

Nature of STEM

Nature of Mathematics

According to Peters-Burton, “Mathematicians represent phenomena with models, manipulate the models to test possibilities, and evaluate how well the models fit the phenomena and other related models.” (Peters-Burton, 2014, 100). I believe the Standards for Mathematical Practices lays out a good foundational approach to integrate mathematical content into applications that make it relevant in the 21st century.

As I reflected on how I address the practices in my own teaching, I can clearly see some areas of strength as well as areas of improvement. I enjoy utilizing the CCSS Mathematical Practice #3 - **Construct viable arguments and critique the reasoning of others** using an error analysis strategy. Often, I will have students engage in error analysis by sharing a task with a student answer as well as their work or thinking. Students must then identify the error and explain why they think the error was made by the student. This paired with the strategy Think/Pair/Share provides an opportunity for students to communicate their reasoning and respond to the argument of others. Finally, students will need to solve the problem correctly themselves and explain their process. This also strengthens their ability to identify errors in their own mathematical problem solving.

The CCSS Mathematical Practice #7 - **Look for patterns and make use of structure** by asking students to look closely to recognize a pattern or structure. I like to take this approach when time allows me to guide students in an investigation to come up with their own mathematical rules. For instance, when we are learning about the Triangle Inequality Theorem to determine if 3 side lengths can form a triangle. Rather than telling the students what the theorem is, I first teach them how to construct a triangle given 3 side measures using a ruler and compass and practice this process with side measures that will consistently create a triangle, before throwing in a set that will not make a triangle. This always puzzles the students as to why that set of measures does not form a triangle when constructed. That will lead into an investigation where they will continue to construct triangles if possible given side length sets, but will start to sort the sets into 2 groups: sets that form triangles and those sets that do not. After we complete several trials, students then analyze the data by looking for patterns in the two groups and see if they can determine a rule to determine if 3 side lengths will make a triangle. This process takes them through a scientific process of making sense of the phenomenon.

The 4th CCSS Mathematical Practice - ***Model with Mathematics*** asks students to apply their mathematical knowledge to real-world situations, which to me is the most important. In preparing students to have a meaningful impact on their communities, they need to be able to apply what they know to problems that arise in their everyday life, on the job, and to society. I try to bring in real-world applications for the math concepts I teach, but know there is still room for improvement here. Some content lends itself to making those connections easier than others, so I need to be intentional about making those connections to the concepts that aren't so easy to help students to see the relevance to what they are learning.

There are some practices I know I can continue to help my student improve in, such as CCSS Mathematical Practice #2 - ***Reason abstractly and quantitatively*** which states "Mathematically proficient students make sense of quantities and their relationships in problem situations." I myself will often refer to a number line to help students to work with operations with integers or use a "Money talk" but I don't always observe my students referring to that when stuck on a problem. Also, in middle grade math, being able to translate word problems to equations can be very challenging. I need to continue to research ways to make improvements in this area.

Use appropriate tools strategically is the 5th CCSS Mathematical Practice which looks for students to be able to "consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, and computer algebra system, a statistical package, or dynamic geometry software." Though the use of pencil and paper, concrete models such as 2 colored counters for integers & number lines, rulers, protractors, and scientific calculators are staples in my middle grades classroom, I believe i am following way behind in the utilization of tools such technology tools such as computer resources, graphing calculators, and software to allow students to explore and deepen their understanding of the concepts we are learning in class. This would be an excellent way to cross over into implementing another STEM discipline into my classroom by implementing technology.

Nature of Science

I always tell my middle grade math students that math and science are like cousins, and are closely related in the fact that math is used so much in science as a way to measure and make sense of data. In Appendix H of the Next Generation Science Standards, it states that "students should develop an understanding of the enterprise of science as a whole - the

wondering, investigating, questioning, data collecting and analyzing” which will often require quantitative data and mathematical computation of data. An example given in the matrix on page 5 of the NGSS document shares a middle grades learning outcome for the category Scientific Investigations Use a Variety of Methods as science investigation as “Science investigations use a variety of methods and tools to make measurements and observations. This overlaps with the Mathematical Practice #5 - use appropriate tools strategically.

Another connection I found between Mathematica Practice #7 - Look for and make sense of structure to the NGSS category ‘Science Knowledge Assumes an Order and Consistency in Natural Systems’ where the learning outcome goes on to say “Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation” where both are investigating data to create a rule or understanding of what is happening based on patterns observed and structure that can be supported.

A third noticing made is with the NGSS category ‘Science is a Human Endeavor’ that states the learning outcome “Science and engineers rely on human quantities such as persistence, precision, logic, imagination and creativity” used the same skills described in Mathematical Practices #1 and #6 which are ‘Make sense of problems and persevere in solving them’ and ‘Attend to precision’ respectively. In both the nature of science and mathematics,

References

APPENDIX H – Understanding the Scientific Enterprise - Next Retrieved September 27, 2021, from <http://nextgenscience.org>

Peters-Burton, E. E. (2014). Is There a “Nature of STEM”? *School Science & Mathematics*, 114(3), 99-101.

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