22 Math Learning through Electronic Journaling

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Walls to Learning

> I have been pretty confused this week because I am very math illiterate. Math makes me nervous and I think that I am going to have some difficulty with this class.
>
> I have always tried to stay away from math because it is not a subject in which I ever did very well.

In statements like these we see problems that teacher education students, particularly females, bring to their mathematics courses (National Research Council 1989). Many prospective elementary and early childhood teachers are uncomfortable with their own ability to learn mathematics. Their prior experiences have been all-but-encouraging, so new encounters with math are entered with trepidation and fear, further hindering new attempts to learn math (Fennema & Hart 1994; Williams 1988). Educational applications of neuroscientific research call this type of phenomenon "downshifting" of the brain. Most people are familiar with downshifting from high-stress level situations, tests and the like where the brain seems to "freeze" instead of processing knowledge or information, although the material might be well learned and immediately accessible after the stress is removed (Hart 1986; Jensen 1995; Sylwester 1995). Preservice teachers' negative emotions are interfering with their learning of mathematics. This interference is problematic, for it occurs at a time when the philosophy of and curriculum for precollegiate math education is being revised and new demands are being placed on teachers' mathematics knowledge base (National Council of Teachers of Mathematics 1989). These revisions require that these students must study mathematics if they are going to be able to implement best practices in their classrooms (National Council of Teachers of Mathematics 1991). As we strive to empower young learners, we need to mathematically empower those who teach math with both an intrinsic motivation for the subject and the ability to engage in genuine dialogue (Cuevas 1995). The problem then is how to accomplish two tasks:

- to help reluctant students overcome their fear of the subject, and
- to raise to an acceptable level the mathematical knowledge base of these same students.

One component of the answer I have explored is the use of e-mail journals. The students taking the required math course for elementary, early childhood, and special education majors submit electronically a weekly journal entry. What follows describes this pedagogical exploration.

A Plan for Passage

The decision to use e-mail journals in the math cognate course was based on my experience as a teacher and my reading of several areas of research. After teaching preservice teachers math for several years, it was clear to me that their attitudes were interfering with students' ability to engage the course material. It appeared that the students had placed a wall between themselves and the course. The intuitive-affective barrier described by Lozanov (1978) in which the learner rejects everything which fails to create confidence and a feeling of security was a clear factor influencing the students' mathematical development. A portal through that wall was needed.

During my first three years of teaching this course, I began to connect the problem of math anxiety with writing across the curriculum, the benefits of metacognitive thought, and the effective use of telecommunications. Advocates of writing across the curriculum suggest that by having students write in the various disciplines they will make stronger connections between their current learning experiences and previously developed knowledge schemata (Kelly 1995; Smagorinsky 1995). "One learns by writing. Writing is an integral part of the learning process because it enhances and supports what one reads and thinks about. One way to help remember something is to write it down: The act of writing reinforces what is spoken aloud or pictured in the mind" (Grinols 1988, 15). Literature also suggests that the inclusion of reflective practices promotes both a deeper understanding of the subject being studied and of the learning process itself (Henderson 1992; Schon 1987). The use of e-mail held the potential for enhancing the effect of a writing/reflecting activity (Sumrall & Sumrall 1995; Slovacek & Doyle-Nichols 1991). Female students brought to the class a higher propensity to be involved in language activities than in activities involving mathematics. Informal polling of my class showed that, if given a choice, most of the students would not take additional math classes. The use of a journal activity looked like a means to link these ideas. The writing process would allow the students to relax as they used their favored means of communications in a manner which had them engaging the content of the course and reflecting upon their experience. Possibly, journaling would be a key to opening a gateway to more productive learning.

Constructing an Opening

The journaling process I use today is somewhat different from the procedure I first tried. Initially, the students chose to use either paper and pencil or e-mail to summarize what had been studied in that day's class. The purpose of requiring summaries was the constructivist, brain-based theory that by revisiting current experiences, the building of knowledge constructs is enhanced (Wolffe & McMullen 1995; Brooks & Brooks 1993). Students were also encouraged to reflect on their learning experience. During class I suggested that they could discuss how they were learning, addressing both the nature of their frustrations and their successes. This metacognitive aspect was not required. Analysis of the first semester entries indicated that nearly 80 percent of the time the students adequately summarized the new content and nearly two-thirds of the students chose periodically to reflect upon their experience. As I will illustrate here, the content of the reflection showed that this aspect of the journaling process was crucial and needed to be made mandatory instead of being optional. It also became apparent that the writing should done using e-mail. For example, only 19 percent of those students communicating with paper and pencil ever used their journal entry as a means of posing questions. This was compared to 44 percent of those using e-mail who asked for further clarification about something being studied in class when they journaled. This first semester of journaling made it clear that the use of e-mail provides immediacy of dialogue between teacher and student. Next to private face-to-face meetings, e-mail seems to be the most effective means to communicate between teacher and student. The use of e-mail enabled the sender to articulate questions and concerns in writing. The receiver could then read and respond to the message quickly. This process could take place at any time of the day or night, rather than just during class, on the phone, or during a scheduled meeting. As one student who switched from paper-pencil journaling to using e-mail put it, "I think you should make e-mail journal entries mandatory. They are more prompt. Even though you always got paper journals back by the next class period, I had forgotten my questions. They just aren't as meaningful." (Wolffe & McMullen 1995, 27). What is most important is that the e-mail journals provide an ongoing opportunity to elicit thoughts about math content and the learning of this subject which might not have been expressed otherwise. With so many females reluctant even to take math courses, moving them to be reflective about the experience can be problematic. Through the use of e-mail, the teacher is able to work individually with each student, and through the energy created by this interaction move toward deeper and deeper thought.

The requirements for the first journal assignment were quite loose; the idea was that by providing a fair amount of choice, the students would be comfortable with the assignment. While no one expressed concerns with their ability to write the journals, it should be noted that a certain portion of the students did

not value this course requirement. They saw twice weekly entries as imposing on their time and/or as "busy work."

Since this first attempt, I have made three changes in the journaling. It did appear that having the assignments be a bit more defined did not take away from the students' attitude regarding the assignment and that there was potential for improving the effect. Therefore, the assignment now requires not only a summary of what was learned but also asks the students to talk about some aspect of their recent learning experiences which either went well or was problematic. Students no longer have a choice of using either e-mail or paper-and-pencil entries; all of the entries are to be sent electronically to me. Last, to decrease the dissatisfaction with doing this assignment, students may journal either after each class or at the end of each week.

A Door Worth Opening

The use of electronic journaling as just described has reaped many more benefits than I initially expected. The journal entries provided students an opportunity to express themselves in relationship to growth in content knowledge, self-image, understanding themselves as learners, and the ability to connect their own experiences to their futures as teachers. It is quite likely that many of these thoughts would not have been realized if they had not been required to formulate the ideas in their journal entries. The web shown in Figure 22.1 depicts the many areas being connected by students as they wrote their journals.

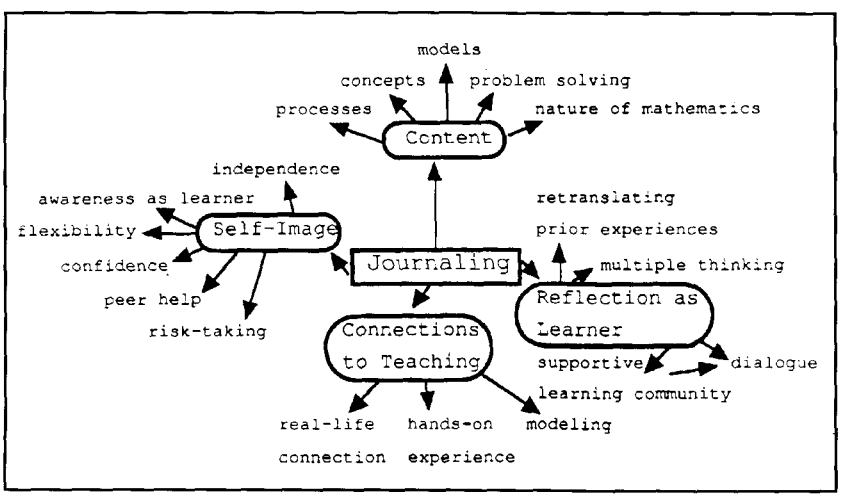

Figure 22.1. Web of ideas generated from student journals.

The summative aspect of the journal entries has motivated students to keep up with their readings and other assignments. While some students are not sold on the advantages of this requirement of reviewing what they have just learned, others have commented on the benefit of doing this as a part of their studying process. In addition, journals which include questions show how the students have used their entries to build their content knowledge. With some prodding by the instructor, the students have learned to ask questions within the context of what they already know. They pose questions related to concepts:

> Is this the correct procedure for differentiating the arithmetic sequence from the geometric ones? When the numbers increase by a common difference, it is an arithmetic sequence. While in geometric sequences, the numbers increase by the same ratio. Please correct me if I'm wrong.

and processes and models:

> I just had a question about the charged fields. I need to get something straight. When your adding and subtracting numbers, just when your adding, you cancel out the positive and the negative, but you don't cancel them out when your subtracting. Does that make any sense?

The questions also relate to content in the areas of problem solving and the nature of mathematics.

As students asked questions, they came to understand that even though they still have questions, they know a great deal. This is an important part of improving the students' self-image. The reflections also have worked well in bringing to a conscious level the writers' attitudes about themselves as math students. As the students reflect, the instructor reacts to the comments and poses questions to help the students expand their thoughts. The students' statements fall into a number of categories.

Some students express a new found awareness of themselves as risk-takers. One student commented:

> What I learned about myself from Wednesday's class is that I need to be more brave. The people in my group were having problems with that problem concerning marbles. I was able to complete it, but I wasn't exactly sure if I got the right answer. I didn't want to explain what I did to my group just because I was afraid I did it incorrectly and I would confuse them more. Later, you came over and showed us how to do it. It turned out that I did the problem right and it felt pretty good. I think I learned that I should be more willing to try even if I turn out to be wrong.

Other students' improved self-image is apparent in their reflections about working with their peers. Two students filed the following entries:

> *S1*: When we were going over the homework I felt pretty good about myself because the others at my table were asking for my help which not only

> made me feel smart, but it also made me feel like a leader and it tells me that I have a good grasp on the subject.
>
> *S2*: I would also like to thank you for taking the time to explain #16 on section 1.2 with our group. I actually understood where each preceding answer arrived from while working backwards. How am I sure of this? Because I was able to help someone in another group with this identical problem at the end of class.

Some students seem shocked that they actually can learn mathematics: "The sections that we covered for class this week I actually think I understand." This revelation may be somewhat shocking for some students because they have little to no prior experience constructing their own knowledge of math. Female students more than males are often given less help when they encounter difficulties in precollegiate math classes. This entry above and the one which follows speak directly to the students' increased confidence and an emerging belief in themselves as independent learners:

> I feel more comfortable with the math problems now. I am learning shorter ways to get the answer, but it takes a while. I always start with the long way first, but then the light comes on later. I am a lot neater with the solving of the problems. I am also coming out of that math phobia that I had.

Finally, the students' journals relate to their enhanced self-image as they write about their newly constructed awareness of the need for flexibility when solving math problems. One student wrote, "I am glad that I am learning to work these problems in a new way. I finally am starting to feel comfortable in solving a problem in more than one way."

Connected to the students' expressions of improved self-image are the insights they gain about themselves as learners as they think about their experiences in this math class. As was the case with self-image, the entries related to reflections on being a learner fall into several categories.

One area discussed in a number of entries is the need to retranslate one's prior learning experiences into more effective learning practices. The students recognize that how they learned in the past can impede their current progress. Two comments are indicative of this type of thought:

> *S1*: The problems assigned in this section proved to be challenging to say the least. I am trying to look at the integer relations from a teaching perspective, but I seem to keep falling back on the notion that "I know the rule so this is the answer." In other words, I tend to want to just give the answer than show why or how I know the answer. It's tough!
>
> *S2*: I had a hard time at first with chapter one, but after working through the problems with my group I have come to realize that the reason I have trouble with these problems is because I am not used to thinking in the way I am required to in order to solve these problems. It is as if I have to train my brain to a whole different way of thinking.

Students also communicated the need to consider multiple thinking strategies if they are to be successful learners:

> By building the problem, I was able to see visually the rows and columns of the triangle pieces and how they fit together to form a rectangle. Building helps you to move the pieces around and manipulate the shape to possibly come to new conclusion or equation. In the future I won't be afraid to build and then rearrange a problem in different ways until finding a solution.

Furthermore, the students reflect their own learning processes in relationship to setting their own pace so they can have the time to understand new material. This idea is apparent in the following journal entry:

> The use of the cubes definitely influenced me positively as a learner. The use helped me because the cubes made the problem "real." We could see it. I was able to do my homework and understand it better because of the cubes. The activity made me slow down and think of why I was doing what I was doing rather than just rush through just to get an answer. I actually took time to understand the homework and thus I believe did a better job.

The reflections on being a successful learner show insights concerning the need for a supportive learning community and for dialogue. One student writes, "I have trouble when I am trying to do my homework alone, but if I can talk out the problem then it seems to be easier." Another entry recalls,

> I'm feeling more confident this week about understanding the material. I find it helpful to know the different strategies that could help lead to an answer to the problem. I talked to another girl in the class, who lives on my floor, and she understands the material pretty well. She said she would be willing to help me work through the problems if I needed help. We worked on the homework together. She helped me understand some of the problems. I think that if I learn how she knows what strategies to try, eventually I will be able to see the strategies by myself.

Some of the students expanded their reflections regarding their own learning experience and discussed how their own efforts to comprehend mathematics would influence their actions as a teacher in the future. The students' writings capture how important it is for teachers to provide learners real-life connections, hands-on experience and a chance to work with models. By thinking and writing about their own experience, they are becoming aware of what Peltonen (1985) reports in his research about learning. Within total learning 10 percent is learned through hearing; 30 percent through seeing; 50 percent through seeing and hearing; 70 percent through talking, seeing, and hearing; and 90 percent through doing, talking, seeing, and hearing. The more multimodal learning experiences are, the more effective learning will be. Two students came to the following conclusions:

> *S1*: Wednesday we played with the flats, longs, cubes and singular thingies which I can't remember the name for! We built a multiplication problem out of them and dissected the pieces to see many different multiplication problems within. It was the first time I had ever done this, so I was a little confused at first, but I think I'm cool with it now. In my opinion, I think it's really good that we're learning in OUR class how to use these items to solve OUR problems, so we can use them in our FUTURE classes to help our students learn as well.
>
> *S2*: Wednesday's class was especially good because we got to play with the manipulatives. It was very helpful to have those when we are trying to understand the concepts. Everyone in the class knows how to add, subtract, multiply, and divide, but it makes everything so much clearer when we can make and have our own sets right in front of us. When I teach, I am definitely going to make math more of a hands-on experience for my students. I remember learning math by working on probably hundreds of dittos. I learn better by doing and I am sure that the children I teach one day will be the same way.

It is clear from the comments reported above that having students record through e-mail journals both what they are learning about math and reflections on the learning process can lead to many intertwined positive effects. As students submit their entries and read the instructor's responses, they are stimulated by purposeful thought which makes it more likely that they will become cognizant of their successes as learners and will become aware of how they came to be successful. The importance of the fact that the students' self-esteem is enhanced should not be underestimated. As they become aware of their own learning styles, they become more effective learners and they begin to connect their collegiate course work with their future aspirations. There is no reason to believe that the positive impact journaling has had on these math students could not be repeated in courses in other disciplines. The interactions between attitude, metacognitive analysis of one's own learning, and the ability to project one's learning onto future goals is not specific to any particular discipline. E-mail journaling is a beneficial way to foster these interactions in a manner which is efficient, effective, and empowering. All students can benefit from a better understanding of their image of themselves as learners, of their learning processes, and of how their present efforts connect to their future dreams and aspirations.

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