Philosophy of Teaching

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1 Overview

My approach to teaching has remained student focused and detail oriented throughout my career but over time I have tried to improve and expand my classroom technique in a variety of ways. Some recent areas on which I have focused include

- Improving the dynamic of large lecture format classes for first year students
- Investigating the use of a wide variety of technological tools in the classroom
- Working with K-12 mathematics teachers to investigate the way in which students develop their backgrounds for college mathematics

My position within the Department of Mathematics at WVU is tasked with improving the success of students in first-year courses and I have approached that task from the point of view of a mathematician in the sense that I believe students must develop deep understandings of core concepts in a given topic area in order to be successful. Each of the above items represents a fundamental component in addressing the development of successful students as they progress from middle school into high school and then into college level mathematics. Taken together, I feel that these notions can be combined in a way that builds a bridge allowing students to grow from early mathematics learning into successful calculus understanding and beyond. In each area the same basic principles apply: students must be presented with engaging topics and activities that build understanding and generate questions, questions from students must be dealt with thoughtfully and constructively, and students must learn that they are accountable for their own learning outcomes as well as the teacher.

I have worked on these ideas in several roles. I have instructed courses ranging from pre-calculus to algebraic topology at the university level, and I have developed and instructed courses for in-service K-12 teachers in support of students tracking into the courses that I teach myself. I have coordinated large lecture applied calculus courses enrolling approximately 1200 students per academic year, developing the curriculum, exams and laboratories for the course as well as supervising the instructors, mentors, graders and graduate students involved in the course. I have conducted research to determine what aspects of that instruction are most successful as well. Finally, I have also interacted with K-12 teachers in an outreach capacity as the principal investigator of a project supporting as many as 31 teachers per year in professional development intended to build their understanding of the mathematics they are teaching. In all these areas, I strive to employ a common approach built on the experiences that I have had.
2 Large Lecture Classrooms

Undoubtedly, the teaching of mathematics in large lecture sections is one of the most challenging issues facing the mathematics education currently. As resource issues have changed the logistics of instruction to require larger and larger classrooms, student demographics and backgrounds have shifted in the last few decades, creating an environment in which students are challenged by both the material they encounter as well as the format of their classrooms. This move away from a motivated audience to one that sees mathematics courses simply as a means to an end creates classrooms where the traditional didactic approach to instruction fails miserably. At WVU, first year courses are taught in lectures that vary in size from 200 students to 120 and 80 for the majority. In such an environment, the lecturer must work constantly to motivate students and engage them in the process of learning. To do so, I have incorporated in class activities and a wealth of examples designed to draw students into the development of concepts. My lecture style is to present pieces of a puzzle and then challenge students to put them together after giving a broad context that hopefully they can identify with. This context is constructed in such a way as to spark their curiosity and lead them to the same sense of discovery that we as mathematicians feel towards mathematics. My strategy is variably successful and depends strongly on the population so that a great deal of my time is spent analyzing the makeup of the classroom and finding topics that they can connect to. Moreover, as millennial students tend to have short attention spans and get discouraged easily, I focus on small ideas that are manageable for examples and take on the task of larger constructions myself. I also find that returning to topics and examples again and again allows students an opportunity to reinforce their understanding and connect older information to the current discussion. This in turn leads to better performance on summative assessments.

3 Smaller Classroom Settings

4 Graduate and Upper Division Courses

5 Technology to Support Teaching

This area spans a wide variety of tools in my career. Beginning as a graduate student, I employed Maple based laboratory activities to supplement classroom instruction along with an example driven lecture style that utilized Maple and Excel for classroom demonstrations. This ideology matured into the development of courses at WVU that incorporate a strong laboratory component as well as engaging in class activities to encourage formative development of concepts and assess this development effectively. My philosophy here is that engaging students in the lecture is best complemented by a laboratory experience that allows them to discover and reinforce concepts tied to what they have learned in lecture. As an example, the applied calculus course that I coordinated used an array of Excel based projects to reinforce a variety of topics. During the development of the definite integral, we used a spreadsheet based project that helped students apply the Riemann sum tools they had learned to better understand the Fundamental Theorem of Calculus by constructing the total change of a quantity using the rate of change of the quantity directly. This idea is built on later in the course in a lab that develops the concept of Future Value of an Income Stream using Riemann Sums to justify the definite integral formula presented in the book.
and in class.

6 Outreach to K-12 Classrooms

In 2003, through a grant funded by the Benedum Foundation, I assisted in the development of a set of distance learning based graduate courses targeting middle school teachers in the areas of geometry, foundations of functions and calculus, algebra, and probability with data analysis. These courses combined an asynchronous component delivered via recorded lectures and Powerpoint presentations with a synchronous meeting delivered online using a collaboration tool called Centra (www.saba.com). These courses and their development led in turn to the successful proposal for a US Department of Education funded Math and Science Partnership from 2004-2007 for which I was Principal Investigator. Through this project I was fortunate enough to work with a group of K-12 teachers in West Virginia schools as part of my effort to gain insight into the teaching of mathematics at that level. We built our program around the learning community model and endeavored to build groups within schools and counties that could work with each other to improve their teaching incrementally rather than trying to change what they did all at once. We used techniques based on the work of Ball, et. al. in the Learning Mathematics for Teaching program and the University of Michigan to improve the teachers’ deep understanding as outlined in the NCTM standards (both process and concept).


These learning communities studied topics from geometry, number and operation, algebra, probability with data analysis and the pedagogy associated to each of these during monthly in place workshops. Using specific concrete examples that were grade appropriate, we discussed how these topics should be taught, and then the teachers developed lesson plans using the Connected Mathematics and Mathscape curricula at the middle school level and the IMP and Glencoe materials at the high school level. They implemented these lessons and video taped portions of them. We then viewed the tapes and discussed the lesson outcomes. The teachers then modified their approach and taught them again in subsequent years. Data was gathered relating to student learning outcomes using the state administered Westest and data related to teacher learning outcomes was gathered using a pre- and post-treatment administered measure of content knowledge developed by Ball and Hill, et.al. at Michigan. The outcome from these measures indicated substantial gains in both student learning and teacher knowledge. One outstanding outcome was the result at Big Creek High School in McDowell County WV, where before the program students in 10th grade were measured as 49% at or above proficiency and after the program measured 81% at or above proficiency. This ranked the high school as one of the highest in the state.

6.2 Math and Science Partnership 2012-2015

More recently, in partnership with RESA in central West Virginia
7 Conclusions

This is an overview of my approach to helping students develop an understanding of a subject that I love and consider central to their abilities to be successful in a 21st century workforce. An effortless competence in mathematics means that students can conquer a variety of other disciplines, and it opens up a world of opportunities for them.