Teaching Philosophy

Learning in mathematics happens through discovery, inquiry, and reflection. I favor the use of discovery-based learning to actively engage students and improve the development of their mathematical knowledge. Through discovery learning, students not only become more engaged in the learning process, they also learn more effectively because they discovered the ideas on their own. Assessments in discovery learning provide students with an additional learning opportunity while also treating mistakes as part of the learning environment. By making discoveries on their own, students develop "soft skills" such as metacognition, critical thinking, communication, and teamwork. Developing these soft skills in students equips them for success in life outside the classroom, such as in the workforce.

How I Implement Discovery Learning: ACE Teaching

I implement instructional practices that promote discovery learning through the ACE Teaching Cycle, which consists of **A**ctivities, **C**lassroom Discussion, and **E**xercises. The ACE Teaching Cycle begins with a hands-off activity that allows students to arrive at their own conclusions and engage with others, with the intention of sparking curiosity. Through the activities, students work together to discover and build concepts toward the mathematical norm. After completing the activity, we move into a classroom discussion, which formalizes and consolidates the concepts students discovered through the activity. During class discussions, I ask questions and rely on student participation, rather than traditional lecture classrooms. Consequently, students are in charge of their own learning process and develop a more concrete mathematical knowledge. After arriving at conclusions through the activities and class discussions, students then complete homework exercises and supplemental practice. The exercises serve the purpose of reinforcing the concepts that were developed during class discussion.

For example, while teaching College Algebra, I designed an activity on Real and Complex Numbers that aligned with ACE teaching and ultimately promoted discovery learning. The activity was formatted to have students categorize a carefully chosen set of numbers and come to the realization that numbers can be grouped based on unique properties. In the exact order they were given, the numbers I asked my students to categorize are as follows:

$$-\frac{8}{2}, \frac{8}{2}, \frac{0}{5}, \frac{5}{0}, \sqrt{4}, \sqrt{-4}, \frac{4}{16}, \frac{2}{4}, \pi, 1.24, \sqrt{3}, -\sqrt{3}, \frac{2}{\pi}, \frac{\pi}{2}$$

I chose the numbers to not be simplified so that students would first simplify before grouping them into categories. I additionally chose the numbers to be listed in a specific order. For instance, $\frac{0}{5}$ and $\frac{5}{0}$ are right next to each other with the hopes that students wouldn't just identify them as reciprocals, but to look deeper and discover that, in the Real Numbers, one can be simplified and that the other cannot. By completing the activity, students themselves established what the unique properties of Real and Complex Numbers may be, and thus acquired the foundation needed to participate in the classroom discussion. The discussion then focused on formalizing the distinct properties of Real and Complex Numbers, which prepared

them for their homework exercises. For instance, one student grouped the rational numbers and defined this group as “fractions.” During discussion, I was able to guide student thinking and formalize their definition of “fraction.” After formalizing their concepts during class discussion, students were able to go home and complete their homework. Their homework exercises primarily consisted of categorizing numbers according to the formalized definitions learned in class.

Additional Learning Opportunities Through Discovery Learning:

Discovery learning through the ACE Teaching Cycle serves as a means of informal assessment because it primarily provides learning opportunities for students. All three stages of the ACE Teaching Cycle can be used as an informal assessment opportunity through which students expand their mathematical knowledge while also providing me with an insight of student thinking. Assessments in discovery learning through the ACE Teaching Cycle enable students to experience productive failure. During class discussions, students are encouraged to share their conclusions discovered from the activity, whether they are “right” or “wrong.” If students arrive at a misconception, I am able to correct their thought process and probe them to understand why they were wrong. In this way, “failure” provides students with an additional opportunity to learn from their mistakes and enhance their mathematical understanding. While completing the homework exercises, students are allowed an unlimited number of attempts to answer a question, until they arrive at the correct solution. This allows students to realize they are doing something wrong and provides an opportunity to learn from and correct their mistakes. Thus, the homework exercises turn into a learning opportunity through productive failure while also reinforcing the concepts learned during class.

Skills Developed Through Discovery Learning:

Discovery learning in my classroom instills social and metacognitive skills in my students. Metacognitive skills developed through discovery learning include critical thinking and productive argumentation. Discovery learning forces students to reflect on what they know and what they don’t know, and hence requires metacognitive skills. Discovering concepts using prior knowledge requires students to actively participate in the cognitive process of recollection, which will help alleviate common “learn then forget” tendencies. In a traditional classroom setting, students are told what they should know and how to arrive at certain conclusions, but are not given the opportunity to come to this realization on their own. Critical thinking is developed when students reflect on their past knowledge, organize their cognitive processes, and recognize patterns. Through discovery learning, students further develop critical thinking skills when they connect their prior knowledge to new problems so that they can construct possible conclusions on their own. By making this connection, students are able to participate during class discussions using productive argumentation. That is, students use the connections they make between their prior knowledge and new problems to back up their claims. Developing these soft skills in students prepares them for struggles they may face in their future classrooms, workforce, or even personal life. Thus, metacognitive skills students develop from discovery learning are useful for career advancement and social interactions.

On the other hand, social skills developed through discovery learning include teamwork and communication. By using their metacognitive skills, students are able to communicate misunderstandings to their peers and exchange ideas, thus fostering an efficient classroom environment. Through this process, students are collaborating to explore ideas and possible solutions in an effort to draw mathematically sound conclusions with an independent mind.

Conclusion:

My teaching philosophy centers around engaging students and helping them reflect through discovery learning. I promote discovery learning in my classroom through the ACE teaching cycle, which allows students to become actively engaged in the learning process. Assessments in discovery learning provide students with an additional learning opportunity and encourage productive failure. In addition to productive failure, teaching through discovery learning develops metacognitive and social skills in my students. It is my belief that discovering learning creates an atmosphere that both challenges and engages students, enhancing the overall classroom environment.