What should be in a training course for adult numeracy teachers?

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Since 2001, adult numeracy teachers in England have been required to undertake courses satisfying two sets of specifications:

- *a set of general teaching and learning standards that apply to all teachers in the post-compulsory sector; and*
- *those specifically for adult numeracy specialists involving issues related to practice and some mathematics which includes ideas around calculus and hypothesis tests in statistics.*

Research is beginning to suggest that participants do not feel the current specifications are helpful to their practice. The LLU+ took part in a small scale research project that investigated the initial and continuing motivations of adult numeracy teachers in attending training. The participants have made clear their concerns about the level of mathematics in the training and its relationship to their practice. In recent years, Maguire and others have looked at the professional development of numeracy teachers on an international stage. In addition, there has been a discussion of the mathematics that elementary school teachers should undertake following the argument that teachers should have a 'profound understanding of fundamental mathematics' proposed by Ma (1999). A second project at the LLU+ suggests interventions that teachers have found useful and offers a way forward for research and training.

The past few years have seen a transformation in the training requirements for teachers of adult numeracy. Not very long ago there were no requirements for teachers to have any particular training. Some institutions encouraged teachers to take a teaching qualification in the post-compulsory sector. These courses attracted some government funding to enable individuals to undertake the course although institutions still had to free individuals from teaching to participate, usually on the basis of one day per week. This training had no particular set specifications but usually covered the post-compulsory context, general learning theories and some training in very general techniques that apply to all subjects. Alternatively (or maybe in some cases, additionally) some teachers were asked to undertake some training in adult basic skills. This usually took the form of a particular qualification, the 9281 Initial Certificate in Adult Basic Skills, run by the City and Guilds awarding body. This qualification gave some really useful information about the background of adult learners, barriers to learning and techniques for supporting individual learners. The courses were usually relatively short, consisting of approximately 30 hours of learning, and included an observation of the trainee supporting one learner. The specifications for the award included some numeracy specific elements although at a rather general level.

Since September 2001 Adult numeracy teachers have been required to complete courses which satisfy two separate sets of criteria:

1. a set of general teaching and learning standards that apply to all teachers in the post-compulsory sector; and
2. those specifically for adult numeracy specialists involving issues related to practice and some mathematics which includes ideas around calculus and hypothesis tests in statistics.

In Kaye and Griffiths (2005), there is an outline of these specifications and ways in which training has been interpreted at the LLU+/London South Bank University. In addition the authors also noted that in course evaluations many participants felt that the course did not contain the right level of mathematics or an adequate amount of teaching and learning strategies.

Stage 1 Maths4Life

Maths4Life is a three year, Department for Education and Skills (DfES) funded project which is looking at adult numeracy. From October 2004 to March 2005 the LLU+ took part in a small scale project run under the auspices of Maths4Life. This project looked at the initial and continuing motivations of teachers attending two training courses at

LLU+. In addition, the project also investigated through a questionnaire why some other teachers have not undertaken courses so far, although this will not be discussed here. The intention of the project was to gain a better understanding of the reasons for teachers taking part which in turn may inform course design and specifications. The first part of the project consisted of semi-structured interviews (at the beginning of the course and half way through) with 12 participants. The main question that was used for analysis was the following (see Appendix 1 for the questions used by the interviewers in the first interview):

> Can you tell me what your main reasons are for enrolling on this course, or what were the main factors that made you decide to join?

The following were offered as responses to be discussed

- Was it to improve your career prospects?
- Was it to enable you to get on another course in the future?
- Develop your numeracy skills?
- Give you a better understanding of some of the issues around teaching numeracy to adults?

The interviews were transcribed and the team categorised the comments and came up with six main reasons that participants stated, in one form or another, for joining the course. These were (the brackets indicates the number of participants who were categorised under each reason):

- Does not have, and wants, this qualification. (9)
- The qualification will provide more options and opportunities and improve career prospects, including being able to teach at higher levels. (8)
- To gain more confidence and improve knowledge of maths, particularly at higher levels. (8)
- To improve and update their pedagogical knowledge and skills. (11)
- To gain more ideas and skills to teach particular areas. (6)
- The institution where they work encourages personal staff development. (7)

It is worth noting that the numbers should not be taken at face value as it is possible, in some cases likely, that those who did not mention a particular reason may well still have this as a motivation. It is quite likely that all of the participants would sign up to Reason 1 it is just that some did not discuss this, maybe taking this as obvious and feeling that it does not require discussion.

Aside from the external motivator of the qualification and linked job opportunities, the participants were interested in improving their knowledge of mathematics and updating their teaching skills and knowledge.

At the half way stage, the trainees were asked whether they considered that the course was achieving what they wanted. The responses were very mixed with some stating that they gained a lot of useful knowledge about teaching, to those who thought that there was not enough material directly useful to their teaching.

On the positive side

> …this has helped me to incorporate different activities and get students moving around doing different things, making it interactive.
>
> … it helps me reflect on my teaching practice, in how to enhance it and do better, and become a more effective teacher.
>
> … I enjoyed learning about the reasons, many of the reasons, why people give up number work and numeracy.

More negatively

> … there isn't enough of how to teach it.
>
> … I suppose what is at the heart of it is that what I am doing here … is not going to make one hapeth of difference to my teaching.
>
> … I want to listen to my colleagues and learn, see the resources, listen to expert practitioners, showing me how better to deliver a class on percentages.

Views on the mathematics elements were also quite diverse in relation to their abilities and whether they found it interesting. Nevertheless the only comments on its appropriateness questioned the level of mathematics in the training.

> … I think you need to have a good, strong, maths base above level two, obviously, but the things we are doing are not relevant to what we will be teaching.
>
> … We don't do enough maths that covers the maths we need – as a numeracy teacher.

As in the evaluations from previous courses, mentioned in Griffiths and Kaye (forthcoming), the course appears to contain a mathematical element that is not considered useful to a adult numeracy teacher (even though some enjoyed the element).

Training and mathematical content

The professional development of numeracy teachers has been of interest in a number of countries. Maguire, Lindeskov and Seabright (2005) outlined a number of developments at ALM-11. Maguire and O'Donoghue (2004) proposed a model for tutors of adult numeracy. Among the seven Core Elements that they identify are the following two:

- Develop tutors mathematical eyes; and
- Incorporate pedagogy congruent with the pedagogy desired for their own teaching

The first of these raises the issue of the mathematical content of training. The authors state that "(d)eveloping the tutors' mathematical eyes … incorporates the development of a deeper understanding of mathematics" (Maguire & O'Donoghue, 2004, p5). As reported in Griffiths and Kaye (forthcoming), the specialist qualifications were intended to supply a mathematical content to the trainees that would enable them to be successful teachers although many participants have suggested this is not so. This has been reported in course evaluations, the feedback from the Stage 1 Maths4Life Pathfinder and from data collected for a forthcoming NRDC report.

In addition to this raising of the mathematics knowledge that is considered necessary, there is also a connection between that knowledge and teaching raised by various authors.

Maguire and O'Donoghue argue that

> With successful professional development, tutors will move from a view of mathematics as decontextualised, abstract skills and formulae, to a view of mathematics as an integral part of their own and their learners' lives. (Maguire & O'Donoghue, 2004, p5)

In a similar vein for the different sector, Ma (1999) has argued that we need to develop a 'profound understanding of fundamental mathematics' in elementary school teachers. In her research, Ma looked at the responses of teachers in China and the USA to a number of mathematics related questions (see Appendix 2). The questions were intended to reveal the mathematical understanding of the teachers. Ma showed that the profile of the teachers was different between the two countries and argued that the understandings in Chinese teachers were more useful for teaching mathematics.

Ma argues that it is more important to investigate the mathematics that will be taught to a deep level. This would involve considering, in some detail, different models for various mathematical concepts, ideas for teaching and learning and connections between concepts.

> Profound understanding of fundamental mathematics (PUFM) is more than a sound conceptual understanding of elementary mathematics – it is the awareness of the conceptual structure and basic attitudes of mathematics inherent in elementary mathematics and the ability to provide a foundation for that conceptual structure and instill those basic attitudes in students. (Ma, 1999, p.124)

There is a growing body of research that is looking at the mathematical knowledge of primary school teachers in the UK (for example, see Askew et al, 1997; Murphy, 2005; Thwaites et al, 2005). This work suggests parallel developments for the adult education sector, to change the content of the specifications to move away from higher level mathematics content to studying a more fundamental mathematics in a deeper way and connect more with pedagogy.

Stage 2 Maths4Life

In response to the lack of specific subject pedagogy in the specifications, the LLU+ began a second project funded by Maths4Life. This involved looking at how teachers can use diagnostic / formative approaches to teaching adult numeracy. The purpose was to follow the change in practise of six teachers (in three different institutions). The project involved: the research team observation of classes; the participants undertaking peer observations; the running a number of training sessions; and the encouragement of discussion about the project between all involved (through meetings and emails). The project is due to complete in September 2005 and so data is partial at present. Nevertheless some interesting issues have already arisen.

The initial discussions focused around the questions, the types of questions and the responses of the learners in the classrooms. The following is an example of a section from recorded discussions:

Interviewer So we were talking about these questions and things …

Teacher Well, I think what … I threw out a few questions and you threw out a few questions at the end, but actually most of the questions this time came from students themselves talking to each other and looking at the data we gave them. There was a range of data about life expectancy and poverty in various countries. I think they were very interested in the data. And giving them quite a lot of real data, they had to puzzle over it a bit. And I was surprised at how long they talked about it. They actually looked at the numbers and they were trying to think about … one or two people at first didn't know what the median age meant. [One learner] couldn't make sense of that. But the other people explained that to her.

Interviewer Yes, I suspect it was probably throughout the whole session they were trying to come to grips with that. Even at the end there…

Another segment following the first involved a learner trying to make sense of one of the categories of data.

Interviewer Victor, well, he was focusing on the total as opposed to the male and female, but he had forgotten what the total meant in relation to that, actually. So when you asked him he was thrown for a bit.

Teacher It was the word total that threw him. But previous to that I heard him discussing it, and he looked up his own country, which is Ghana, and he was quite surprised to see the median age was very low. And he said – what … everyone is under twenty? And they said – no, that's half the people. And he said – yeah, that's everyone. You don't count the other ones.

Such discussions were able to focus the participants on their use of questions and to consider what the responses actually meant. This is often lost in busy day-to-day practice. The use of questioning is a standard part of most (generic) teacher training courses although in this project it has been possible to focus on numeracy-specific aspects, for example, what is an open question in numeracy?

In addition we asked the participants to keep their own diaries of events in their classes. The following is an example of an excerpt from a diary (in this the italics are direct statements from the participants):

Continuing work on capacity.

Started with a challenge – *How can I make 50p using only 10p, 5p and 1p coins? How many ways can you find?* Students worked in small groups or on their own to come up with the answers. I had planned the questions and possible blocks – When learners did stop after 2 or 3 combinations I asked *How will you know when you have found all the possible combinations?*

No one could answer the question with a definitive answer but it encouraged several to go on looking. I asked *Can you find an easy way to make sure that you have found all the combinations?* Learners didn't seem to have a definite strategy although some had the beginnings of one.

We went through on board and tried to spot emerging patterns. Questions including *Can you see where this is going? Is there a pattern there? Can you spot the pattern here? What do you think comes next?* (after guesses for answers) – *so what's the pattern here?* The activity generated a lot of questioning and a lot of interest. (One learner approached me in the corridor 2 days later to say he'd worked out another way of doing it – he'll bring it to the next lesson).

The participant in this case had felt that she had been deliberately focusing on producing more open-ended questions. Initially this proved difficult for the learners but eventually a discussion was generated and responses were generated which could be used formatively.

The participants have all expressed positive feelings about the project and feel that this has had a real impact on teaching and learning. These feelings will need to be converted into some form of self reported data for analysis as

the project comes to a close. It should be noted that the observers also noted a change in practice of the classes observed although this has not yet been formalised. The team is looking forward to some interesting material and ideas for use in training.

Pedagogy

The two Maths4Life projects mentioned here have been relatively small scale, but, along side other research (from the elementary school and adult learning sectors), point towards a need to change the content of training programmes from those specified in England. The team at LLU+ feel that it is time to examine various approaches to training in pedagogy. With this in mind the team are beginning to look at designing a research project that would investigate a number of specific interventions, across different courses, with the aim of looking at changed practice and discussing the value of such work with participants. Such interventions would build on the work of the Stage 2 project which may in itself provide the model for such an investigation.

Conclusion

The requirement that teachers of adult numeracy should be trained is a step forward in relation to professional standing. There would be few commentators who would suggest that professional development of teachers is not a positive move. Nevertheless, the content and type of provision has, and will continue, to be the focus for much argument and discussion. An increasing body of research suggests that learning mathematical content at a higher level is not a particularly fruitful path and that developing more 'profound' understandings of the mathematics taught is a step in the right direction. Indeed a more developed training that focuses on numeracy specific pedagogy would be enormously helpful. What is required is some research into specific training interventions to investigate and test possible routes.

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Appendix 1

TEACHER Interview schedule ONE (for Stage 1 project)

This is……(researcher's name) interviewing

……(teacher's name) on……(date).

Teaching issues

1. How did you become a numeracy teacher?

2. Do you enjoy it?

3. What are some of the best things about your job?

4. What are some of the worst things about your job?

5. What are some of the things that enable you to teach well?

6. What are some of the barriers that make it more difficult to teach well?

7. What areas of your numeracy teaching do you feel that you need to develop or improve? (Prompt: the mathematical knowledge; pedagogical issues?)

The course

8. Do you know anyone else who has taken the Adult Numeracy Subject Specialists?

9. What do you hope to get out of the course?

10. Where do you see yourself being in 5 years time?

Reasons/motivations

11. Can you tell me what your main reasons are for enrolling in this course, or what were the main factors that made you decide to join? (**Allow time to answer**)

Why this particular course and this particular year?

Use these points as a checklist:

How many of the following factors played a part in your decision to join the course?:

- Was it to improve your career prospects?
- Was it to enable you to get on another course in the future?
- Develop your numeracy skills?
- Give you a better understanding of some of the issues around teaching numeracy to adults?

12. Was it a fairly easy decision, or did you have to think about it quite hard and for some time?

13. Did anyone else influence your decision? (for example, a colleague, family member or college manager?)

14. What part did the college play in your decision? (Did it help, hinder you?)

Appendix 2

Problems discussed with Elementary School Teachers in China and the United States by Liping Ma (1999)

Try answering 3.

(1.) Let's spend some time thinking about one particular topic that you may work with when you teach, subtraction with regrouping.

Look at these questions ($\begin{array}{r} 52 \\ -25 \\ \hline \end{array}$ $\begin{array}{r} 91 \\ -79 \\ \hline \end{array}$ etc).

How would you approach these problems if you were teaching second grade? What would you say pupils would need to understand or be able to do before they could start learning subtraction with regrouping?

(2.) Some sixth-grade teachers noticed that several of their students were making the same mistake in multiplying large numbers. In trying to calculate the multiplication 123×456, the students seemed to be forgetting to "move the numbers" (ie the partial products) over on each line.

They were doing this:

$$\begin{array}{r} 123 \\ \times 456 \\ \hline 615 \\ 492 \\ 738 \\ \hline 1845 \\ \hline \end{array}$$

instead of this:

$$\begin{array}{r} 123 \\ \times 456 \\ \hline 615 \\ 492\_ \\ 738\_\_ \\ \hline 79335 \\ \hline \end{array}$$

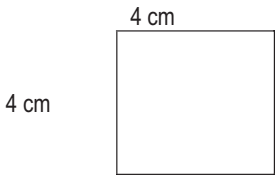
While these teachers agreed that this was a problem, they did not agree on what to do about it. What would you do if you were teaching sixth grade and you noticed that several of your students were doing this?

(3.) People seem to have different approaches to solving problems involving division with fractions. How do you solve a problem like this one?

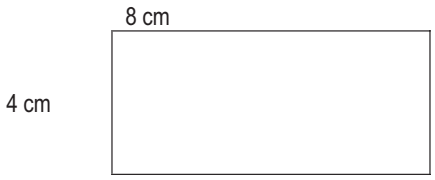
$$1\ \frac{3}{4} \div \frac{1}{2} =$$

Imagine that you are teaching division with fractions. To make this meaningful for kids, something that many teachers try to do is relate mathematics to other things. Sometimes they try to come up with real-world situations or story problems to show the application of some particular piece of content. What would you say would be a good story or model for $1\frac{3}{4} \div \frac{1}{2}$?

(4.) Imagine that one of your students comes to class very excited. She tells you that she has figured out a theory that you never told the class. She explains that she has discovered that as the perimeter of a closed figure increases, the area also increases. She shows you this picture to prove what she is doing:



Perimeter = 16 cm
Area = 16 sq cm



Perimeter = 24 cm
Area = m32 sq cm

How would you respond to this student?