Final Essay

Advice

The responsibility of tutoring students, like most anything, can be viewed as both an art and as a science. On one hand, becoming a better tutor takes creativity, inspiration, and innovation. On the other, professional researchers have established techniques and reform methods to help educators become better.

For someone new to the tutoring experience, I have a few words of advice. First of all, I would not suggest going right into the job without preparation. A review of the student's material before the tutoring session will jog the tutor's memory and will suffice for an in-depth explanation. A successful educator has proficient subject matter knowledge in addition to pedagogical knowledge. Unfortunately, there are some testing systems that require "special tricks" or hard-to-remember identities and rules to solve. There is no amount of review that can prepare the tutor for these problems, other than having past experience with them. A good tutor will review these problems and tricks in the course of his tutoring experience.

As a first semester tutor, I found the experience a bit overwhelming at first but quickly adapted to and assimilated my environment. By "adapted," I mean there are some circumstances that I cannot control so I must change my techniques to fit them. By "assimilated," I mean I implemented techniques that would change the tutee's thinking and/or behavior.

For example, I would adapt to a situation in which the given answer on a practice quiz is in a different form than the one we have obtained. To fix this, I would make it clear to the student that a little algebra is required to change the expression to fit the one on the screen. A similar situation involving adaptation is that in which I must tend to the student's speed of learning: some students take a bit longer than others and require a bit more explanation, and I find myself working at different paces among different students.

Conversely, there are situations that I am able to control. If a student had a misconception about a concept, such as: "the natural log of 1 is undefined," I would have to assimilate the situation by revamping the student's concept image of the natural logarithm function. (I would do this by recalling the definition of $ln\ x$: the exponent to which e is raised to obtain x.)

One very effective and my personal favorite strategy to use when tutoring students is to ask them questions. Asking students questions has multiple advantages. The most obvious reason to ask questions is to obtain a reference point. I try often to

get students to explain to me what they know, because I get a better sense of how much they know, and how *well* they know it. Finding out how much a student knows saves time and makes the tutoring session more efficient. Other than asking students what they know, asking them questions forces them to explain their thought processes, which is beneficial to their learning. When students can explicitly identify what they know and how well they know it, they are able to evaluate their knowledge and make decisions on where to go from there. It also helps students realize small mistakes they've made, since they are hearing it out loud. Getting explanations from different senses (e.g. visually, aurally, tangibly) enriches the learning experience.

Another way to use questioning is to guide students' learning. After obtaining how much students know and how much they've done, I'll ask them questions (rather than telling them) about what should be done next. Doing this helps keep in mind the goals of the problem. Asking just the right question may possibly help students discover something they have not learned before. It can help them build on their own knowledge and construct new knowledge. On the other hand, I may ask students hypothetical questions about the problem from a different point of view. Doing this forces the student to think about the problem differently, for example, if a different parameter had been given. This ensures that the students' minds are staying active and dynamic, rather than procedural. With repetition and persistence of this strategy, students will be used to the process of producing or attempting to produce answers to these questions. Eventually they will form a habit of asking themselves the same types of questions that I have asked them before.

I have learned a lot from my position as a mathematics tutor, but one of the most important things I can take away from the experience is modesty. I know that I cannot know everything. There are some things with which I am not comfortable (yes, even in the lower level math classes) and I mustn't be afraid to admit this to my tutees. Although this may appear unprofessional, I point out to the students that we are "in the same boat" and are both trying to understand the problem or topic.

Connections

Tutoring and teaching can be compared and contrasted, but I would argue that the differences between the two professions are more apparent than the similarities. In a tutoring session, the student seeking help and the tutor form a one-on-one interaction; and the student has more individual attention. The tutor is focused directly on the tutee's thinking and processes. Rather, in a classroom, the teacher does not have the capacity to give this concentrated amount of attention to each of his

students. A tutor may need to address more remedial that is, prerequisite topics with a student while the teacher's job is to introduce new math. One of the biggest reasons students fall behind in a math class is that their prerequisite skills (e.g. fraction manipulation, exponent, root, and logarithm rules, algebra skills, etc.) need to be refurbished. Chances are, this is the reason these students seek extracurricular help in the first place. Regarding similarities between tutoring and teaching, I believe students have a wide range of motivation in either environment. In the tutoring environment, students who willingly seek help are more motivated and eager to learn than the students who are unwillingly required to seek help. The motivation of students in the classroom also ranges widely. It is possible that students who typically sit in the front of the room will be more motivated than students who sit in the back. Both the tutor and teacher carry the task of motivating their students.

I can use the abilities I've obtained and developed as a tutor and expand on them in the classroom. As a math teacher, I would like my students to be able to discover things on their own. I think discovery is an important step in the learning process. Students will remember and own what they've found much easier than what they've been told. In addition, discovery helps students make connections to other topics, to other courses, to previous knowledge, and to their lives outside of school. Part of implementing this philosophy in my classroom involves letting students obtain their own information. Just like asking questions to a tutee, I will try to get my classroom students to ask themselves questions such as, "How can we go about solving this problem?" or, "What do we need to do to get the answer?"

Another big part of learning is building on previous knowledge. Mathematics itself is cumulative, so when students struggle with a particular topic, I will surface the underlying concepts (e.g. definitions, theorems) required to define that topic. When students develop a "procept," they perhaps encapsulate it as its own object. Sometimes all it takes is to remind them to use its definition a.k.a. break it down into smaller objects so they can fully understand the procept. I'll use the example of the natural logarithm as above. When students are used to dealing with the natural log as a function in calculus, they focus on its behavior, properties, and images. When it comes time to apply it in context of a problem, for instance in modern algebra proving that it is an isomorphism, students sometimes forget to relate it back to its original definition as an exponent.

Reflections

With the weekly reflections, I found that I was able to become aware of my methods and philosophies. It helps to keep track of my experiences to see the bigger picture and focus on what I can do to improve. This is a good ability to have for anyone: being able to see and evaluate what oneself does helps one become better in one's profession. For example, toward the beginning of the semester, I would feel frustrated that students would be able to "get to the punchline" before I delivered it. But through my journaling, I was able to quickly identify this and reflect on why I was feeling that way. I was made more aware of this occurrence during my tutoring sessions and I decided to change my outlook. I chose to view this phenomenon as a beneficial one for the students because they were able to obtain information without my help. This is a major goal of any tutor or teacher.

Mathematics

In class, I thought the discussion of apparently valid operations leading to logical contradictions was most stimulating. We had talked about setting corresponding parts to equal expressions equal was not always possible and operations on imaginary numbers. For example, in the case that $ax = ay$, we can't be quick to assume that $x = y$, because it is possible that $a = 0$. In high school and early college, I was always wary of setting corresponding parts to equal expressions equal because I was never exposed to this process explicitly. When learning partial fraction decomposition in Algebra II, for example obtaining

$$3x^2 - 4x + 5 = (A)x^2 + (B - 2)x + (C + 3)$$

we had learned to set the coefficients equal to each other. Thus $A = 3$, $B = -2$, and $C = 2$. This was the first time I was formally exposed to the process and I had never seen justification of why we could do it. Sometimes this involves making assumptions that are only implicit, such as $x \neq 0$. Unfortunately, these assumptions are never announced. It was only until later in my college career that I was able to identify these assumptions and recognize when they were supposed to be made.

Another topic I was interested in was the manipulation of complex numbers. From the example on the board, students start off with a tautology such as $1 = 1$; they proceed with valid operations such as multiplying both sides of the equation by the same constant, distributing exponents across multiplication, etc.; and then they end up with a contradiction like $1 = -1$. This is another phenomenon in which our assumptions are not explicit. The operations and rules students are used to holding

true only apply to real numbers, not necessarily complex numbers. Also, when we take the square root of a number, we are assuming its positive form only (when we take the nth root of a complex number, n roots exist). As teachers, we must tell our students to take caution when performing operations like these or common pitfalls may result.

Conclusion

The tutoring experience for me has been satisfying, beneficial, and rewarding. I see it as an opportunity to gain experience in the field and uncover my own values and philosophy of teaching. As a side effect, it is a chance to review material that I haven't seen in a while and solve problems. With journaling and reflections throughout this semester, I am able to take these observations and apply them in the future as a tutor and then eventually as a teacher. Through personal experiences and intuition (the artistic side), and accredited research and recommendations (the scientific side), I will be able to experiment with different methods and techniques and develop and revise my own teaching philosophy, so that I can discover what works best for me and what's best for my students.