Literacy Philosophy

21st century literacy learning and problem solving are all about connecting the dots, and in math education the ability to make connections is essential. The late Steve Jobs, an entrepreneur and innovator, was quoted saying: "Creativity is just connecting things. When you ask creative people how they did something, they feel a little guilty because they didn't really do it, they just saw something. It seemed obvious to them after a while. That's because they were able to connect experiences they've had and synthesize new things. And the reason they were able to do that was that they've had more experiences or they have thought more about their experiences than other people. Unfortunately, that's too rare a commodity. A lot of people in our industry haven't had very diverse experiences. So they don't have enough dots to connect, and they end up with very linear solutions without a broad perspective on the problem. The broader one's understanding of the human experience, the better design we will have." This design that Jobs is referring to speaks true to the design of 21st century education, where the ability to problem solve, make connections, apply understanding, and reflect in terms of the big picture are qualities instilled within learners.

The push for creative problem solvers in math education, as well as educators that provide diverse learning experiences, is more evident than ever. However, the principles behind this new face of education are not new. Learning by making connections between old and new experiences is known as the theory of constructivism, generally attributed to Jean Piaget. In fact, this theory suggests that learning happens through our experiences and knowledge is internalized through assimilation and accommodation. We experience new information all the time-- reading the newspaper, walking down the street, talking to a stranger at the bus stop, etc.--- and if we are interacting with the world around us, there is no way we can avoid learning experiences. We assimilate these experiences by relating them to old experiences and existing frameworks, or we can accommodate for the new information by reframing our mental representations to fit the new experience. In essence, the learning builds on what we already know and establishes new or more extensive relationships within our mental frameworks.

This approach works exceptionally well in the mathematics classroom because math is an umbrella of interconnected ideas, so there is an abundance of connections. Further, this theory suggests that if the student is given the opportunity to interact with others and question new ideas, they will move from the known to unknown. Perhaps they will make mistakes within this process, but by accommodating what they thought to be true with what they have found to be true, they are learning from their mistakes and experiences. This idea also supports The National Council of Teaching Mathematics' Process Standards- problem solving, communication, connections, reasoning and proof, and representations, and inherently balanced literacy incorporation. By using the constructivist approach and NCTM's process standards as a foundational framework, teachers can focus on giving each learner the opportunity to explore and create their own understanding through differentiated instruction at a level that makes the content meaningful. For example, as creative problem solvers we make qualitative and quantitative observations. Then, we organize these observations to make sense of the data through tables, graphs, or other visual representations. Finally, we make connections within the new information and to our previous knowledge by reflecting on the experience (Polya). This problem solving process is not only relevant to material in the mathematics classroom, it also relates to problem solving skills needed in real life situations and is highly associated with being a literate learner.

Many people associate literacy education with the ability to read, write, listen, and speak, but this educational design is different; it's far out, definitely more progressive, and quite honestly, significantly better. Why? Because it requires learners to apply their literacy skills by delving into a world outside of their comfort zone where mistakes are celebrated and diverse learning experiences are integral. Debbie Shults, author of *Content Area Literacy,* writes: "Teachers across the entire curriculum spectrum are beginning to realize that they are responsible for producing learners who possess the literacy skills

needed for the 21st Century. They are realizing that literacy is the ability to comprehend all sorts of text, and helping students accomplish the goal of comprehension requires more than asking them to open a book and read a chapter." Instead of learning ideas separate from one another, this classroom model encourages learners to make connections and build off of what they already know. Through this process literacy learning occurs much more indirectly, it happens naturally in a meaningful way. So, how can we implement this into our mathematics classrooms? Lee Stiff, president of NCTM from 2000 – 2002, talks about two types of constructivism: radical and social. We can't hand over knowledge in its final form. The information and experience must be assembled in the learner's mind in their own way. We must also focus on the teacher-student interaction as well as student-student. Together we can create our own strategies for solving problem situations (Stiff). In a classroom that models the constructivist framework and encourages creative problem solving and literacy the teacher acts as facilitator, they are passive and the learners are active. But, the teacher's role is essential. They have to set up a structured yet open classroom environment and plan activities that support learners while providing them with choice, and both need to reinforce the learning model.

The curriculum must be presented to mathematics learners by implementing appropriate conditions for learning: schema activation, focus, activities, and reflection. In order for the learning to be meaningful it must be relevant and serve a practical purpose. One way to engage the learners is to provide some sort of anticipatory set or schema activation that serves as a connection to their lives. While the opening activity serves a powerful purpose in engaging the learners alone, it must also hone in on the focal point and build off prior knowledge. By opening the lesson in this manner, the learners are encouraged to discuss their ideas with one another and make connections. In fact, most of the knowledge they build in this stage is from the discussions they have with one another, which is empowering for the learners and gives them a sense of ownership. Moreover, the teacher can direct the discussion by posing questions that scaffold understanding and encourage collaboration. The progression of the discussion should naturally lead the class to the activity, or construction of new knowledge. The activities presented to mathematics learners should be compulsory and have choice. They will allow learners to bring their ideas to the mathematical forefront and explore them using multiple representations. Instead of teaching rules without reason, the teacher will support the learners by asking challenging, open-ended questions that require reasoning and critical thinking skills. For example, think-aloud journals, similar to double-entry journals, ask learners to work through a problem and explain their thinking in writing after each step. The activity has organization and reflection embedded within and stimulates literacy skills in a natural way. Despite the constant flow of information, students still need time to pause and recollect their ideas with one another. Reflective pauses are great assessments of how students are internalizing new information and ensuring they are seeing the big picture. By using activities like these the learners will discover the rules (algorithms) by building on previous knowledge and constructing new knowledge rather than having the information handed to them. The main goal is to help the learner see that math is an ongoing process and is not about finding the answer or being right. Because learners will be working with open ended questions, they have the ability to respond to the challenges at their own level of development. Perhaps one of the best models for reinforcing learning in our literate learners is problem writing. The applications of problem writing are endless and worthwhile. Instead of giving a test that shows the learner is able to solve the problem, have them write the problem so they can show which factors are important and through their writing emphasize why they are important. Not only does this reinforcement tool show their ability to reason and organize their thoughts, the open-ended question allows students to show what they understand in a way that makes sense to them. Many learners know how to solve problems, but they don't know how to explain how they got to their answer. By having learners write out the process they are making connections and synthesizing understanding. For example, the student's ability to use vocabulary correctly emphasizes their conceptual understanding. Student responses give insight on levels of understanding and help the instructor determine which

concepts the students understand and which concepts they need assistance with. For instance, the student may use the wrong vocabulary or may have represented the problem wrong. These insights allow the instructor to tailor activities so they better meet the needs of all learners. Many classrooms follow a 'cookie-cutter' approach to learning and do not give the learners the opportunity to engage in the type of learning that best fits them. This method provides the learners with a framework that they can build and expand on to create an individual approach to learning rather than basing their understanding on someone else's.

Amidst the activities, discussions and writing prompts, the dreadful math textbook should also be used as a resource. Reflective reading strategies must be implemented as they prove to be effective for conceptualization and comprehension. Math can be read similarly to any other language, although, when reading for understanding the context from which mathematics should be read will vary according to each learner. To support the diversity amongst learners and how they construct their understanding, the classroom must include access to optimal resources --reading materials, learning manipulatives, calculators, computers, etc. The teacher should model how the resources can be effectively and efficiently used to maximize the learning potential in individual and group settings. By having the classroom structure organized the learners will be able to take ownership of their learning and utilize the resources they have been given. Moreover, the classroom library and resources should be organized and available to learners so they may choose resources that appeal to their interests and accommodate their individual learning levels. The goal of this framework is to have each learner working on something they are passionate about, which engages them in the learning process and keeps disciplinary issues minimal. Again, to ensure each learner is constructing their own understanding, the teacher must be a large factor in the learning process. That is, the teacher must conference with individuals and groups to discuss the progress and quality of the learning taking place. The teacher can also use this time to assess whether the materials being used match the readiness and interest of each learner and can redirect them appropriately. By facilitating learning in this manner, the learners will continue to be productive as they communicate with one another and build on their understanding.

The balanced literacy approach to teaching mathematics has evolved greatly. Teachers need to be reflective and adaptable, stay current in best practices, and continuously assess their teaching strategies. Actually, teaching math is a lot like teaching someone how to speak. Consider language development. We began by listening, then we began mimicking, and eventually we learned to speak. When we were ready we were taught reading and writing and eventually we were exposed to more extensive reading and writing practices and perhaps even other dialects. Language is a framework that we are constantly building off of by assimilating and accommodating. Math is a language, too. It has its own vocabulary, grammar, and syntax (think equations/expressions) that we use to translate back and forth via speaking, reading, writing, and listening. Just like with any other language, the goal of mathematics is to communicate complex ideas simply and efficiently. Processing information, making connections, reflecting, and learning through constructivism are qualities of creative problem-solving mathematicians and literate learners and defines the educational ideology of the 21st century.

Works Cited

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