“I would really love to stop learning new things in calculus at this point” (#44)

By the end of the semester, I was over the class and really didn’t feel motivated to put in the effort to learn new material.
(Comment.)

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Follow up?

- The language aspect of mathematics learning.
- Train students of these courses to reflect on the material they find challenging and learn to formulate specific questions.
- Training of GTA's (think time).
- Review of our teaching environment (lecture theatres and semester structure).

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Thank you.