

Making Math Concrete (and Iron, and Plastic...)

An interview with
Sue Grecki

Numeracy and construction trades

Since 2002, the BC Construction Industry Skills Improvement Council (SkillPlan) has been involved in a research project with the University of British Columbia, funded by Social Science and Humanities Research Council (SSHRC). The project has explored numeracy and the growth of mathematical understanding in a variety of construction trades training programs. We spoke with Sue Grecki, one of the SkillPlan's Workplace Educators involved in this research.

Literacies: Where and how do you teach numeracy?

Sue: I go to wherever apprentices are taking technical training, like BCIT (the British Columbia Institute of Technology) or the union schools, for plumbing or painting for example. Usually the technical trainer identifies a few students who need some extra help.

Literacies: Is teaching numeracy a new thing? Did you have questions about how to teach it when you started?

Sue: Oh, I had many questions, I was illiterate as far as teaching math goes. I had to go back and teach myself a lot of things. I had to review per cent again. I knew how to do it, but to explain it to someone else is different. Trig freaked me out and I had to do it the way it's done within trades. I also had to establish relationships with the technical instructors and get them to show me how they do things.

Literacies: When you say you needed them to show you—do you mean in terms of how the math concepts were applied?

Sue: Yes. Trig's a good example—in school you learn hypotenuse and the adjacent and the opposite sides.

In the trades they almost always call it long side, travel, and the rise and run. Rise and run are the two sides of a triangle. I would never have known that and would not have found it in a book.

Literacies: SkillPlan has been doing some research with UBC. Have you been involved since the beginning?

Sue: Yes, Lionel [LaCroix] from UBC and I have been working with apprentices. We've spent time in first-year and then third-year ironworkers' technical training, which last six weeks each, then in two different entry level training groups of plumbers. We were lucky because students got quite excited by the research and we were able to do a lot of videotaping, taking what they were doing in class and then showing them a different way to do it with numeracy or math skills.

Literacies: When you were working with different groups of students was it just to observe the way in which they apply concepts they understood or learned?

Sue: Yes. We had two goals: to gather materials for UBC's research and also to provide remedial help to improve apprentices' skill levels and their chances of success in training. As the instructor did things in class we would help students, for example, if they did not know how to change a decimal to a fraction. We did the coaching in the background as they carried on with the class.

Literacies: Why were you interested in being part of the research team?

Sue: I'd been involved with essential skills research with Human Resources and Skills Development (HRSD). We were one of the teams across Canada going out and interviewing people about their jobs in terms of essential skills. Numeracy was an interest of mine because I worked on teaching math foundations



and concepts as used in industry. It made sense to combine both.

Literacies: When you say combining the two, you mean numeracy and essential skills? So does that mean the application of numeracy to a particular job?

Sue: Yes, and in a bigger sense...basically when somebody learns the fundamentals of trig, the math is not difficult. You're either multiplying or dividing, it's not difficult, and you have to know how to use the formula. What is difficult is the reading around what they are doing. They look at a drawing of a piping system and realize they can't use a 45 degree angle so they say, "I'm going to have to use trig to figure out what elbow—what degree elbow—I need to fit the pipes together." And, "Because I can't get up there to measure, I have to use trig or A squared plus B squared." Sometimes they're reading tables and charts or diagrams and, really, a lot of times it's being able to set up the problem. So those are the complex parts.

Literacies: That seems to be one of your findings—that it's not enough to teach people just a particular skill, they have to understand what they're doing and why they're doing it—what concepts to use in order to know how to do it. It's interesting that the conclusion was that it's important to develop the general math knowledge that's not tied to a specific task. That's the only way to know which concept to apply in a given situation. People might assume that if you try to tie numeracy to essential skills you are narrowing it, but in fact you are broadening it.

Sue: In apprenticeship training you spend many hours in the classroom and then in the shop applying the

math. So we'd work with plumbers using a piping system drawing, and figure out the elbow degree and the length of the travel. Then we'd go into the shop and start measuring and cutting pieces to see if they work. That's when they realize something worked or that they were looking at setting up the problem the wrong way.

Literacies: Do they then go back and look at the concept and recalculate?

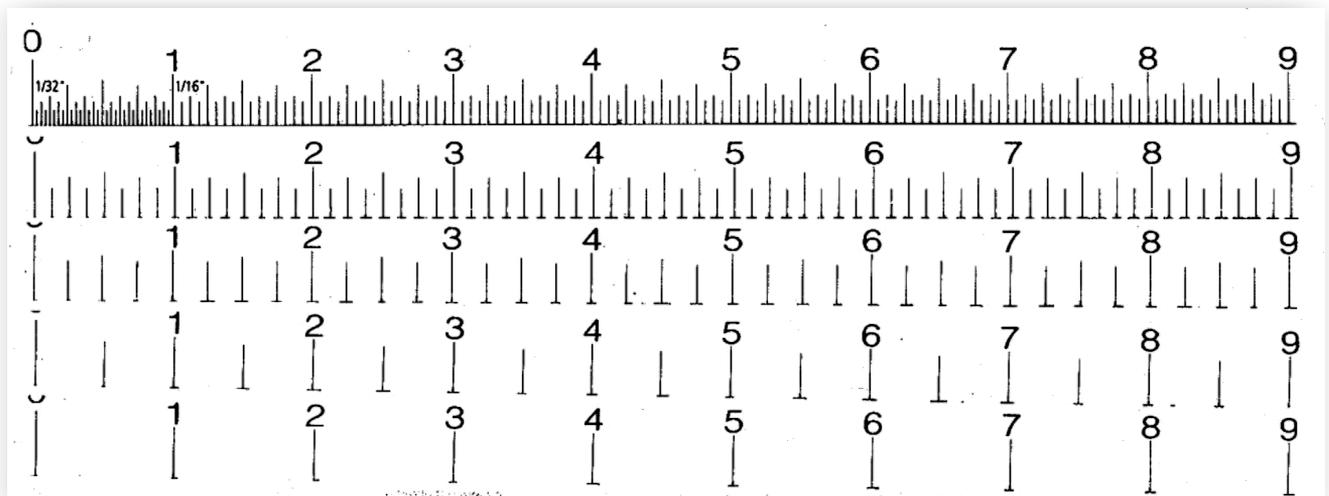
Sue: Yes, we'd take pipes with us into the classroom, go back to the sheet, and they could say, "This is where I went wrong and I'm starting over." It's interesting because it's concrete. If they have a good picture of what the pipe system looks like, they can apply math concepts. If they don't have that good picture then they don't know where to start.

Literacies: Do you think that has to do with people being visual learners or is it more about how you help them create a visual image?

Sue: Both. We all went through high school and math didn't mean a lot—it becomes abstract very quickly. I really do believe that if students in high school were cutting pieces of cheap plastic pipe, they could carry away a better picture of trig. Two years later they won't remember everything but they will have a more concrete memory of what it is and how it works.

Literacies: Do you feel that the research has affected how you work with students?

Sue: Yes...because I'm working with adults and most have been to high school up to grades nine, ten or 12. They have gaps in their knowledge of the math



The researchers created these acetate rulers to help apprentices learn fractions.

foundations. You never know exactly where those gaps are going to be. The idea of folding back—knowing how far back to go to make sure they get a picture of that concept in their head—is really interesting for me. For example, using imperial measurement and assuming people know how to measure in eighths or sixteenths. I meet a lot of apprentices, who don't know eighths, sixteenths, thirty-seconds, because they were taught the metric system in school.

Literacies: Can you say more about folding back?

Sue: You go back to, "Where wasn't I sure?" or "Where did I start to go wrong?" Hopefully this is something students can learn to do themselves. When people do have difficulty they always assume it's their fault, that they're doing something wrong and that they don't know anything. They don't have confidence to say, "I knew it up to this point and this is where it went wrong." They come to me and say, "I don't know how to do it."

Literacies: So part of teaching them is saying, "You do know some part of this, you know this much."

Sue: Yes, you can say, "You do know how to do this, you know some of this. What you need to practice or think about is, for example, changing decimal inches or decimals of a foot." A lot of times when we were in a technical training class people became more confident more quickly because they had more help at each step. Sometimes all the help they need is to have someone who they can ask, "Am I doing this right?"

Literacies: Is one end result of the research that the Workplace Educators and the technical trainers will know more about how to teach applied numeracy?

Sue: Yes, or we will know enough to work with technical trainers to say, "Have you tried this?" or "Have you thought about presenting it like this?"

Literacies: Is there anything else you'd like to add?

Sue: I never thought I would be doing math like I am now...You can't teach numeracy without teaching the other literacy skills around it, about understanding documents and so on. In other kinds of research, numeracy is always situated somewhere. The question is, Do people feel confident to tackle the problem? They don't know the math but they do know how to estimate, so they do know some

things. Maybe they don't know the formula but they can ask, "Where do I find it?" The opposite is also true—it would be very worthwhile when you are instructing with reading or with a document to include numeracy. ■

For more about the research findings, read

Martin, Lyndon C., Lionel N. LaCroix and Lynda Fownes (2004). *Making Mathematical Images in Workplace Training: The case of John, a plumbing apprentice* Available online at www.ppforum.com/skills_symposium/lyndon_martin.pdf.

This paper focuses on how an entry level plumbing trainee tries to solve a pipefitting problem. It explores the ways in which he tries to decide which calculation to perform, as well as his understanding of fractions and units of imperial measure. The authors suggest that while John may have appropriate images for these concepts, he does not access them, and that he needs to either make or re-make images that will help his understanding grow in this context. They stress that image-making activities can enable the development of numeracy and the growth of mathematical understanding.

More about math at work...

The following sources include information about how tradespeople use and apply a range of mathematical skills and understandings:

Belfiore, Mary Ellen, ed., (1998). *Chronicling the Learning Curve: Workplace Education Instructors Share their Stories* (1-8). Don Mills: ABC Canada.

Folinsbee, Sue (1990, 1994). *Workplace, Literacy and Basic Skills*. Ottawa: National Literacy Secretariat.

Fownes, Lynda, Elizabeth Thompson, and Julian Evetts (2002). *Numeracy at Work*. Burnaby: BC Construction Industry Skills Improvement Council.

Grecki, Sue (2000). *Tools for the Trade: A Guide to Success in Apprenticeship*. Burnaby: BC Construction Industry Skills Improvement Council.

National Literacy Secretariat (1997). *Consultation on Workplace Literacy, June 1997: A Report*. Ottawa: National Literacy Secretariat.

Taylor, Maurice C. (1997). *Workplace Education: The Changing Landscape*. Toronto: Culture Concepts.