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Reflective Practices in Mathematics Courses (Part 1)

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Conversations with Amir

Several weeks ago I ran into Amir[1] while walking around on campus. Amir is a junior engineering major at AUC, and was a student in my Calculus III class in the fall of 2006. I remember him particularly well because of the insightful questions he asked in class and the consistently high quality of his homework assignments. As we chatted, Amir said to me, "Doctor, I really like math. I would be a math major if I weren't in Egypt where an engineering major carries so much more credibility." (This is a common statement from students, which is an unfortunate byproduct of the cultural reverence for only a few select majors.) Amir continued, "But Doctor, I have a problem. When I go to the next math class, I forget everything. I know how to do it when I'm in class, and I do well on the exams, but in the next semester I don't remember any of it. I mean, none of it."

As I parted with Amir, this statement weighed heavily on my mind. Amir was by all means a good student; he earned a solid B in my class, and, as I mentioned above, demonstrated the ability to be insightful with his observations in class. Yet he had candidly revealed to me a common situation with AUC students. If Amir, who is both perceptive and enthusiastic about math, recalled very little from his math classes, what would the average student be taking with them from their courses? While it is common for faculty to blame students for their lack of retention and abilities, the (often unexamined) attitudes and habits of teachers (myself included) contribute just as much if not more to this problem. In the following paragraphs I wish to explore ways of dealing with this situation, but not by presenting a set of didactic points about "How to teach". Instead, my aim is to provide several talking points that we as teachers can use to reflect upon and engage in dialogue about the assumptions that we use in creating our lessons and courses.

Education as Information Transfer

A common assumption that I have found that pervades the pedagogy of many professors is that teaching is fundamentally about information transfer. The teacher is presumed to be a keeper of a vast storehouse of information that is to be distributed to the students in pieces that they can digest. To demonstrate that the student has done their duty of "absorbing" the material, they transfer the information back to the professor via paper or exam and are evaluated on this process. As a discipline, mathematics is set up especially well for this procedure. Students do well in math courses if they answer problems in standard templates that have been handed down from teacher to student throughout the ages. The problem with this methodology is that while students may become competent at reproducing standard answers, they do not necessarily develop the ability to ***create*** answers to problems. Moreover, without having grappled with the material and "making it their own", students do not develop the capacity to evaluate, modify or articulate their own thinking about the subject.

[1] This name has been changed for privacy of the student.

In Egypt, the mindset of information transfer seems to have taken a particularly strong hold in mathematics. In Egyptian secondary education, students are by and large taught mathematics via rote memorization. For example, in preparation for the university entrance exams, Thanawiya `Amma[2] students will sometimes complete the exams of several previous years as their *sole* method of study. Understanding when, how or where such information came to be becomes irrelevant; the goal is simply to advance through the next hoop of educational advancement via passing the test. The result is that students enter mathematics classes at AUC terribly under-prepared, and even worse, they do not realize their situation.

What I have found myself doing in response to this situation is to try to supplement my classes with the content of Calculus that the students may have missed in high school. Time and time again I have derived the formulas, stated the key ideas, and reiterated the basic techniques. My hope is that in learning the derivations behind and connections within the material, the students will not only have a more complete understanding of Calculus but also will be able to perform well in future math classes or in problem-solving activities in general.

Yet despite this effort, there still are cases like Amir's, where students demonstrate proficient knowledge (even of the derivations) while taking a course but are unable to retain benefits of that knowledge once the course is finished. What is going wrong? It seems that as teachers we deal with this situation by doing the same thing over and over: we grumble about the lack of student abilities and continue to try to fill in the gaps by repeating the fundamental concepts of the course enough times so that they stick with the students. We have, however, arrived back at square one – trying to teach the students by transferring more information to them. This only leads to more of the same problems for students. Is there an alternative to just focusing on information transfer?

As I have reflected on this question, I have noticed that much of the problem lies in the fact that effective teaching requires the development of two very different skill sets in students. On the one hand, we must teach the students the mechanics and technical processes required to engage in the discipline, such as the requisite formulas or templates. On the other hand, we must teach students how to be creative in the discipline, so that they can produce their own work and generate their own ideas. The latter process is made difficult by the fact that no template seems to work here. Due to this difficulty, often we default to teaching only the templates and formulas, resulting in our classes becoming primarily about information transfer and leading to the aforementioned problems.

We will continue this discussion in the next New Chalk Talk issue, where we will consider how we can teach both skill sets – technical procedure and creative process – and examine assumptions that can hinder such development.

Share with us your experiences by contributing to the New Chalk Talk series, or by simply sending comments/suggestions to:
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[2] Thanawiya 'Amma is one of the secondary education systems in Egypt. It concludes in examinations, the results of which many universities (including AUC) use for admission standards.