



Research – Another Way to Bless Students

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When I graduated from college for the last time, one of the professors I admired most gave me only one piece of advice. He knew I was headed to a job teaching Math at the Air Force Institute of Technology (AFIT) in Dayton, Ohio. His advice was to “keep doing research; it will make you a better teacher.” This was not welcome advice for two reasons. First, I had just completed an intense research experience and was looking forward to a break. Second, I was headed to teach in a department that had very few graduate students. The Math department at AFIT was a service department, meaning we taught Math classes to graduate students from Electrical Engineering, Aerospace Engineering, Physics, and other technical disciplines, but had very few Math graduate students. With a sigh of relief, I thanked this admired mentor, and in a perfect passive aggressive maneuver, decided to reject his advice. It wasn't that I didn't want to do research; I was just looking forward to working in an environment where it wasn't required!

Much to my delight, when I started teaching at AFIT, I was assigned to teach some very fun engineering math classes to highly motivated, bright professional students (they were being paid to go to school and had no occupational distractions – in fact – their assigned military “mission” was to graduate). About 85% of the students at AFIT were seeking Master's degrees and about 15% were PhD students. All were required to do a research project. It was great fun and a little stressful as I tried to keep up with the very talented students. I was cruising through my second year teaching Linear Algebra and Numerical Analysis, when a knock came at my door. A student entered who I recognized - he had been in one of my classes a few quarters earlier. He politely asked if I had a few minutes; he needed help with a math problem. I naively thought I could answer his question in a few minutes and get back to what I was doing. The student was working on a dissertation topic that involved geo-locating downed pilots based on a radio beacon. This is actually a simple problem unless you are on a battle field and want the friendlies to find you but not the un-friendlies. I showed him some “mathemagic” which he thought was pretty cool. One thing led to another and I had the privilege of working with this student over the next few years and became his PhD advisor. I learned a lot about signal processing and how fun it is to solve real problems that impact the lives of real people. His research was used by the US military in Iraq to save the lives of downed pilots and others.

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Over the eight years I taught at AFIT, this experience was repeated multiple times with students coming to me with a math question related to their research. Sometimes the relationship was short and sweet. Other times it turned

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into a multiple year collaboration with significant impact on real problems. As this experience unfolded, I began to recognize important patterns in the contrast between students doing classwork and students doing research. Here is a summary of these observations:

1 Students doing classwork are trained to believe that all problems can be solved on a few pieces of paper and in a relatively short period of time. Students doing research discover that in order to solve important and difficult problems, they must learn how to organize their work and give a consistent and focused effort over an extended period of time. They also learn to keep going even though the end may not be in sight. They learn to keep going even though the desired outcome isn't certain. They learn to enjoy the journey, because the journey may be all there is. They discover that if they pay attention during the journey, they may discover a more important question than the one they started out to solve. Armed with this perspective, they are better equipped to serve an employer well. When applied appropriately, this perspective can be a valuable ally as they create and implement a long term plan for the growth and development of their children and family.

2 Students doing classwork get excited when they recognize a pattern or relationship for the first time, but will probably forget it sooner than they think. Students doing research who discover a new pattern or relationship are more likely to remember it and be energized by it in a way that will probably change what they believe and how they behave. In other words, this type of learning has a deeper, long-term impact on student behavior.

3 Students doing classwork live within a protective shield that affects how they think (whether they are aware of it or not). They have faith they can solve the problems in the classwork because they believe the teacher has already solved them (this may not be true but students don't need to know this). On the other hand, they do not develop confidence that they can solve problems that don't come from a book or other academic source. Students doing research discover that their mentor doesn't know the answer either, and so they have the opportunity to develop a type of faith, learning from their own experience that they can do difficult things. These students become solvers of real problems and not just problem solvers. This perspective can translate into other aspects of life in addition to academics. Students who believe they can do hard things are more likely to lead out when others hesitate to get started.

4 The level of passion for their work generated by students doing classwork can be pretty impressive, and varies a lot from student to student. The level of passion for their work generated by students doing research can also be impressive and vary a lot from student to student. My experience is that the average level of passion among students doing research is measurably and significantly higher than the average classwork doer, especially when the students chose their own topic.

A reader of the previous list may infer that doing classwork is an ineffective way to learn. This is not the intended message. Classwork is one step in a progression of learning activities that points to learning by doing, and doing hard things.

In addition to the immediate benefits students involved in research enjoy, there are longer term benefits available to them as well. They are more attractive employees, particularly if they can use their research experience to benefit their employer. Doing research requires balancing both individual and team work. It often involves collaboration in an interdisciplinary environment. All of these experiences are attractive to employers.

Students involved in research have an advantage when applying to graduate school. They also have a much better

idea if graduate school is really a good fit for them. Since many graduate programs are research oriented, research experience can be a critical piece to the admissions puzzle. Unfortunately, for some graduate programs, if a student doesn't have research experience, they are very unlikely to be seriously considered.

For those of us who don't have students knocking on our door asking us to help them with their research, I would offer one way to get started in guiding students toward a learning by doing experience. Since students aren't asking us for help, let's ask them. We are all extremely busy. There must be some of our professional work students could do. Imagine how nice it would be if we had someone to help us do some of the many things we have to do each day. Students can do a great job providing feedback on course materials. I have seen students do a great job writing test questions. They are very good at research tasks that involve finding resources on the internet. You might want to provide historical context for a topic you are teaching. This could be a great research experience for the right student. Of course, there are many more ways students can experience your profession than these "getting started" ideas.

Before closing, I should clarify what I mean when I use the word research. The Lord invites us to "Ask, and it shall be given you; seek, and ye shall find; knock, and it shall be opened unto you." (Matthew 7:7) He hopes we will heed his invitation at the beginning of our journey back to him, and all along the way. When I read this invitation, I see it as an excellent definition of research. By asking important questions, seeking to find the answers, and knocking on his door for help, we discover that we are not alone in our efforts to learn and discover new and important things.

I have reflected on the advice shared with me by my mentor several times over the years. One realization is that it is not always true. It is possible to engage in research in such a way that teaching actually suffers. My mentor said doing research will make you a better teacher, not a great one. I believe this is true in most cases. More importantly, his advice suggests a corollary: "give students the opportunity to do research; it will make them better learners." ❀

