Conversational Mathematics

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In 2009 Paul Lockhart declared that mathematics is a form of art. He argues that mathematics as rote procedures and contrived applications destroys the natural curiosity of children. Mathematics as a memorization game, diminishes the inherent beauty in mathematics, and completely overlooks the fact that mathematics is a form of art. We agree with Lockhart and push the argument one step further: beyond being a game, beyond being an art form, mathematics is one of only five non verbal languages. Mathematics like Music, American Sign Language, Morse Code, and Signaling use symbols arranged in varying sequences to convey information. All are taught in formal education courses. But unlike the other non-verbal languages, many mathematics classes are taught with the removal of application, which returns us to Lockhart's lament, that with the abstraction of mathematics there is a loss in appreciation of both the beauty and application. Imagine, if folks only wrote music but never performed it, wouldn't music lose some of its beauty? If we only read another language we miss the nuances of pronunciation, inflection, beat and pace? In short we miss the romance of the spoken word. If all language is a way to effectively and efficiently communicate and collaborate, then it is important to promote *Conversational Mathematics* as a means of engaging people in solving relevant problems.

In all languages spoken and unspoken it is the performance, conversation, presentation, and application that infuse both meaning and beauty. With respect to mathematics, it is the *conversation,* application and presentation of solving authentic problems that makes it agile, relevant and beautiful. In this light, mathematics can be thought of as a way to foster collaboration between individuals as they engage in problem solving and organize data to illustrate, elaborate and generalize solutions, giving people the tools to converse in this manner.

Ron Eglash uses ethnomathematics, or the study of mathematics of other cultures, to look at the full spectrum of mathematics ranging from unintentional behavior to the development of "rules of thumb", to the analysis of those rules. At one end of the spectrum non-mathematical actions are those done without any intentionality. An example is found in the honeycombing patterns that bees use in the construction of their hives. While mathematical forms can be applied to explain these patterns, we cannot engage in a discussion with the bees to determine their reasoning or intentionality. In the mid spectrum mathematics are used to solve everyday problems in the lives of people. For thousands of years shipwrights built boats and ships by "rack of eye" and "rule of thumb" without any tape measures or mathematical equations, but it was intentional and deliberate rules that helped them not only pass down these methods to the next generation, but also optimize the process of construction. These rules of thumb are self conscious and deliberate, and as such mathematical. At the far end of the spectrum, abstract mathematics form the basis of algebra, geometry and calculus. According to Eglash, abstract mathematics in our western culture is motivated by developing abstract rules and procedures, and considering why they work, and how to build upon them to make new rules. Yet, no mathematics regardless of how abstract remains unapplied for long, real world applications are quickly discovered.

In the classrooms, teachers often spend more time on the denotational and decontextualized aspects of academic mathematics rather than providing students with the opportunity to engage in *Conversational Mathematics*. The applied approach of *Conversational Mathematics* empowers students to use mathematics to solve authentic and meaningful problems in areas of health, cyber security, the global economy, city planning, or the physical sciences, just to name a few. We must move away from rote procedures, pre-solved problems, with an emphasis on academic mathematical jargon, and rather help learners generate and solve meaningful problems.

To accomplish this transformation from rote processes to *Conversational Mathematics*, requires an agility to embed foundational concepts of mathematics in problem solving with the acceptance of multiple solutions. Rote processes can be quickly and effectively calculated with the help of calculators or computers. Making this transition does not negate creating abstract equations or consideration of mathematics philosophy, but it does gamify rote processes, much like Spelling Bees have gamified the mechanical parts of learning language. Sugata Mitra in his 2012 *Future Learning* documentary predicted that rote process mathematics will become a sport. He pointed out that mathematics must be seated in culturally relevant problems to help students understand how mathematics (not formulas, procedures, algorithms and contrived situations) can help them solve problems and create a shorthand for solving similar problems in the future. Rote mathematics may become a sport, but *Conversational Mathematics* will always be relevant as cultures will always have problems to solve.

So what does *Conversational Mathematics* look like in the classroom? It might be tasking students with solving flow patterns of Air Traffic Control using variant speed and time. It might be solving a murder mystery through the trajectories of blood spatter to calculate the height of the murderer. It might be an exploration of nature to find natural occurrences of fractals

and describe or model those patterns in clay. It might be the design of a skateboard park and figuring out which is the most extreme trick. Whatever the problem if it resonates with the students they will drive their own learning deeper and broader. They will surpass expectations. They will have better understanding of mathematics. *Conversational Mathematics* is all around us in everything we do, using it to engage in problem solving brings it into the forefront of learning and makes it a powerful tool of life.

References

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Steve Lewis is part of the School Design team at PAST specializing in mathematics and education. Sheli Smith is the Chief Academic Officer of PAST heading up programs and research. *This report is part of ongoing conversations and brainstorms focused on helping educators make the paradigm shifts towards transdisciplinary problem-based instructional and delivery strategies that are culturally relevant for education today.*