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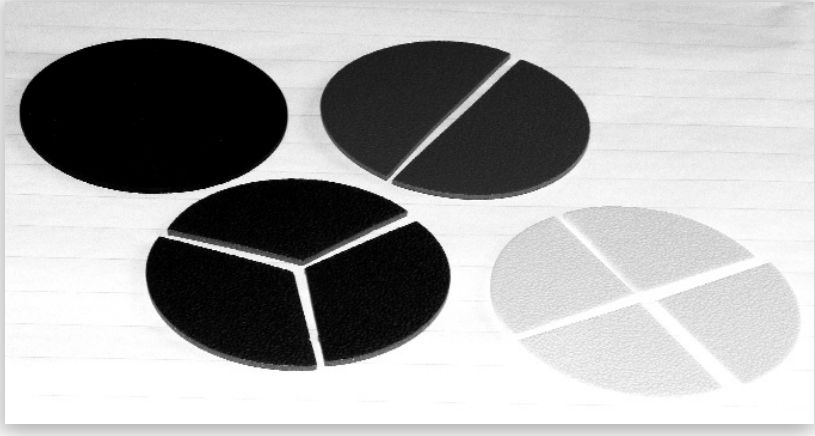
Working with student resistance to math tools

by **Kate Nonesuch**



KATE NONESUCH

When I began teaching Math 020 (fractions and per cents) twelve years ago, I started teaching as I had been taught, that is, the teacher did the math at the blackboard and the students watched the teacher do math, and listened to her talk about doing it. From the beginning, I knew it wouldn't work; students were bored and frustrated by their lack of activity and their lack of understanding. I was bored and frustrated by their lack of engagement and their lack of understanding. I wanted more. I decided to start using math manipulatives: tools which would allow them to join me in doing math.

In this article I will discuss the sometimes difficult but ultimately rewarding road to using math manipulatives with the adult students I have taught in the intervening years, in light of some of the principles and goals of the math department at the Cowichan Campus of Malaspina University-College (MUC) where I work, and more particularly in light of the philosophy of teaching and learning at the Reading and Writing Centre, a storefront literacy program that is part of Malaspina, and in light of some aspects of my personal teaching philosophy. At the Reading and Writing Centre our goal in teaching basic numeracy is to prepare students for the next level, equivalent to grade ten math, from which they might move into a trades program or go on to grade 11 or grade 12 algebra. Hence we do not teach 'everyday' math or life math or business or consumer math, although we try to use examples and problems from everyday life and from trades applications. Our philosophy at MUC, Cowichan Campus, is to teach math concepts, not only algorithms, and to teach groups of students whenever possible, rather than providing self-paced programs for students.

The use of manipulatives, it seemed, would fall within those parameters. They could certainly be useful in teaching concepts, and I suspected that they would be useful in class management, since I thought using them would help even out the differences in students' abilities to remember what they had previously learned, and in their confidence at doing math. I hoped that making manipulatives part of the assigned work in the class would mitigate the difficulty that always comes in a teacher-paced class, that is, that from the first day there is a gap between how much explanation, attention and practice is

needed from one student to the next, and, as time goes on, the gap gets wider. In our program, we prefer to struggle with these difficulties rather than go to a self-paced delivery style. We want the advantages we see in group teaching and learning, and we notice that self-paced is often dead slow.

I thought that using the manipulatives to do fractions work would make more of a level playing field; that the students who were confident and dextrous with the pieces might not be the same students who were confident about their ability to manipulate numbers mentally in the often rote process that leads to the right answer, and that the leadership of the class might be spread out a little more widely. Eventually, that proved to be the case, but not before I encountered intense student resistance to using the manipulatives, and developed some ways of reducing it.

I began by introducing some homemade manipulatives—strips of paper representing a whole, colour coded so that halves, fourths, eighths and sixteenths were pink, thirds, sixths and twelfths were blue, etc. I began by using them in the class, so that students each had a set and could manipulate them with me as I taught various lessons. I assigned them the job of using the strips to prove their answers to some exercises involving equivalent fractions and adding and subtracting fractions. Later I bought a variety of commercial manipulatives: sets of plastic towers and flat squares and circles cut into various fractions. I also bought two sets of cardboard pizzas, each set having several pizzas in full colour, some cut in halves, others in quarters, thirds, eighths, etc. Over a period of a year or two, doing 'proofs' became more and more central to my math class, and I began to let the individual work with manipulatives do more and more of the teaching of the concepts, while the whole class discussions, lectures and practice activities focused on reviewing concepts and practicing the algorithms.

I had expected some resistance from students, but was not prepared for the strength of it. Students resisted using both my homemade manipulatives and the commercial manipulatives, their responses ranging from silent withdrawal to open refusal to use them. Over the years, I have tested different strategies of honouring student resistance and working with it rather than against it. I find that students need to be able to express their resistance in order to maintain their sense of self in the class, and that when they can do so with dignity, they are more likely to be able to stay present and attend to the work. When Arleen Pare did some research for her MA thesis in my classroom, she found a positive correlation between student expression of resistance and student retention. The more complex and open their resistance to me and my teaching, the more likely they were to continue to come regularly.

These results suggest a positive association between conscious, active resistance and regular attendance. It also suggests that the more that conscious resistance is encouraged, the more likely it is that regular attendance will result (p. 115).

Students sometimes express their resistance by leaving the class, but over the years I have developed a teaching stance that recognizes, honours and encourages open expression of their resistance, and hence many students will question the use of manipulatives, although, as you will see from the examples that follow, their resistance may be indirect, and often comes in the form of a question that is not a real question.

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Jessica Jones

"This is not real math."

I made a mistake the first time I brought the commercial manipulatives to class; I was excited about them, and I said something like, "I've got a bunch of new toys for us to play with." It hit the wrong note with the students: they were not in the class to play games, and in any case, they did not expect to enjoy any math activities. I soon learned to call the manipulatives 'math tools.' Nearly every student who enrols in the class has years of experience as a math student; it stands to reason that they have a firm idea of what math class should be and what success in math looks like. They expect me to give them sheets of questions and some tricks to help them remember how to work with fractions. When I don't, they resist. "This is not real math."

I deal with that resistance by acknowledging that what I am asking them to do is not what they are used to, and it feels strange. I ask them to tell me all the ways they have tried to learn math in the past. Then I ask, "Does anyone know a way to learn math that really works?" Invariably, nobody does because they have all been previously unsuccessful. This conversation with students is part of making my work and theory transparent, and makes them partners in designing their own learning. The discussion about past methods of learning math, an evaluation of what parts were more useful or less useful and the conclusion that something new needs to be tried, means that they are part of the team talking about what form teaching will take.

"How can those things help me learn?"

At the Reading and Writing Centre, we aim to make the learning process more transparent so that students can make decisions on how best to accomplish their academic goals; we ask students to be in control of their learning and to understand their own ways of learning best; and we offer a variety of modalities to students in every subject area. I often do some work with students on learning styles, and using manipulatives gives them a chance to experience and talk about their own styles—"I'm a body (kinaesthetic) learner, and holding the pieces and piling them up helps me remember"; or "I'm an eye (visual) learner, and the different colours and patterns really help me remember how things go together."

"Why do we have to use those things?"

My answer to this question is, "You don't have to use them." No matter the theoretical discussions referred to above, or the general agreement in the group to try this new way of learning math, any individual is free to choose whether or not to use the manipulatives. This is fundamental to my stance as a teacher: a refusal to get into a power struggle with a student about the way learning will take place, and a desire to honour their resistance to being put into the traditional 'one-down' role of the student. Of course, I am not saintly enough to pull this off every day, but every day I strive to do it. So I do not require students to use the manipulatives. Their assignment is to prove various propositions: that 3/4 = 6/8, that 2 2/3 plus 1 1/2 = 4 1/6, 1/2 x 1/3 = 1/6 and even that 1/4 divided by 1/8 equals 2. If they want to use drawings or apples or anything else that will prove it, they can do so. (If they reject the assignment altogether, we will work on a plan that will allow them to complete the course without doing proofs, although often we are not successful at doing so.) They have the choice to use manipulatives or not; my hope is that this

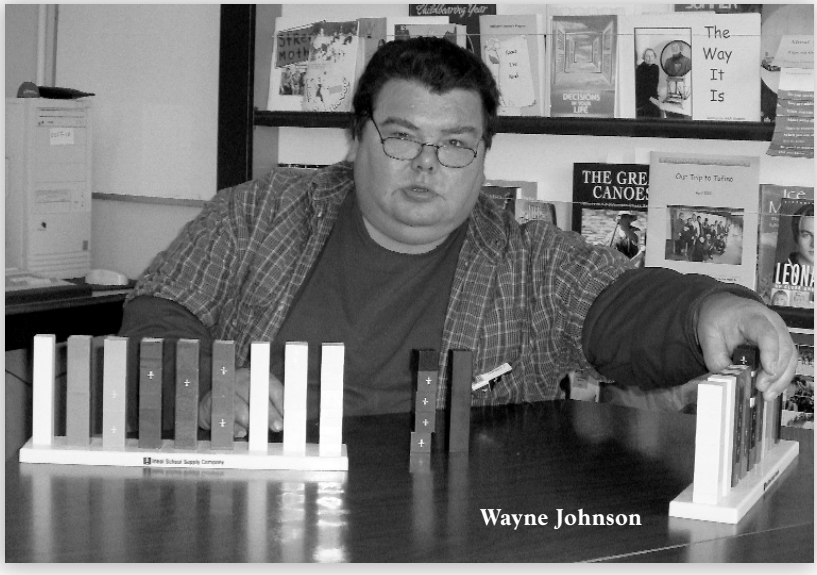
position of choosing will allow them to see the advantages of the tools, so they might decide it would be worth overcoming feeling silly or awkward about them. In any case, if I insist, if I answer this question with a list of reasons, I am in a power struggle that I cannot lose and the student cannot win except by leaving. The student's right to choose is the only position from which we can both win.

"I feel like I'm in kindergarten."

An important strand of my teaching philosophy is to deal with emotions, my own and the students, so they don't get in the way of the learning. This comes partly from my training as a Life Skills Coach (Saskatchewan NewStart Model). My coach trainer, Audrey Adilman, used to say that it probably takes less than a minute to deal with the emotions that come up in the moment; that if you leave it for an hour, it might take two minutes to deal with them; if you leave it until the next day it might take half an hour, and if you leave it for longer, who knows how long it will take? I know that a student whose mind and heart is occupied with feeling stupid and resentful about using the manipulatives will not see that 2/6 = 1/3, and since my interest is in exactly that, I'll do something to help express the feelings, so we can both get on with the job we came to do. I am happy to hear people express their feelings, but if a student is not expressing anything, just sitting with hands in pocket, I may make a stab at identifying the emotions by saying something like, "When I first started using these I felt clumsy with all these little pieces," or "Sometimes students tell me that the tools are just for kids, and they feel silly using them." That is often enough to open the way to the student expressing her or his feelings, and once that is done, a rational decision can be made about if and how the manipulatives will be used.

"I'm not allowed to express opinions/I don't have any opinions worth expressing."

I know from my reading (Horsman), and from my experience, that students who have experienced violence may be reluctant to engage in anything as 'out front' as piling up plastic towers, or taking the risk of proving that they know something. Expressing an opinion has been dangerous in the past, and it is not possible to work with the manipulatives while avoiding expressing an opinion. With these students, I will often start by doing the proofs with them, so I am the one building up the plastic towers under their direction. When they have more confidence that they know what to do, they take over. With every student, I concentrate on the fact that the proofs are correct. (It is one of the advantages of using manipulatives that student work is nearly always correct. They will find that 1/8 plus 3/8 always equals 4/8 or 1/2, never 4/16, a common error students make without the manipulatives.) I ask questions so students can get a chance to articulate what they are doing, but I say first, "This is the right answer." Now they can be relieved of the worry that the teacher is pointing out their errors and concentrate on my questions and the new learning, rather than being lost in the often humiliating process of the teacher proving they are wrong.



Wayne Johnson

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What I've learned

How do I know the manipulatives are useful for students learning fractions? And how do I know that I have successfully reduced student resistance to using them? Many observations over the years have given me some evidence: at the beginning of a term, when there are many new students busy resisting using the manipulatives, I have no trouble getting old students to talk about how useful they are, and old students encourage new students by their words or by their matter-of-fact use of the tools. Many students ask to take manipulatives home to help their kids

understand their own schoolwork. Several students have even bought a set of the most popular kind of tool for their kids, at about $50 a set, more than 10% of the monthly income of many of our students.

Furthermore, students treat the manipulatives as tools: they take care of them, and they use them for their appointed purpose. The same sets have been in use at the Centre for six years, and there are no pieces missing or broken. Even the cardboard pizzas are still in good repair, a little dog-eared, but not torn and not covered with writing or doodling. Four years ago I asked a student to sort some sets of plastic fractional pieces into five plastic tubs—fourths and eighths in one tub, thirds and sixths in another, and so on. The tubs remain perfectly sorted; students take them out and put them back in the proper tub. Since this is not anything I ask them to do, and since many of them are careless about leaving their books and binders around, and don't take their coffee cups back to the kitchen, I infer that there is something special about the tools. I have never seen anyone use a piece of the math manipulatives for any other purpose than doing math; they don't use them for holding down papers, for example, or for propping up a window. I trust that kind of feedback.

I see that manipulatives are a useful way to teach fractions to adult students, as I thought they would be. However, instructors must plan to take into account student resistance to using them if manipulatives are to be useful in the adult literacy classroom. A careful attention to dealing with emotions, making the students part of the team that plans the teaching methods, giving individual students control over their learning, and inviting students to become more aware of their own learning styles and needs are all strategies I use to reduce resistance to using math manipulatives. ■

Kate Nonesuch has been teaching adult literacy for twenty years, most of that time at Malaspina University-College, Cowichan Campus, in Duncan, BC. She gives workshops on teaching writing and other aspects of teaching literacy students. Her publications include material for teaching science, math and English, as well as practitioner research.

SOURCES:

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