Active engagement in the learning process is of great importance for undergraduate students; actively engaged students tend to be more successful in school and after graduation. My teaching experiences have shown that it is important to engage students in class, since so much contact time occurs in the classroom. Current teaching discussions, such as a seminar on *Deep Learning Through Evidence-Based Course Design* for the STEM Faculty Launch Program at Worcester Polytechnic Institute, reinforce the importance of incorporating activities which make the material relevant to a specific class and the experiences of those students. Therefore, I have spent time purposefully trying to engage students in all my roles as a teaching assistant at the University of Kentucky (UK). While at UK, I have taught a variety of students, including freshmen and future teachers. Further, I have taught courses in which I served as the primary instructor (both in a classroom setting and online), as the recitation instructor, and as the recitation instructor who oversaw undergraduate teaching assistants in UK’s Math Excel program. As all of these experiences have taught me, the importance of incorporating guided discovery, questioning, and oral and written communication into all of these teaching roles cannot be overstated.

**Guided discovery.** When using guided discovery, my goal is to facilitate student learning as students discover mathematical ideas individually or in small groups. Students benefit more fully when the instructor provides them with basic mathematical building blocks and then enough time to struggle to arrange the blocks into important theorems on their own. In doing so, they build intuition for solving problems and sharpen their own tools for solving real-world problems. As an example, students study the point-slope form of a line and how to interpret the derivative before using both of these concepts to determine how to find the equation of a tangent line. Smaller classes, such as Math Excel recitations, are more conducive to such activities. Math Excel is a UK program in which calculus students work together in groups of three or four to complete more challenging problems and meet more frequently than normal recitations. With smaller class sizes and three instructors, students receive more individual help. A motivating factor behind the program is research that argues how students who come together to discuss mathematics tend to be much more successful than their peers, such as low-income or first generation students, who work more independently. Thus, Math Excel provides this opportunity to all students. When I taught Math Excel, two undergraduate teaching assistants and I moved among groups to help students develop more positive study habits through group work.

Last year I taught future elementary teachers, again working with guided discovery. There were several occasions for which I prepared an activity which challenged students to note patterns and draw logical conclusions. Using Polydrons, students worked in groups to build 3-dimensional polyhedra. Within a group, students counted the number of vertices, edges and faces of their particular polyhedron. Each group then recorded the number of vertices, number of faces, and the negation of the number of edges in a chart on the board. Using this information, the class was able to discover Euler’s formula. In this type of class, we also specifically discuss the importance of incorporating guided discovery into the students’ own future classrooms.

When students draw correct conclusions, they are more likely to provide for themselves a fuller explanation for why those conclusions hold. When students draw incorrect conclusions, I facilitate a class discussion in which students work together to figure out why the conclusion is incorrect. Then when answering the related free response question on the exam, many students provided a solid explanation. When students are able to explore an example that motivates a particular mathematical fact, then they are better able to understand that fact. Simply stating the main result often leads to confusion and a lower level of confidence. The importance of illuminating activities with instructive examples cannot be overstated.
**Questioning.** When teachers purposefully ask students questions during class, students are responsible for solving mathematical problems. One benefit of questioning is guiding students to develop their critical thinking skills. Since questioning complements traditional lecturing well, I tend to ask a lot of questions throughout class. Students help me solve arithmetic problems, reason through steps in a problem, and more. Often, when a student responds, I will ask the class whether they agree with the answer or not. When I wait for students to respond, I am able to evaluate whether the students understand the material and then provide immediate feedback. This more interactive lecture style encourages students to develop their abilities to solve problems and draw connections.

There are some classes in which most students are willing and active participants in our class discussions. However, when teaching a lower level fundamental course like College Algebra, I quickly found that there were only a handful of students who answered all the questions. To hear from more students consistently and provide all my students with feedback, I write every student’s name on a note card. I shuffle the cards before every lecture and call on everyone at least once. Thus, more students pay attention and answer questions during class. Students have noted that their understanding also increased. Hearing from as many students as possible, especially in lower level courses, is very important. As an instructor, I want to know where my students are in the material on a regular basis. Hearing from more students helps me make more informed decisions as we move forward. Also, students are more likely to actively engage in the material when answering questions.

**Oral Communication.** Challenging students to develop their mathematical communication skills is a positive way to encourage students to actively engage with the material. In a variety of classes, I ask students to complete think-pair-share activities. This activity allows students to work independently, then discuss the solution in a smaller setting, and finally discuss the solution as a whole class. Students spend time working on explanations in pairs before I facilitate a class discussion. Thus, students have time to specifically work on mathematical reasoning. During the paired discussions, I walk around so I can hear from all the groups. Similarly, to motivate students in Elementary Calculus recitations this semester, I had students draw cards to determine groups. In groups, students worked together to understand a representative subset of problems before students with red cards recorded full solutions at the board and students with black cards explained those solutions to the class. Discussing solutions with peers is helpful in providing students with the tools necessary to succeed on exams and to develop more understanding of the material and their thought processes.

Students who must share and discuss full solutions are more actively engaged in the learning process. As a primary instructor, when time constraints limit group work opportunities, I still purposefully ask students to explain certain problems and steps during class lectures. Thanks to a suggestion from one of my professors, I now implement more explanation questions into notes and class discussions. Even as an online instructor, I purposefully push my students to communicate with each other and myself through an online discussion board, Piazza. To encourage more of this participation in the future, I would require students to post there from the start of the course.

**Written Communication.** Written free response homework challenges students to grow in a more independent way. To complete written assignments for calculus recitations, I asked students to explain why particular formulas are useful in solving real world application problems and how to use those formulas correctly. Several students struggled with written assignments, because they explained the steps of a process rather than the conceptual ideas behind why a particular process works. From this, I learned how critical it is for me to provide explicit feedback. Such assignments led to discussions concerning how to effectively communicate mathematics. As the
semester progressed and the students received my feedback and participated in class discussions, I noticed that many students improved their written communication skills.

Certainly, teaching future elementary teachers reinforces the importance of having students practice writing explanations and providing detailed feedback. When teaching future elementary teachers, I asked students to complete a few free response questions from each section in the textbook. Since I posted complete homework solutions, students were able to read what a complete explanation looks like. I also graded at least one free response question on each quiz to provide some written feedback before giving an exam. When students provide written explanations, they must interact more with conceptual knowledge and I am able to give them more useful feedback.

**Mindset.** How we view learning plays a significant role in how successful we are in mathematics. Students who believe that mathematical abilities may grow through hard work are more likely to actively participate in the learning process than students who do not believe this. One major obstacle that students must overcome is the common misconception that people are born with fixed mathematical ability and are either good or bad at mathematics. People who successfully study mathematics know that persistence is ultimately what leads to success in mathematics. I purposely discuss this belief with my students and share my own struggles with mathematics to encourage them to engage as more active participants and fully develop their mathematical ability.

**Beyond the Classroom.** My interest in education came to fruition while tutoring middle school students during my high school years. Attending the University of Tennessee at Chattanooga as an undergraduate student, I earned my B.S. with a double major in Mathematics and Secondary Mathematics, my B.A. in Humanities, and 7-12 Mathematics certification in Tennessee. While here at UK, I have maintained my interests in, and connections to, K-12 education. During math circles, I facilitated math-based activities that encouraged elementary students and high school students to discover important mathematical concepts. These experiences showed me how much students can figure out when given the appropriate tools. I also helped organize and run a couple of high school mathematics days for women. At these events, we encourage women to gain confidence and be persistent as they struggle with mathematical concepts. We also encourage them to pursue science in their future studies. During my time in Lexington, I also spent a few nights in local schools completing interesting and fun mathematical activities with middle school and elementary school students and their families. In all of these experiences, I enjoyed seeing students successfully use logic to reason through new mathematical concepts. Further, I appreciated seeing how much students, and their families, enjoyed the activities. In the future, I would like to continue my involvement in K-12 education.

Students who actively engage in their learning process are better equipped to develop a deeper and richer understanding of mathematics. Thus, in any teaching role, one of my top priorities is encouraging my students to be active participants in the learning process through these techniques of guided discovery, questioning, oral communication, and written explanation. I challenge my students to explain how to solve mathematical problems and why something works. I strive to create an environment in which students are encouraged to actively participate and discuss personal explanations and struggles. In the classroom, some of my strengths include my continued conscientious efforts to incorporate guided discovery and high cognitive questioning. Since discussions of explanations, both written and oral, are so important, I am working on increasing the amount of time we spend on them. I am constantly striving to improve the various activities through which I offer positive feedback to students. All of these efforts contribute to students taking on an active role in their learning.