



## College Quarterly

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### **A Reflection on My Teaching Practices Using Students' Math Moments**

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#### **Abstract**

This paper focus on the reflection of my teaching practices using students' Math Moments. I began to invest time in the past mathematical experiences of my students to better help me understand my own teaching practices. Throughout this paper I will reflect on my own teaching practice, delve into relevant literature and will use poignant math moments to illustrate student's thinking and beliefs about learning mathematics.

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#### **Introduction**

Being an educator for more than 21 years at various levels, there have been numerous occasions where I have tried to reconcile meeting the objectives of a mathematics curriculum with how to teach it. I have wondered often, that given a specific teaching objective, what teaching strategy would best work in a particular situation with the students in front of me. At times, I found myself forsaking methods of instruction for curriculum objectives. During these moments, reality dictated that the Socratic Method was most efficient despite the theoretical frameworks encouraged by the NCTM Standards. At the high school level, content in a mathematics classroom was of paramount concern, and at times was the facilitating factor in determining how the subject was taught. Sometimes, not covering the prescribed content was seen as a disservice especially to graduating students. At other times, I wanted to embed an important concept in a different way other than the Socratic Method. Although this was time consuming and devoured valuable teaching time, I felt those particular moments were necessary to my student's understanding of mathematics. At the college level, mathematics curriculum is dependent on the program of study. Regardless of the program, however, I believe that college instructors still struggle to balance and reconcile the curriculum with engaging the adult learner. This constant meta-probing juggling act, is not new to educational professionals teaching at any level, who seek to do the best by their students.

#### **The College Mathematics Learner**

I began to wonder about the psyche of the college mathematics learner. What particular moments in their math career have contributed to the feelings they might have about the learning of mathematics? What type of positive moments and what type of

negative moments define who they are? How do these math moments affect their learning? Can we ever unpeel the various layers of their understanding? Bound by these persistent questions, thus began my journey to delve into the “math moments” defining the mathematics college learner. Throughout this paper, I will reflect on my own teaching practice, delve into relevant literature and will use poignant math moments to illustrate student’s thinking and beliefs about learning mathematics.

In the past five years, I have been involved with teaching mathematics to “at risk” students at the college level. These are students who lack the necessary skills in mathematics and are therefore in danger of completing their program of study. Weak raw scores on the Canadian Achievement Test, Third Edition (CAT 3) or College Placement Test scores (CPT) determine that they take a remedial level or preparatory mathematics course prior to beginning their program of study. What is lacking, is how best to teach the required mathematics skills necessary to this specialized group. They are considered specialized and unique because many of these students have encountered countless years of frustration and lack of success in their classrooms that often translate to negative mathematics experiences. These negative experiences varied for each individual. Some experienced personal failure, some had unconstructive relationships with their teacher, some disliked the subject and others experienced bullying in the classroom. (Reference will be made to student’s specific math moments later on in this paper as it relates to these experiences.)

Mindful of the unique qualities of this group, often, I found it problematic engaging these students in meaningful ways so that their past mathematical learning would not be trivialized. As adult learners, some students felt inadequate and misjudged as overall weak learners when it was specifically mathematics that gave them difficulty. Many students felt the exposed sting of one subject; mathematics, holding them back from their life ambition. Although the NCTM Standards exist as a guide, there are no set program standards in mathematics at the college level. Mathematics as a discipline falls into a skills set within each program of study and as such does not stand alone as it does at the high school level. So mathematics is taught within the confines of business, or biotechnology, or media studies, or ambulatory studies etc. I began to invest time in the past mathematical experiences of my students to better help me understand my own teaching practices.

### **Math Moments**

At the beginning of every semester, I invite my students to describe a situation in their mathematics past that was either a positive or negative memory. They are asked to describe their feelings and thoughts of that particular “math moment”. Many of their stories were enlightening and helped me understand them as individual students with individual needs. It is an exercise that opens a dialogue

between my students and me, and sets up the bond that is necessary in a trusting relationship.

How we teach mathematics impacts deeply in the understanding for the student. The NCTM standards ask teachers to be mindful in providing students with:

Numerous and various interrelated experiences which allow them to solve complex problems; to read, write and discuss mathematics; to conjecture, test, and build arguments about a conjecture's validity; to value the mathematical enterprise, the mathematical habits of mind, and the role of mathematics in human affairs; and to be encouraged to explore, guess, and even make errors so that they gain confidence in their own actions. (Batista, 1994, p. 463)

I found many of my students feeling that they rarely experienced mathematics in this way. Many felt that the curriculum was too demanding and did not allow opportunity for students to experience success. One student wrote:

In high school, everything was taught so quick that the harder I tried to pay attention and stay on top of it the worse I got. Getting confused half way through class was the worst because then that meant the rest would just be a blank.

Another student alluded to the problem of relating math to everyday life:

Grade 10 I began to think that what they were teaching wasn't important and majority of what we were learning was not going to be used in the real world, (I) became bored in class. (I) had problems remembering steps when it came to tests and exams. (I) continuously have this problem.

The experiences of these two students were not unique, as others also echoed the same sentiments and it had an effect on how I was going to deliver the curriculum. I acknowledged that many students found it difficult to relate to mathematics in everyday life. Yet they never stopped to really think about how it actually surrounds us everyday.

### **Discussions of Accuracy versus Estimation**

An exercise in an article by Marilyn Burns nicely facilitates students thinking (Burns, 1998) about real life applications. (I engaged in this exercise early in the semester. My purpose was to get students to articulate for themselves the usefulness of math in their daily lives. I found this exercise challenging and exciting.) It entails two steps. The

first step involves listing situations in students' lives—outside work—when they need to do arithmetic. From this, the student sees that “doing arithmetic is a regular part of our lives” (Burns, 1998, p. 6). The next step was to separate these situations into tasks involving mental work/estimation calculations, paper and pencil calculations, finally calculator calculations. When I performed this exercise with my class, the results were the same as stated in the article: many found that most people performed mental or estimation calculations on a daily basis. A dialogue emerged whereby students realized that “there are disturbing mismatches between how we were taught arithmetic in school and what the arithmetic that we need to do in our daily lives really calls for” (Burns, 1998, p. 8). This prompted a discussion about the relevance of the math taught in school. This discussion was necessary for students to see that arithmetic methods we use “depends on the numbers we're dealing with, the context in which we encounter them, and the extent to which we need to be accurate (Burns, 1998, p. 11). Students also recognized that in real-life, we have to be able to estimate and know when estimates are appropriate (Burns, 1998, p. 11). Students also acknowledged that sometimes we actually solve problems differently inside and outside the classroom. As Heibert put it:

Outside of school, many.....seem to use their intuitions and conceptual understandings to decide what to do, what strategy to use. Inside of school, many.....try to recall and execute rules for solving problems “like this one” to find the answer. (Heibert, 1989, p. 39).

Once students acknowledge that real life situations and artificial classroom situations have different experiences, they begin to make sense of their own experience with mathematics.

### **Real Life Experiences of Students**

In the confines of the classroom, we sometimes forget the importance that real life experiences have on students' learning. One student stated:

One memory I have of math class was in my grade 12 class, we went to Wonderland for Math Day and we had to do this scavenger hunt....It was a positive experience and it made me realize just how much math we were exposed to and how even without realizing, we (were) doing math in our heads.

Another student wrote:

An outstanding memory that I had that was very positive was in high school, studying areas of a circle. This was a topic that was giving me a lot of difficulty, but after comparing it to a day to day activity; I realized that it was easy. Mathematics can be related to day to day life and

this made me somewhat more interested in math because in general math is not a subject that I am interested in at all.

So now that students recognize that math is real, what exercises in student's work will reflect this? Once again, I borrowed from Burns. In her article Talking Turkey About Arithmetic she suggests that students recognize how to use arithmetic to solve problems in a variety of contexts (Burns, 1998, p. 13). I asked students to plan an important meal for their family. We talked about uncertainty and variability and I provided them with guided questions as well as a rubric for evaluation. I was pleasantly surprised as I found students going above and beyond the boundaries of the assignment. The quality of the papers suggested that given a real-life problem, students were able to relate and make sense of it better. (This assignment was asked of students only after I taught them computational skills of whole number and fractions.) Solving a non-routine problem like meal planning and preparation enabled students to find individual ways to demonstrate their understanding of arithmetic. So the student who "became bored in class" and "had problems remembering steps" may be better able to relate back to this task when asked to perform the same arithmetic procedures in a test or exam. The feedback I received and conversations I overheard from students about this assignment, affirmed that the experience gained was relevant and real for them.

### **Attitudes, Beliefs, Emotions of Students**

In my experience, attitudes, beliefs and emotions of the student play an integral role in the learning of mathematics. I believe that student's attitudes, beliefs and emotions are an underestimated domain that often goes unchallenged in the classroom. This is more acute at the college level, where students already come prepackaged with certain views in mind. Having spent twelve years (or more in some cases) in formal mathematics learning, these students have very specific attitudes, beliefs and emotions embedded. In some instances, many years of negative experiences has built over the years to obstruct the learning in mathematics. In other cases, it took only one event to set the stage for future mathematics endeavors. Sometimes, I need to tease, sift out and negotiate these "affective factors" before I can begin to teach. McLeod and Ortega offer us a way to think about these set of factors:

Beliefs, attitudes, and emotions are terms that reflect the range of feelings and moods that make up our affective responses to mathematics. These terms vary from cold to hot in the level of intensity of the affect that they represent. They also vary in stability: Beliefs and attitudes are relatively stable and resistant to change, but emotional responses to mathematics may change rapidly. (McLeod & Ortega, 1993, p. 22)

One belief that I observed consistently throughout the “math moments” exercise, was one that questioned the student’s ability to do mathematics. These students often expressed a sense of powerlessness in performing mathematics. (See McLeod & Ortega, 1993, p. 29 on the myths associated with ability in mathematics in the U.S.) In three separate incidences students emphasized this point:

My outstanding memory in math class was not that great because when a topic got thrown my way and I do not understand it, it distracts me and I loose focus in the whole topic.

Another student outlines the frustration felt:

One memory that I have was failing grade twelve math. This class was a very bad experience for me because I struggled throughout the whole semester and barely passed each test or failed it. Towards the end, I tried really hard to pass the course, but I ended up failing the course and cried for a few hours. I was frustrated because I tried hard, but nothing seemed to work.

Another student shares memories of constant struggle:

I have struggled with math since elementary. So, all of my memories of math are pretty bad. Basically when it comes to math, I have this thing where “if I don’t get it, forget it”.

It is clear from the three stories above, that if students fail to experience success; their negative belief about their own ability in mathematics is hard to change. We must provide instances where students can be successful so that they can feel empowered to do mathematics. These moments must be built upon so that strong belief in negative ability can be changed little by little. In my classroom, I sometimes have students pair up to help talk each other through some math problems. This provides both individuals with an opportunity to share in “math talk” and in small ways also empowers them in their mathematical sense making journey. Sometimes students need to know that these feelings are a normal reaction to hard problems. (See McLeod, 1993 article where he outlines that students need to experience frustration in problem solving in order to change their affective response.) What is needed is for a teacher to negotiate honestly and sincerely by validating the attitudes and beliefs of students first. I firmly believe that once student’s affective response is met with honesty and sincerity, only then can the learning of mathematics occur in a meaningful way. Then both teacher and student work together in a common bond.

In many of the “math moments”, students believed that the teacher made a difference in the learning of mathematics. Some had negative memories, while others had positive ones. Below are three

examples of negative moments and three examples of positive ones. Three negative responses that hold the same view are as follows:

In math if the class moves at my speed then I can understand it and I will do well, but in grade twelve, my teacher was all over the place and it didn't really get through to me.

In the second example the student stated that:

I was never very good at math. I am horrible at multiplying and dividing. In grade five is where you learn how to multiply. I was made fun of by my grade five teacher. That's where I really hated math.

Finally, the last example of a negative memory where the student felt that the teacher had an impact was in the following:

One time in math class everyone knew the answer to a question, but the teacher called on me to answer the question, but I couldn't and someone shouted out the answer after a few seconds. It made me feel really stupid.

The instances of positive moments include three different scenarios. The first example is when a student stated that:

During my elementary school years, especially grade seven and eight, my experience in grade seven was not all that good. I wasn't doing that well and I simply did not enjoy it. Coming into grade eight the last thing I wanted to do was go to that math class. However, one thing changed my view on math; my teacher. He helped me a lot. I guess just the influence of one person can change everything.

The second example a student stated that:

I had a really good experience with my grade twelve math course because the teacher was amazing. She was helpful and tried different ways explaining something until the person understood the material. I never knew I could actually enjoy math as much as I did.

In the final example of student moments involving positive teacher influence, it was stated that:

My memory regarding math is not a certain moment but a certain teacher. He was always there whenever I needed help and never got frustrated if I asked a lot of

questions. He made math fun and easy to learn.

It is evident from the above “math moments” that the role of the teacher is essential in helping students understand and engage in the mathematics.

### **Teacher’s Beliefs and Attitudes**

Often, a teacher’s own beliefs and attitudes come into play. An article by Karp entitled “Elementary school teachers’ attitudes toward mathematics: the impact on students’ autonomous learning skills” (Karp, 1991) examined teachers’ attitudes toward mathematics and the impact that the attitude had on their students. The sample of teachers was purposefully selected so that the two opposite spectrums of attitude were clearly delineated. Teachers with positive attitude and those with negative attitudes regarding mathematics were specifically selected. The results of the study speak to two major themes emerging of teachers with negative attitudes regarding mathematics: teacher dependence and learned helplessness. It was found that teachers with negative attitudes were observed providing instruction which was based on rules and memorization (Karp, 1991). This type of teaching reinforces the belief that the teacher is the only source of information and learning. The implication of this is that students may be unable to transfer the learned skills or apply higher level thinking to novel situations without the help of the teacher (Karp, 1991). The other finding of teachers with negative attitudes was one of learned helplessness. By their behavior, (limiting students’ active involvement and opportunities to respond to questions, spending extended periods of time with individual students, asking questions and immediately answering them) they affected a students’ ability to have control over a learning situation (Karp, 1991).

In contrast, teachers with positive attitudes used instructional methods that encouraged student independence. Some of the behaviors exhibited by these teachers included: focusing on the “why” of algorithms working, less rule-based instruction, resources other than the teacher for self-instruction and requesting that students prove their answers (Karp, 1991). The above teacher behavior encouraged self-instruction, reflective thinking and self-correcting in their students (Karp, 1991). By doing so, students are able to learn and think independently and are better prepared to deal with real life problems. The teacher must model not only “conversations by listening to students, following students’ arguments and encouraging students’ attempts to support (or challenge) assertions of knowledge”, (Smith, 2003, p. 13) but also must provide the emotional and attitudinal support necessary to deepen their knowledge construction. Once these are met, the student will be empowered to build, adapt and construct their own relevant mathematical knowledge more positively in terms of their world. In doing so, the teacher can become a positive influence in the student’s learning of mathematics. The fact that I received more positive comments about the teacher’s role in math learning (in the “math moments”) than negative leaves me optimistic.



If student's attitudes, beliefs and feelings are to change for the better, the teacher must also convey positive attitudes, beliefs and feelings.

### **Final Thoughts on Engaging the College Mathematics Learner**

Positive classroom culture that enriches class beliefs, attitudes and behavior patterns as well as effective collaborative activities is therefore seen as key factors in building class community that moves toward engaged ownership in learning. Students can be directed to participate in small or large groups where the conversation of mathematics is encouraged. Creative tasks need to be designed in such ways that do not "require the imposition of a definite right answer upon the student" (Smith, 2003, p. 19). Too much of what we ask our students to do involves computation or following the algorithms in a directed way. Students need to understand that "mathematics is a lens with which we can investigate our world rather than an exercise in calculation" (Smith, 2003, p. 20). We need to encourage dialogue of problem solving among and between students. To this end, perhaps a journal writing activity might be asked of students to complete that shares their thoughts, ideas and discussions in group situations. This would provide a forum in which students could communicate in a different way, their knowledge production of mathematics.

Teaching and learning are complex activities. Engaging the adult learner in mathematics is often tricky as they come with previous knowledge and experience. It is hoped that in hearing a student voice in the day to day activities of the classroom, it can better inform the way we teach. Sometimes, a written reflection of student's attitudes, beliefs and feelings is a good starting point in that direction (as in the case of writing about "math moments"). This type of dialogue engages the learner at the very beginning and is necessary in setting the positive atmosphere so that learning can occur. I do hear their voices and I try to make it permeate every facet of my teaching practice. Once we have accepted the challenge of investing in issues that confront students in their mathematical journey, only then, can we hope to involve teaching as an activity that moves beyond the classroom to produce students who are globally trained critical and autonomous thinkers. Their collective voices should sound the beacon for how we should approach the teaching and learning of mathematics.

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