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ABSTRACT

This paper describes a case study in which one woman in a focus group of 11 women recounted her use of numerical and mathematical tools in her personal and work life. According to the researcher, the subject's experiences engendered strong feelings and revealed that aspects of her self-identity were bound up with her use of tools and feelings about them. In addition, the interplay between socio-cultural factors and the subject's mode of thinking shaped the strategies she chose to address problems that arose. She was competent at using calculators, computers, and maps and at programming video recorders. But she panicked when she had to mentally calculate prices, take money, and give change. The researcher distinguishes between serialist and holistic thinking to explain these differences. When the subject was able to see numerical and mathematical problems holistically she was able to grasp them, but when a serial operation such as making change was required, she had difficulties. The subject's self-identity was both influenced and formed by the situations she was in and it is the interplay between her thinking and the culture that produces her differing facilities with numerical and mathematical tools. (Includes 8 references.) (MO)

The Role of Mathematical Tools in Addressing Problems in Everyday Life: The Interplay Between Socio-Cultural Factors and the Individual's Feelings and Ways of Thinking

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Abstract

I asked a group of women to discuss activities in which they used mathematics and number in their everyday lives, encouraging them to describe the socio-cultural contexts in which these activities took place. In this paper I investigate one woman's accounts of her use of some of the numerical and mathematical tools which are an intrinsic part of Western culture today. She describes her proficiency with using some tools and difficulty with others. Her experiences engender strong feelings in her, both positive and negative, and her accounts reveal that aspects of her self-identity are bound up with her use of tools and feelings about them. I discuss how the interplay between the socio-cultural factors and her individual mode of thinking shapes the strategies she chooses to address problems that emerge in her everyday life.

Introduction

The problems in people's everyday lives and the way in which they are solved are inseparable from the socio-cultural contexts of the activities out of which they arise. These contexts are both the person's relationships with other people and with the environment in which they live. People interact with both through the use of tools and conventions (Saxe, 1991). The way these relationships are conducted and the tools and conventions are themselves products of the culture to which they belong. Tools and conventions are created by people to enable them to take part in activities which are part of the culture (Lave & Wenger, 1999).

In the Western post-industrial society of today, people have a range of sophisticated tools with which to engage with their environment and each other. Many of these tools are used to solve numerical and mathematical problems: calculators, computers, tills. Others use numbers and mathematics to solve other kinds of problems: telephones, video-recorders, cash machines.

Ruth was a participant in a focus group where a group of women discussed how they use mathematics and numbers in their everyday lives. The group met four times for a total of about seven hours. Eleven women participated in the group at different times: attendance at each session varied from two to ten people. The conversations in the group were tape-recorded and the tapes were transcribed. The transcriptions were analysed using Lincoln and Guber's method of developing grounded theory (1985). For a fuller description of the composition of the group and its organisation, see my previous paper (Colwell, 1998).

Ruth recounted several events in her life that involved the use of tools with a numerical or mathematical function. In this paper, I will show how her self-identity is inextricably linked to her use of tools; how they can provoke strong feelings in her, varying from nightmarish horror to intense enjoyment; and how most of these events happen in the context of social relationships.

Ruth also brings her own prior understandings (Saxe, 1991) to the solution of the problems she meets in her everyday life. Her competence varies dramatically, from professed inability to do mental calculations about money, to proficiency in reading maps and using computers.

The Use of Tools

Learning to Use a Calculator

Ruth described finding herself in a job where she was required to use a calculator to work out VAT (Value Added Tax) on building contracts. She wasn't given any formal training, just told, "So here you are ... here's the bill, here's the paper, sit down and put it on there. Here's a calculator."

But when she told the person who was showing her the job that she didn't know how to use a calculator, they still gave her very little instruction, "They just told me ..., 'Well, you know, you just multiply, here's the multiplication sign button, ... multiply it like this.'"

In spite of this cursory training, Ruth seems to have learnt how to use a calculator effectively. She had to calculate both the VAT and the total including VAT. She entered the sum, put it into Memory, then multiplied by .15 to calculate the 15% VAT (as it was then). Then she added the VAT into Memory and pressed the Memory Recall button to get the total price. This is a fairly sophisticated way of using a calculator.

This experience Ruth had of learning to use a calculator enabled her to go on to learn to use computers, "Well that was good then, because that led me on then to sort of using spreadsheets and stuff, once I'd used a calculator."

Handling Cash at Work

But Ruth had a great deal of trouble when she later got a job at a sports stadium, taking the money. "I just couldn't do it, because it was money, I think, particularly, I couldn't handle it really. ... I can't do mental arithmetic, full stop."

She gave an example of the kind of mental calculation she had to do:

> Well sometimes people would want to book the tennis courts and they would want to book them for so long. And one person had a pass, so therefore they were entitled to a reduction and the other person didn't, so therefore they weren't. Plus they wanted to hire a racket and ball.

Ruth used two common methods of giving change. She put the proffered notes on the till, using them as tools to remind her of what amount she was giving change for. Then she used the coins as tools to calculate the change, "if something came to 18p, take 2p and then 10p out (of the till)." But Ruth found that these methods did not really help her. "But then I would see the note that I put in front of me that they gave me and I'd think, 'Well they gave me ten and I am about to give them three back.' By that time I am in a big muddle, you know."

Finding Her Way

Ruth is very competent at map-reading: she knows exactly where she needs to go. When she was coming to the group for the first time, she looked at the A-Z map before she left home. She told herself which road to follow from the station and where to turn. She was able to use this information successfully to find her way. She found the task "quite easy really."

Feelings and Self-Identity

Learning to Use Calculators and Computers

When Ruth discovered that she was expected to use a calculator in her job, she said she "had to confess" that she didn't know how to use it. In other words she was embarrassed or ashamed, maybe apprehensive that she would find that she couldn't learn how to use it and would therefore not be able to keep her job.

She found that the person showing her how to do the job "thought this was highly amusing, fortunately," that she had never used a calculator. Although it must have been uncomfortable for Ruth to be laughed at, this attitude on the part of her colleague probably contributed to her ability to learn to use the calculator: it was a social situation where she was expected to be able to do it.

Learning to use the calculator made a great impression on Ruth. She thought, "Wow!, you know, this is a revelation to me." This experience gave Ruth the confidence to go on to learn to use computers. She said that using computers and programming video-recorders is so easy anyone could do it, if they didn't think it was difficult.

Handling Cash at Work

When Ruth was working on the till in the sports stadium, she was in a social situation where she was dealing with members of the public and she felt she had to calculate fast. "So I'd be struggling trying to do that (work out the discounts and total the prices), while they give me the money. And I'm a stage behind them and then trying to work out the change." She described the job as "an absolute nightmare." Buxton (1981) recognised these two factors, imposed speed and exposure to other people, as important factors in creating maths anxiety. Ruth described her feelings of panic, "I just know that I have got a bit of a problem with numbers generally, ... with money anyway. ... I feel a bit panicky if I have to think about it really."

Ruth was also in a social situation with her fellow workers. She was shown how to do the job by someone who was also having trouble with managing it and they supported each other. Ruth thought it was "fortunate" to be working with someone who had as much difficulty with the job as she had. She wasn't annoyed that she had not been shown the job properly. She was glad that someone else had the same difficulties she had: someone she could identity with.

Ruth also said that she didn't think that the workers in that job were really expected to be able to do the work effectively, "It was such a badly paid job that, you know, everybody who worked on the till had some kind of problems. ... It was like a Scale 2 council job, which is the lowest you could possibly go." Ruth did not give any indication of gradually improving her skills in this job and feeling more confident. It was as if the management's expectation of the workers, or Ruth's perception of them, and the other workers' inability to do the job effectively made Ruth unable to learn to do the job properly.

Finding Her Way

Ruth really enjoys looking at maps. When she is on holiday with her partner, he drives and she navigates. "I do like going to places I haven't been to before. ... I like looking at the map and then going there and finding my way around." She described herself in relation to this as "sort of anorakish, somehow" and then "sort of swotty, really." These are both mildly derogatory terms: it is as if she feels she has to defend her self-identity as a person who is good at and enjoys reading maps.

Categorising Ways of Thinking

Ruth is very competent with using calculators, computers, and maps and programming video-recorders, probably more competent than the average adult. But she panicked when she had to mentally calculate prices, take money, and give change.

Pask's model of different kinds of thinking distinguishes between serialist and holist thinking (1972). Ruth probably likes maps because they enable her to think about where she is in a holist way. "I like to ... have the map as I am sitting there and know where we are in relation to the whole of Spain or whatever." She put her household accounts on a spreadsheet which enabled her to see them holistically. She finds programming the video easy because she can see all the variables together on the screen. Both the spreadsheet and the video programme obviate the necessity of her doing any calculation, which would require what Pask defines as serialist thinking.

Whereas when Ruth was working on the till at the sports stadium, the thinking required to do the job is serialist: she had to take discounts off prices, total them up, and calculate the change from the proffered money. The way she said she coped with this situation was, "I kind of went into a trance-like state I think, when I was doing it." She may have been able to do the job by taking her focus of attention away from the detail of what she was doing, rather like being able to ride a bicycle without consciously focusing on balancing it (Polanyi, 1983), which is probably similar to thinking in a holist way. However, a calculator cannot be used in a holist way: the numbers have to be keyed in, then read off in a series. So Ruth can manage this kind of thinking: she just seems to feel more confident with tools which can be used in a holist way.

Ruth has constructed her life around avoiding situations where she might have to calculate. When I asked her how she would work out a 50% reduction, she said, "Phew! Just avoid it really, if possible." But she has an

enthusiasm and curiosity for mathematical tools which I think is very unusual for someone who has problems with calculation.

Summary
The problems Ruth has to solve in her daily life have a socio-cultural context. They are embedded in her relationships with other people: her partner, and her customers and colleagues at work. They involve tools and conventions like calculators and money. Ruth's self-identity both influences and is formed by the situations she is in and she sometimes experiences strong feelings as a result. But Ruth also brings her individual understanding and modes of thought to the solution of problems. It is the interplay between her thinking and the culture which produces the results she describes: a facility with using maps and computers and an avoidance as far as possible of calculating money.

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