Getting at Adult Basic Education Students' Sturdy Strategies: A Pilot Study

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Introduction

In the fall of 1997, I combined a course assignment to conduct a pilot field research project with a long-standing interest in learning more about mathematical understandings of adults who enroll in adult basic education (ABE) programs. The setting was an adult learning center in Massachusetts in a math class of 16 adult learners, three of whom were the focus of the study. Through twelve participant class observations and five interviews I aimed to devise a way to begin to investigate and to document strategies low literate adults with little formal education use to successfully negotiate the mathematics embedded in the activities and demands of their lives. The findings from this initial foray suggest that adults enrolled in basic skills programs use some sensible strategies in their everyday math activity that either appear idiosyncratic or differ from traditionally taught school math. I believe the study might be worthy of extension because such data would inform curriculum design and instruction in ABE math classes.

Research Questions

My questions were:

1) What sturdy methods, strategies, and algorithms do adults (who enroll in ABE programs in the U.S.) use in their out-of-school mathematical practice?
2) How might it be possible to uncover such strategies in an ABE setting?
3) Once we do uncover personal strategies, what do we as teachers do with that information?

While this was the first time I was trying to investigate such questions in a systematic way, several years in the adult education and mathematics education have contributed to strong hunches about adult numeracy practices. For example, adults have many math strategies that may not look like "school math." I've noticed among co-workers, friends, and students that the less a personal strategy resembles "school math", the less the individual gives herself credit for knowing or using a strategy. Some of these "non-school" strategies may be successful in that they aid the person in reaching his or her desired goal. But, because the methods are not school-approved, the user of such strategies tends to hide them from others. An equally strongly held notion of mine is that bringing those strategies out in the open and documenting them are bound to give numeracy teachers and curriculum developers a more solid base from which to proceed . We often teach with a workbook or textbook-driven pedagogy that may have more to do with how we teachers were taught formal arithmetic years ago and less to do with the ways in which adults unselfconsciously weave mathematical content into the fabric of their lives.

Ethnographic studies in western and non-western societies of adults and children engaging in everyday mathematical behavior point to key differences between in-school mathematics and out of school mathematics. (Lave, 1988; Scribner, 1984; Millroy, 1992; Nunes, Schliemann, and Carraher, 1993). Such differences include strategies and algorithms used to compute and to solve problems as well as in the nature of the problems themselves (in situ vs. conventional of math word problems). For example, Lave in her study of adults shopping contrasted a traditional school problem to the dynamic actual situation: 'Becca has four apples and Maritza has five apples, how many apples in all?' versus a shopper standing in front of a produce display—putting apples one at a time in a bag, saying:

> 'There's only about three or four (apples) at home, and I have four kids, so you figure at least two apiece in the next three days. These are the kind of things I need to resupply. I only have a certain amount of storage space in the refrigerator, so I can't load it up totally... Now that I'm home the summertime, this is a good snack food. And I like an apple sometimes at lunch time when I get home ' (1988, p. 2).

Researchers (e.g., Harris, 1988) have concluded, as do Nunes, Schliemann and Carraher, that "the mathematical skills used in everyday activities go unrecognized. They are so embedded in other activities that subjects deny having any skills" (1993, p. 11). ABE teachers have noted similar situations where adult learners admitted to approaching problems differently from "real life" because "this is school" (e.g., Moses, 1994).

Methodology

The interview protocol was an important piece of the project because I was trying to accomplish two things at once. My main goal, of course, was to elicit authentic testimony from the adults about math they did in their "real lives" outside of class. Most researchers interested in authentic math practices of adults go to where the adult is actually doing the activity such as he marketplace or the workplace (Lave, 1988; Nunes, Schliemann and Carraher; 1993, Scribner, 1984). Researchers have found that math questionnaires tend to elicit very little response from adults about "math in their daily lives" as contrasted with more open-ended (non-math) questions. For example, when hairdressers were asked if they did proportion, they said no. However, when asked to describe hairdressing they spontaneously used the word "proportion" (Harris, 1994).

My secondary goal was to develop a protocol that could help ABE students communicate to their teacher how they do math outside of school. This could be a good initial assessment tool for a teacher's planning. I wanted to create something between a questionnaire (convenient, can be done on location) and observation of the actual activity (authentic and embedded). With these two purposes in mind—obtaining authentic information and usability, not to mention something that would be fun and/or pleasant, I designed a two-part interview protocol, described in detail below.

The Interview Guide

Interview Part I. Time: 20-30 minutes
Goal: To find out about (assess) some of the ABE student's "owned" everyday math strategies in a limited (not in the real situation) setting.

Interviewer says: "Thanks for meeting with me. I'm doing a project to find out some ways adults use math thinking in their everyday lives. Here's a permission slip (read it together) to make sure you know just what I'm going to do with the information, and that you're OK with that. What I have here are some photos of people doing some activities. Which ones remind you of things you do often?
Could you put the pictures into two piles: What you never do or don't usually do. What you do sometimes or do often?

Interviewer shows twelve photos some of which were taken in the neighborhood:
1. A furniture store
2. A cafeteria
3. A person cooking
4. A produce section at the supermarket
5. A lottery machine
6. A pharmacy cashier
7. A dairy section at the supermarket
8. A family watching TV
9. A person roller skating
10. Parents holding a baby
11. A family picnic
12. A family at the beach

After the interviewee divides the photos, the interviewer uses "DO OFTEN" as the conversation starters. For each photo, there are two or three questions aimed to get at some "figuring." The plan is to concentrate on one or two situations, but the discussion is flexible. I'll start out by saying, "Tell me a little about what you do that this picture reminds you of. Where? When? How often? What kind of things do you do when you're there?"

At the end of the interview, the interviewee gets an inexpensive disposable camera with flash to take some pictures of herself or friends/family doing math or using numbers in their everyday lives. We will use these pictures as a start of the next discussion. I was curious to see where she saw math embedded in her daily activities

Some early results

The photos seemed to work quite well in eliciting stories. While I asked direct questions about how a person figured something out, it was only within a story that was well on its way. For example, I did not ask a hypothetical question such as, "If you won the lottery, how would you figure how much your earnings were?" Rather, when the person got to a point in the story that she was reporting a win, I asked her to describe her thinking.

In the first interview, S. told four stories which exhibited personal workable strategies: about the lottery, cooking, helping a friend at the bank, and recounting supermarket shopping strategies. The story below is taken verbatim from her account of how she figured out how much she had won on a lottery "scratch" ticket.

> S. So I got the ticket . I was standing at the bus stop. This wasn't even in Cambridge. This was in Dorchester. I was standing at the bus stop scratching. I thought I was seeing things (M. giggles) So I said Oh my God. I saw the coin. I remember what card it was. It was the Winner Take All. And it was a twenty-one. On the Winner Take All, I scratched I saw a coin
> S. Yeah, there's ten scratches on it.
> M. Yeah, do they .. how are the ten? Are they all lined up or do they…how does it…what does it look like?
> S. OK. So then it's like ten, you know ten (she points to the place where the covered spots would be) and you scratch them off …
> M. OK
> S. Now I had, like a coin. So I won all of them automatically.
> M. So what did they have in those other blocks? I know they had a coin. Did they have other numbers like 18, 20?
> S. No. OK. Every block had forty dollars in it … So forty um dollars. And ten. So that's four hundred dollars. I couldn't count it at first cause…
> M. Couldn't ? Oh my God. (M. and S. start laughing).
> S. I mean I was like .. how much money is that.. 40 and 40, I couldn't count it up…
> M. So, how did you end up counting it up?
> S. I started concentrating on it. I said wait 40 ten times, what, I kept doing it, wait that's 400… I said Oh my God, a hundred dollars. Me and my boyfriend were mad at each other at the time so I went over his house anyway. He said, "You're not supposed to be over here." I said "I've got five hundred dollars. You want to go out?" (M. laughing). He got dressed and he left. (muffled) the biggest I ever hit. When I first played a ticket, I hit for two hundred and fifty dollars.
> M. Show me how you counted that.
> S. So, forty and eighty … eighty… eighty that's um… that's four times… so that's sixteen… so that's four times… another hundred and sixty… eight , twelve, that's three … three hundred and twenty…oh I think this is wrong… yeah OK, three twenty…and eighty , ten, yuh, that's right, just like that. That's how I did it.

S. was not able to automatically say what $40 times10 was, but she used a strategy of doubling to get to the correct answer, and she was in control of the situation. Her motivation and interest in the situation seemed to drive her to mathematize. Each of the three women I interviewed consistently spoke with convintion and offered rich and amusing narratives - and often philosophized - when they spoke about their 'owned math' in the interviews. S.'s lottery story was robust, amusing and philosophical, and more

more interesting than a workbook word problem or any hypothetical story that a math teacher like me could make up. The emotional content struck me.

M. (interviewer) They say the odds are against you.
S. I haven't heard of that. They must be against me, 'cause I sure ain't winning nothing.
M. How do you think the lottery works?
S. I don't know how it works. I bought a scratch ticket today. One dollar. They can't give you that one dollar? I mean.... When you think about it. It's not their fault you went to the store. Nobody told you to buy a ticket..... One day I spent my last dollar. I was sitting home by myself. I had one dollar and that's all I had. What am I going to do with it, save it up? I went to buy one ticket. I picked that ticket. I won $ 100... That happened to me a dozen times.

Coding and Keeping Track

I coded the interviews for areas that the student wanted to talk about (e.g. lottery, shopping) and any of her 'owned' strategies (e.g. estimation, multiplication strategy). Keeping track over the long run and looking for themes across cases would be important for my own research. I began with an empty two-dimensional matrix that evolved during the three interviews and some class observations as shown below. The lottery conversation with the doubling strategy has an S1 in the cell indicating that this (theme x
strategy) unit appeared in S.'s first interview. My plan is that after several interviews a composite profile of typically used strategies might emerge from the data. Other than the practical concern that ABE math teachers might use this information to inform instruction, I thought the same data might shed some light on mathematical methods that adults more naturally gravitated to than others. For me, this resonated with the evolutionary psychologist's position that the human brain has evolved to perform some mental operations easier than others (Dehaene, 1997; Pinker, 1997). I have begun to think that the data might reveal the strategies that are fairly universal.

Nature of Math S. and A. Reported (Strategies or Algorithms)

Area discussed	Checking Strategy	Addition Strategy	Subtract Strategy	Multiply Strategy	Measure	Reading text	Sequent. Direction s	Reading Number notation	Charts / Tables	Compare Prices
Supermkt Shopping	S1 A1	S1 A1								A1
Lottery	S1			S1		S1				
Cooking				S1	S1	S1				
Banking	S1		Ac	Ac				S1		
Hospital Work						A1	A1	A1	A1	
Shopping for Stereo										L1

Code: S1 = instance in S's first interview, A1 = A's first interview, A2 = A's sec. interview; Ac = A. in class

Once you do uncover a strategy, what is the next step?

> A.'s calculation:
> In class, A. had shown me her personal strategy for subtraction. If she is faced with a problem with dollars and cents—"I just forget about the cents." But, when I asked her what she did if she had a paycheck for $52 and had to pay a bill for $36, how she would figure that out, her strategy did not use borrowing or renaming.
> M. Could you do this?
> S. (After concentration, without a pencil.) 16.
> M. How did you do that?
> A. I took 30 from 52. Leave 22. 6 from 10 leave 4. 12 and 4 is 16.

A. admitted that her way worked all the time, except for cents. (Meaning $52.35 minus $36.98 would get burdensome.) The teacher and I found her algorithm very interesting, and unlike any I had heard from students from other countries. She used a partitioning of both numbers, sometimes adding, and sometimes subtracting. It took me several times of her patiently explaining for me to feel sure I understood her way. It was easy to understand that she first SUTRACTED 30 from the entire 52, leaving 22. Then, she partitioned that 22 into 10 and 12. She SUBTRACTED the 6 (The other part of 36) from 10, leaving 4. Then, she ADDED that 4 to 12, the other section of 22. What struck me was her confidence with and mastery of this method. I labeled this a "sturdy" strategy.

We were eager to find ways to build upon her method, because she was so secure with it, but the strategy was incredibly cumbersome to build on for more than three digits.

Do patterns emerge in their successful and sturdy methods? While there is not enough data to tell if a strategy is idiosyncratic or whether it's a strategy of choice for many, there was an example where there seemed to be a similar non-school approach. S. and A. showed some similarity in their estimation strategies for keeping track of how much the items in their grocery carts were adding up to. Both paid attention to the dollars and took cents into account at the end. A. did that more broadly, S. more systematically, rounding amounts close to a dollar sometimes as she went along.

From S.' supermarket story:

> S. Well, when I go food shopping. Like say if I have bread and like after I get a carriage full of stuff … I don't get the right amount in bread, like I don't say 99cents. I say one dollar. And a gallon of milk, two thirty-nine. I say two dollars. Then something costs one-fifty, so I put it (Muffled) add it another dollar. So I'm looking for one, two, three, four. Then add 50 cents for the eggs and the milk so I make that five dollars.
>
> S. You know what I'm saying, I put a little change in it. One day I was just like a dollar less than what I said I was. I was just like I know what I'm getting. I don't say 39 cents.. plus this and take away that. I cant do that . Plus you can't do all that in the store. So I say like two dollars, three dollars. I keep on adding it up. Take the change and you know that's a dollar . That's another dollar.

From A.'s supermarket story:

> Milk costs two twenty-nine. I never check the twenty-nine cents.
> M. What do you do with the 29 cents?
> I go and then and I pick something up again, and I ALWAYS put myself ahead… I always leave my 29cents…

I could follow S.'s reasoning, but A., even though she was sure of herself, and was very confident of her method, didn't quite get through to me. I was not sure what she really was doing… if she was rounding up or down…or where she was leaving the 29.. What is interesting here is that we had different vocabularies to express estimation strategies. For example, A. called the cents, "overs".

Do adults' methods and strategies resemble schoolbook methods and strategies?
As mentioned above, S. figured 40 x 10 and A. 52-16 with non-conventional algorithms. But there were other school/street differences. None of their narratives sounded like school "word problems." S. and A. did not speak in the hypothetical, but in a narrative action format. In the second interview, S. and A. were uninterested or unable to devise a "math word problem" for school. In their narratives A. and S. reported successful dealings with numbers, or what they perceived as successful. A.'s pride in her work at the hospital and S.'s joy at a lottery win kept them involved and in control. It was almost as if their responses to those contexts were the drive behind their learning and development. There was another example from A., where in class A. said she never heard of the word "digit", and could not respond on a diagnostic test to the question, "how many digits in 1,520." However, in her interview, she related in detail how she pressed the " 3 or 4 digit code" into the phone at the hospital. I think this might be a good example of the way in which adult students carry different meaning in school and out for what teachers assume should carry over across contexts.

Conclusion

While these few pages touch only briefly upon my pilot project, I hope I have given the readers of ALM-5 Proceedings the flavor of what I am aiming to accomplish. I would gratefully accept any comments or suggestions about this line of inquiry.

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