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ABSTRACT

This publication focuses on the work of one bright but math avoidant student in a writing seminar in mathematics. The introductory portion of the document explains the philosophy, goals, and activities of the seminar. The course is intended to provide opportunities for students in the humanities to experience mathematics as a discipline at once creative, intuitive, and historical, with special attention to the alienation of women from mathematics. Topics considered might include Pascal's triangle, the Pythagorean theorem, the Fibonacci sequence, the golden ratio, the roles of zero and the square root of 2 in the number system, and geometries beyond Euclid's. Through informal writing in a personal journal the students: (1) record their insights on the mathematical activities done in class; (2) record their reactions to the course and to writings about mathematics; (3) ponder their views of mathematics as a field of knowledge and their recollections about being taught mathematics; and (4) develop their ideas for use in the writing of short essays. After this general discussion, excerpts from the student's journal are presented in the second half of the paper. (PK)

To Carolyn Werbel

Whose spirit and drive "forced me sometimes against my will" (entry 26) to see in new depth the disparity between our goals for mathematics learning and our classroom practices.

She continues her struggle (now at a large state university) to be true to her spirit, to learn, and to earn an academic degree -- efforts that often conflict.

With deep gratitude to Susan Laird, Kathryn Quina, Blythe Clinchy, Carolyn Werbel, Anne Fausto-Sterling, Nona Lyons, and Jill Tarule who read and responded to various drafts of this paper over the past year, who deepened my understanding of Carolyn's words and Carolyn's struggle, who urged me to complete this project, and whose questions have given new directions to my continuing work in mathematics education.

Carolyn Werbel's Journal:
Voicing the Struggle to Make Meaning of Mathematics

by Dorothy Buerk
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> Keeping a journal was my favorite part of the class. I got to yell, scream, rant, rave, and just plain complain about math. Once done, "out of my system," I could begin exploring things that interested me. I could express whatever I desired about math and not have you rip it up as slanderous garbage.
>
> The journal for me was an outlet of many ideas. More than that, though, it forced me - sometimes against my will - to develop those ideas. (Carolyn, journal entry 26)

As a traditional-aged exploratory freshman, Carolyn wrote these words in her journal in my Writing Seminar in Mathematics, a writing-across-the-curriculum course at Ithaca College, a private, co-educational, four-year school in upstate New York. She has encouraged me to share her story in the hope that it "might help save someone else." Regularly enrolling about sixty percent female students, the course provides opportunities for students in the humanities to share mathematics as a discipline at once creative, intuitive, and historical. They ponder such topics as Pascal's triangle, the Pythagorean theorem, the Fibonacci sequence, the golden ratio, the roles of zero and the square root of 2 in our number system, and geometries beyond Euclid's. Through informal writing in a personal journal, they record their insights on the mathematical activities done in class; they record their responses to the course and to writings about mathematics; they ponder their views of mathematics as a field of knowledge and their recollections about being taught mathematics; and, in addition, they can develop their ideas ("sometimes against my will," as Carolyn said) for use in the writing of short essays, the more formal writing of the course.

While I suggested various journal topics to students, I also encouraged them to use the journal in their own ways. Each student wrote two two-page entries weekly and I responded to the ideas in each student's journal biweekly. I tried to develop dialogues with my students within the journals, through my questions and comments. These questions and comments asked for clarification, encouraged deeper thinking, raised alternative points of view, and expressed my support of the students' attempts to understand the material and their individual responses to it. I responded to misconceptions about mathematics with questions or examples that might give contradictory or unintended results. I encouraged students to respond to my comments in their journals. The course textbook, The Whole Craft of Number (Campbell 1976), helped students develop their thinking about mathematics. The book develops mathematics historically and in depth, but with the questions and skepticism of those on the fringes of mathematics in mind. Chapters are often followed by "counteressays" offering different points of view. Students found that these counteressays helped them to find their own viewpoints about mathematical notions and to realize that even in mathematics there are disagreements.

Carolyn came to my course feeling negatively about mathematics and about her past experiences with it. Her friend, Kate, and her advisor, encouraged her to enroll and she had just received an A in a fundamentals of mathematics course (a course in concept development at the pre-calculus level) at the college. Her struggle with herself as a mathematics student and with her ambivalence about the course are evident throughout her journal beginning with her first journal entry.

Much of the work on mathematics avoidance tries to find ways to help women like Carolyn survive in the traditional mathematics classroom. This work does not address the larger issue of how the mathematics curriculum might be changed to accommodate women. Peggy McIntosh (1983) describes the interactive phases to be used as we work at integrating the new research on women into curricula in which part of the content is, or should be, women's lives and experience. But how do we deal with a curriculum like mathematics? Jane Roland Martin (1985) has suggested that the feminist transformation of the curriculum involves more than the "very legitimate concern over the genderization of the subject matter of the liberal curriculum," arguing that the values fundamental to liberal education itself may be implicitly genderized. What are the new questions that arise for women in disciplines like mathematics, where the content appears impersonal so that integrating women into the curriculum is not clearly an issue, even while women's alienation from the curriculum does remain an issue?

I have been concerned for many years about the ways in which the classroom presentation of mathematics distorts the very nature of mathematics as it is understood by mathematicians, by making it appear absolute rather than constructed (Buerk 1985). The voices of my women students have most forcefully made this problem clear. Through listening to the voices of women, Mary Belenky, Blythe Clinchy, Nancy Goldberger, and Jill Tarule (1985) have traced women's ways of thinking about thinking and about themselves as knowers. Using the metaphor of "gaining a voice" they describe a process that for many moves from absolute acceptance of others' words and ideas to integration of "constructed knowledge." My research as a teacher, including this case study of Carolyn, indicates that a similar process to gain one's mathematical voice is the central educational task of the woman mathematics student. Important to that process, reflection upon firsthand experience with mathematical ideas precedes any movement to abstract those ideas. (See Clinchy, Belenky, Goldberger, and Tarule (1985) on the importance of including firsthand experience in the learning process.)

My research explicitly aims to understand what effect the mathematics curriculum and mathematics teaching have on women in the liberal education context. My approach to this question with women students is analogous to Mina Shaughnessy's work (1977) with urban Basic Writing students alienated from written English language. My students, especially the women (including Carolyn), are similarly alienated from mathematics. I am adapting, to the mathematical context, Shaughnessy's method of making case studies of students, following them along their own developmental paths, trying to understand the logic of their errors and the complexity of their learning tasks from their perspectives, in order to make an instructive mediation between their expectations and those of the discipline. As in Shaughnessy's work, I have found that this mediation involves basic curricular changes, which the "Writing Seminar in Mathematics" itself exemplifies.

The purpose of the paper then, is to engage you in listening to the "voice" of a bright, math avoidant women as she experiences mathematics in a new way and struggles to put her past experiences in some perspective and to make mathematics meaningful for herself. What follows are some of my concerns about mathematics education for those not "gifted" in it and some guideposts for you to keep in mind as you read excerpts from Carolyn's journal from the course. She has graciously given me permission to share it with you.

I have separated Carolyn's words from my own words deliberately. In reading her words, we can see her struggle with mathematics; we can feel the power of her negative experiences in the mathematics classroom; we can see and hear her growth and the deepening of her ideas and understanding. We can see her working to make mathematical concepts meaningful, working to overcome her misconceptions about mathematics, and, if you teach mathematics, you can see that some misconceptions remain. You may also see Carolyn's growing trust in me as the reader of her journal and the collegial relationship that begins to develop between us. I believe that to interrupt Carolyn once she begins to speak would distract us from her experience and our own efforts to understand that experience. Therefore, before Carolyn speaks, let me speak briefly about my teaching and about Carolyn's journal.

Through careful listening to my students, I have learned that at least two major beliefs about mathematics inhibit the learning of mathematics for many like Carolyn. The first is the conception that mathematics is made up **only** of rules, formulas, algorithims, and proofs to be memorized; skills requiring rote, but meaningless practice; and methods to be followed precisely. This view of knowledge is called "dualistic" by psychologist William G. Perry, Jr. (1970, 1981). His theory of intellectual growth suggests a sequence of ways that college students and adults conceptualize knowledge and provides a frame of reference to use in interpreting this "dualistic" view of mathematics as a field of knowledge. He defines dualism as:

> Division of meaning into two realms -- Good versus Bad, Right versus Wrong, We versus They, All that is not Success is Failure, and the like. Right Answers exist somewhere for every problem, and the authorities know them. Right Answers are to be memorized by hard work. Knowledge is quantitative. Agency is experienced as "out there" in Authority, test scores, the Right Job. (1981, p. 79)

The second belief is that mathematics was not "person-made," but rather, existed always as a finished, polished product - a view that prevents many from finding a way to make it meaningful to themselves. Even those who do acknowledge that mathematicians create mathematics believe that the proofs that verify mathematical statements come out of the heads of mathematicians in concise form without the need for revision. They believe that the minds of mathematicians work only deductively. (See Buerk 1985.)

These beliefs, the "dualistic" conception of mathematical knowledge and the belief that mathematics was not "person-made," seem to be particularly problematic for women. The work of Carol Gilligan (1982) has extended my thinking on these issues. Gilligan postulates a way of thinking I have found applicable to mathematics. This way of thinking suggests a view of mathematics as global, contextual, and intuitive, one that considers the relationships between ideas and the limitations of solutions. Although this reasoning style is consistent with the way many mathematicians actually create mathematics, it is inconsistent with most teaching methods and most curricular expectations in the field. (See Buerk 1986.)

I have over twenty-five years of mathematics teaching experience in various settings: two-year college, four-year private college, state university evening division, experimental high school, overseas military hospital, and maximum security correctional facility. This wide-ranging experience has challenged me to develop strategies to help students move away from a "dualistic" view of mathematical knowledge, become aware of the person-made quality of mathematics, and develop confidence in their own abilities to do mathematics. These strategies include placing topics in their historical context, acknowledging and encouraging alternative methods and approaches, encouraging collaboration in mathematics learning, helping students to value their own intuitions and experiences with mathematics, developing a means to check and test the theory that is developed from these intuitions and experiences, making concerted efforts to avoid absolute language, and offering opportunities for students to reflect on paper about their ideas and feelings about mathematics. (See Buerk 1985 for an elaboration of these strategies.)

I made extensive use of these strategies in the writing seminar to help Carolyn and her classmates gain confidence and power in relationship to mathematics. This approach to mathematics provided Carolyn the opportunity to struggle with the past and present and, in a reflective and insightful way, to see herself as a student of mathematics. Her journal recorded the richness of her experience.

Carolyn, like many other students I talk with, describes mathematics in the context of specific incidents involving specific teachers (entry 6). David, a classmate who hoped to teach mathematics someday, triggered in Carolyn some reflections on the ways that she had been taught mathematics (entries 11 and 14). The journal also provided an outlet for the frustrations caused by Carolyn's interactions with David in the classroom, an outlet not often available in the setting of the mathematics classroom.

In entry 10 Carolyn mentions "a certain part of two that is half of 2" when discussing the square root of two. I asked her how half of 2 differed from the square root of 2 (for they are very different). In entry 27 she acknowledges her confusion.

Two-thirds of the way through the course I read to the class my paper, "Sharing Meanings in Mathematics: An Approach for Teachers" (1986). I shared it both as a sample of my own writing and as an expression of my teaching philosophy. I also made it available for students to reread and to respond to in their journals. Carolyn did this in entry 25.

Carolyn used her journal to reflect on her past experiences and struggled with her conception of mathematics as a discipline and with herself as a student of mathematics. Her experience with the development of the notion of a non-Euclidean geometry was particularly insightful to me. We spent several classes talking about Euclidean geometry (geometry on a flat plane) and the possibility of a comparable geometry on the surface of a sphere. We used a large rubber ball as our model, with rubber bands as candidates for "lines." We agreed that we needed to decide what a "straight line" might be **ON THE SURFACE** of our ball before we could talk about geometric figures formed by straight lines. Most of the class agreed that a straight line on a sphere was a great-circle (a "line" that would cut the sphere in two equal hemispheres as the equator "cuts" the earth). Carolyn realized that her definition of straight line was deeply tied to the plane and her high school training in Euclidean geometry. She struggled with the idea of a "straight line" bending, which it must do to stay ON the surface of the sphere. She worked on her own definition and listened to the class discussion, easing some of her frustration with a playful approach to "line" (entry 12).

Finally, she conceded to our great-circle definition of straight line, but was distressed by some new properties of triangles that emerged. For example, we demonstrated a triangle which, we all agreed, had three right angles. (Imagine two "lines" meeting in a right angle at the north pole. Extend these "lines" so they each form a right angle with the equator. Rubber bands on a grapefruit may help you to see this triangle.) Carolyn struggled with what she saw and demanded "guidelines." Carolyn, who doesn't like mathematics and doesn't want to remember what she learned in earlier courses (entry 1), questions assumptions and demands definitions, guidelines, and order as a mathematician would (entries 12 and 17).

Several themes emerge in the text of Carolyn's journal, which follows: mathematics teachers use trickery and stealth rather than honesty (entries 4, 8, 11, and 25); mathematicians lack compassion (entries 2 and 4); teachers often misread her responses and reactions (entry 14); and the journal process was both difficult and rewarding (entries 14, 26, and 27). Carolyn seems to be asking that we consider what is fair as we teach, but that we cannot succeed if we do not also care (entries 14 and 25). She wants to make mathematics meaningful to herself. For Carolyn, as for many of my students, keeping a "math journal" provided a means to do just that.

Here, then, are excerpts from Carolyn's journal for the course, "A Writing Seminar in Mathematics."

Entry 1 - Reflect on the course after attending one class.

> When I got to Ithaca College I realized I blew the math exam. Boy, did I feel inadequate. I had always worked hard in math. I always could sense the patterns, feel them, I just could never do them! Ugh. My advisor sort of conned me into the class and admittedly I was gung-ho.
>
> I realized that after passing Math 100 with an A, I was theoretically allowed to go on. What I couldn't figure out is how I got that grade and to this day, I believe that the professor helped me out. Even if he didn't, I could never

remember anything I learned, nor would I care to.

Before class began I really wanted to cop out! I kept asking myself why I am in this class when IC offers so many other amazing courses that travel more along my path of interest. My best friend, Kate, told me to stay and if nothing else to benefit from a small classroom experience which I must admit is something I am very excited about.

After the first class I still wonder what I'm doing and this little man inside me keeps yelling, "Quick, run to registrar, you still have time to get out before you regret it." Another little man says, "Don't be stupid, you're in college now, stay cool."

Entry 2 - Respond to Campbell's counteressay, p. 18.

I agree with the counteressay, "A Reply from the Radical Right," (Campbell 1976) which says that "Knowledge is worthless unless related to human needs." It's nice to know that some people find mathematical theory interesting, but I find no reason to study it.

I am a person who needs a good, humane reason for everything. Math is too logical, too structural. It gives no room for compassion.

Entry 4 - Read and write about a woman in mathematician.

A woman in mathematics seems to me one whose characteristics are more on the intellectual, unemotional side. Mathematicians represent logic, skill, and science. Not compassion, honesty, and love.

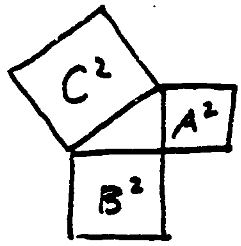
Personally, when I came to Ithaca College, I was considering becoming a teacher . . . and I still am. There's supposed to be a clause somewhere that says Reagan will pay for your education if you become a math or science teacher. I felt it would be worth it, even though it wasn't my favorite, to have my education paid for. I know I can do a better job than all the men teachers I've had. They are boring, have no wit, and just repeat everything from the book.

I, on the other hand, would do amazingly well teaching little kids how to add. I'd tickle them, and prod them, and play with them, and then I'd stick it to 'em! Huh, they'd never even know they were learning math.

Entry 5 - After "proving" the Pythagorean Theorem.

[Students used the same geometric shapes to convince themselves that the square on the hypotenuse of a right triangle (c^2) has the same area as the sum of the squares on the two legs ($a^2 + b^2$).]

The Pythagorean Theorem is an amazing theorem. It really works!! What I found very interesting were the squares you can make along the edges of the triangle.



(Just drew them 'cause they're so neat!)

What is so neat about the squares to me is that they express geometry very visually. I see clearly how it works. The theorem is one of the few in mathematics that I find logical. Doing the squares on the sides of the triangle pointed out a neat origin and a whole different form of logic. So, while the algebraic form of the Pythagorean Theorem is nicely concise, the geometric side adds nice background as well as a second proof of its validity, and some interesting history to boot.

Entry 6 – To you, what is mathematics?

Mathematics, to me is a variety of things. Mostly in my memory, it is the people who have caused mathematics to be enjoyable or unpleasant. My earliest memory of math began as a positive experience. I got up to long division. I understood pretty well, but more than that they looked neat! Each column fit right under another, my big red pencil made perfect numbers. Each problem looked like a distinct, long, eloquent giraffe. I remember long division to this day as giraffes. I guess I needed help. Ms. Natland, my teacher and now my friend taught me those giraffe problems with patience, understanding, and most of all the love that everything she touched had.

Early mathematics to me is friendship and challenges. It wasn't until middle school that I grew restless, impatient, and frustrated with my teachers and the repetitiveness of the books, as well as the blank, matter-of-fact methodology of teaching.

Entry 8 – Reflect on the notion of proof.

The nature of proof is one that should always be questioned. Precisely for the reason that it is a proof. When I think about the many aspects of just one question, and how easily you can be tricked into believing something false, it's amazing. Proof is not something that just happens in math. It is a central idea.

Random House's first definition of proof is "evidence sufficient to establish a thing as true or believable." This is a good statement. In math sometimes hard to believe. Why proof you ask. To make sure your numbers, terms, patterns are believable, concrete, or real. If they aren't, the basis for all mathematical work would not be accurate.

Interestingly enough, in our book there is the idea of counterproofs. For example: proving that the square root of 2 is not a rational number and that $x^2 = 2$ is not a rational equation. The idea of these counterproofs should be just considered another aspect of proof. They offer final statements, and proof that the square root of 2 is not a rational number as "true or believable."

Another reason for proofs is in geometry. Once I had the knowledge of the first beginning postulates I knew I could continue on and establish more and more. Proofs is what geometry is all about. It makes intangible ideas tangible. It makes geometry exciting and endless. Proving proofs is also interesting.

Why proofs? Well, reasons are endless, but overall to make things believable. Math should be concise and clear. Proof is the evidence to support yourself in anything you do.

Entry 10 – On the square root of 2.

I think it's funny that brilliant mathematicians can find prime numbers 30 digits long, send people to the moon, but can't find the square root of 2. $x^2 = 2$ has got to be literally the simplest equation that I have seen, algebraically speaking. It is fascinating and curious as to why there is no easy answer.

We DO know there is a certain part of two that is half of 2, if we could just get our fingers on it. [See entry 27 where Carolyn corrects this misconception.] If we keep sending people to space and using increased technological data we should soon enough find the square root of 2 and its properties. Or even before that we may decide that "consumption" with finding the square root of 2 may not need to be an unending priority and we may let well enough alone.

Entry 11 – Reflecting on the course at midterm.

I find this course interesting. The major thing I do like in it is the very clear and concise steps we take in everything we do. Everything moves slowly, no rush to comprehend and get things shoved down my throat. I feel as if I'm not "cramming" my way through the hour and a half, but as I walk down the hall after class, I can't help but giggle as to how much you snuck in.

I also like, as mentioned before, the small classroom environment. It's pretty neat to get to know everyone, whether or not I like them. It's also a neat room because its so small it usually forces me to direct my attention to the blackboard.

I like the stuff we're dealing with because as you pointed out it is the backbone of a lot of other mathematical material. It is also interesting to be able to work both ways on the material. To go from the present way of thinking to the past, and from the past to the present. My biggest fear of the course is not getting a good grade. Especially easy to say as it looms up in front of me in 3 days. I know that tests and I don't get along, but also that in this case it's all information I could deal with. Primes have been giving me nightmares as I feel I have milked them to death, and have nothing left to say.

Another fear I have is of David becoming a math teacher of young women. They'd probably have to be cute and flirt to get an A. Ugh.

I am pleased with my work in this course.

Entry 14 – An entry of her own design.

Although this isn't an assigned journal entry, there are two things, I've been trying to write down. While I could write them in my personal journal, I'd rather save that for mushier/love, stuff.

The first thing I have to question, is David's ability to be a math teacher. That is very, very closely aligned to my being a math student.

As a kid I have a lot of spirit, and drive. As a student, I don't. I know that, and I know that I usually can't contain myself. The problem lies with the fact that I use my spirit against my student.

I also know, that for some reason, this aspect of myself has particularly frustrated and annoyed the majority of my math and science teachers. Although I can recall one jerk of a music teacher, and one history bore. But for some reason, David has particularly sparked the memories that are so startlingly quite painful.

Those memories, of men, or more rightly I guess, teachers, who tried with all their might in the world to break my spirit. Men who for the "sake of classroom discipline" found it necessary to stifle and frustrate me. Or more degradingly, send me to the principals' offices. Those teachers never got any math or science through to me, and I still hate their guts. God knows, how much David reminds me of them. But how funny, how loud and outspoken he is as a student.

Somehow almost spoo..ily, I think they see a need to break people's spirit. Past that, I can't explain what it is. I really try, as I have tried to explain to parents, friends, and administrators, but I just can't figure out what it is. It makes me sad to think, how so many of my friends and I fought against something so much bigger than ourselves, or David, but how badly we lost. Are teachers supposed to enforce the system, be the system, or the individuals they are?

How can they do a job of caring, and sharing, when they must discipline and enforce behavior? On the other hand, how can they not? A child must be educated, but did they have to force it down my throat? And tie me to chairs with threats? Maybe that was the only way, I wish it wasn't.

They didn't break me. I may be defeated temporarily, because they did a damn good job. David is just another in the accepting, the never-ending, always replenishing chain that doesn't question love or life. He just is, and that's scary.

The second aspect I wanted to explore is why I have so much trouble with these stupid journal entries. I can't seem to be interested in writing two pages about losing a square to a rectangle. Ask me to write 10 pages about the sky, or about love, or about hate, or about poverty. I could do it, but 2 pages of math journal might as well be a term paper.

Similarly, ask me to describe English teachers, and I would do so happily. One particular man, was not only the farthest thing from a jerk, but a great teacher, a good friend, and a trusted confidant. While math teachers, (you of course as an exception) are jerks. Hee, hee!

Where do the two tie together. I'm not sure. Did I hate math, or my teachers, which first? Why did I enjoy high school chemistry and geometry so much? Where can that lead? How does that tie in to Shakespeare? How does any of that lessen the pain David brings out. Why do I feel as if he will inflict it on someone else. Why do I feel it would be out of both their power anyway?

Entry 12 - **On geometry on the sphere.**

Everything dealing with a plane has to do with straight lines. My definition of a straight line is the shortest distance between two points, <u>AND</u> a line that will never touch itself, and continue forever.

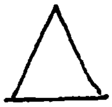
Random House says, a "mark made to divide an area, determine a direction, distribution or limit", etc.

Also under the same "line" they say you could be handing me a "line" to believe that where you draw the "line" I should toe the "line." But I think you're out of "line" and that whether or not you hold the "line", I'm going to go ahead and read between the "lines."

So, a line doesn't just have to be the shortest point. But for geometry's point of view I think that's what it should be. It is the basis for all other geometry. Triangles have to be made of straight lines because angles have to be precise. All other geometry should be the same, too. Quadrilaterals, parallelograms all need to be precise and concrete.

Thinking outside of the plane is a lot harder. Especially thinking in terms of a circle, or a sphere is different. There lines can be a shortest distance but they definitely will cross and won't continue forever.

Okay, I'll say that we can call a rubber band the shortest point, but it's hard to make triangles without specific angles. They have to add up to 180°, and we have proven that they don't. It has to look like :



not

That is against all theories, plus with no guidelines you could go haywire trying to establish some.

If a triangle doesn't need to add up, even if it wasn't to 180°, it would still be hard to make any more theorems. Because of the sphere, a different set of postulates may be established, but they would at least have to have some order and coincidence. If we decide on some specific guidelines, we can continue our spherical geometry. If we can't we should stop while we're ahead.

Entry 17 - **More geometry on the sphere.**

To dispute Euclid's axiom 5 of parallel lines is possible. Yet I don't see any concrete statements forming. I don't see a sufficient number of axioms to allow for an in-depth geometry. Or do I, am I just fighting it?

Entry 22 - **More on non-Euclidean geometry.**

Yet the world is not a plane; it is a sphere. Who knows what the universe is. So, why teach kids plane geometry? Well, we live on a sphere, but we do everything in our power to alter that. We build square houses, rectangular buildings, etc., etc. We create devices called "levels" and flatten things. Only two cultures live in anything remotely spherical — the Indians and the Eskimos.

Entry 25 - Respond to my paper, "Sharing Meanings" (1986)

In "responding" to your paper, "Shared Meanings," I'm not exactly sure what you mean. Do you mean judge it, alter it, approve or disprove it, mark it, or fund it?

Your paper is great. Clear, well-worded, and complete. I guess there are lots of people who feel as I do. I think it's a shame and unjust that many women feel this way. I find it really interesting that you were able to pin-point those feelings and instances and realize the need to change them.

I am curious as to why teaching has taken a generally boring, mundane approach. I also wonder why people wait until college to teach compassionately, truly and honestly OR DO THEY? What kind of math teachers did you have that you were able to avoid this roadblock of uncreative thinking? Most of all, do other teachers have the ability to teach math creatively, historically, etc. as you suggest, and choose to take the easier way out?

That question is one I ponder often. Do the math teachers that bored me to death, really have the ability to teach excitingly, but don't. Are they truly math teachers if all they know is algebra? Are they satisfied with shoving numbers down someone's throat? Do they recognize that they're doing that?

What do math teachers learn at conventions? Don't they question themselves? If math teachers have known all along about the "better" side of math, yet don't teach it, are they morally fair? Is it right that they don't share this. I feel like they're stealing something from me.

In response to your paper, I'd give you money! I'd hope you used it to go around to every high school and maybe college in the United States and wrap your hands around all those boring math professors necks, and shake some of that "Perry and Gilligan" stuff into them, and then make them attend your class. Not necessarily in that order.

P.S. I'd give you an "A."

Maybe we can set up a deal if I don't do my last paper.

Entry 26 - Reflect for yourself on keeping a math journal.

Keeping a journal was my favorite part of the class. I got to yell, scream, rant, rave, and just plain complain about math. Once done, "out of my system," I could begin exploring things that interested me. I could express whatever I desired about math and not have you rip it up as slanderous garbage.

The journal for me was an outlet of many ideas. More than that, though it forced me - sometimes against my will, to develop those ideas. Every time I sat down with two blank pages in front of me - I'd groan loudly and decide I could never finish. I would then proceed to listen to 3 albums, call home, watch TV, and talk to everyone whom I ever had anything to talk to about in the dorm. Finally, my roommate, sadist that she is, chased me down and dragged me back to our room, threatening bodily harm if I didn't do "it." A couple of times I cleverly escaped her wrath, but it became easier to do the thing than risk getting my head bit off.

So the two endless pages would get furiously scribbled upon -- as if to save my life -- and I'd wipe the sweat off my brow. But a funny thing happened. I liked what I had said. Some ideas were kinda neat, and a few even more developed than I thought they would be. While I may not jump up and down for four pages on non-Euclidean geometry, I can at least deal with a counteressay pretty well. It also made me use the book more. The book sometimes developed ideas I had in my head and then I could do more, agree or disagree with them.

It has also helped me keep a better personal diary -- as I can see now that ideas take a while to develop, as well, as what ideas are better thought about, and when to leave them alone -- and when not to. Also, once I get started writing it was easy to go on writing, and some of my feelings about math were also memories, and personal feelings.

Keeping a journal was a good experience, my only suggestion is to keep it in the course, and keep teaching the course!

Entry 27 - Reread your journal and respond to it.

In looking back through my journal I have a bunch of mixed emotions. Firstly, though, I have to laugh! I have "I hate math," in everything I wrote. My first entry should have been titled "I Hate Math, Take One of Many." But what's even funnier is how by the second journal entry, I'm still saying I hate math, but I'm beginning to question, and wonder, and really dive in. The whole time saying, I'll never dive in! I like my entry 4 and think its pretty strong.

By Entry 5, I can clearly see where I've already learned so much in the class, but I'm totally unaware of it. I'm beginning to perceive questions that we didn't answer for a month or two after I began to think about them. I also didn't realize how thoroughly complex those questions really were. I'm also a good writer!

In my proofs entry, I think I was very perceptive and looking back that makes me laugh at the good questions I asked, the whole time thinking I had nothing to think about, and I was on the wrong track.

Journal Entry 10 shows I was confused about the square root of two. Square root of two is different from 1/2 of 2. Another thing about it is, that we haven't "not found the square root," but we have found that we don't know what it is.

From there on, it seems as if I began to get a better overview of math. Overall, I began to see it as not just "clear, concise, and metallic," but open and unending, and exciting. My journal was an interesting thing to reread. I'm glad I got to reread it, and answer your comments.

THE END

References

Blenky, Mary, Blythe Clinchy, Nancy Goldberger, and Jill Tarule. (1985). Epistomological Development and the Politics of Talk in Family Life. Journal of Education, 167(3), 9-27.

Buerk, Dorothy. (1985). The Voices of Women Making Meaning in Mathematics. Journal of Education, 167(3) 59-70.

Buerk, Dorothy. (1986). Sharing Meanings in Mathematics: An Approach for Teachers. Radical Teacher, 30, 26-29. (Prepared for National Conference of Education for Women's Development, Mt. Holyoke College, May, 1984.)

Campbell, Douglas M. (1976). The Whole Craft of Number. Boston: Prindle, Weber and Schmidt.

Clinchy, Blythe, Mary Belenky, Nancy Goldberger, and Jill Tarule. (1985). Connected Education for Women. Journal of Education, 167(3), 28-45.

Gilligan, Carol. (1982). In a Different Voice: Psychological Theory and Women's Development. Cambridge: Harvard University Press.

Martin, Jane Roland. (1985). Transforming the Liberal Curriculum: Rewriting the Story of Sophie and Emilie. Working paper #156. Wellesley College Center for Research on Women.

McIntosh, Peggy. (1983). Interactive Phases of Curricular Re-vision: A Feminist Perspective. Working paper #124. Wellesley College Center for Research on Women.

Perry, William G., Jr. (1970). Forms of Intellectual and Ethical Development in the College Years: A Scheme. New York: Holt, Rinehart and Winston.

Perry, William G., Jr. (1982). Cognitive and Ethical Growth: The Making of Meaning. In A. Chickering (Ed.), The Modern American College, (pp. 76-116). San Francisco: Jossey-Bass.

Shaughnessy, Mina. (1977). Errors and Expectations: A Guide for the Teacher of Basic Writing. New York: Oxford University Press.