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Utilizing CoCoRaHS Climate Data to Improve Climate Literacy at the Middle School Level

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Using Scientific Measurements to Improve Basic Understanding in Math

One of the biggest obstacles seen in K-12 education today is the lower scores in math and science related subjects versus language arts and historical perspectives. Due to the need to improve these scores, many different methods are being tested and reviewed to improve overall understanding and ability. It is becoming more recognized in these efforts that the use of scientific method, experimentation, data collection and measurements are fantastic ways to improve understanding in math. One commonly noted difference is that math is "just numbers" and one can often go through the motions and complete the problem, but not necessarily understand the thought behind the numbers. However, science requires understanding of the situation and applying math accordingly, a skill that carries over into basic math understanding. The improvement of the sciences would not only benefit students in their science courses, but also in math as well ((Brown, and Borrego 41-54).

According to the Response to Intervention program (VanDerHeyden), the following things are true:

1. Children who have had less experience or exposure to mathematical concepts and numeracy are at high risk for mathematics failure
2. Most students fail to meet minimal mathematics proficiency standards by the end of their formal schooling
3. Students identified with specific learning disabilities perform lower and grow at a slower pace relative to their peers in learning mathematics.
4. Existing instructional tools and textbooks often do a poor job of adhering to important instructional principles for learning in mathematics.
5. Math is highly proceduralized and continually builds on previous knowledge for successful learning. Hence, early deficits have enduring and devastating effects on later learning.
6. Early mathematics intervention can repair deficits and prevent future deficits.

With the state of mathematics being so critical, it seems natural to want to try a sort of seamless way to incorporate the two disciplines. In Stamford CT, students at the Turn of River Middle School are doing exactly this (Gordon). One teacher - Klein - states that she has students go out and measure the lengths of their shadows and ties it into lessons about the sun; and while she's at it she shows them how to calculate information about their shadow using the Pythagorean Theorem. "'It's not like they come in here and just do the same thing they were doing in math class. They're gathering their own data here, whereas they're provided with data in math,' she said. She cited a project during the distance and time unit, when students were recording times of certain events with stopwatches in hands-on lessons". She goes on to say that: "For middle school, they need this. If I did slope once in here and they never saw it again, they'd forget it. But they do it in here multiple times, and they do it in math multiple times, and they make the connection between learning in science and learning in math, so they learn the concept of slope and relate it to both subjects" (Gordon).

Clearly there is a connection that can be benefitted from by tying together the math and science disciplines. "I never saw any connection between math and science when I was in middle school. I was one of those kids who is like, `This is my math, and this is my science'…And as a team, in my experience, the teachers didn't work as closely together as we do. But now this is how we do it, and it's so evident how it can be used not just in one classroom or the other" (Gordon). Once teachers in this school began implementing these tactics they not only noticed better overall performance in both math and science, but they also noticed an increase in standardized testing scores as well.

The idea of incorporating both disciplines into each other is not a new one, considering you cannot successfully do math without science. However the idea has become more popular; simply type "science and math" into an internet search engine and you are littered with bloggers, researchers and other teachers/instructors writing creative ways on how to mix the two in a way that students better understand. One principal (Johnson) writes "In math class one of the biggest needs is relevance. Why not use science to teach math? Since one of the biggest uses of mathematics in science is data gathering and analysis, that is the best place to start. When a teacher gives students a real science problem to solve -- one that requires math tools -- the teacher is giving the students a reason to use math. Math then becomes something useful, not something to be dreaded".

The Math & Science Collaborative is comprised of representatives of school districts, non-profit organizations, institutions of higher education, and other stakeholders committed to strengthening the teaching and learning of mathematics and science ("About the Math and Science Collaborative"). Originally established with foundation support within the Carnegie Museums in 1994, the Collaborative moved to the AIU in September 2002. The committee has two major beliefs that coincide with the goals of this Capstone project:

- A mathematically and scientifically literate population is essential to the social and economic success of this country. The region must do a better job to align math and science instruction with the "best practices" described in research findings and the nationally-developed Standards to make sure that all students have the necessary skills and opportunities.

- By working together, more will be achieved. Most schools and teachers face similar challenges in delivering quality math and science education, but often do so in isolation of one another. This way the two will be combined.

All students need the knowledge and reasoning skills that good science and mathematics education provides; and, what teachers and students do in schools determines how much learning takes place (Murnane and Raizen). Overall, the undisputed success of combining math and science together in an educational setting is a practical and fun way to encourage learning, and better prepare students for a 21st century future in today's society.

Works Cited

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The following shows several examples as to how CoCoRaHs meets The Next Generation Science Standards for Grades 6-8:

1. **MS-ESS2-1: Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.** CoCoRaHs would be an amazing resource for this standard; students can easily precipitation data and use this to conceptually and quantitatively understand the water cycle, along with other various Earth System processes. For example: Snow depth over time and its relationship to spring flooding. This addresses graphing, observing change over time, and recognizing differences between locations (spacial reasoning).
    - **Goals**: To incorporate more data analysis and graphical skills into student's school day.
    - **Objectives**: Students will be able to implement spatial reasoning by observing snow data from multiple locations, as well as furthering their graphical skills by plotting data and analyzing it; this will be completed by the end of the lesson.

2. **MS- ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. :** One great exercise would be to use

a CoCoRaHs rain gauge to measure rainfall over the course of a month that a classroom experienced, and then have students look up how much water their city uses in a month. Student's could then compare our water use to how much water we received as a system that month and draw conclusions.

- **Goals:** To demonstrate human impact on the environment versus how much water a system actually produces.
- **Objectives:** Students will be able to compare and contrast data, as well as think analytically about solutions to a real world problem over the course of the lesson, with a duration time of a month.

3. **MS-ESS1-3: Analyze and interpret data to compare similarities and differences in findings:** Students could access CoCoRaHs rain data to compare average annual rainfall data from different locations around the state, and based on that make predictions as to how much rain they anticipate for a particular area based on their findings. They would also be able to compare and contrast different locations (ex: a mountain versus a valley) and draw conclusions about weather systems. For example: Pick three locations, and based on how much rain they each received students could triangulate and model how much precipitation they expected a fourth location to receive. This addresses spatial reasoning, basic geometry, and compare/contrast.

    - **Goals:** To bring in more math and geometric skills into student science exercises.
    - **Objectives:** Students will be able to complete basic geometry, as well as spatially predict and prove weather observations by the end of the lesson.