

Some Notes on Learning

One meta-goal your professors have is to help you develop the skills to become a life-long learner. That is, we want you to learn how to learn even when there is no classroom, no one specifically lecturing to you or testing you.

But how do we do it? And how do *you* do it?

In academic classes, your professors are (hopefully) providing different types of assignments to help you build knowledge up. For example, in mathematics, daily homework provides a repetitive sort of practice, whereas quizzes and mastery exams ask you to do routine calculation on your own. Exams provide external motivation for you to reflect on what you are learning, and integrate those ideas into what you already know more than daily homework allows for.

Your professors are (hopefully) also modelling for you good learning strategies. We do this by asking questions and talking critically about ideas. We do this by calling attention to the most important pieces of information and putting that in context.

But do we make this explicit? Maybe not enough. So what are some things which help us learn?

Think about how you learn something non-academic. How would you (or how did you) learn to play lacrosse? You'd likely watch a game. Then you'd maybe ask questions of your friend who is a lacrosse player. Then you'd...play. Likely, after your first match, you'd have more questions, maybe about strategy, or maybe about something that seemed to violate something you thought was a rule. Then, you'd play again. And again, and hopefully the more you played the better a player you'd become, and the more you'd be tempted to study the good players. Maybe you'd realize that you need to do some cross-training to become better...

Let's step back. Probably, the game you watched after you decided that you wanted to learn to play was one that you didn't *passively* watch. Likely, you watched it with a certain amount of focus – trying to ascertain what some of the rules are, trying to figure out the ways players move around the field, trying to anticipate what might happen next etc.

And you'd recognize that being able to play lacrosse is not the same thing as being able to knowledgeably watch a game.

Just reading something is not learning something. Learning something involves being able to “use” it.

So, when learning mathematics in particular, here are some considerations:

After you read something (or participate in class!), summarize it for yourself.

What is the main point? The second most important idea?

What are the new main definitions?

How would you summarize it for someone else?

How does this fit into the framework you already have for this subject?

What questions do you have? If you don't have questions, why not??

Do these things actively, just like you would watch that lacrosse game. Summarizing a section of our text as "about linear transformations" isn't particularly useful. Saying this section gives the definition and main properties of linear transformations, and examples is better. Being able to recite the definition, and decide which properties seem most important is even better.

As you read the material, remember that reading a page of a math book is not the same as reading a page of a history book. Sometimes in mathematics, after each sentence you need to stop and think about it. Why is it true? How does it work in an example? How did the author get this value?

Likely, rereading a section or parts of a section is a worthwhile thing to do. Some pieces may be much easier – test yourself. Can you state the definition before reading it this time? Can you do a different but similar example by following along what's written?

If you cannot articulate a question, work at it! Go back to the last piece you do understand. What was that....now: what came immediately after? That piece could be a sentence, an example, the last section, three sections ago (but try not to let it get to 3 sections ago); where it is doesn't matter, but find it. Or perhaps you say that you understand everything. Great! Then your questions can be bolder: How might this idea generalize? Could we create an example that has certain behavior? Why is this idea introduced here in the sequence of ideas? Does this have any links to things we've studied in other classes?These are just meant as examples to help you engage more deeply with this aspect of learning. Questions are natural, and important. You should have them. But to be useful, questions have to be more actively articulated than just "What is going on?"

One last note: doing things actively is sometimes easier when you do them with people. The same is true for mathematics. Form a study group. Try to articulate the main points to the rest of your group. Try to work on examples together. Share the places you get confused.

Some Resources on Learning

Here are some quick overviews of some influential research on the art of learning. Check them out!

Blooms' Taxonomy <https://cft.vanderbilt.edu/guides-sub-pages/blooms-taxonomy/>

Mindset by Carol Dweck <https://www.mindsetworks.com/science/Impact>

The Art of Changing the Brain by James Zull <https://www.youtube.com/watch?v=9GR3RuORcj0>