

CONSTRUCTIVISM AND THE ADULT LEARNER: MARIEANNE'S STORY

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When women return to study mathematics they frequently have to overcome obstacles, both long-term and short-term, in order just to be present at classes. Voluntary attendance at mathematics classes can provide both mental stimulation and an escape from the reality of everyday existence. It can also provide a support to sagging morale when self-esteem is under attack elsewhere. Further it can be emancipatory when a woman discovers that she is capable of actively helping her children learn mathematics in a productive manner, making it an enjoyable experience for all. This paper will discuss the positive effects of a constructivist mathematics classroom on one woman's life.

A SHIFT TOWARDS SOCIAL CONSTRUCTIVISM?

At a recent conference on constructivism Lerman (1993) suggested that there is a need for radical constructivism to shift to a sociocultural view of learning, which takes into account, among other things, that subjectivity is constituted through social practices, and that cognition and affect are not separable. This is supported by Ernest (in press) who claims that the greatest strength of radical constructivism is in its detailed account of the psychological processes of individual construction of knowledge, but notes that there is a need for it to accommodate the complementarity between individual construction and social interaction. He states that radical constructivism is evolving and adapting to accommodate the criticism it has met, especially in the social and cultural dimensions of learning and knowledge. Cobb (1990) asserts that while the cognitive context includes the constructs of scheme and reflexive abstraction, it should also include sociocognitive constructs such as obligations, expectations and beliefs, as "teachers and students modify their context as they act within their contexts" (p. 206). He argues that it is essential to include a mathematico-anthropological context, since "learning is an interactive as well as a constructive activity" (p. 209).

AN EDUCATIONAL RESEARCH PARADIGM

Ernest (in press) distinguishes four components of an educational research paradigm: an ontology; an epistemology, comprising theories of knowledge from both psychological and philosophical perspectives (where the relative strengths of knowing and believing are juxtaposed) emphasising both individual and shared knowledge; a methodology; and a pedagogy. He notes that there may be some overlap in these categories, and although he sees that the last may be problematic he justifies its inclusion on the grounds that a central concern of constructivism in mathematics is to improve pedagogy.

Values

Since Ernest (in press) believes that pedagogy is predicated on a set of values, it is likely to be eclectic, being a theory of techniques for achieving the ends of offering selected knowledge or experiences to learners. In fact he suggests that the model may be extended to include a set of values as a fifth component.

The question of values was raised, following the paper by FitzSimons (1993), as to whether teaching from a constructivist perspective could not be replaced by simply teaching from a set of principles based on respect for the learner. Teachers following any of a variety of paradigms, even the most absolutist, may justify them on the grounds of their own values, but a constructivist perspective provides a coherent framework for pedagogical choices. It provides a philosophical basis for the myriad of decisions a teacher makes in every class and is a referent to analyse the learning potential of any situation, according to Tobin and Imwold (1993).

This paper will illustrate how teaching from a radical constructivist perspective, accommodating a sociocultural view of learning, has helped to change one woman's image of mathematics, and improve her self image.

CHANGING THE PUBLIC IMAGE OF MATHEMATICS

Ernest (1992?) describes the public image of mathematics as cold, abstract, inhuman, and related to absolutist philosophies of mathematics. He argues that the image should be changed to a fallibilist one, which views mathematics as the outcome of social processes, and "rejects the notion that there is a unique, rigid and permanently enduring hierarchical structure" (p. 7). According to Ernest, many people believe that "only a fallibilist view can provide the epistemological basis for critical mathematics education" (p. 9).

One way of changing the image is to raise public consciousness about the nature of mathematics, and an example of this is to be found in mathematics classes at the Centre for Women's Education, Box Hill College of TAFE. A constructivist approach to teaching is consistent with the philosophy of the Centre, and is given the full support of the Head of Department. According to Pateman (1993), administrative support is necessary for teachers attempting to implement a different approach to teaching. Not only do the mathematics classes raise the consciousness of women who attend, they also impact on the family and friends. Women, especially those with children, communicate powerful messages in being seen as a person who takes a vital interest in things mathematical, and with whom productive conversations can take place. The women themselves have commented, in private conversations, on their increased self-esteem.

THE CLASSROOM

Sociocultural context. Belenky, Clinchy, Goldberger and Tarule (1986, p. 4) observed that women students frequently speak of "problems and gaps in their learning, and so often doubt their intellectual competence." They make recommendations for educators of women, consistent with a constructivist perspective, such as emphasising connected knowing, understanding, acceptance, and collaboration; allowing time and respect for knowledge that emerges from first-hand experience; and encouraging students to evolve their own patterns of work.

Adults returning to study are in transition, in two senses: between phases of life, and between schools. Spanard (1990) proposed that adults continuing with their education do not see this as an end in itself, but as a means to a future change or coping with life changes that have already occurred. With their last formal mathematics classes likely to have been many years earlier the experience of discontinuity can be significant, and almost always accompanied by anxiety. Many women, even those with tertiary study in other areas, have little self-confidence, and ask to start "right at the beginning."

The social context of the classroom critically influences the attitudes of women returning to study. An environment that is uncomfortable, humiliating, or authoritarian can destroy any nascent self-confidence. According to Nordstrom (1989) a major theme in the continuing education literature is that adult learners are concerned with maintaining a positive self-concept. Although adult learners tend to be highly motivated to learn, they lack confidence in their ability to do so, and require continuing encouragement. One way of learning that is consistent with the recommendations made above, and which happens in most other subject areas at the Centre for Women's Education, is to have discussions about the subject matter. In fact discussions take place on several levels: the content of mathematics, its historical development, theories of how mathematics is learned, and so on.

Mathematical discussions

Richards (1991, p. 46) asserts that language "is the means by which a student is brought into a community," and believes that the best way of assisting students to construct their own mathematics is to provide a classroom designed to teach the language of mathematical literacy. According to Richards a consensual domain must be established where participants are prepared to respond to each other and to learn. While the teacher can be a facilitator and moderator at times, there is also a need for her to be a genuine participant in discussions. Cobb (1990) believes that mathematics is learned through the construction of a consensual domain, as learners participate in the process of negotiating and institutionalising mathematical meanings.

The teacher's role

Students need to be supported by the teacher in discussion so that they do not feel vulnerable as they disagree with their peers or ask for clarification. Lampert (1990) acknowledges that the teacher's role involves managing the tensions between individual learners and social conventions, as she offers vocabulary, encouragement, suggestions, and support for revisions; and modelling a way of knowing mathematics which depends on reasoning, not authority, for its veracity.

MARIEANNE'S WRITING ABOUT HER MATHEMATICS LEARNING

Personal History of Mathematics

As part of the assessment requirements for the course women are asked to write their personal history of mathematics learning as a homework task. One reason is for them to reflect on their experiences and beliefs about mathematics teaching and learning, as these issues are discussed throughout the course, in addition to the specific content and processes of doing mathematics. A second reason is that the history provides useful information for the teacher - as much as the students feel comfortable about sharing, although for some this can evoke painful memories. It can give greater insight into the obstacles that students have faced in order to be in a situation to both need and take up the option of further study in mathematics, as well as inform the teacher of strategies which have had negative consequences in the past.

This is Marianne's personal history:

I really don't remember that much about maths in the early days.

After emigrating from Holland my first recollections were of being very frightened amongst people I could not understand. I was always very quiet and was too afraid to ask if I did not understand. Looking back I did grasp the basics but when it came to algebra and geometry, I just couldn't see the point in it at all. I left school at 15 as my parents did not see the point in educating a mere girl.

I now find I enjoy maths and at last feel that the things I learnt as a child in maths I am starting to understand now. The knowledge I had as a child is still there and it is fun to bring it to the surface.

Although this history is short it has much to say about Marianne, especially after one has worked with her for some time. Not being able to remember much about the early days is not surprising, given that she was so frightened. This is in contrast to another woman's history (see FitzSimons, 1993), where memories are happy. Marianne, like so many women returning to study mathematics, is intelligent, and takes a real delight in learning, especially when she confirms her new knowledge, but also when she affirms her previous knowledge. Yet she was disadvantaged by a school system which failed to make mathematics appear relevant, and by parents who discriminated against her, curtailing her education, because of her gender. In 1993 Marianne's education has been interrupted yet again, by family responsibilities. She has missed many classes on account of illness suffered by her children and by her aging close relatives. While her husband is supportive of her study, he is not in a position to assist with family responsibilities during class time.

Journal writing

Students are encouraged to keep journals to reflect on what they are learning each week, the progress they are making, and their feelings about the class. Recently their own evaluation of their journals has been included in assessment requirements.

The following are examples of Marianne's journals:

18/2/92 The work today has really made me think. It is not what it at first seems with numbers and powers into the negative. (See FitzSimons 1992 for the full transcript of a class discussion on powers of ten and two.) I took for granted that the power numbers would be the same as $10^2 = 100$, 2^2 would be 4, then 2^{-2} would be .4, instead it is $1/4$ or .25. Once this was realised I could then do the other numbers.

12/5/92 I love doing fractions. I feel very confident with them. I am still not sure about the calculator. The process does not seem to stick in my mind.

19/5/92 I was frightened of starting negative numbers. Using the red and the black squares I feel I am understanding them better. Homework did not take long as I used the squares to do the additions. I feel fairly confident of addition of negative numbers.

26/5/92 What a blow! I feel completely lost, so much for my new confidence. I could not grasp negative numbers today - or rather subtracting negative numbers. For once I felt better using a calculator.

Hooray I have sat and worked through the sheet. Although I have most of the answers wrong, by going over them with the calculator I am starting to grasp what is happening. I shall try to keep practising and see if it works. I am also at last starting to understand what the number line is for! I actually used it to work out some of the answers or rather corrections together with the calculator. I worked through the sheet again and this time got only 6 wrong. I feel *better about it*.

These journal entries reflect several things about the class and about Marieanne. Discussion is clearly an important aspect of all classes, and the journals capture some of an ongoing dialogue between Marieanne and the group. She made reference to the use of multiple representations, such as algebra blocks and the number line, in the study of negative numbers, as well as the integral use of calculators, which provide yet another representation. The journals reflect the link between cognition and affect, and the use of schemes and reflective abstraction. They show Marieanne's positive attitude towards learning, and her persistence in the face of initial setbacks. She is able to express her uncertainty without shame or fear of reprisal.

The Constructivist Learning Environment Survey

During the first few weeks of class Marieanne completed the Preferred and the Perceived forms of this survey (see Taylor & Fraser, 1991). Three of the four scales were: Autonomy (the extent to which students control their learning and think independently), Prior Knowledge (the extent to which students' knowledge and experiences are meaningfully integrated into their learning activities), and Negotiation (the extent to which students socially interact for the purpose of negotiating meaning and building consensus). A fourth scale has not proved satisfactory and is expected to be replaced (Peter Taylor, personal communication). With a maximum score of 35 in each scale, allowing for question reversals, Marieanne's perceptions were very close to her preferences in Negotiation (27/26) and Prior Knowledge (30/30), but in Autonomy her perception exceeded her preference (22/16). Typical statements in the Autonomy category were: "I decide how much time I spend on an activity" and "I do investigations in my own way." Marieanne is not yet fully confident about her own autonomy as a learner, but is fairly supportive of a constructivist classroom.

AN INTERVIEW WITH MARIEANNE

In order to gain a more complete picture of events which Marieanne had alluded to in class I conducted an interview with her in her own home. The following is compiled from notes taken.

Before I enrolled in the computer class and the maths class I felt depressed. I was working part-time, but looking for something more. All the kids were at school, and I wanted to do something for myself. I was scared of not being able to help them in computers and maths.

When I started back at work I was terrified at first. On the first day I panicked, felt ill. My husband literally pushed me out the door. I built up my confidence after being back at work, but I needed to build up some more confidence through study. You lose your confidence really quickly, when you are not working.

On my first day at the Centre for Women's Education I nearly turned back. My parents were no help. They said: "What do you want to do maths for?" Only my husband and kids gave me support. As I came in, I was talking to myself: "What's the worst they can do? Make me look stupid? Ask me to leave if I was not up to the standard?" I came in because I could not forgive myself for not trying, and would forever wonder if I could do it.

I have kept on coming over the last three years because I feel accepted. My input helps me to understand. I am not made to feel foolish or put down. There are lots of ways of explaining things. I feel comfortable asking questions now - you get more out of it if you do. It took about a year to have the courage to ask, I felt shy. At first I used to ask my husband - now I show him what I do. He boosts me up. Being with much the same group over the three years helps - you get to know each other, and trust is built up.

Personally I have gained confidence from coming to class. The main benefit has been in helping my children. It gives me a great deal of pleasure. We get out the whiteboards and everyone gets excited. Michael (7 years) learned the 11 times tables in grade 2 "the easy way." We started with 2 (digit) numbers, then 3, and so on up to the millions. I used to say: "I wonder what if ...". It felt good to let them think for themselves. We also used a calculator to check.

It was good to see Catherine actually understand fractions. She felt a real glow of pride. She was one of the few in her class who actually understood them, and went out to the board to demonstrate. She was glowing when she came home. I used to trace round plates for circle shapes, and we'd cut out $1/2$, $1/4$, $1/8$. Also we would fold computer paper sheets. I would start with one child, and all the others would come round to listen and watch. We all enjoy doing it. I set work for the children, and tell them to show all their working out, as this helps their thinking. Sometimes the work is still on the boards when my husband Ken comes home, and he is most impressed.

I started to help the neighbour's children, but Catherine was upset, and asked me not to tell anyone else. She enjoyed having the advantage. She said that I was the only Mum who knew fractions - I can't understand why that is. Knowing that there are many ways of explaining things is useful. Also it's good for girls to have a role model. In any case, Ken isn't home until 8, and then it's too late to help them anyway.

I enjoy maths now, but it was a chore at school. I enjoy finding out new things, exploring, and feeling satisfaction when I understand something that I never knew before. Now it's clicking, dropping into place. At school I was frightened, I would groan, and was fearful when we had maths, because of not understanding. I didn't want my kids to feel that way. Maths was closed for me before, but now it's opened up; there are different paths. I wonder how much I would have learned if I had stayed on at school. Now I will attempt to answer new questions.

CONCLUSION

Marianne's interview underlines the link between cognition and affect. Not only is her self-concept strengthened (she confided that it had helped her during a period of harassment in the workplace), she is pleased to be able to constructively assist her children, and they too have gained in self-confidence in mathematics. The strategies she uses with her children are based on those used in our mathematics classroom. Bliss (1990) states that collaborative learning and parental involvement show significant potential. This paper has attempted to demonstrate the positive impact that constructivism can have on adults as learners and teachers of their children.

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