

Nature of STEM

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“Technology is how humans modify the world around them to meet their needs and wants or to solve practical problems.” (Standards for Technological Literacy 2007) I often use storytime STEM with elementary students in our Library Media Center. After a read aloud I challenge students to build a solution to the problem of the feature story. “In order to comprehend the scope of technology, students in grades K-2 should learn that The Natural World and Human-Made World are Different.” (Standards for Technological Literacy 2007) One example of how students solved practical problems was to create a bridge for 21 elephants (21 limestone railroad rocks) after reading “Twenty-One Elephants and Still Standing” by April Jones Prince. After reading the story, students first had to investigate the structure and stability of bridges and the foundational design of bridges through video clips, images from bridges in books, and graphic designs found online. Then, students planned their design through discussion and drawing models. Students then built their bridges and tested by placing all 21 limestone rocks/elephants on the bridge. Many groups had to modify their bridge to hold all 21 “elephants”. Students modified by going back to the pictures from books, rewatching video clips of bridge structure and design, and then asked questions such as, “what if we add this to the bottom of our bridge” and testing and physically modifying until their bridge met the challenge and problem of the story. It is always fun to pull technology and building activities for lessons from stories with young students. Not only do students ask questions and become increasingly engaged in the story but they often request to read other books similar to the books I share aloud with them or books by the same author.

Middle school students should learn the technology that “New products and systems can be developed to solve problems or to help do things that could not be done without the help of technology.” (Standards for Technological Literacy 2007) I utilized Code.org lessons to teach how to create an app with seventh grade students. This was a great lesson that started with whole group engagement. I created an anchor chart web asking what their daily problems were. Students listed problems such as: stinky bus rides, yucky cafeteria salads, and getting reprimanded for their phone ringing during class. As a group, students chose to create an app that would use GPS to turn their phone on silent upon entering the building and then turn their ringer back on upon leaving the school campus. Students planned the features of the app, designed the app icon, and decided what fees would be applied for this app. Students decided this app would be worth adding to their phone to solve the problem of forgetting to turn their ringtone to silent and facing reprimands for their phone ringing in class. It was a great unplugged lesson experience with seventh graders. When presenting problems that are specific to the student or to problems with the world, then students become more engaged in the lesson beginning with discussion all the way through to the finished product they helped create.

To enhance my teaching I would first need to correct the misconceptions I originally delivered to my students during previous instruction. I would also need to correct my students' previous years of science teachers misconceptions that they taught. I would begin with the "vocabulary of theory compared to a hypothesis and how they aren't the same, experiment compared to investigations, and dead words with their alternatives." (Schwartz 2005) Beginning with the correct vocabulary understanding is imperative to enhancing student learning.

Another way I could enhance my teaching is to include the Nature of Science Matrix into my annual curriculum map along with my Kentucky Core Standards for Library Media Center. In collaboration with intermediate science teachers I could build the foundation for scientific knowledge based on empirical evidence. Through phenomena to engage students and scientific observations students could build their scientific background knowledge in the Library before they even begin learning the scientific objective in the classroom. The research I could use with students in the library to collect empirical data could be the study of plants utilizing sunshine. Students could perform a scientific investigation by placing potted plants in front of a window and other potted plants in a dark closet. Students would enter their study of plants with their regular education teacher with an observatory knowledge gained from the Library and would understand the relationship between plants and the sun. Greater success would most definitely come to students by building this empirical evidence. "When a student develops a knowledge and skill base around an activity, the context of that activity is essential to the learning process." (Putnam and Borko 2000)

Continuing with the basic understanding with the Nature of Science Matrix-"Scientific knowledge is open to revision in light of new evidence." (Nature of Science NGSS Appendix H 2013) Many students have little to no prior knowledge of scientific background behind what they know is true in science. In the Library I can use books to introduce Christopher Columbus. Many students do not know who Christopher Columbus was or that he was an explorer. I would present that scientific knowledge is open to revision in light of new evidence with Christopher Columbus to explain to my students that long ago scientists and scholarly leaders knew the world was flat. But it was Christopher Columbus that convinced the King that he would not fall off of the end of the flat world while sailing the ocean. That he would, indeed, sail around the world to prove that the world was round. It is important that educators explain to students that there is not one final answer with scientific knowledge. That new technologies and discoveries are made daily.

It is clear that I have much room for improvement with enhancing teaching with the nature of science. Students learning how to ask questions about a concept is a goal that I have recently focused on in the Library. Using STEM activities has helped with this professional growth goal. "STEM education can link scientific inquiry, by formulating questions answered through investigations to inform the student before they engage in the engineering design process to solve problems." (Kennedy 2014) Students are loving the STEM activities that are flooding classrooms and learning minds.

Nature of Technology and Nature of Engineering overlap in multiple ways in my Library classroom. Principle 1. K-12 Engineering education should emphasize engineering design (Engineering In K-12 Education 2009) discusses how engineering must be open to the idea that a problem may have many possible solutions. Through engineering activities, small groups collaborate to build structures and designs to solve problems with feature stories during their time in the Library. Students understand that technology is modifying the world around them to solve practical problems. The practical problems come from stories shared while in the Library. One activity students engaged in was to build a perch for a “Harry” character I made out of a tennis ball size hairball that I glued large wiggly eyes onto. The problem was that Harry was so short he couldn’t see in the library. So students planned, built, tested, modified their collaborative perch and highest inches measured decided the winner of the challenge. Using principle 1 that a problem may have many possible solutions came with understanding when I gave each small group of students a different type of blocks and building pieces such as KEVA planks, Lego’s, brain flakes, fiddlesticks, and interlocking cubes.

Another way that both technology and engineering overlapped in my Library classroom is “Principle3. K-12 Engineering education should promote engineering habits of mind.” (Engineering In K-12 Education 2009) Students work in collaborative small groups utilizing creativity and collaboration, and communication within their group. Students then use communication to explain the processes they took to build and create their project.

Two years ago I applied for membership for two levels of Girls Who Code clubs to be held at our after-school program. Our school was honored to be accepted into Girls Who Code Grades 3-5 Club and Girls Who Code Grades 6-8 Club. Students learned how to code Dash, Ozobots, Scratch, Hour of Code, and snap circuits. The girls planned and built wooden obstacle courses to code Dash to maneuver through. It was all their idea to create such a course. The growth in the girls in our school was astounding. The growth carried over into different leadership roles. I was in a classroom giving the teacher library books for an upcoming lesson when I heard one of her students say, “I am a Girl Who Codes so I can help you figure it out.” It was a math problem. The summary of the book “Engineering In K-12 Education” explains how , “the number of girls and underrepresented minorities who participate in K–12 engineering education initiatives is well below their numbers in the general population.” (Engineering In K-12 Education 2009) Being active members in Girls Who Code for grades 3-8 greatly corrected this issue of girls being below their numbers in the general population. What a wonderful way to overlap the Nature of Technology and the Nature of Engineering.